Applied Developmental Systems Science: Everything You Always Wanted to Know About Theories, Meta-Theories, Methods, and Interventions but Didn't Realize You Needed to Ask.

An Advanced Textbook

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Chapter 1. Introduction

This textbook provides a toolbox, a guidebook, and an instruction manual for researchers and interventionists who want to conceptualize and study applied problems from a developmental systems perspective, and for those who want to teach their graduate (or advanced undergraduate) students how to do this. It is designed to be useful to practitioners who focus on applied developmental problems, such as improving the important developmental contexts where people live, learn, and work, including the applied professions in education, social work, counseling, health care, community development, and business, all of which at their core are concerned with optimizing the development of their students, clients, patients, workers, citizens, and others whose lives they touch.

We start from the assumption that all applied problems become more tractable when they are viewed as parts of complex changing systems that are multi-level, interactive, and dynamic. We have learned that advanced undergraduate students and graduate students, even really smart and well-prepared students, do not find it easy to generate theories, design research, create interventions, or engage in practices that reflect developmental systems principles. Their views, just like the views of most developmental researchers and interventionists, are shaped by the prevailing scientific, political, and disciplinary cultures, which tend to conceptualize and study applied problems as if they were discrete parts of phenomena that are flat, linear, and static.

We think that three forces conspire to keep researchers, practitioners, and students from realizing the utility of developmental systems frameworks. First, the theories that currently guide applied developmental research and interventions have embedded in them assumptions about the nature of people, their contexts, and how they work together to generate change or maintain stability. Second, the methodologies we typically use to study and intervene bring their own assumptions to our work. Third, we are not always aware that our views have been hijacked by prevailing conventions. In fact, many researchers, interventionists, practitioners, and students have not had the opportunity to reflect on their own assumptions or to consider alternatives, activities which might enable them to articulate more complex and dynamic understandings of the people and organizations they are attempting to study or to serve. Moreover, even when we and our students espouse developmental systems meta-views, which over the last 20 years have been slowly moving into prominence (Lerner, 2006), we have often not thought carefully enough about their corresponding implications for the kinds of theories we should be trying to build, the methodologies we need to master, and the interventions and practices we should construct and test.

What is the purpose of the textbook and the course?

This text is designed to act as a guidebook for advanced undergraduates and graduate students in awakening them to the dominance of conventional assumptions in shaping our approaches and solutions to applied developmental problems, and in enabling and encouraging them to try out the lens of developmental systems with its power to transform their approaches to research and practice. This book contains multiple versions of the course we have created and taught jointly with our colleagues and students over the last 20 years, a course that is a requirement in our doctoral program on Applied Psychology and serves students specializing in social, community, and industrial-organizational psychology, as well as in developmental science and education. These students go on to be academics and researchers, but they also join public and private organizations, like businesses, school districts, hospitals, and non-profits, where their perspectives on the people they are trying to serve and the problems they are trying to solve, change lives.

How are the course and the guidebook organized?

This class is not an easy one to take or to teach. It is at once abstract and philosophical, while also reaching down into the foundations of our identities and our science. We have not found "exposure models," in which we assign readings or lecture students on the benefits of developmental systems approaches, to be very effective in creating the internal paradigm shift that is the ultimate goal of the course. Instead, as described in subsequent chapters in more detail, we begin the course by inviting students to select the phenomena and applied problems of their choice, one that is authentically meaningful to them and in which they are already invested and informed, and bring it to the class as their work project. It is our conviction that any applied problem actually is, and so can be revealed to be, embedded in a complex multi-level developmental system, and this revelation can generate rich theories, interesting studies, important intervention efforts, and innovative practices. It is our commitment to students (and our challenge to ourselves as teachers) that, over the course, we (and the rest of the class) will be working with them to complete this transformation. In working with students who come from all over the map in terms of applied problems and (sub)disciplines, we have discovered that there are many pathways to developmental systems perspectives, but since no one can be an expert in all areas of applied psychology, following any of them requires hard work for students and teachers alike.

From these joint efforts, however, came the process that we now follow in the course and that is carefully described in this book, taking student (and instructor) through a series of exercises, readings, discussions, and activities. We think that it is students' work on their projects, through a sequence of short papers, class presentations, real-world observations, and open-ended interviews, that ultimately allow students not only to view their applied problem through a developmental systems perspective, but also to understand *how* they accomplished this-- and so find themselves prepared to use these tools on any applied problem they tackle in the future. Each step on these projects also makes students' thinking and questions visible to instructors and, because they are worked on by the whole class, creates as many examples of how to "developmental system-ize" an applied problem as there are students in the class. This allows the class to reflect on the characteristics of a phenomenon (and its sub-specialty within social science) that make it easier or more difficult for researchers and practitioners to bring a developmental systems lens to bear.

There are four parts to the teaching and learning process and they correspond to the four sections in this textbook. First, students learn to "understand theories," using a set of tools for unpacking and analyzing theories that allows us to look at the components of theories and distinguish their micro-developmental processes from their macro-developmental processes. Such an analysis is the basis for locating places where a theory can be "developmentalized" and allows students to unpack their target phenomenon, focus on their applied problem, and start identifying and generating their developmental possibilities.

Students first practice understanding theories on conceptualizations that represent dueling assumptions about the nature of development, and this exercise introduces them to the second set of tools, which we refer to as "meta-views on meta-theories." These activities allow them to chew on the key assumptions (e.g., nature versus nurture) that underlie our developmental science and see how they are packaged into higher-order families. The class visits a series of developmental systems meta-theories, including the life-span perspective, the bioecological model, the transactional model, relational meta-theories, probabilistic epigenesis, and dynamic systems. These visits allow students to experience first hand the three “big ideas” that underlie all developmental systems perspectives: (1) “levels,” or the notion that integrated multi-level organized people are embedded in integrated organized multi-level contexts; (2) “proximal processes,” or the notion that all development is caused by the reciprocal social interaction between these biopsychosocial people and their local contexts, and that the effects of lower- and higher-order personal and social attributes are all channeled through their influences on the social interactions that take place in these microsystem “envelopes;” and (3) “dynamics,” or the notion that these multiple reciprocal proximal processes, operating at their multiple levels, can be seen, when we “take our hands off” to create movement or change within the system, self-organizing and giving rise to emergent properties and qualitative shifts that then entrain subsequent lower-order processes.

In reflecting on the sources of our meta-theoretical assumptions, it becomes clear that the standard methods we use in our science (e.g., strategies of sampling, measurement, design, and analysis) contain assumptions about the nature of development. For example, if some areas within psychology are dominated by designs that include only one time point, it becomes clear that they assume that no change is occurring or, if it is, it is not important. If researchers use the same measures for participants of different ages, they are also assuming developmental continuity in the target phenomenon. If researchers rely primarily on self-reports and use no direct assessments of contexts or social interactions, then they are assuming the primacy of the person and their perspective. Hence, in the third part of the course and textbook, we consider methodological issues, including developmental sampling and measurement equivalence, causal inference, observational strategies, person-centered approaches, and the use of time in designs, including longitudinal, sequential, and time series designs.

The fourth and last section of the course and textbook zooms in on mechanisms or processes of development, trying to take seriously what is changing or developing in individuals and in their contexts. We consider different perspectives on what is “on the arrows” in most developmental theories and how these different views might lead to different strategies for designing, improving, and evaluating practices and interventions that aim to optimize development. We take as our target developmental phenomena in this section the features of the person and context that are most often assumed to be stable (e.g., neurophysiological structures or higher-order contexts) and examine evidence that they are plastic and review the multiple developmental pathways they can visit.

How should the book be used?

In general, this textbook is designed for three primary audiences, and for each target group, it would be combined with different sets of materials (see Table 1.1 for an overview). First, more senior researchers, interventionists, and methodologists might use the text as a primary guide to their own reflection which, in combination with their day-to-day readings in developmental science and their own specialties, could be used as an opportunity to reconsider and improve their ongoing work, guiding their own professional development to be more fully informed by systems approaches. A complementary text for such an expedition might be Slife and Williams (1995) small book, *What’s behind the research? Discovering hidden assumptions in the behavioral sciences*, which deals with many of the same issues for psychology and social sciences more generally.

Second, the textbook can be used in courses designed to prepare graduate students for several different kinds of careers. For graduate students considering careers as researchers in the applied social sciences, the text could provide the primary guide, in combination with original conceptual and empirical readings that illustrate the key principles of a developmental systems approach. To select readings, instructors can use the menu of those listed in the textbook or find alternative readings that cover the range of topics appropriate for the respective doctoral program. For graduate students in developmental science, this text could be combined with an advanced textbook covering the contents of lifespan human development (e.g., Bornstein & Lamb, 2010) or focused on a specific aspect of development (e.g., cognitive development,) or age period (e.g., child and adolescent development, Damon, Lerner, & Kuhn, 2008), as a way to frame and ground an understanding of the many programs of research that contribute to descriptions, explanations, and optimization of development. To prepare graduate students as researchers or methodologists in dynamic systems, this text could be used as an introductory bridge from current conventional perspectives to dynamic systems approaches, in order to prepare and motivate students for an advanced text on theories and methods in dynamic systems (such as Molenaar, Lerner, & Newell, 2014). This text could also be used as a supplement for graduate courses in the applied practice disciplines, such as education, social work, health care, or business, where it could help frame major debates and decisions in policy and practice.

Third, the text can be used in courses for advanced undergraduates, as a supplement to more standard textbooks, whether the upper division class focuses on human development (or specific areas of development or age groups), or on preparing undergraduates for further research training in the applied social sciences or for further study in practice careers. Although this textbook deals with complex ideas, it intentionally presents them in a clear and straightforward manner, according to a developmentally sequenced set of activities, that together allow undergraduates to grapple with, master, and apply its principles to their own thinking and applied practice. For example, when we used the chapter on meta-theories in an advanced undergraduate lifespan human development class, we found that over the course of 10 weeks, with repeated guided practice and discussion, students were able to thoughtfully and accurately analyze the meta-theoretical assumptions underlying major theories, research questions, and intervention applications of developmental science.

We have modeled this textbook after a small paperback book by Paul Baltes, Hayne Reese, and John Nesselroade, entitled *Life-span developmental psychology: Introduction to research methods*, which was first published in 1977. This small text was part of the paradigm shift from child psychology to lifespan developmental science and was instrumental as a tool in graduate training in lifespan development. We do not aspire to instigate a paradigm shift in the field, as these great theoreticians and researchers did, but we do hope to help researchers and their students create conditions and interactions that can facilitate their own internal paradigm shifts.

Table 1.1. Who should use the textbook?

TARGET AUDIENCE	GOALS	PRIMARY TEXT	SUPPLEMENTARY
Researchers, Interventionists, and Methodologists			
Applied social science researchers	• Generate rich and innovative theories and designs for research	This textbook	
Applied social science interventionists	• Generate rich and innovative theories and designs for interventions	This textbook	
Applied social science methodologists	• Critique and improve current methods	This textbook	
Graduate Students			
Graduate students in applied social sciences	• Improve applied descriptive and explanatory research • Create and test better interventions • Critique and improve current theories and research	This textbook	As suggested in Textbook: Original theoretical and empirical articles
Graduate students in developmental science	• Deeper understanding and • More insightful critique of developmental theories, research, and interventions	Advanced textbook on content of human development	This textbook
Graduate students in dynamic systems theories and methods	• More insightful critique of current methodologies • Greater innovation and flexibility in improving current developmental methodologies	Advanced textbook on dynamic systems theories and methods	Preparatory text: This textbook
Graduate students in practice disciplines, such as education, social work, health care, or business	• Deeper understanding and better integration of evidence base • Improved practice	Standard disciplinary textbook or readings	This textbook
Advanced Undergraduate Students			
Advanced undergraduates in research track	• Improved understanding of theories and methods in applied descriptive, explanatory, and intervention research • Commitment to applied work	Standard social science methods textbook	This textbook
Advanced undergraduates in human development	• Deeper understanding and improved integration of evidence base • Become more positive force in own and others' development	Standard developmental textbook	This textbook
Advanced undergraduates preparing for practice careers	• Deeper understanding and improved integration of evidence base • Improved practice	Standard practice textbook	This textbook

What should students be getting out of the course and book?

Table 1.1 also summarizes what researchers, interventionists, methodologists, and students should come away with at the end of the book and/or course. At the highest level, they should have their own "meta-view" on meta-theories, capable of articulating, inferring, critiquing, and building on their own and others assumptions about the nature of applied developmental systems, their study, and their use in guiding policies, practices, and interventions. This should allow researchers to become better able to generate rich and innovative theories and designs for research and interventions, and to critique and improve theories and methods for studying and optimizing developmental systems.

Graduate students should show a more nuanced understanding and insightful selection and critique of developmental theories, research, interventions, and methodologies; an improved capacity to generate interesting applied descriptive and explanatory research questions and to design studies to examine them, and to create and test more effective interventions. Undergraduates should show a deeper comprehension and improved integration of the developmental evidence base, and as a result, evince a greater commitment to applied work and improved practice.

What should instructors be getting out of the course and book?

As co-instructors of this course, we learned a great deal—about our students, ourselves, and our science—and we have tried to organize this text so that other instructors can use this course as a learning experience for themselves as well. About our graduate students, we learned that our training largely teaches them to think in methodological terms, about variables and associations, and to organize their understanding of their phenomena in terms of research questions and analyses. For that reason, this text and course has as one of its primary goals to help students “de-fuse” their thinking so they can move up several levels to become more flexible in their conceptualizations and representations of their phenomena. We also learned that students are largely unaware of the meta-theoretical assumptions that “reside quietly and unrecognized in the background of our day-to day empirical science” (Overton, 2007, p. 154).

Perhaps most importantly, we learned about sequence and patience, both of which are represented in the structure of this text and course. It is tempting to start a class at the end—by telling students what you want them to end up learning. We did, in fact, teach this course that way—once. We started with a pile of fascinating papers on dynamic systems; we assigned students to read them and tried to discuss them in class (Skinner & Lendaris, 2007). This way of teaching the course crashed and burned. Students looked at us as if we had transported them to a distant planet and asked them to speak a foreign language—one that had no relevance to them and which they would never use again. So we learned to start where students currently reside—even if, to some instructors, the starting places seem too easy. If you watch students working with these beginning ideas, you will see that they are not easy or simple. They are foundational. And we learned to be patient while students struggle with the activities and exercises in this book. They need time and space to re-construct their working models of their phenomena, and at the same time, to re-construct their working models of applied developmental science. If we can make ourselves slow down and really try to figure out what our students are thinking and doing, we can learn and discover along with them.

We suggest that, the first time through, instructors try the sequence recommended in this text. And then, after they have experienced its effects on student engagement and learning directly, they can freely refine, reorder, and optimize the class for their specific students and their own particular style of teaching. We always co-teach this course and we highly recommend this practice. It allows instructors to embody the key notion of multiple perspectives and competing claims. It prevents the meta-theory of a single instructor from taking on the unexamined status as "correct," and demonstrates how good scientists remain skeptical about their beliefs, no matter how deeply rooted. We would wish for future instructors all the frustrating, confusing, and precious moments we have experienced in teaching the course-- all the good arguments, the floundering attempts to articulate clearly our own positions and warrants and to comprehend the differing views articulated by respected others, the laughter at uncovering our own hidden assumptions, and the rare and delicious moments of insight and of opening and changing our minds.

Why are all the sections headed by questions?

We view this class as a series of conversations and discussions with our students, and so we have written the textbook using the same format. We have used students' frequently asked questions to organize the ways that we provide information. We hope that it is not too distracting, and might even be helpful in providing clues to instructors about how students typically think about these issues. We have also included as figures, the graphic information we have found useful in communicating and illustrating these ideas to students. They can also be found in the series of Powerpoint slides on the website that accompanies this book. We invite instructors and students to submit additional materials to the website, and we look forward to the opportunity to learn from them, as together we continue the process of figuring out how to interact with our science and our phenomena in new ways, using key concepts and principles, and slowly incorporating the lessons of a developmental systems perspective on applied social science.

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The SAGE Program on Applied Developmental Science

SECTION I:

GOALS OF DEVELOPMENTAL SCIENCE, THEORIES, AND TARGET PHENOMENA

Chapter 2. Goals of Developmental Science

For most students (and for many established researchers), the highest level at which they have thought about their target phenomenon is the level of the conceptualization or theory. That makes the analysis of theories a good starting point for meta-theoretical reflection. In order to analyze a theory for its underlying assumptions about the nature of people, their contexts, and the meaning of development, however, we have to be clear on how theories fit into the goals of developmental science, and to deeply understand the theories themselves.

What are the goals of developmental science?

Developmental science has three goals: to describe, explain, and optimize human development (Baltes et al., 1977; see Table 2.1). There two target of human development: (1) patterns of normative change and stability and (2) patterns of differential change and stability. Patterns of *normative change* refer to regular age-graded constellations of intra-individual change, including quantitative changes, often referred to as “trajectories,” and qualitative changes, such as reorganizations or the emergence of new forms. Patterns of *normative stability* refer to regular age-graded periods of constancy, including quantitative consistency, or flat trajectories, as well as continuity in qualitative organization or functioning. We illustrate what it means to describe, explain, and optimize these kinds of development using examples from the area of children’s motivation for school (Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006).

Table 2.1. Goals of Developmental Science

1. **Description** of patterns of intra-individual change and stability
    - Depiction of patterns of *normative* change and stability
        - Delineation of typical *quantitative* trajectories
        - Delineation of typical *qualitative* shifts
    - Depiction of *differences* between people in their developmental pathways
        - Delineation of range of quantitative trajectories
        - Delineation of different kinds of qualitative shifts
2. **Explanation** of patterns of intra-individual change and stability
    - Account of the set of causes that produce *normative* change and stability
        - Specification of influences that generate typical *quantitative* changes
        - Specification of influences that give rise to typical *qualitative* shifts
    - Account of the sets of causes that produce *different* pathways
        - Specification of influences that generate different *quantitative* trajectories
        - Specification of influences that give rise to different kinds of *qualitative* shifts
3. **Optimization** of intra-individual development
    - Identification of conditions that promote optimal *normative* and *differential* development
        - Specification of influences that generate optimal trajectories and qualitative shifts
        - Specification of influences that give rise to resilience
    - Discovery of strategies and levers to create such optimal developmental conditions
        - Discovery of ways to remediate or compensate for non-optimal conditions
        - Discovery of ways to promote occurrence of optimal developmental conditions

Description of Human Development

What does it mean to *describe* human development?

The task of *description* for developmental scientists involves depicting, portraying, or representing patterns of development in the target phenomena. As shown in Figure 2.1, this includes description of *normative* development, or typical quantitative and qualitative age-graded changes and continuities, as well as identifying the variety of *different* quantitative and qualitative pathways the phenomena can take. In the area of academic motivation, many decades of descriptive research reveals that, normatively, children's enthusiasm, interest, valuing, and engagement in academic activities show quantitative declines, starting the day they enter academic classes and ending when they graduate from high school or drop out. These declines can be depicted as relatively steady linear decreases, punctuated by steeper declines at school transitions, typically around the transition to academic curriculum (during Kindergarten or first grade), around grade 3 (considered the transition from "learning to read" to "reading to learn"), over the transition to middle school (about grade 6), and the transition to high school (grade 9).

In terms of differential pathways, these quantitative declines are less pronounced for girls, for high achieving children and youth, for white middle class students, and for students who attend schools that include kindergarten through eighth grade in the same building. In contrast, declines are more pronounced, and more likely to lead to dropping out prior to high school completion (which can be seen as a qualitative shift), for boys, for children and youth who struggle with the dominant language or academic material, for students who are low in socioeconomic status, or from some ethnic minority and immigrant groups, and for students who attend schools in districts that separate elementary from middle schools.

What does it mean to describe *qualitative* changes in development?

In general, describing qualitative change involves depicting the age-graded organizations and re-organizations in the constituents of a phenomena, sometimes referred to as phases, stages, structures, or developmental tasks. The clearest descriptions of qualitative shifts can be found in Piagetian and neo-Piagetian accounts of development, which depict sequences of qualitatively different structural reorganizations of cognitive and affective processes (e.g., Case, 1985). In terms of academic motivation (and many phenomenon not as directly tied to cognitive developments), relatively less consensus exists about how to characterize the pattern of normative qualitative changes. Some examples can be found in work on the normative development of self-perceptions that seem to underlie children's motivation and engagement, for example, self-perceptions of ability, which during early childhood are initially high and unrealistic, and subsequently come to be tied more directly to actual levels of performance (e.g., Stipek, Recchia, & McClintic, 1992), and children's conceptions of effort and ability, which initially are fused, but, with the onset of formal operations, come to be differentiated and take on an inverse compensatory relationship, in which low performance under conditions of high effort implies low ability (e.g., Nicholls, 1978).

How can the description of *stability* be part of the goals of developmental science?

Sometimes it may seem surprising that developmentalists would be interested in identifying time windows during which phenomena are stable or unchanging. Doesn't it seem like stable phenomena would be left to non-developmental scientists to study? Such questions makes sense if one subscribes to certain assumptions, namely, the assumption that stability is the default state of all phenomena; if so, then of interest are states that differ from this default, namely, states of change. However, it is also possible to assume that the natural state of affairs is movement, flux, or change; from this perspective, it is important to describe not only the qualities and directions of these changes, but also to document states that manage to differ from this default, namely, periods of stability, continuity, or constancy.

Explanation of Human Development

How is the *explanation* of development different from its description?

Although, when studying any phenomenon, it is an important step to describe age-graded patterns of change and stability, age by itself (that is, time since birth) cannot explain *why* these patterns occur. Age (and other measures of time) can provide a metric along which change and stability can be plotted, but they are only considered to be *markers* for the temporally-graded causal factors that give rise to development patterns in the target phenomenon. Hence, *explanation* differs from description in that it refers to an account of the *causes* that together are necessary and sufficient to produce the patterns of changes and stability that have been described or observed. If descriptions answer questions like "what?" (i.e., the nature of the target phenomena), "how?" (i.e., the ways in which phenomena can change or remain the same), and "when?" (i.e., the ways in which these patterns appear as a function of age or time), then explanations focus on the "why?" questions: What sets of factors cause, influence, or produce these different patterns of change or stability over time?

Explanations of normative development focus on the causes that underlie typical patterns of change and stability. In the example of motivation, explanatory theories and research would focus on the causes of the steady declines in students' academic engagement and motivation, and why sharper declines are typically evident during school transitions. They would also focus on the causes that maintain engagement or compensate for losses in motivation, and so produce patterns of normative stability. Causal processes can remain the same over development, resulting in what can be called "explanatory continuity," or different causal processes may be involved in explaining similar phenomena at different ages, resulting in "explanatory discontinuity."

Explanations are completely different from descriptions. Researchers can compile the most elaborate description of the development of a phenomena, and not have discovered anything about the causes that underlie it. In the motivational area, general consensus exists about normative and differential changes in academic engagement over the school careers of children and youth, but a great deal of lively debate persists about the causes of these developments—neurophysiological, psychological, social, and contextual factors have all been nominated. Of course, description and explanation are linked—the search for explanations are guided by signposts originating in the patterns of development that have been described-- but even when normative descriptions have been ascertained for decades (e.g., the sequence of locomotion from creeping to crawling to walking described by Gesell in the 1930s; Gesell & Ames, 1940), it often takes many more decades for causal accounts to be well-established and accepted (Thelen & Adolph, 1992; Thelen, Ulrich, & Wolff, 1991).

Why do developmentalists need to *explain* stability?

Just as with descriptions of stability, it may seem that the search for explanations for stability would be a waste of developmentalists' time. And indeed, if researchers assume that the natural state of all phenomena is constancy or continuity, that is, if they assume that all phenomena are inherently at rest, then no explanations for this state are needed. However, if, on the other hand, *change* is assumed, then the natural state of all phenomena is considered to be movement or flux, and explanations are needed for how constancy could be accomplished. In general, such states of stability or constancy are often described as "steady states," and they are considered to be achieved through active means, such as are visible in all those activities needed to maintain the steady state of “balance” when walking on a narrow ledge or, over longer periods of time, all those activities needed to maintain a constant weight. These active processes are captured in concepts such as maintenance, conservation, preservation, compensation, equilibrium, homeostasis, or homeorhesis.

What is meant by explanations of *differential* patterns of stability and change?

In addition to explaining normative patterns of development, researchers are also interested in providing a causal account for why a target phenomena should take any of the variety of different pathways it has been observed to follow. Sometimes this task is relatively straightforward—especially when pathways differ only in mean level or age of onset. Then it can be the case that the same factors that explain normative change and stability also can account for different pathways. Pathways are traversed at earlier ages or at higher mean levels because some individuals have more of the factors that promote the phenomena and less of the factors that undermine it, whereas pathways are traversed at later ages or at lower mean levels because some individuals have less of the factors that promote the phenomena and more of the factors that undermine it. In the case of motivation, this kind of “explanatory continuity” has been found for some of the differences between girls and boys in motivational development. In general, many of the same factors that predict and explain engagement in girls (who start and remain higher in motivation) also predict and explain engagement in boys; they just operate on a lower plane for boys.

The task of differential explanation is made more challenging when the causal factors that produce normative development are not the same ones as those that generate the different pathways. Such “explanatory discontinuity” seems to be the case for differences in motivation, engagement, and achievement for students from different socio-economic classes and ethnic groups. Explanatory models for white middle class students simply did not include factors like affordable medical care (e.g., to treat ear infections which otherwise produce high rates of school absence), dangerous neighborhoods (e.g., which can interfere with getting to school and completion of homework), and discrimination from teachers and peers.

Optimization of Human Development

How does optimization of human development differ from explanation?

The goal of optimization of human development refers to research and intervention activities designed to figure out how to promote healthy development (also referred to as flourishing or thriving) and the development of resilience. This task goes beyond description and explanation in two ways. First, in order to optimize development, trajectories and pathways must be identified as targets—targets that represent "optimal" development. These kinds of trajectories are often better than normative development, and so represent rare or even imaginary pathways, especially for groups with many risk factors. The search for optimal pathways reflects the assumption that individuals hold much more potential and plasticity in their development than is typically expressed or observed.

The second way that optimization goes beyond description and explanation is that even when explanatory theories and research have identified the necessary and sufficient conditions likely to promote optimal development, researchers and interventionists still need to discover the strategies and levers that can consistently bring about these developmental conditions. For example, suppose that in studies of motivational development, researchers have uncovered multiple factors that are important to promote student engagement, such as teacher autonomy support, authentic academic work, school climates organized around mastery-oriented learning goals, parent investment in student academic success, and student self-efficacy. These would all be potential candidates for inclusion in interventions to optimize motivation. However, from such research, interventionists have no clues as to the strategies that will allow them to effectively (and permanently) change those developmental conditions. One way to understand the difference between explanation and optimization is that, if explanations focus on the antecedents of a developmental phenomenon, then optimization efforts need to focus on the antecedents of these antecedents.

Conclusion

How do these three goals of developmental science fit together?

In one way, the tasks of description, explanation, and optimization from their own sequence: If a team of developmentalists wants to understand their target phenomenon, first, they must discover and document its developmental course, including both quantitative and qualitative changes and periods of stability (i.e., describe the development of the phenomenon). Once its course has been charted, researchers can begin searching for underlying (or overarching) factors that produce these patterns of change and stability, working toward causal accounts of both normative development and differential pathways (i.e., explain the development of the phenomenon). Then when the explanatory network is sufficiently well-established, researchers can begin building interventions that target the creation of developmental conditions that support and maintain these explanatory factors (i.e., optimize the development of the phenomenon). In practice, research is more recursive, of course. Descriptive research suggests targets for optimization; experimental study of interventions can be used to identify causal factors; the analysis of explanatory factors suggests additional potential descriptive pathways; and so on. In fact, the active pursuit of all three of these tasks simultaneously characterizes the most generative research areas.

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Chapter 3. Understanding a Theory

The goals of developmental science are to describe, explain, and optimize human development, including quantitative and qualitative topographies of stability and change, both as these unfold normatively and as they follow differential pathways. These worthy goals fit within the larger goals of science and of social science, which are to describe, explain, and optimize whatever target phenomena, that is, whatever aspects of the social and natural world, we have chosen to study. There are great ethical responsibilities that come with these goals. As scientists, we must bring as much clarity to our work as possible, describing and explaining what we are studying as truthfully and accurately as we are able. We must also bring compassion to our work—taking the full picture into account, including the perspectives and interests of all involved. And we must try to carry out our work mindfully, with full awareness of how we are conducting our science, and the historical and social pressures that shape our work. Hence, to prepare us for our profession as scientists, we require training in both ethics and science.

Empirical science, as a way of knowing, offers us a set of tools. Two of the most important are theories and methods. Theories, at their core, are ways of thinking about phenomena, representations or working models of our targets, if you will. Methods, at their core, are ways of looking at phenomena, rules for observation. These two sets of basic tools, for thinking and looking, are reciprocally connected to each other (see Figure 3.1): Theories guide us about the "who," "what," "when," "where," and "why" we should look or observe. As the German saying goes, "Das Auge schläft bis es der Geist mit einer Frage weckt," which means "The eye sleeps until the mind wakes it with a question." If our eyes are open, we then see things through our observations that, if our minds are open, should inform what we think, or update our working models.

Insert Figure 3.1 about here

An important step in our scientific training is the realization that we are not studying theories or constructs; we are studying whole people functioning in the real world, or the slices of the real world delineated by our target phenomenon. Theories are highly selective and impoverished representations of these real world phenomena, and we should always be trying to rework our conceptualizations to more truthfully, compassionately, fully, and clearly map onto our targets. Our theories will get “better,” that is more useful, to the extent that they can more fully integrate all the empirical information that is currently known about our phenomena and suggest new avenues for research. As has often been noted, theories become more useful as they expand in scope (the range of phenomena they map), precision (the exactness of the mapping), and generativity (the new territory they open up for exploration). If we believe that the social and natural worlds are complex intertwined dynamic systems, then we will naturally be attempting to construct theories that can more clearly capture more of this complexity and change. To do this, however, we first need to carefully and deeply understand the theories that currently guide our developmental science.

For the process of “understanding theories,” this text offer a set of strategies for unpacking and analyzing theories that allows us to look at the components of theories and distinguish their micro-developmental processes from their macro-developmental processes. This kind of analysis allows us to deconstruct theories—to identify the elements that are descriptive and explanatory, and to examine their implications for optimization. Importantly, we can also analyze the assumptions about humans and their development that underlie theories. Once completed, we can go “beyond understanding” to processes of critique, elaboration, and generation of conceptual and empirical questions. Such an analysis is the basis for locating places where a theory can be “developmentalized,” “complexified,” and “systematized,” bringing it closer to our target real world phenomenon and rendering it more useful to finding solutions to important applied problems.

What are the steps to “understanding a theory”?

The steps to understanding a theory are pictured in Table 3.1. They include a set of questions that allow us to focus on the goals of the theory, its historical context, its key constructs, the parts of it that are relevant for description, explanation, and optimization, and its underlying assumptions. In addition, we also encourage students to draw theories, focusing especially on “what is on the arrows,” namely causal or micro-developmental processes. After such an analysis, students are ready to go “beyond understanding,” for example, by critiquing and elaborating the theory, or using it to derive research questions or intervention ideas.

Why would it be important to “understand” theories? Why can't we just start using them?

Because we have meta-theoretical lenses that we bring to the study of our phenomena, it is easy to “misunderstand” theories, that is, to assume that they are more comprehensive or dynamic that they really are. It is also easy to dismiss theories with which we are not as familiar, if they raise our meta-theoretical hackles. We are likely to accept the theories that our mentors use, that are dominant in our areas, or that reflect current historical conventions. When we read theoretical papers (which are still in the minority in our scientific journals, Slife & Williams, 1997), we typically just follow the ideas as they are presented and often do not question them or notice what is missing. To begin seeing theories clearly and afresh, and to become aware of what they are (and are not), it is helpful to take them through the understanding process.

To illustrate the process of understanding a theory, we use the theory of attachment, as presented in Mary Ainsworth's 1979 article in the *American Psychologist.* We selected this theory because it is applicable to a wide range of phenomena and because it was part of a "meta-theoretical duel" with social learning theorists in the late 1960s and early 1970s (Gewirtz, 1969). We discuss these ideas and events more completely in the next chapter, in which we contrast these perspectives. We also offer alternative "dueling formulations" in theories of intrinsic and extrinsic motivation (e.g., Ryan & Deci, 2000). In terms of understanding a theory, it is always necessary to specify the source article because theories are themselves developmental phenomena, and different papers, even by the same author(s) can present different versions of the theory (e.g., see Chapman, 1988, for a historical analysis of Piaget's changing theoretical views on cognitive and affective development). We selected Ainsworth's *American Psychologist* article because it was suitable for general readers. We also provide a relatively general understanding of Ainsworth and of the differences between Bowlby and Ainsworth, but we encourage readers to follow up on these theories and theorists in more detail (e.g., Bretherton, 1992).

Why does understanding start with articulating the "theoretical question"?

It is important to start the understanding process with a clear perspective on the goals of the theory, what it is trying to do, as reflected in the "theoretical question" it is intended to answer. This provides a frame for analyzing the parts of the theory and insures that we begin our analysis at the right "grain size." Sometimes we zoom in too quickly and get stuck on specific concepts or methods. Focusing on the theoretical question allows us to zoom out and get a feeling for the whole package before we consider its elements. Alternatively, we sometimes zoom out too far, and end up disliking a theory because it is not helpful to us, when it was never designed to answer the questions we would like it to address. In this case, focusing on the actual theoretical question allows us to get oriented to the goals of the theory's authors, instead of our own. When trying to understand a theory, we often put up pictures of the theory's authors and laughingly pretend that they are with us in the classroom, to remind us to be as accurate and constructive as we can be in analyzing their work.

Table 3.1. Steps to Understanding a Theory

1. **Theoretical question**. What is the theory trying to do? What is the purpose of the theory?

2. **Theoretical context.** What are the main theoretical tradition(s) within which this theory is situated or from which this theory was derived?

3. **Key constructs and definitions.** What are the most important terms, phenomena, or objects of study? How are they defined?

4. **Description.** What is the target phenomenon and what is its developmental trajectory?

5. **Explanation**. Draw a picture.
   a. **Antecedents**. What causes, produces, or influences the target phenomenon?
   b. **Consequences**. What does the target phenomenon cause, influence, or produce?
   c. **Mechanisms**. What processes are on the arrows?

6. **Optimization**. How can we improve or produce the best target phenomena? What are the implications for intervention?

7. **Meta-theoretical assumptions**._ What does the theory assume about the nature of development and change?

8. **Beyond understanding**
   a. **Theory**: Question, critique, compare, integrate, enhance, elaborate, improve
   b. **Research**: Design, select variables, hypotheses, next steps
   c. **Optimization**: Antecedents, consequences, mechanisms
   c. **Self-reflection**: Understand, question own assumptions, views

It is surprisingly difficult to read an entire theory paper (even one as short as an article in *American Psychologist*) and then to pull back and figure out what the authors were trying to do. Rarely do authors directly state their theoretical questions. In trying to articulate Ainsworth's central question, students often land on the term "attachment" and suggest guiding questions such as "Where does attachment come from?" and "Why are babies attached to their mothers?" These are not Ainsworth's questions, of course, but we usually let students' ideas sit on the whiteboard as possibilities, and suggest that continuing with the "Understanding" process may help to surface Ainsworth's guiding questions, which it usually does.

What is meant by "theoretical context"?

The second step in understanding a theory is to identify the theoretical tradition from which the theory emerged or within which it is currently situated. Often we can gain more appreciation of the goals and constructs of a theory when we know about the theory's general precursors, or what the theorist was reacting against or trying to supplement or replace. It can be difficult for students to figure out the theoretical context of a specific theory. Often the authors do not explicitly identify the root theoretical traditions, and students are not familiar enough with the history of psychology to know the "lineages" of specific theories or theorists, nor do they have mental models of the range of families of psychology that are elaborated enough to allow them to recognize that specific terms, such as "drive" or "trait" or "appraisal" or "reinforcement," are important clues to a theory's larger context. In fact, this process is often students' first introduction to the idea of "families" of theories or theoretical traditions, like constructivism or social learning theory or motivational theories of fundamental needs or trait personality theories. Here, classes or readings on the history of psychology would be helpful (e.g., Cairns & Cairns, 2006), although students should not be surprised if alternative accounts of the history of a field are provided by narrators representing different traditions (e.g., histories of the field of motivation provided by Edward Deci and Bernard Weiner at AERA in 1990).

Understanding Ainsworth: Theoretical context. Luckily, Ainsworth (1979) is explicit about the theoretical tradition upon which her work builds. In fact, the first word in her 1979 paper is “Bowlby” as in “Bowlby’s (1969) ethological-evolutionary attachment theory implies that it is an essential part of the ground plan of the human species-- as well as that of many other species—for an infant to become attached to a mother figure” (p. 932). Ainsworth tells readers directly that her theoretical and empirical work relies on the previous work of John Bowlby. At this point in the class, we usually pause to “understand” Bowlby and then return to “understanding” Ainsworth—a task made easier once we have analyzed Bowlby.

Understanding Bowlby: Goals and theoretical context. John Bowlby’s theory of attachment (Bowlby, 1969/1973) was focused on the question, stated in colloquial terms, “Why do infants love their mothers, and why do mothers love their infants?”. Posed in a more scientifically exact manner, his question was, “Why do infants form attachments to their caregivers, and why do caregivers form attachments to their infants?”. As pointed out by Ainsworth, Bowlby approached these questions from the theoretical context of ethological and evolutionary traditions. Ethology, sometimes considered a sub-topic of zoology, focuses on the study of animal behavioral processes in their natural contexts; and evolutionary psychology focuses on the role of natural selection and survival in shaping the current functions of human behavior, cognition, and neurophysiology in adapting to changing physical and social environments. When considering attachment from these perspectives, Bowlby was focused on two issues: (1) What is the function of caregiver-infant attachments in allowing infants to survive to reproductive age? and (2) What are the kinds of species-wide biobehavioral systems (initially called “instinctual response systems”) that typically guarantee the normative formation of attachments between infants and caregivers?

What are the key constructs of the theory and their definitions?

Key constructs are the building blocks of any theory. They are simply the specialized terms used to label the elements in the theory. They are called “constructs” in order to emphasize that they are theoretical representations of real objects and processes. In a good description of a theory, authors provide a comprehensive list of the key constructs used in the theory along with careful and precise definitions of these concepts. For example, in Bowlby's theory, such key constructs would include "attachment," "infant distress," "proximity seeking," "protection," and "responsiveness." Identifying the key constructs and locating their definitions are important steps in getting a handle on the pieces of a theory. For Bowlby and Ainsworth, these are listed in the examples of "Understanding a theory" summaries at the end of this chapter.

The search for key constructs and their definitions is an important step during which students often discover that theorists' presentations of their theories have "holes" in them. The definitions, even of key terms, are often incomplete, or they are missing all together. Sometimes definitions can be inferred from how terms are used, but sometimes, in understanding a theory, we must refer to other papers or just leave definitions blank. In preparation for drawing a theory, we often ask students to place each key construct and its definition on an index card—this deck of cards can then be used to create alternative depictions of the relationships among these constructs, as prescribed by the theory.

What is the target phenomenon and what is its developmental trajectory?

The target phenomenon of any theory is the heart or core of the theory, the central thing or construct around which the theory is formed. When getting straight on one's own program of research, this target phenomenon often seems to be moving. We can shift our interest from attachment itself to the characteristics of the infant or caregiver or higher-order contexts that shape it, or from attachment itself to its short-term or long-term consequences. However, when understanding a theory, getting a bead on its central target is usually not too difficult. Typically theories are named for their target phenomenon—such as self-efficacy theory, emotional selectivity theory, transactional coping theory, and so on. In the case of Bowlby, the target phenomenon is “attachment.” One way to begin to graphically represent a theory is to place the target phenomenon is the middle of the drawing, as shown in Figure 3.2.

Insert Figure 3.2 about here

The developmental trajectory of the target phenomenon is the descriptive part of the theory—depicting (as presented in more detail in the previous chapter) the way that the phenomenon changes over age or time. From its description of development, one can already start to get a feeling for the assumptions underlying the theory. Does the description involve a single progressive quantitative trajectory of age-graded change? Does it involve qualitative shifts? Different pathways? Patterns of stability and continuity? Each of these kinds of descriptions of how the target phenomenon develops reveals the authors’ beliefs about the nature and course of development.

Understanding Bowlby: Target phenomenon and description of its developmental course. In Bowlby’s theory, as might be expected if one is thinking of attachment as a connection between infant and caregiver that allows for greater chances of survival, the developmental course of attachment is a relatively universal normative progression. Less obvious from an ethological-evolutionary perspective, the formation of all attachments are hypothesized to proceed through several qualitatively different phases, from undiscriminating and then discriminating social responsiveness to the emergence of a strong affectionate bond that binds the infant to a specific intimate companion (sometimes referred to as “full-blown attachment”).

What are the parts of “explanation”?

The next step in understanding a theory is to analyze its “explanation” by pulling out (from the list of key constructs if such constructs are presented comprehensively in the theory paper) the antecedents and consequences of the target phenomenon, and the mechanisms or processes that causally connect them. *Antecedents* are the proposed causes of the target phenomenon and its pattern of developmental change(s). What produces, influences, or generates the target? Here again, clues can be found as to the assumptions underlying the theory. Are the causal antecedents all to be found within the person, perhaps all in the individual's biology or in their psychology or in their social cognitions? Conversely, are the causal antecedents all to be found within the environment? Or in a mix of person and environment? In drawing a theory, the antecedents are usually placed to the left of the target(s) and connected to them via an arrow pointing from the antecedent to the target (see Figure 3.2).

Understanding Bowlby: Explanation and antecedents. For Bowlby, again not surprising given the theoretical context, the antecedents are found in the biobehavioral predispositions of all humans (in fact, of all mammals who do not cache their young). Newborns come with a set of characteristics and action tendencies that make them attractive to caregivers, such as their "baby-ness" (as seen in their small bodies, large heads, big eyes, soft skin, floppy movements, and so on), their sociability, and their preference for and interest in other humans. They also come with the capacity and willingness to vigorously express their distress as well as with reflexes that allow them to physically attach or fasten themselves to caregivers when distressed, through grasping and huddling. They also bring with them the capacity to be comforted by other people, through, for example, close physical contact, rocking, and humming. Correspondingly, caregivers come with the capacity to be attracted by infants' "baby-ness" and the desire to draw near to, comfort, and protect newborns when they are distressed. These are the proposed antecedents of attachment. See Figure 3.3.

Insert Figure 3.3 about here

What are the consequences of the target phenomenon?

The consequences of the target are the outcomes that the target itself causes, generates, or produces. These are usually the reason that the target is of interest to researchers—because it has a positive or negative impact on people's lives. For example, in Bowlby's theory, attachment to a caregiver has the infant is more likely to survive to reproductive age, as depicted in Figure 3.3. In drawing a theory, the consequences are usually placed to the right of the target, with an arrow connecting them, that starts at the target and goes to the consequences. Sometimes two arrows would be included, one to the positive consequences and one to the negative consequences. Sometimes two sets of consequences might be considered—the short-term consequences and the long-term consequences of the target. These options are shown in Figure 3.2.

What are the processes that connect the target phenomenon to antecedents and consequences?

In depicting theories, arrows have a special meaning. They denote influences or causes. One of the most interesting questions about any theory is "What is on the arrows?" or in other words, "What are the processes or mechanisms by which influence is transmitted?". A theory can posit multiple answers to the question of *how* causes produce their effects. For example, the mechanisms through which the antecedents produce the target phenomenon are different from the mechanisms through which the target phenomenon produces its consequences. It is also possible for a theory to posit multiple mechanisms through which either of these causal chains operate—for example, multiple pathways through which an attachment increases the chances of the survival of offspring.

Understanding Bowlby: What is on the arrows? In the case of Bowlby's theory, the processes that connect biobehavioral predispositions to the formation of an attachment are well-specified. Newborns, when distressed, express this directly through crying or fussing. Caregivers, who are attuned to these signals, approach the newborn, figure out what is wrong, and provide comfort and care (e.g., feed the newborn or change a wet diaper). The newborn expresses relief and happiness in having his or her needs met. The caregiver also experiences relief and happiness at the infants' satisfaction. After many such interactions, the infant learns to direct their communications to their caregiver with the expectation that the caregiver will respond sensitively; at the same time, the caregiver becomes more adept at “reading” the infant’s signals and so becomes more effective in calming and caring for the infant. This positive feedback loop leads to thousands of infant-caregiver interactions from which emerges the specific affectionate bond between caregiver and infant. Over time, these interactions organize the infant’s behavior, so that when distressed, it seeks proximity to the caregiver; and this proximity in turn acts to calm the infant’s distress and stabilize the infant’s behavior. These interactions are depicted in Figure 3.4.

In terms of the other set of arrows in the depiction of Bowlby’s theory, namely, from “attachment” to “survival,” a different set of mechanisms are proposed. For immature offspring, and especially in times of distress, proximity to a caring adult (whether accomplished by attracting, gripping, staying near, or getting to a caregiver) makes it more likely that the baby will be taken care of and protected from threats, and so survive to reproduce.

Insert Figure 3.4 about here

What is on the arrows?

It is worth highlighting that the mechanisms of transmission in Bowlby’s theory are processes of reciprocal social interaction, in the form of thousands of exchanges between the newborn and its caregiver. In general, we argue that “what is on the arrows” is most often a set of social interaction processes, reciprocal exchanges between the target person and others in his or her natural and social contexts, or their surrogates, like books, academic tasks, work assignments, television, Facebook, or other social tools. In subsequent chapters, we will return to the idea that reciprocal social interactions, also called “transactions” (Sameroff, 2010) or “proximal processes” (Bronfenbrenner & Morris, 2006), are the “engines” of development. BY this we mean that they have the power to shape development, and may be the only forces that can accomplish this.

Why does this theory seem to be operating on two different time scales?

All developmental theories operate on multiple time scales. In many theories, two time scales are made explicit: (1) the "micro-developmental" portion of the theory is grounded in "real time," and depicts the moment-to-moment exchanges between the target individual and their social partners; these exchanges can be captured, for example, by *in vivo* observations or digital recordings of social interactions; and (2) the "macro-developmental" portion of the theory is grounded in "developmental time," and depicts the time scale over which these social interaction episodes aggregate to cumulatively shape the trajectory of the target developmental process (which we sometimes refer to as "moving the dial") or cumulatively lead to the reorganization and emergence of qualitatively new states.

Understanding Bowlby: Micro- and macro-development. In Bowlby's theory, the micro-developmental part is depicted in the reciprocal social interactions between caregiver and infant, which become more attuned with practice. The macro-developmental part is depicted in the emergence of the attachment bond, which takes place over a much larger time scale and requires the development of additional underlying antecedents, such as the infant's neurophysiological, attention, memory, and cognitive subsystems.

What are the parts of a theory that focus on optimization?

"Optimization" refers to the implications of the theory for prevention and intervention efforts aimed at producing the best target phenomenon possible. Most developmental theories, because they focus on progress in normative development, are pretty good at identifying "ideal" or "optimal" development trajectories (although there are often many alternative optimal pathways and end states). Sometimes the theory's optimization implications are not stated directly, but have to be inferred from the antecedents specified by the theory—these are the intervention levers. For example, theories positing that personal attributes (e.g., cognitive level, self-efficacy, personality) are key antecedents imply that healthy development could be achieved by promoting those personal attributes, although the theory may not specify how this can be accomplished.

Understanding Bowlby: Optimization of attachment. Bowlby is clear on the optimal developmental outcome—a secure attachment between caregiver and infant. At the same time, because the antecedents posited by Bowlby are species-wide biobehavioral predispositions, it may seem as if there is no room for optimization. However, this theory would suggest that any infants or caregivers who do not come with these characteristics may be at-risk for difficulties in the formation of a secure attachment. So infants who do not have a reasonable amount of "baby-ness" (e.g., preterm newborns) or who cannot demonstrate their interest in caregivers (e.g., blind infants) as well as caregivers whose natural protectiveness and responsiveness have been undermined by illness or exhaustion might need supports to establish the kinds of exchanges that will lead to the formation of a secure attachment.

Discussion of a theory's implications for optimization are also interesting places to discover what is missing from a theory. For example, many theories posit that the antecedents to certain sets of target actions are beliefs. An illustration of this kind of conceptualization can be found in theories of academic engagement (i.e., students' enthusiastic participation in academic activities), some of which hold that a key antecedent of students' classroom engagement is their perceptions of the extent to which teachers respect and appreciate them. Sometimes we encourage our own students to think about whether these perceptions are the "real" antecedents in such theories, pushing them to consider whether teachers' actual treatment of students is more relevant. Our students correctly point out that the "active ingredient" that shapes students' engagement is not what teachers are doing but what students *think* teachers are doing.

However, it is instructive to consider the optimization implications of such a position. Focusing on students' perceptions as the ultimate antecedents implies that intervention efforts should be focused on students themselves, for example, by systematically attempting to persuade them that teachers really *do* respect and appreciate them. This is not the strategy that interventions to optimize engagement utilize, of course. Instead, they focus on working with teachers to change the ways that they interact with students, with the assumption that improved teacher-student exchanges (in which teachers are warmer, listen more closely to students points of view, and so on) will cumulatively lead students to change their minds about whether teachers like and respect them. In such cases, it becomes clear that the theory has not yet fully articulated all the strings of antecedents that are involved in generating the target phenomenon. It also suggests that sometimes the analysis of standard intervention practices can be helpful in filling out the missing pieces of a "theory of change"—as the basis for optimization.

What are a theory's "meta-theoretical" assumptions?

The endgame of this text is to help researchers articulate their own assumptions about development and to begin re-tooling their conceptual and empirical work to align more fully with those assumptions. A good first step is to begin to surface the assumptions about the nature of development that are contained in the theories we rely upon most often. Throughout the description of the understanding process in this chapter, we have tried to indicate the places in a theory where these assumptions are most apparent—for example, in the description of the nature of the development of the target phenomenon (e.g., as a quantitative trajectory or as emergence) and the location of its key antecedents (e.g., in the person, the context, or their transactions). In subsequent chapters on meta-theories, we will consider some schemes for grouping and labeling these assumptions. But the first step in this direction can be part of the "understanding" process, in which, once we analyze the theory, we start locating and discussing the assumptions it includes—assumptions that are so easy to overlook.

Understanding Bowlby: Meta-theoretical assumptions. Consistent with other ethological-evolutionary theorists, Bowlby is focused on attachment as an outcome of inherent species-wide neurophysiological subsystems that have evolved as part of the human “ground plan” because they have provided an evolutionary advantage. If newborns and caregivers come with “standard biological equipment,” attachments will be formed. These assumptions (which since the introduction of Bowlby’s theory have been substantiated by research on the nature of this neurophysiological equipment) suggest the primacy of biology in the development of attachment.

We often start “understanding” discussions by asking students for their emotional reactions to theories or other readings for the class. We have found that encouraging students to talk about what they liked and disliked about readings serves two functions. First, it allows us to empty out our reservoir of personal likes and dislikes, which typically are our first and most compelling reactions, and until they are dispensed with we may find them shaping our analysis. Second, our emotional reactions can provide some useful information about our meta-theoretical predilections – one of the main reasons we dislike theories is because they contradict our view of people and their development. So we can begin to learn about our own assumptions by discovering the families of theories that we like and dislike. We also encourage our students (and ourselves) to turn toward and spend time understanding theories that initially do not resonate with us—it is one way to learn more.

What happens next-- “beyond understanding”?

After the process of careful analysis required to really understand a theory, we have now achieved a clear picture of the “map” that the theory provides for its target phenomenon. We can use understanding as a launching pad for further theory construction—by clarifying construct definitions, critiquing what is present as well as what is absent, and filling in holes. We can use it as a basis for comparing and contrasting different theories that focus on the same target phenomenon. We can integrate the theory with others that we have previously understood, or we can go in search of additional theories to shore up, enhance, or elaborate the current one. We can also use the theory to design research studies and intervention efforts.

An important accomplishment in understanding theories and reflecting on their assumptions, is that we are beginning to differentiate our thinking. We distinguish elements that are often “fused” in our everyday research practice. We separate our target phenomena (which function in the real world beyond our immediate grasp) from our theories or representations of these phenomena, which are always highly selective and simplified. We can separate the theories from their constructs, and both of these from their operationalizations and measurement in specific variables. We can then examine the assumptions packed in all of these elements. This kind of “defusing” allows us to become more flexible in considering multiple perspectives—meta-theoretical, theoretical, operational, and analytical—in studying and trying to optimize our corner of the world.

Is it really necessary to draw theories?

Theories are representations of our phenomena, and drawing theories forces us to make explicit all of our (or the theorist’s) decisions about the key constructs and their relationships. When “drawing,” we don't need to worry about our artistic skills—boxes and ovals, stick figures, and arrows are typically sufficient for depicting even complex theories and models. There is a clarity to drawing, or to moving around our pack of index cards (containing key constructs), that scaffolds clear thinking. We consider how constructs are potentially grouped according to individual and/or contextual attributes; we notice whether some constructs are embedded in other higher-order constructs. We register temporal and causal priority based on the convention that the time course moves from left to right, and that causes precede their effects. We indicate reciprocal relations by including both feedforward arrows and feedback arrows.

One of the things that we noticed about our students’ drawings is that the only context in which they have systematically been exposed to visual representations of their phenomena is in their statistics classes. And they have tended to adopt those depictions—based on multiple regressions, latent path models, hierarchical linear modeling, and so on. This can create a kind of "statistical creep" in which certain analytic techniques come to dominate our representations—and so shape our theories of phenomena. Instead of looking for analytic methods that allow us to test our genuine theoretical questions, we end up asking the theoretical questions that our statistical methods are designed to answer. So it was important to "defuse" conceptual form statistical representations, so that we could consider their fit in making decisions about design and analysis.

Finally, it was great fun to ask all our students to draw the same theory and then examine all the different ways that it could be represented. Some of the representations were "better" than others, in that they contained more information, were more consistent wit the theory's propositions, or were easier to understand. And sometimes, some of the student representations were actually better in all those ways than the graphics offered by the theorists themselves! But often times, all the variety of representations were equally good—but just very different. Again, this allowed us to reflect on the multiple perspectives that can be brought to bear on any phenomena, and to seek out and appreciate ways of looking at them that are different from our own.

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Activity 1: Articulation of a Configuration

In order to deeply understand the ideas and tools presented in this book, we think it is important for students (and researchers) to practice using them to conceptualize and design research and interventions that focus on target phenomena of their own. Questioning, reconsidering, and enriching our own work is a challenging task, and we have found that the passion and enthusiasm we have for understating our target phenomenon and improving the lives of our participants helps sustain researchers in these efforts. So we encourage students to select phenomena and applied problems to which they are genuinely committed, or as one of our professors always said—"Ideas that keep you awake at night."

We have also found that it is important to practice with phenomena about which one knows a great deal. To make progress, students need to be familiar with the big theories in an area, the major and minor controversies, and the latest findings from a variety of perspectives. One of the most important advantages of developmental systems perspectives is that they allow researchers to integrate a great deal of (what can often seem to be unconnected or even contradictory) information about a phenomena. So, the more that one knows about the research findings in an area, the more apparent the utility of developmental systems perspectives becomes. Of course, some areas within the social sciences are so new or so narrowly focused on a single theoretical perspective that they do not yet have the kind of complexity that seems to require systems thinking. To these areas, developmental systems perspectives bring a variety of ideas about how to "build out" toward conceptualizations and research that recognize and create a complex multi-level dynamic picture of the target phenomena.

What are the goals of "articulating a configuration"?

The activity of "articulating a configuration" allows researchers to communicate clearly about the topic upon which their scientific efforts are currently concentrated. We find this process useful in helping students develop their “elevator speech”—which we use as shorthand for a very brief focused non-technical account of one’s area of study and its importance—a set of sentences that are so short and pithy that they can be meaningfully delivered to the Dean of one’s college in answer to the question, “So—what kind of research do you do?” in the time it takes an elevator to travel from the ground floor to the third floor (where our Dean’s office is located). So far, only one of our students has ever been asked to deliver this speech in an elevator, but the mental discipline and care it takes to select each idea, each word, and its sequence can be clarifying.

Because students are always starting their training in the middle of their mentor’s research program, it is typical for their “point of attack” in thinking about their research to be very low, very close to their own specific research questions and variables. So it is helpful for them to “pull back” or “zoom out” and start thinking about their topic from the perspective of the Dean, a non-psychologist, or a generic grandmother figure—wise but not knowledgeable about the topic. This rids elevator speeches of jargon, which is an easy place for assumptions to lodge. Students can also learn something about their own phenomena by answering the questions need to identify their configuration. They are presented in the next set of tables, along with the actual assignment sheet that we ask students to complete.

Table 4.1. Elements of a Configuration

What is a CONFIGURATION? A configuration locates an area of study on the developmental map. A configuration consists of:

1. A phenomenon or target of study (e.g., moral development, coping, peer relations, school readiness, mindfulness)
2. An age group (e.g., infancy, childhood, early adulthood, old age)
3. A context or setting (e.g., family, school, the street, hospital, daycare, work)
4. A social address (class, race, gender, and nationality)

Why do we need to specify these elements?

The elements of a configuration start with the phenomena itself as well as the parameters that "embody" and "contextualize" the target, including the age group(s), contexts, and social address (race, class, and gender) where the target unfolds. In terms of specifying a "target age group," it is common for students from I-O, social, community, or other areas outside of developmental to point out that they do not have one. This exchange becomes an opportunity to ask these students exactly what they mean by not having a "target age"—are they interested in workers or teachers form birth to death? Of course not, they are interested in "adults"—which students then realize is (obviously in retrospect) an age group. It doesn't seem like an age group because adulthood is the default in the social sciences, and so often it is not named or examined. Typically, students are interested in an even more restrictive age range than that covered by "adulthood"—which extends from age 20 to 120. Typically, workers are studied from the time they enter the job market until they retire—which include different age groups for different professions.

The same set of principles applies to decisions about the "context" and "social address" of phenomena. When we study phenomena that reside largely in the mind (e.g., identity, appraisals, health beliefs), we can easily assume that there is no "context," until we reflect on the actions and social partners that are relevant to these phenomena and begin to enumerate them (e.g., the contexts of home, school, peers, and neighborhood that are relevant to the development of identity during adolescence and emerging adulthood). It is also typical to assume that we are not interested in any specific "social address," that is, any specific class, race, gender, or nationality. This is possible, in which case we would specify "universal"—with the notion that our phenomena would operate in exactly the same way across all social categories.

Most researchers would not go so far, and so students often re-consider, realizing again that the “default” is white middle class Americans—who, of course, possess their own social address—because it is the dominant one in our culture, it often goes without saying. Sometimes, the phenomenon itself implies things about its social address. If researchers are studying stress in the prison population, or commitment in workers in a high-tech industry, or how people with autism use online resources, each of these populations are characterized by a pretty narrow range of social characteristics. In specifying them, we can see the effects of selection processes on the nature of the people we are studying—whether they are based on discrimination, education, access, or other combinations of factors that differentially sort people into contexts.

What is meant by the “question” and the “real world application”?

The question captures what the researcher would like to know about the target phenomena. For any given target, there are an infinite number of interesting questions. We link this issue to the “real world application” in order to help students differentiate their conceptual question from the series of research questions they might ask in order to make progress on answering their conceptual question. This question and its real world application are like an umbrella that sits over top of a researcher’s program of empirical and intervention research, guiding it and being fed by it. We use this conceptual question and application as a yardstick throughout the course—to help make decisions about the theories and constructs that are relevant, the contexts and social partners we should consider, the course of development, and the nature of the processes that shape it. We also use these issues to help plan each student’s big outside project—their observational project, as explained in later sections.

Table 4.2. Question and Real World Application

What is a QUESTION? A question is something that you would like to know about a configuration. It determines which theories, research, and interventions about that configuration will be of interest. Metaphorically speaking, the configuration is a noun and the question is a verb.

What is a REAL-WORLD APPLICATION? A real world application is an issue that should be of concern to people in their everyday lives. It should be an issue for society in general. It can include optimization, prevention, amelioration, or remediation of a configuration.

Because it busily interacts with all the activities and discussions throughout the course, we have gotten used to thinking about students' conceptual questions as objects that themselves develop as students handle them and talk about them. So it is important to explain to students that the articulation of a guiding question is a *process*. Researchers are typically interested in the well-being and optimal development of people who are relatively low on the totem pole—children, students, workers, patients, single parents, crime victims, people with disabilities. So it is natural that we first assume that we are interested in these people—what does their optimal development look like (description)? And what kinds of supports do they need to develop optimally (explanation)?

As soon as we turn to issues of application and optimization, however, we discover that many of the supports that people need to develop in health directions do not reside *inside* the people themselves. They are located in their social partners and developmental contexts—in the children's parents and neighborhoods, in the students' teachers and classrooms, in the workers' supervisors and workplaces, in the patients' doctors and healthcare systems, in the single parents' extended families and communities, in the crime victims' advocates and the justice system, and in the potential employers of people with disabilities and their physical environments. Hence, it is very common for researchers to begin to expand their target phenomenon and question to include key intervention issues—What do we need to change so that these social partners and contexts can support the development of our target individuals?

Table 4.3. Examples of Configurations

Configuration: Infancy, family home, universal, mother-child attachment
Question: How does the temperament that infants come with affect the way that caregivers treat and attach to their infants?
Application: What should intervention programs target if they want to optimize caregiver-infant attachment for children with different kinds of temperaments?

Configuration: Childhood, school, universal, engagement and coping
Question: What can developmental histories tell us about why some children are really engaged in school despite failures and setbacks, whereas other children give up easily?
Application: What can interventions do to optimize engagement and coping?

Configuration: Adolescence, the street, females, relationship dissolution
Question: Why do adolescent girls stay in unhealthy romantic relationships?
Application: What can schools and parents do to help girls end these relationships?

Configuration: Old age, universal, universal, intelligence
Question: What happens to intelligence as people age?
Application: Why do some people maintain their intelligence and others not?

Why does a configuration proposal include a problem statement?

We ask students to write a fat paragraph about the problem in order to get them out of “jargon” and “research question” mode and into “everyday language” and “conceptual question” mode. Without these introductory paragraphs, we often found students’ statements of their interests to be so highly stylized and studded with specialized vocabulary (which meant a great deal to them but which we did not understand) that the statements were impenetrable. However, once they were directed to write paragraphs that their grandmothers could follow, we found our way into the issues that mattered to them. We ended up circulating those problem statements to everyone in the class, and we understood each other better right away. Students also noted that the exercise of expressing themselves in everyday language was good preparation for their eventual forays into the field, where they would be talking to non-specialists about their work.

Table 4.4. Configuration Proposal

The configuration proposal is 1-2 pages long (double-spaced) and includes the following information. All references should be in APA format.

General problem statement:

Configuration

1. Age group:
2. Context or setting:
3. Social address:
4. Target of study:

Question:

Application:

Review article or chapter:

Empirical articles (3 - 5):

Observational setting ideas:

Comments (optional):

Why does the configuration proposal include ideas for an observation project?

One of the central experiences of the class is the observation project, in which students directly observe their target phenomenon as it is operating in its naturalistic setting(s) of everyday life. We feel strongly that *in vivo* contacts with one's phenomenon provide some of the most educational experiences students can gain. Unlike studies in the lab or naturalistic studies based on survey data, which are already highly selected and simplified representations, *in vivo* observations are largely uncut and unedited (although they are also likely to be shaped by students' participation in the setting). So, of course such observations are more confusing, but they are also more enlightening, and quickly lead students to appreciate the complexity of their phenomena, as well as how clear it is that their phenomena are embodied and contextualized.

Because students are typically less familiar with observational methods, we started thinking with them from the first day about where they might go to see their targets, using some general guidelines, as presented in Table 4.5. It is interesting that students sometimes feel uncomfortable about going out into "the wild" to scout for their phenomenon, and suggest that they would learn more by hunting through their mentors' questionnaires or test batteries. Sometimes even students' mentors themselves had reservations about students making contact with "real" children or workers or patients. These mentors felt that their students were not "ready" for these experiences.

Although we understand that researchers are appropriately protective about access to their sites and participants, and correctly insist that any additional intrusions or demands on their participants' time be held to a minimum, we subscribe to the principle that all researchers (and especially beginning ones, like students) should spend as much time with their target phenomenon "in the wild" as possible. So we begin brainstorming about how each student can get this access as soon as we have a handle on the target phenomenon. At the very least, we suggest that students imagine the “perfect” observation—the ones they would conduct if there were no limitations based on access, time, or money. These idealized observations, conducted over years, would be the yardstick by which we would measure the information which we use to reconstruct our targets. We also realized that are observers who are naturally embedded in the contexts were are interested in, namely, actual participants, who have been exposed to the information we seek, sometimes over periods of years. These expert observers may agree to allow us to “pick their brains” about what they have observed, through open-ended interviews or daily diaries.

Table 4.5. Guidelines to **the Search for an Observational Setting**

1. Needs to be a "natural context" for your configuration.
2. Needs to be openly observable public behavior.
3. Can be friend or family member setting.
4. Can involve your own participation.
5. Must be a contrast design.

References

SECTION II:

THEORIES, META-THEORIES, and METAPHORS

Chapter 4. Contrasting Perspectives on Attachment:

Bowlby, Ainsworth, and Gewirtz

In order to illustrate how assumptions about humans and their development shape theories, research, and interventions, we selected sets of theories on which students could practice their "understanding" skills that are all focused on the same target phenomena, but that approach it from different meta-theoretical perspectives. There are many such sets of theories, and we offer descriptions and analyses of a few examples in subsequent chapters (see Chapter 6 for contrasting theories of *motivation* and *learning*). In this chapter, we follow up on theories of attachment, and finish "understanding" Ainsworth and Gerwirtz, before we begin comparing and contrasting their assumptions about infants, caregivers, and the development of attachment relationships.

What is Ainsworth's conceptual question and theoretical context?

Although students sometimes have difficulty articulating the "theoretical question" guiding Ainsworth's view on attachment, we often find that once the class has finished understanding Bowlby, Ainsworth's theoretical question becomes clear. Since Ainsworth builds on Bowlby, and Bowlby is focused on the species-wide bio-behavioral predispositions that underlie the general formation of attachment relationships, it becomes clear that Ainsworth's theoretical question is something like, "What is the basis for individual differences in the quality of attachment relationships, and how do these individual differences shape children's subsequent development?" So Bowlby is asking the normative question (i.e., "How do attachment relationships typically form?") whereas Ainsworth is asking a question about differential pathways of development ("How do different kinds of attachments form?").

What are Ainsworth's key constructs and target phenomenon?

The building blocks, or key constructs, of Ainsworth's theory and their definitions are presented in an example of an "understanding paper" on Ainsworth, which appears in Table 4.1. The target phenomena of Ainsworth's theory are the different qualities of attachment, as shown in Figure 4.1.

Table 4.1. Example Paper: "Understanding Ainsworth"

1. **Theoretical question**: What is the basis for individual differences in the quality of attachment relationships, and how do these individual differences shape infants' subsequent development?
2. **Theoretical context**: built on John Bowlby's evolutionary ethological perspective.
3. **Key constructs:**

   Different qualities of attachment:

   - *Secure attachment relationship (Group B):* "use their [caregivers] as a secure base form which to explore in the preseparation episodes; their attachment behavior is greatly intensified by the separation episodes so that exploration diminishes and distress is likely; and in the reunion episodes they seek contact with, proximity to, or at least interaction with their [caregivers]" (Ainsworth, 1979, p. 932)
   - *Ambivalent/ Resistant attachment relationship (Group C)*: "show some signs of anxiety even in the preseparation episodes; they are intensely distressed by separation; and in the reunion episodes they are ambivalent with the [caregiver], seeking close contact with her and yet resisting contact or interaction" (Ainsworth, 1979, p. 932)
   - *Avoidant attachment relationship (Group A)*: "rarely cry in the separation episodes and, in the reunion episodes, avoid the [caregiver], either mingling proximity-seeking and avoidant behaviors or ignoring her altogether" (Ainsworth, 1979, p. 932)

   Different qualities of caregiver behavior:

   - *Sensitive responsive caregiving:* contingent and appropriate responding to infant signals about their needs (e.g., food, stimulation, tiredness, wet diaper), letting infant behavioral cues determine the onset, pacing, and termination of interactions.

- *Rejecting, angry caregiving:* Insensitive, unresponsive caregiving; painful rebuff when infant seeks bodily contact; restricted in expression of affect.
- *Neglectful caregiving*: Insensitive, unresponsive caregiving; disregarding signals or responding in grossly inappropriate fashion.

Internal working model of attachment figure: "inner representation"

- *Secure internal working model*: inner representation "of his or her [caregiver] as generally accessible and responsive to him or her" (Ainsworth, 1979, p. 933).
- Insecure working model: anxious inner representation.

Outcomes: Exploration, learning, interactions with environment.

4. **Target phenomena**: individual differences in quality of attachment relationships.
5. **Explanation**: Antecedents, consequences, and mechanisms.

***Antecedents*:** Individual differences in maternal behavior: "in our sample of normal babies there is a strong case to be made for differences in attachment quality being attributable to maternal behavior" (Ainsworth, 1979, p. 933).

Consequences: healthy development: "the way in which the infant organizes his or her behavior toward the mother affects the way he or she organizes behavior toward other aspects of the environment, both animate and inanimate" (Ainsworth, 1979, p. 936).

- *Securely attached*: More exploration and learning from the environment, healthy self-reliance; more cooperative, affectively positive; more competent, sympathetic in peer interactions; longer bouts of exploration, more exploratory interest, problem-solving, more enthusiastic and persistent; better able to elicit and accept help from mother; more curious, self-directed, ego resilient, better scores on developmental tests and language development.
- *Avoidant*- more aggressive, non-compliant, and avoidant.
- *Ambivalent*: more easily frustrated, less persistent, generally less competent.

Mechanisms:

- Between caregiver behavior and formation of attachment: History of (in)sensitive (un)responsive interactions.
- Between quality of attachment and healthy development: Construction of secure or insecure internal working models of attachment figures.

6. **Optimization**: Optimal attachment: Secure. To optimize attachment, improve quality of caregiver-infant interactions, by helping caregivers become more sensitive, more responsive, and more comfortable with bodily contact.
7. **Meta-theoretical assumptions**: Biological basis, but context and social interactions critical to the quality of the attachment that will be formed.

Insert Figure 4.1 about here

What are the antecedents, consequences, and mechanisms in Ainsworth's theory?

These are most easily seen in the graphic representation of the theory, as pictured in Figure 4. 1. The antecedents are individual differences in maternal (or caregiver) sensitive responsive behavior; and the consequences are summarized as "health development"—the specifics of which are listed in the Understanding paper (see Table 4.1; and have been elaborated in research following the publication of the theory). Together, these targets, antecedents, and consequences comprise the outlines of Ainsworth's "macro-developmental theory" of individual differences in attachment.

The "micro-developmental theory" is depicted by the mechanisms describing what is "on the arrows." As shown in Figure 4.2, the mechanism on the arrow between individual differences in caregivers' behavior and the formation of different qualities of attachments are differential histories of social interactions. The different qualities of caregiver behaviors initiate different sets of experiences for their infants: (1) the normative experiences depicted by Bowlby, in which caregivers respond to infant distress signals with sensitive caregiving, leading infants to develop feelings of trust and security, so that they will seek the caregiver when distressed; (2) experiences in which caregivers respond to infant distress signals with insensitive and rejecting caregiving, leading infants to develop a feeling of insecurity or indifference to caregiver support, so that they avoid the caregiver when upset; and (3) experiences in which caregivers either do not respond to infant distress signals or respond inconsistently, leading infants to develop a feeling insecurity and anxiety, so that they are ambivalent and resistant to contact with the caregiver when they are distressed.

Insert Figure 4.2 about here

The mechanism on the arrow between quality of attachment and its consequences is shown in Figure 4.3—the internal working model, in which the history of interactions between caregiver and infant lead the infants to construct an internal representation of what they can expect from the social world created by their caregivers, whether or not they can expect consistently safe, loving, sensitive, and contingent responses to their signals and needs. Infants and then young children are posited to take these internal working models with them into subsequent interactions with the animate and inanimate environments, where it guides their expectations and interpretations of interactions, especially through its effects on exploration, wariness, emotional reactivity, and coping through proximity seeking. Consistent with the theme started in earlier chapters, it is important to point out that, in both cases, social interactions are a key part of this theory's explanations— caregiver-infant interactions are essential ingredients in the mechanisms or pathways through which the antecedents and consequences of attachment exert or register their effects.

Insert Figure 4.3 about here

What are the optimization implications of Ainsworth's theory of attachment?

According to Ainsworth, the antecedents of attachment formation rest squarely on the mother. She states, "in our sample of normal babies there is a strong case to be made for differences in attachment quality being attributable to maternal behavior" (Ainsworth, 1979, p.

933). As a result, the optimization implications are stationed there as well. In order to help more infants and their caregivers achieve an optimal attachment, that is, a secure dyadic attachment relationship, researchers should target caregivers, helping them to become more sensitive and responsive. (Of course, if this is to be accomplished in a theory-guided manner, then an additional theory is needed, namely, one that explains the antecedents of caregiver behavior.)

What are the meta-theoretical assumptions of Ainsworth's theory of attachment?

It is easy to consider Ainsworth's assumptions about the antecedents of attachment (i.e., caregiver behaviors) as evidence that she privileges environmental or contextual factors in her account of attachment. However, she also states explicitly that she is building on Bowlby's evolutionary-ethological perspective, which means that she also assumes that infants come with bio-behavioral predispositions that are "experience expectant," (Greenough, Black, & Wallace, 1987), in that these neurophysiological systems expect (and require) the experience of a sensitive responsive caregiver to become well-organized for dealing adaptively with distress and stressful encounters. If these bio-behavioral imperatives did not exist, the experience of insensitive and nonresponsive caregiving would not be so serious.

Hence, Ainsworth assumes that *both* neurophysiological systems (which are characteristics of the infant or individual) and individual differences in caregiver behaviors (which are characteristics of the context or environment) are essential to the formation of different kinds of attachments. Although not used consistently in the work that follows from Ainsworth's theory, Ainsworth herself never considered "quality of attachment" to be an attribute of the child (as is implied by the use of phases like "securely attached infant"); instead she thought of it as a *dyadic* quality that characterizes the *relationship* between an infant and a specific caregiver.

Why do we need to learn about Gerwitz's theory of attachment?

The reason that we have thrown an "old-fashioned" theory like Gewirtz's (1969) into the mix is to illustrate alternative learning theory perspectives on the formation of attachment. The essential elements of Gewirtz's theory are summarized as an example of an Understanding paper in Table 4.2. Like Bowlby and Ainsworth, his theoretical question was "How does an infant acquire and maintain a bond (tie, relationship) to a caregiver?" (Gewirtz, 1969, p. 160-161). However, as can be seen from the title of his chapter, he derived the answer to this question using concepts provided by social learning theory. According to Gewirtz, "dependence and attachment are best conceptualized as abstractions for classes of functional relationships involving the positive stimulus control over a wide variety of an individual's responses by stimuli provided either by a class of persons (dependence) or by a particular person (attachment)… In attachment, the efficacy of discriminative or reinforcing stimuli in controlling an individual's behavior systems depends upon the unique physical and/or behavioral characteristics of a *particular* "object" person dispensing those stimuli (e.g., his facial stimuli, tactile characterstics)" (1969, p. 161).

Table 4.2. Example Paper: "Understanding Gewirtz"

1. **Theoretical question:** How does an infant acquire and maintain a bond (tie, relationship) to a caregiver? (Gewirtz, 1969, p. 160-161)
2. **Theoretical context:** Social learning theory (in title). Influenced by dependency research, operant conditioning, and drive theory.
3. **Key constructs and definitions:**

   Attachment: "a form of (social) dependence of the behavior systems of one person upon the unique physical or behavioral stimuli provided by a particular other person (or a very few individuals)" (p. 162)

   Also called "person-specific dependency"

   Infant response/behavior system: approaches, visual orienting, regard, tracking, smiles, and directed vocalizations (p. 165)

Caregiver discriminative and reinforcing stimuli:

- Proximal: being held, touched, caressed, waved in the air, warmth, etc.
- Distal: Sight of person, appearance (hair color, facial features, size), behaviors (gait, approach, movements in space, auditory stimulation (sounds made by approach, vocalizations), olfactory stimulation

4. Target phenomenon:

5. Explanation:

Antecedents: Infant is hungry and caregiver provides food, so caregiver becomes a secondary drive in which caregiver stimuli comes to control infant response system.

***Consequences*:** Infant's positive responses to caregiver reinforce caregiver behavior systems, so infant stimuli comes to control caregiver response system.

***Mechanisms**:*

- *From caregiver behavior to bond:*

  Primary drives: Food satisfies infant's primary drive for hunger.

  Secondary drives: Because mother feeds infant, she is associated with primary drive until mother acquires properties of primary drive, and controls infant's behavior systems.

- *From bond to mutual control of behavioral systems:*

  Discriminative stimuli: Caregiver stimuli preceding reinforcing event (food) come to control infant behavior, and so presence of caregiver stimuli increase the likelihood that that infant behavior will occur.

  Reinforcing stimuli: Infant's positive response following caregiver behavior increases the likelihood that that caregiver behavior will occur in the future.

  Discriminative stimuli: Infant stimuli preceding reinforcing event (infant positive response) come to control caregiver behavior, and so presence of infant stimuli increase the likelihood that that caregiver behavior will occur.

  Reinforcing stimuli: Caregiver's positive response following infant behavior increases the likelihood that that infant behavior will occur in the future.

6. **Optimization**: "stronger" attachments are ones that have:
   - greater number of behavior systems of child under caregiver control
   - greater number of behaviors under control relative to others' control
   - greater degree of control over behavioral systems
   - greater number of stimulus settings in which control operates
7. **Meta-theoretical assumptions**: Social learning theory assumes that primary drives elicit behavior, associations between contiguous events lead to learning, external stimuli trigger behavior, and external contingencies control behavior.

How do we draw Gewirtz's theory of attachment?

Gerwirtz's macro-developmental theory, presented graphically in Figure 4.4, places the target phenomena, namely, the attachment or bond between infant and caregiver, in the center of the picture. As antecedents, infants bring their primary drives (such as hunger), and caregivers bring the means to satisfy these primary drives (such as food). Together these produce a bond (the target). This bond allows a set of consequences to unfold, in which the response systems of the interaction partners come under each other's control. As shown by the return arrow, these consequences in turn feed back to the target, strengthening the bond or attachment.

Gewirtz's micro-developmental theory specifies the mechanisms, or what is on the arrows. The explanatory mechanisms depicting how the antecedents cause the target are pictured in Figure 4.5. According to this perspective, all newborns arrive with a desire for food, warmth, safety, and so on. These are considered "primary drives" or "unconditioned reinforcers," because the presence of these commodities increases the likelihood of infants' behaviors without any prior experience. When caregivers provide food, warmth, physical comfort, and so on, they become associated with the satisfaction of these primary drives, and take on their properties. Through classical conditioning, the caregiver (or more precisely, their attributes, such as their physical appearance, voice, and smell) acquire the status of a secondary drive: These are reinforcers that are conditioned on their association with the satisfaction of primary drives.

Gewirtz explains the essential elements of the notion of "acquired" or "secondary drive:" "The central features of this theory were the concepts of discriminative and conditioned (generalized) reinforcing stimuli (e.g., provided by incidental caretaking appearance characteristics which acquired and maintained their reinforcing value by being discriminative for a limited set of apparently unconditioned reinforcing stimuli thought to be the satisfiers of physiological needs (in particular food, water, and the removal of noxious stimuli)" (1969, p. 164). Over time, through continued social interactions, this connection creates a bond between infant and caregiver.

The mechanisms hypothesized to create a causal link between the target and its consequences are pictured in Figure 4.5. The attributes of the caregiver become discriminative stimuli for the arrival of primary reinforcers, like food, and so now the caregiver and his or her attributes (even in the absence of primary reinforcers) trigger a host of positive anticipatory baby behaviors, such as tracking, vocalizations, and wiggling. These baby behaviors in turn serve to reinforce the caregiver's caregiving behaviors (such as responding to cries, feeding, and holding the baby). As a result, the baby's attributes (such as their physical appearance, characteristic movements, or the feel of their skin) themselves become discriminative stimuli that trigger caregiving behavior.

As Gewirtz explains, "It is assumed also that the behaviors of the object person or persons who function in a caretaking-socializing role at the same time will come under the control of the behaviors and appearance stimuli provided by the child. These processes will account for the progressively longer S-R chains between the infant's responses and the stimuli provided by his caretaking environment" (1969, p. 165). These positive caregiving behaviors then reinforce the baby's behaviors. Through these mechanisms, operating in the social interactions between newborns and their caregivers, the behavior systems of each party come under the control of the physical characteristics (discriminative stimuli) and behaviors (reinforcing stimuli) of the other party, which feedback into the attachment or bond.

What are the optimization implications of Gewirtz's theory?

There is nothing in Gerwirt's theory to suggest that there are multiple kinds of attachment or that one would be better than another, so Gewirtz does not specify an "optimal" attachment *per se*. However, he does indicate what would qualify as "more" of an attachment: A "stronger" attachment is one in which mutual control over behavior systems is stronger or more extensive—for example, when a greater number of behaviors and behavior systems of the infant are under caregiver control and vice versa, when partners exert a greater degree of control, or when control operates in a greater number of settings. All of these kinds of "increases" in attachment behavior would be achieved through the same procedures that are described in his theory—processes of reinforcement. So presumably teaching parents how to be more contingent and consistent in their responses to infants would be one optimization strategy, or perhaps reinforcing them for doing so.

Why are the assumptions underlying Gewirtz's theory?

As is made clear by the name of the theory (i.e., social learning) and the explanatory mechanisms that he proposes, Gewirtz assumes that behavior change is a function of associative learning (e.g., acquisition of the status of secondary reinforcers) and the operant reinforcement of behaviors that were initially elicited by biological reflexes. As Gewirtz explains, "the analysis proceeds in simple conditioning terms, using the concepts of responses, discriminative and reinforcing stimuli, and the conception of sequential contingencies or chaining" (1969, p.160).

Why are the theories of Bowlby, Gewirtz, and Ainsworth so very different?

Although they have in common a focus on the construct of "attachment," these three theoretical perspectives were selected to illustrate that theories ostensibly focusing on the same phenomenon can be very different from each other. Table 4.3 provides a side-by-side comparison of these theories, considering how each one would answer fundamental questions about attachment—what it is, its antecedents, consequences, the mechanisms that connect these processes, how it develops. For example, in response to the question, "What is attachment?", Bowlby would describe it as a system preprogrammed by biobehavioral predispositions selected by evolution that allows the newborn (and later the infant) to seek proximity and protection from its caregiver when distressed. Gewirtz sees it as a set of responses systems that are under the mutual control of infant and caregiver; and Ainsworth sees it as a dyadic affective bond, shaped by maternal sensitive responsiveness.

As is clear from Table 4.3, Bowlby emphasizes species-wide biology and genetic programming, whereas Gewirtz highlights social conditioning and environmental programming. Ainsworth focuses on different pathways that species-wide predispositions can take depending upon the contextual conditions in which they emerge. About the only thing that all three theorists agree on is that the mechanisms of effects can be found in social interactions, but Bowlby emphasizes the regularity with which they play out, Gewirtz posits that the are contingent antecedent-consequence chains, and Ainsworth focuses on how the tenor of these interactions leads infants to construct different kinds of "working models" about the social worlds they inhabit.

These differences are not just academic. They represent fundamental differences in the way these theorists think about human functioning and development. Highly instructive in this regard is Gewirtz's analysis of Bowlby's and Ainsworth's theories, presented in the second part his chapter (Gewirtz, 1969, p. 166-173). It is interesting to see the evolutionary-ethological perspective through the lens of learning theory, as exemplified by how Gewirtz chooses to label it—"Pre-learning theories." These disagreements came to a scientific head in a series of critiques, rejoinders, and replies exchanged by Gewirtz and Ainsworth (Ainsworth & Bell, 1977;

Gewirtz & Boyd, 1977a, 1977b) following a study Ainsworth published with Bell in 1972 (Bell & Ainsworth, 1977). The fundamental disagreement was straightforward and focused on a simple question—"Does maternal prompt responsiveness to an infant's crying increase or decrease the likelihood of future crying?" From a learning theory perspective (and consistent with pediatricians' advice of the day), responsiveness is hypothesized to *reinforce* crying and so *increase* its frequency and duration—if a mother wishes to see crying decrease, she should extinguish it by ignoring it. From Ainsworth's perspective, sensitive responsiveness should *reduce* crying, because it allows the infant to build a generalized expectation that care is forthcoming, and this security should provide equanimity and foster other means of communicating distress.

No empirical resolution of this disagreement was reached through this series of exchanges, but they are very revealing about how easily discussions about data and statistical analyses can flare into meta-theoretical disputes. Particularly informative are differences in opinion about the *kinds* of studies (design, data, and analysis) that could actually answer the target question. Gewirtz and Boyd (1977) outline the empirical requirements of an investigation of a learning theory account of maternal reinforcement of expressive and "non-distress" crying, and point out the differences between these kinds of studies and the one conducted by Bell and Ainsworth (1972). Not surprisingly, disagreements continue about the interpretation of date, conclusions that can be drawn, and practical implications. The two camps seem to be operating in different worlds, with little common ground. One factor that made these discussions more challenging is the assumptive bases of these two groups of researchers, and the fact that they reflected different meta-theoretical worldviews.

Table 1. Contrasting Multiple Perspectives on Attachment: Theories of Bowlby, Gerwirtz, and Ainsworth

	BOWLBY	GEWIRTZ		AINSWORTH
UNDERSTANDING the THEORY				
What is attachment? TARGET	Proximity seeking Protection	Behaviors of infant and parent		Affective bond
ANTECEDENTS	Bio-behavioral predispositions Preprogrammed instincts	Secondary reinforcement Discriminative stimuli Reinforcement		Maternal responsiveness
CONSEQUENCES	Survival	Dependence of behaviors		Individual differences in success
MECHANISMS	Social interaction	Social interaction		Social interaction
How does it DEVELOP?	Unfolding of biological program	More behaviors Stronger control		Internal working model
ANALYZING the UNDERLYING ASSUMPTIONS: DESCRIPTION				
Unit of ANALYSIS of CHANGE	Behavior systems selected by evolution	Discrete behaviors		Dyadic interaction
Nature of PERSON	Reactive (to biological program)	Reactive (to environmental program)		Active partner
Nature of ENVIRONMENT	Reactive (to biological program)	Active and reactive to discriminative stimuli and reinforcement		Active partner
Course of DEVELOPMENT	**Quantitative** change **Continuity** over time	**Quantitative** change **Continuity** over time		**Qualitative** change Emergence of bond
ANALYZING the UNDERLYING ASSUMPTIONS: EXPLANATION				
Role of PERSON in development	**Passive** reaction to biological program	**Passive** reaction to environmental program		**Working together**
Role of ENVIRONMENT in development	Provide fuel for growth from **inside**	Extrinsically motivate and shape growth from **outside**		**Working together**
Underlying Hypothesized Cause of DEVELOPMENT	**Genetic programming** Unfolding over time leading to a mature form	**Social conditioning** Occurring over time leading to observable behavior		**Joint activity**
UNDERLYING ASSUMPTIONS: OPTIMIZATION				
Focus of efforts	Improve **biological** underpinnings	Improve **environmental** program		Improve **interaction**

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Chapter 5. Contrasting Theories of Motivation and of Learning

Motivation

Acquired vs. intrinsic motivation

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Learning

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SECTION II:

METAPHORS AND META-THEORIES

IN APPLIED DEVELOPMENTAL SCIENCE

Assumptions about Humans and their Development

Metaphors and Meta-theories

Comparing and Contrasting Meta-theories

Overview of Systems Perspectives

Chapter 6. Metaphors and Meta-theories in Human Development

In the late 1960s and early 1970s, a paradigm shift was taking place in developmental psychology in the United States, although most researchers were not aware of it at the time. As was true for the rest of psychology, behaviorism and experimental child psychology continued to dominate developmental psychology (Cairns & Cairns, 2006) during this decade. However, new perspectives were knocking on the doors of behaviorism. As discussed in the last chapters, ethological evolutionary perspectives were replacing social learning accounts of attachment. In 1959, Robert White published a seminal article questioning the supremacy of acquired motivation and presenting a case for intrinsic motivation, which would usher in the motivational revolution (Deci, 1975).

Nowhere was this sea change felt more keenly than in the area of learning, which was at the core of the behaviorist agenda. With the publication of *The Developmental Psychology of Jean Piaget* in 1963, John Flavell had introduced American developmentalists to a grand European theory of cognitive development, and it was proving to be a contender to theories of learning. In fact, the late 1960s were awash in dueling studies attempting to empirically adjudicate this clash (for reviews, see Brainerd, 1972; Strauss, 1972). They took the general form in which Piagetians would assert as evidence for structural limitations in preoperational children's cognition, their reasoning and rationales about the conservation of properties of objects over transformations in their appearance. For example, children would assert that the volume of a liquid was increased when it was poured into a taller thinner glass, or that the number of pieces of a cracker increased when the pieces were spread farther apart. In response, learning theorists would conduct studies showing that, with sufficient practice, young children could be trained not only to give the reply indicating that there had been no transformation (namely, “they are the same”) but also to provide the correct rationale (namely, “You didn’t add any or take any away, so they are still the same”).

Although couched in more scientific terms, it is possible to see in these exchanges behaviorists’ satisfaction in disproving Piaget’s theory, an implied “So there!—now we have demonstrated that there are no structural limitations operating in children’s performance.” And the replies from Piagetians are equally instructive, basically “Pah! You have trained these children to say some words—but because you taught children to say them, they are meaningless as indictors of children’s underlying reasoning-- and so prove nothing.” And so on, back and forth. It was in this atmosphere of acrimonious and baffled exchanges that two well-respected researchers, one learning theorist, Hayne Reese, and one Piagetian, Willis Overton, joined forces to examine the basis of these claims and counter-claims, and especially to try to understand why researchers from these two areas seemed to be so successfully talking right past each other.

What did Reese and Overton think was going on?

The resulting chapter—Models of Development and Theories of Development (Reese & Overton, 1970) and its accompanying methodological chapter (Overton & Reese, 1973) were not the first discussions of paradigms and paradigm shifts in psychology and science (e.g., Kuhn, 1962; Pepper, 1942), but they were the first to lay out the issues for developmental psychologists. They argued that the state of mutual incomprehension exhibited in these empirical exchanges was based on the fundamental incompatibility of the underlying assumptions about human nature and human development that each side unintentionally brought to the discussion. Each side had its own “model” of humans and of reality.

As explained by Reese and Overton,

> The most general models, variously designated as “paradigms” (Kuhn, 1962), “presuppositions” (Pap, 1949), “world views” (Kuhn, 1962, Seeger, 1954), and

> “world hypotheses” (Pepper, 1942), have a pervasive influence throughout the more specific levels, as noted by Kessen (1966) and others before him (Black, 1962; Peppper, 1942; Toulmin, 1962). The different levels of models are characterized by different levels of generality, openness, and vagueness. At one extreme are implicit and psychologically submerged models of such generality as to be capable of incorporating *every* phenomenon. These metaphysical systems are … basic models of the essential characteristics of [humans] and indeed of the nature of reality” (1970, p. 117).

Such models, which we refer to as “meta-theories,” have advantages and disadvantages. As Reese and Overton go on to explain, “any model limits the world of experience and presents the person with a tunnel vision. Being committed to a particular model may make a person blond to its faults… However, a good model increases the horizon, since one of its functions is to aid in the deployment or extension of a theory… A good model acts like a pair of binoculars ... Models provide rules of inference through which new relations are discovered, and provide suggestions about how the scope of the theory can be increased” (1970, p. 120). The most important feature of meta-theories is that they are sets of assumptions that are often hidden from our own awareness. They help us as scientists, but they also create a filter that forces us to “see through a glass darkly” (1 Corinthians 13:12). The first step in recognizing our own assumptive world views is to understand what meta-theories are, to become familiar with the kinds of assumptions they contain, and see the different families of theories that are derived from them. In this chapter and the next, we draw heavily on a piece we created for another class on human development (Skinner, Richardson, Pitzer, & Taylor, 2011).

What is a meta-theory?

Meta-theories are sets of assumptions that underlie theories. “Meta” means “above” or “beyond,” like “meta-physics.” Other terms used to describe meta-theories are “world views,” “world hypotheses,” “models,” “cosmologies,” or “paradigms,” as in “paradigm shifts.” Explicit discussions of meta-theories are found most often in philosophy.

What are meta-theories of human development?

Meta-theories in human development are sets of assumptions about the nature of humans and the meaning of "development"-- what it looks like, how it happens, what causes it. An example of a meta-theoretical assumption about human development would be the idea that all development ends at 18, or that aging is a process of loss and decline.

Why are meta-theories important?

Meta-theories are important because their assumptions influence everything about how theories are constructed and research is conducted: the questions that are asked, the measures and methods that are used, and the interpretation of data (see Figure 6.1). For example, if researchers assume that development ends at 18, they do not look for developmental changes after that age. Or, if researchers assume that aging is a process of decline, then they never look for characteristics that might improve as people get older.

Insert Figure 6.1 about here

What kinds of assumptions guide the study of human development?

There are many assumptions about humans and about development that underlie developmental meta-theories—some tell us about what development looks like and so are descriptive, and some refer to the causes of development, and so are explanatory (see Table 6.1)

Table 6.1. Examples of Assumptions Underlying Developmental Meta-theories

DESCRIPTION

1. What is the nature of the person?
2. What is the nature of the environment?
3. What is the unit of analysis of change?

4. What is the course of development?

EXPLANATION

5. What is the role of the person in development?
6. What is the role of the environment in development?
7. What is the underlying hypothesized cause of development?

ASSUMPTIONS ABOUT DESCRIPTION

What are assumptions about human nature?

Assumptions about *human nature* refer to beliefs about whether people are born as blank slates (*tabula rasa*) or whether people bring their own intrinsic characteristics with them into the world. One of the most important assumptions about human nature is whether people can be considered "active" or "reactive." A "reactive" nature suggests that humans are inherently at rest, and so they tend to be relatively passive, non-conscious, and non-agentic. In contrast, an "active" nature suggests that humans are inherently and spontaneously active and energetic; that humans by nature are goal-directed, agentic, self-regulating, conscious, and reflective beings. These differences in assumptions can be clearly seen in theories of motivation—in which some families of theories assume that motives and motivation are acquired, and some assume that humans are intrinsically motivated.

What are assumptions about the nature of the environment?

One of the most important assumptions about the nature of the environment also refers to how "active" or "passive" it is. This notion in reference to environments is very much like the idea of active and passive humans. "Active" environments are ones that have goals and an agenda, and so are energetically trying to shape the developing person in particular directions, whereas "passive" environments do not have a specific agenda that they are using to make decisions about how to interact with the developing person. In school contexts, an example of an "active" environment would be teachers, who have an agenda and goals for their students; in contrast, students' peer groups, who may also be important contexts for their academic development, generally do not have an agenda for the development of their members.

What are assumptions about the "unit of analysis of change"?

These refer to assumptions about the nature of the entities that are developing and which ones are most important to study. Some meta-theories assume that the most important units to study are the fundamental building blocks that make up humans, such as their genes and their related phenotype expressions, or human neurophysiological structures (like the brain), or stable traits and attributes (like intelligence, temperament, or personality). Other meta-theories focus attention on observable behaviors and responses. Others suggest that the key developing entities that deserve our attention are bio-psychological structures and their functions in regulating actions. Yet others suggest that the fundamental units to consider are the interactions between the person and the context.

These presumptions about the nature of the focal system and "where the developmental action" is located are among the most basic assumptions of meta-theories of development. They are visible in each theory's choice of target phenomena as well as in each study's object of investigation. In analyzing these assumptions, it is, of course, important to note the "bull's eye" that theories and studies consider to be the focal point of their activities. However, it is equally important to notice what these theories dismiss as irrelevant, as evidenced in their decisions about what *not* to include in theories and what *not* to study. For example, theories of parenting obviously focus on the role of parents in shaping children's development, but some of them also consider how children shape their parents behavior and some do not. In a similar vein, almost all theories of psychopathology currently include a place for the neurophysiological differences that underpin the presentation of behavioral problems, but some also consider the experiences that shape those neurophysiological systems and some do not.

What are assumptions about the "course of development"?

These are the fundamental parameters that describe the way that development proceeds. One of the most important features of the course of development, as shown already in Figure 2.1, is whether development involves quantitative continuous incremental change or discontinuous qualitative shifts. Some meta-theories assume that development is "more" or "less" of some characteristic, as reflected in descriptors like "trajectories" and the analysis of mean level changes or growth curves. Other meta-theories assume that development involves qualitative changes in the form, structure or organization of a system, as reflected in descriptors like "phases," "stages," or "developmental tasks," and the empirical search for age-graded shifts.

A second is assumption about the course of development, also depicted in Figure 2.1, is whether (1) pathways of development are presumed to be normative and universal, meaning that all people pass through them in the same sequence (and sometimes even the same rate), or (2) pathways are presumed to be differential or individual- and context-specific, meaning that a variety of different pathways are possible and that different people show different patterns of developmental change. Sometimes assumptions about the course of development also refer to its directionality and presumed end state—whether development always refers to positive healthy growth and progression or whether it encompass changes in many different directions, sometimes toward gains but sometimes toward declines or losses.

ASSUMPTIONS ABOUT EXPLANATION

What are assumptions about the role of the person in development?

The causal role of the person in development generally involve two points that follow from a view of the person as "reactive" versus "active" in their own development. A "reactive" model assumes that *stability* is the natural state of affairs, and that development is something that primarily happens *to* people— based on their genetic or environmental programming, and it is these factors, external to the self, that instigate change, which people receive passively. This can be taken to imply that genetics, traits, characteristics, and experiences early in life can have permanent irreversible effects. In contrast, an "active" model assumes that the essence of substance is *activity*, so that is the natural state of affairs is continuous transition or *change*. From this perspective, development is something that people participate in directly as active agents, choosing and shaping their own development. This can also be taken to imply that people should be malleable and remain open to change throughout life.

What are assumptions about the role of the environment in development?

These assumptions involve the causal role of the environment, specifying what is "on the arrows" from the environment to development of the target. The role of the environment can be one of "background" in which it operates only to provide fuel that will spur development from the inside (for example, by providing nutrition for consumption and digestion, leading to growth). A more active role for the environment is one in which it supports intrinsic motivations and growh tendencies by providing developmental affordances, that is, by essentially "handing the organism" what it intrinsically needs for the next steps in its development. Even more active are environments that support intrinsic motivations but also introduce their own socialization agenda through processes such as attunement and apprenticeship. Most active are environments that are assumed to be "running the show," in that they are seen as external forces that actively instigate, motivate, and shape growth from the outside.

What are assumptions about the underlying hypothesized cause of development?

Most people have heard of these assumptions—these are the ones that introduce our favorite dichotomies—nature versus nurture, heredity versus environment, genes versus experience, maturation versus learning, biology versus society, preformed versus epigenetic, innate versus acquired, nativist versus empiricist, and so on. Some meta-theories emphasize one over the other of these poles, and some are more towards the middle—that is, they insist on "and" formulations which emphasize the importance of *both* organism *and* environment. If you are interested in reflecting a bit about your own assumptions, we have included a set of questions in Table 6.2 about the nature of humans and their development. You can use your answers to these questions to see which way you are leaning on these issues.

Table 6.2. What are Your Assumptions about Human Development?

	True?	False?
What is the Nature of Human Nature?		
1. Humans are naturally selfish and self-interested.		
2. Human beings are naturally active curious creatures.		
3. Humans arrive as "blank slates" with no inherent characteristics.		
4. At birth, people's personalities are already determined.		
5. At birth, all people have the potential to develop in any direction, positive or negative.		
6. Human beings are predisposed to both good and bad behavior.		
Nature or Nurture?		
7. It's mostly biology—genetics and maturation—that shapes human nature and development.		
8. It's mostly environment—families and society —that shapes human nature and development.		
9. Genetic and environmental factors shape human nature and development equally.		
Active or Reactive?		
10. People's development is a product of forces outside our own control.		
11. People are actively engaged in their own growth and development.		
12. People are mostly reactive and are molded by other people and their environments.		
13. People actively choose and shape themselves and their environments, and are shaped by their environments in equal measure.		
Stability or Change?		
14. Traits and experiences early in life have a permanent effect on people's development.		
15. People are malleable and can be changed by their environments and		

experiences at any age.		
16. People are malleable and can change themselves at any age.		
Continuity or Discontinuity?		
17. Humans develop gradually through incremental changes, moment by moment, bit by bit, day by day.		
18. Humans develop in fits and spurts over a lifetime through qualitative stages of growth.		
19. Humans develop continuously day by day as well as through stage-like progressions over a lifetime.		
Universal or Context Specific?		
20. There are universal stages we all go through from infancy to childhood to adolescence to adulthood.		
21. An individual's pathway of development depends on that person's specific culture and combination of experiences.		

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Chapter 7. Metaphors and Meta-theories in Human Development

When we consider these assumptions all at once, it becomes clear that they seem to cluster into “packages” of assumptions that go together. These clusters are organized around metaphors—“as-if” statements that liken humans and their development to other entities and processes. For example, the metaphor of the “river:” “Human development is like a river, always flowing, never the same.” Or the metaphor of the “scientist:” “Humans are like little scientists, exploring, investigating, and testing out their theories.” A wide variety of metaphors have been used to depict humans over the centuries—humans are like demi-gods, like grasshoppers and ants.

Metaphors are at the root of meta-models of humans and their development. These metaphors anchor our subject matter in analogues that call up rich associations. As pointed out by Reese and Overton (1970), “the characteristic of models that permits their utilization in the deployment of theories, and increase in their scope, is that they have ‘excess meaning’ (p. 120), meaning that can be useful in suggesting new ideas for theories and places to look for empirical investigation. As long as scientists do not reify these metaphors and come to think that they are the targets of study, the use of metaphors can expand and enrich our work. To do so, we must surface the metaphors that are guiding our current thinking and study.

Reese and Overton (1970) suggested meta-models that are inspired by two metaphors: Humans as machines, as depicted in Mechanistic meta-theories, and humans as butterflies, as depicted in Organismic meta-theories. We consider two more meta-models and their metaphors: Humans as seeds, as depicted by Maturational meta-theories, and human development as a tennis game or dance, as depicted by Contextualist meta-theories (Lerner, 1977). The key characteristics of each meta-theory are presented in Table 7.1. Each of these higher-order meta-theories has sets of lower-level theories that are nested within it. These are called “families” of theories to denote that they share common properties, based on their similarity to the root metaphors and characteristics of the guiding meta-models. Table 7.2 contains several examples of "big" theories of development and provides an analysis of their defining features according to the set of meta-theoretical assumptions we have been discussing. Based on this analysis, we indicate the higher-order family to which we think each big theory belongs.

What are Maturational meta-theories of human development?

Maturational or biological meta-theories can be understood using the *plant* as a metaphor. It is as if humans develop the same way as plants. The important units of analysis to study are people's "seeds," that is, their genetic make-up. People are assumed to be passive and non-agentic; their development is biologically determined, the product of their genes. As summarized in Table 7.1, the role of the person is to be reactive—to their genes. The role of the environment to provide support and nutrition (rain, sun, and soil); the environment is structured—as a developmental niche for the genome). It provides nutriments that the seed will then use as fuel for growth from the inside. However, the environment is essentially passive (soil does not have an agenda for the seeds that are dropped there) and can't change a person's nature (poppy seeds will always produce poppies). The course of development will be quantitative and continuous, fully reducible to and determined by the organism's genetic and neurophysiological make-up and inherent characteristics, such as inborn temperament, personality, talents, intelligence, and so on.

Another good analogue for Maturational meta-theories can be found in the metaphor provided by *brain coral*. Brain coral has many of the same features as plants; in addition, its development is explicitly continuous and incremental in ways not demonstrated as clearly by plants, in each head of brain coral grows in size by adding genetically identical polyps (bits of brain coral) to its colony. Because they are based in biology, maturational meta-theories also tend to subscribe to notions of normative development that channel change along one universal pathway; however, since developmental psychology became so focused on individual differences, theories from these families also include the idea that different neurophysiologies (typically based on different genetics) are the determining factor in prescribing different pathways of development. The underlying hypothesized cause of development in maturational meta-theories is genetic programming which unfolds over time leading to a mature form.

Although maturational meta-theories were prevalent in the beginning of the 20th century (e.g., Gesell, 1928; Parten, 1933), they have taken on many different forms since then that have waxed and waned in their popularity, including some formulations of behavioral genetics, sociobiology, evolutionary, ethological, neuroscience, temperament, and personality theories. As described in the previous chapter, Bowlby's evolutionary ethological perspective on attachment would be an example of a maturational meta-theory because of its focus on species wide bio-behavioral predispositions. Maturational assumptions are signaled by concepts such as "trait," the search for "the aggression gene," the discovery of the brain system, hormone, or neurotransmitter responsible for a specific condition, or any other terms that suggest development is solely the product of innate or immutable characteristics of individuals. Although they are not typically referred to as "maturational," there exist many classes of theories that place all the active ingredients of behavior or development inside the head (or more specifically the social cognitions) of the person. Even if they are not direct descendants, these theories can be considered cousins of Maturational meta-theories, based on the exclusive focus on the role of the individual.

What are Mechanistic meta-theories of human development?

Mechanistic meta-theories can be understood using the metaphor of a *machine*. It is as if humans are composed and change the same way as machines. As summarized in Table 7.1, people are assumed to be made up of parts that can be removed and studied apart from the rest of them. In the social sciences, those parts are typically discrete behaviors or responses. People are assumed to be generally static and passive, with the energy coming from external forces (like gasoline for a car).

The person can only react to the environment that is controlling them (like a car responding to the gas pedal or the brake). All causes for development come from the outside, from environmental forces, which have their own agenda for the machine (like a driver has a destination). From this perspective, development is continuous (a car stays a car) and any changes are quantitative and incremental (like adding new seat covers). The underlying hypothesized cause of development in Mechanistic meta-theories is social conditioning that occurs over time, leading to changes in observable behavior.

The prototypic Mechanistic theories are behaviorist, operant, and classical conditioning learning theories (see Table 7.2), like the social learning theory described by Gewirtz and analyzed in the previous chapter. This family of theories dominated psychology from the early to the mid 20th century (Cairns & Cairns, 2006), and was in the middle of being overthrown when Reese and Overton (1970) wrote their seminal chapter. It is important to note, however, that Mechanistic theories are still alive and well in many areas, such as learning and motivation, and especially those theories that have been adapted for use in educational systems. In fact, the default for theories of the effects of people of higher power on people of lower power (e.g., adults on children, parents on offspring, teachers on students, supervisors on workers, leaders on followers, mentors on apprentices) seems to reflect a mechanistic cast which largely assumes unidirectional external forces emanating from people higher in the hierarchy and exerting an impact on people at lower levels.

As the popularity of behaviorism waned in the mid-1900s, new classes of machines have begun to serve as prototypes for mechanistic theories of memory, learning, and automatic functioning—focusing, of course, on the computer, the robot, and the automaton, as detailed in Bargh and Chartrand's (1999) cleverly titled paper, "The unbearable automaticity of being." Such assumptions have even pervaded our metaphors for biological systems, as seen in metaphors like "the brain is a computer." There are also traces of mechanistic assumptions in certain progressive and feminist analyses of the effects of societal and social conditions, such as poverty, oppression, and discrimination, which sometimes seem to imply that these external forces are the sole determinants of development.

Metaphor: reflex; human as “host” to behaviors

“Cognitive revolution” human as an information processing machine? Slife & Williams

What are Organismic meta-theories?

Organismic meta-theories can be understood using the *butterfly* as a metaphor for development. This metaphor is helpful for illustrating one of the most important assumptions of the organismic perspective, namely, that development progresses through discontinuous qualitatively different steps pr stages (like from the caterpillar, to the chrysalis, to the butterfly). Other writers simply use “the organism” or the “living organized system” as the root metaphor (e.g., Reese & Overton, 1970). This analogue is helpful in emphasizing the interconnectedness of the parts of the system and the impossibility of decomposing them. If, from a Mechanistic perspective, one wishes to understand a carburetor, one can remove it from the car, study it, understand it, and put it back. If, from an Organismic perspective, one tries this with part of an organism, say its heart, one will permanently destroy the object of study, while learning nothing about the heart, because it ceases to have its properties of “heart-ness” (i.e., to function as a heart) once it is removed from the rest of the body.

From this perspective, as summarized in Table 7.1, the target units of analysis are structured parts-wholes, which are organized in specific ways to serve certain functions. Improvements in these parts or their relationships take place through individuals’ active exchanges with their contexts directed by their own goals and interpreted through their current levels of understanding. People are assumed to be inherently active and to construct their own next steps in development based on the affordances and opportunities provided by the environment. Development is caused by structural dynamics, such as successive differentiation, imbalances, or integrations, that lead to the emergence of new (re)organizations. In general, development is assumed to be progressive (gets better), unidirectional (goes only from caterpillar toward butterfly), and irreversible (butterflies do not turn back into caterpillars). Because these developments are guided largely by internal forces (sometimes referred to as “inherent growth tendencies”), Organismic meta-theories often posit that development follows one set of universal stages, steps, phases, or tasks. The underlying hypothesized causes of development in Organismic meta-theories are active goal-directed exchanges with the environment leading to successive reorganizations of bio-psychological structures over time in the direction of adaptive developmental endpoints.

The prototypical Organismic theory, and the one that was causing all the trouble documented by Reese and Overton (1970), is Piaget’s constructivist theory of cognitive and affective development, and the many developmental theories that were based on Piaget, for example, Kohlberg’s theory of moral development reasoning. Other Organismic theories include Werner’s comparative psychology as seen in his orthogenetic principle, and Erikson as seen in his universal age-graded developmental tasks. Other theories that claim kinship with Organismic meta-theories (e.g., theories of intrinsic motivation) do not typically include notions of universal stages or tasks, but focus instead on Organismic assumptions about the human nature, specifically, that humans are innately active, curious, and interested, and inherently desire to explore, understand, and fit in with their social and physical environments. With the rise of radical contextualism and cultural relativism in psychology, theories of “universal” anything (e.g., psychological needs, stages, developmental tasks) have come increasingly under attack.

What are Contextual meta-theories?

Contextual meta-theories can be understood as having as their root metaphor the *tennis game*. In these meta-theories, the target unit of analysis is the game-- the back and forth between the person and his or her context, both of which are assumed to be proactive and acting on their own agendas. Both of them are also assumed to be in motion, so contextualist theorists often describe their task as understanding "developing people in a changing world." Sometimes the exchange between person and context is captured in other dyadic metaphors—such as the *conversation* or the *dance*. All of these metaphors have in common the central notion that you cannot make sense of the conversation (tennis game, dance) by looking at only one of the partners. Because it is co-constructed through their joint activity, development takes its form and directionality from the interaction between the person and context, and can be continuous or discontinuous depending on how the game is played.

Within the contextualist meta-model, as summarized in Table 7.1, the person is seen as an agentic, reflective, self-regulating, socially connected being interacting with a context that is itself active, structured, and dynamic. These partners mutually operate on and are operated on by each other in service of competence and cultural membership. The hypothesized underlying causes of development in these meta-theories are the joint activity of both person and environment leading to the transformation of both. Some of the better known members of the contextualist family include Bronfennbrenner's bio-ecological model and the lifespan approach. The "contextualist" moniker reflects these perspectives' concern with development as unfolding within and shaped by multi-level ecological or contextual forces, such as microsystem settings, society, and historical contexts.

Which researchers have meta-theories?

All researchers have meta-theories. However, these assumptions are usually implicit and unacknowledged, and researchers are often unaware of the assumptions that are built into their thinking and the theories they are using. Typically researchers think that their assumptions are self-evident truths. Meta-theories are not typically cold cognitions or beliefs. They are often deeply held convictions that researchers will fiercely defend. Researchers are typically convinced that their assumptions are right and everyone else's are wrong.

Table 7.1. Key Characteristics of Four Meta-theories

META-MODELS	REDUCTIONIST MODELS		INTERACTIONIST MODELS	
	Maturational Biological Meta-Model (Genes or "G X e" Model)	Mechanistic Contextual Meta-Model (Environment or "E" Model)	Organismic Living Systems Meta-Model (Person or "P X e" Model)	Contextual-Dialectic Developmental Systems Meta-Model ("G X E X P" Model)
METAPHORS	***Plant or Brain Coral***	***Machine***	***Butterfly***	***Tennis Match***
DESCRIPTION OF DEVELOPMENT				
Unit of ANALYSIS of CHANGE	**Genes** (entities) and related phenotypic expressions	**Observable behaviors** and related incentives	**Bio-psychological structures and processes** that motivate and regulate observable behavior	**Gene-person-environment interactions** that motivate and regulate observable behavior
Nature of PERSON	Non-conscious, **reactive** Non-agentic, passive Biologically determined	Non-conscious, **reactive** Non-agentic, passive Socially determined	Conscious, reflective Agentic, **active** Self-regulating	Conscious, reflective Agentic, **active** Self-regulating Socially/emotionally connected
Nature of ENVIRONMENT	**Passive but structured** as developmental niche for genome	**Active and structured** **Operates on** the person in the service of socialization and social control	**Passive but structured** and more less attuned with developing organism's needs and goals **Operated upon** by person in service of needs, goals, and competence	**Active, structured, dynamic** and more or less attuned with developing organism's needs and goals **Operates on and is operated upon** by person in service of competence and cultural membership
Course of DEVELOPMENT	**Quantitative** change **Continuity** over time	**Quantitative** change **Continuity** over time	**Qualitative** changes, stages **Discontinuity**/ emergence over time	**Quantitative and qualitative** change **Continuity and discontinuity** **Peripheral to central** social membership
EXPLANATION OF DEVELOPMENT				
Role of PERSON in development	**Passive** reaction	**Passive** reaction	**Conscious, active person** pursuing goal-directed behavior and competence; Person **constructs** development through activity	**Conscious active partner** becoming a member of a cultural system and its normative goal-directed behavior Person **co-constructs** development through intentional activity with others
Role of ENVIRONMENT in development	Provide fuel for growth from **inside**	Extrinsically motivate and shape growth from **outside**	Support **intrinsic** motivation and development through **affordances**	Support **intrinsic** motivation Internalization of **extrinsic** motivations and development through **affordances** and **apprenticeship**
Underlying Hypothesized Cause of DEVELOPMENT	**Genetic programming** Unfolding over time leading to a mature form	**Social conditioning** Occurring over time leading to observable behavior	**Activity** and related reorganizations of bio-psychological structures over time in the direction of adaptive-developmental endpoints	**Joint activity** and reciprocal transformations in gene-person-environment interactions over time in the direction of person's attainment of "mature status"

Table 7.2. Examples of theories and their underlying assumptions.

	THEORY: THEORIST					
	ETHOLOGICAL THEORY: BOWLBY'S THEORY OF ATTACHMENT	**ERIKSON'S PSYCHOSOCIAL THEORY**	**LEARNING THEORY: SKINNER'S BEHAVIORAL THEORY**	**BANDURA'S SOCIAL COGNITIVE THEORY**	**COGNITIVE DEVELOPMENTAL THEORY: PIAGET'S CONSTRUCTIVISM**	**BRONFEBRENNER'S ECOLOGICAL SYSTEMS PERSPECTIVE**
MESSAGE	Development is the product of biologically-based species-general programs shaped by human genetic and evolutionary history.	Humans progress through eight psychosocial conflicts, from trust vs. mistrust to integrity vs. despair.	Development is the product of learning from the consequences of one's behavior through operant conditioning.	Development is the product of cognition, as illustrated by observational learning and human agency.	Development proceeds through four stages of cognitive development, from sensorimotor to formal operations.	Development is the result of reciprocal social interactions between an active person and their social partners from in a series of nested contexts.
HUMAN NATURE-BLANK, GOOD, OR BAD	In our physiology as shaped by evolution	Good (capable of growth)	Blank (neither good nor bad)	Blank (neither good nor bad)	Good (active, curious)	Good, bad, & blank (biological predispositions toward both)
NATURE-NURTURE	Nature	Nature and nurture equally	Nurture	Nurture	More nature (maturational constraints) but also nurture (experience is also important)	Nature and nurture equally, although more focus on nurture
ACTIVE-PASSIVE	Passive (humans are influenced by biological forces beyond their control)	Active	Passive (humans are shaped by environment)	Active (humans influence their environment)	Active (constructing own understanding)	Active and passive (Reciprocally initiate and receive)
CONTINUITY-DISCONTINUITY	Tends to be continuous, but may have sensitive periods	Discontinuous (stagelike)	Continuous (habits gradually increase or decrease in strength)	Continuous	Discontinuous (stagelike)	Both continuous and discontinuous
UNIVERSAL-CONTEXT SPECIFIC	Universal	Universal (although stages may be expressed differently in different cultures)	Context specific (direction of development depends on experiences)	Context-specific	Universal	Context-specific and universal, but more focus on context
META-THEORY	**Maturational**	**Organismic**	**Mechanistic**	**Contextual**	**Organismic**	**Contextual**

As pointed out by Reese and Overton (1970), researchers holding different meta-theories can have difficulty communicating with each other. Since they are asking different questions and using different truth criteria for research, they often argue past each other or misunderstand each other. One group of researchers will offer what they consider to be irrefutable proof of their ideas, which other researchers then dismiss as irrelevant. Discrepancies, inconsistencies, arguments, and furor often characterize an area of study in which researchers from multiple meta-theories are working.

Does the field of psychology have meta-theories?

During different historical periods, specific meta-theories dominated the field of psychology. For example, during the 1940s and 1950s, behaviorism held sway. In the 1960s, Piaget's theories were introduced to the United States and captured the field's attention. When a specific meta-theory governs the field, it becomes very difficult for researchers from opposing meta-theories to work—they have trouble getting funding, they have trouble getting their research findings published, and they are marginalized by other researchers. For example, when the area of motivation was dominated by behaviorists (who believed that all behavior was motivated by rewards and punishments), it was very difficult for researchers to study and publish research on intrinsic motivation.

What is the dominant meta-theory in the field today?

Since the 1980s, "cognitivism" is one of the guiding meta-theories in the field of psychology. "Cognitivism" is the assumption that all the causal factors that shape human behavior and development are inside the mind or belief system of the person. You can hear the assumptions in the theories of the field: self-efficacy, self-esteem, attributions, perceived social support, values, sense of purpose, goal orientations, internal working model, identity, and so on.

Some cognitivist theories (e.g., health beliefs) are Maturational, in that they only include constructs from the individual's belief system, whereas others (e.g., self-efficacy theory) are more Contextual in that they include a large role for the environment. Some theories that started out focusing on the environment (e.g., theories of stress or social support) have "disappeared into the head" as the study of these phenomena has relied more and more on people's opinions about their occurrence (i.e., stress appraisals and perceptions of social support).

Starting in the 1990s (with the introduction of the fMRI), the paradigm that is currently taking over the field of psychology is *neuroscience*. At its most extreme, this view assumes that the brain is solely in charge of behavior, and neurophysiology is destiny (which would be a Maturational meta-theory). However, many researchers studying the brain see it as a crucial piece of the puzzle, but also incorporate assumptions about agentic individuals and active environments—which puts them in more contextual or systems camps. In the final section of this book, we include a chapter on neuroplasticity, which focuses on neuroscience research that examines the role of experience in the development of the brain itself, most of this research relies on a systems perspective.

News flash: In the field of psychology outside developmental, most researchers assume that people don't develop. In personality, social, cognitive, and industrial-organizational psychology, researchers largely examine individual differences as indicators of people's permanent characteristics. These snapshots, taken at a single point in time, are assumed to contain all the information needed to understand a phenomenon. For developmentalists, it is as if these areas rely on meta-theories that posit a view of reality as a "still-life" whereas developmentalists assume that reality is more akin to a movie, and such snapshots only reflect single frames.

Who else has meta-theories?

Everyone has meta-theories about human nature and development: parents, teachers, nurses, social workers, doctors, business people, artists, politicians, and so on. For example,

- doctors assume that weight loss is all about diet and exercise (nurture), so no one can do research on physiological differences in metabolism (nature).
- teachers have assumptions about whether students come with motivation (nature) or have to be motivated from the outside (nurture), and organize their classrooms accordingly.
- parents often argue about the nature of children's development, whether it's just the child's personality (maturational), or the child is going through a normal stage (organismic), or if they are rewarding the wrong behavior (mechanistic).

Where can meta-theories be seen most clearly?

Once meta-theories become visible to us, we can see them everywhere, but one of the places that they are most evident is in the ways we choose to intervene to improve development. In order to make a positive change, we must select an "intervention lever" or strategy through which we believe we can alter the current course of development. That strategy represents our view of the most important antecedents and so is revealing about our hypothesized underlying fundamental cause of development—which is at the heart of each meta-theory. For example, if we are trying to help families who have children with serious behavioral problems, we could consider a psychopharmacological intervention, which would, because it focuses on biological causes, imply a maturational view. Or we could offer to work with the parents so they could more effectively set limits for their child. This would imply Mechanistic view because of its emphasis on environmental programming.

One exercise that we have found useful in helping students think through the four meta-theories is to assign each student one of the meta-theories and then to answer intervention questions, like the series of questions listed in Table 7.3, from that perspective. If students have a chance to take each perspective, they begin to be able to see patterns in the answers. Some of them are surprising. For example, we tend to be slightly offended by Mechanistic assumptions that we are being run by external forces, but these assumptions are wildly optimistic when it comes to interventions, basically asserting that any change is possible as long as we are clever enough in our social programming. On the other hand, Organismic assumptions are appealing, but more challenging to apply to interventions, because the best way to induce structural shifts is not always apparent. On the third hand, Contextual assumptions seem generally to fit in with our layperson's take on development, but when it came time to derive an intervention, it was difficult to get beyond such generalities as "all of the above" or "it depends," leading students to wonder whether that meta-theory was going to be very helpful for optimization efforts.

Table 7.3. Examples of Questions to consider from Different Meta-theoretical Perspectives

1. How can we get our little girl (toddler age) to eat more vegetables?
   Examples of responses from each perspective:
   - *Maturational*: don't worry, your toddler will eat them when she is ready.
   - *Mechanistic*: model how delicious the vegetables are and then reward her with dessert once she eats her vegetables.
   - *Organismic*: offer a variety of vegetables and she will select the ones she prefers.
   - *Contextual*: wait until she is hungry and then offer a selection.
2. Can the baby sleep in bed with us when he has a nightmare?
3. Should we make the preschool child share his toys?

Moving up several levels:

4. Why are their racial differences in educational attainment?
5. Late onset dementia—how do we best treat it?
6. After you turn 50, should you exercise like mad or just spread gracefully?
7. Adolescent sex offenders, should they be tried as adults?
8. Should 16-year-olds really be allowed to drive? 85-year-olds?

9.	I'm investing in new technology for my business-- Should I fire everyone over 40 or can older workers be retrained?
10.	Are you developing now? Will you develop any more?

What is the meta-theory that guides our class and our book?

One of the goals of this book is to lay out the advantages of developmental systems perspectives on human development. The authors were trained in a variety of systems and contextualist perspectives, including the transactional-dialectic perspective and the lifespan orientation—a view that fought its way through dominant perspectives in child psychology (e.g., development ends at age 18), starting in the 1970s and becoming a well-regarded meta-theory today. (Note that your instructors chose your book, so their meta-theory is influencing the meta-theoretical filter through which you are learning about development.) In subsequent chapters, we touch on several developmental systems perspectives that incorporate organismic and contextual elements, such as the bio-ecological model, transactional-dialectic models, relational perspectives, and dynamic systems.

What is the correct meta-theory?

There is no single correct meta-theory, just as there is no single correct definition of development. Even the developmental systems approach has its drawbacks. However, as research accumulates, many theories derived from certain meta-theories have been found to be incomplete—so far researchers have not found any significant aspect of development that is caused *only* by nature or *only* by nurture. Therefore, most researchers currently say they favor interactive metatheories, like organismic, contextualist, or systems meta-theories. However, it is important to look carefully at researchers' (and our own) actual work, because sometimes we find one meta-theory most compatible with our own assumptions about humans and how they develop, but nevertheless our research (sometimes surprisingly) seems to be more consistent with the assumptions from a different meta-theory, even one we would say that we disagree with in principle.

Do I have a meta-theory about development?

Yes, you do. And you can figure out what it is. Although it's not easy, you can discern your own assumptions about development—by thinking about which assumptions make the most sense to you. You can also see which kinds of theories you prefer and what kinds of recommendations you would make about how to optimize development, like how people should parent, teach, or make policies. The hardest part about discovering your own meta-theory is realizing that it is made up of assumptions you have (based on your experiences and messages from society)—that aren't necessarily true. Our meta-theories seem true to each of us.

How do I get rid of my meta-theory?

It's not really possible to get rid of all of our assumptions. It is our goal to be aware of our own assumptions or meta-theories, to realize that they are not the truth but are our current working models of how the world operates and people develop. The most important thing is to be explicit about our assumptions and to be aware of how they are guiding our actions. It is a goal of this class to help students figure out their own assumptions and to help them become (or remain) open to alternative viewpoints.

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Chapter 8. Comparing and Contrasting Meta-theories

So far, we have presented the four meta-theories under consideration in a list, roughly corresponding to their ascendance in developmental psychology, but still just as a serial string. However, it is clear that among this set of meta-theories, some share similar features and some differ. In order to provide a “meta-view” on meta-theories, we will select some important dimensions upon which the theories can be compared and contrasted. We will also discuss in a little more detail those assumptive issues that have led us to advocate for developmental systems meta-theories.

What are some key issues upon which these meta-theories differ?

An obvious first place to start in identifying similarities and differences among the four meta-theories is their relative emphasis on *nature* versus *nurture*, or on the relative importance of the person and of the environment. Before we embark on this issue, it is important to point that none of the meta-theories assumes that only one of these ingredients (i.e., person or environment) is both necessary and sufficient to generate development. Even the most maturational of meta-theories acknowledges that the environment must provide essential nutrients for the maturational program to unfold. No seeds will germinate without soil, water, and sun. However, it is the seed that contains the developmental blueprint that determines the mature design of the organism. In a similar vein, not even the most mechanistic of meta-theories looses track of the fact that without certain organismic capacities—such as the ability to detect and respond to environmental contingencies—no social conditioning is possible. However, it is the environment that brings the developmental agenda that will shape the trajectory of behavior.

It is the relative weight given to each factor that distinguishes the meta-theories. Figure 8.1 depicts the four meta-theories along two important axes: the horizontal axis represents the relative importance that the meta-theory assigns to the person, and the vertical axis represents the relative importance of the environment. As can be seen by the placement of the meta-theories, Maturational meta-theories assign great weight to the person and very little weight to the environment; these meta-theories assume that any average expectable environment would be sufficient to support the maturational program. For that reason, we sometimes refer to them as “big O” meta-theories (for their overriding emphasis on the “O”rganism). In contrast, Mechanistic meta-theories assign great weight to the environment and very little weight to the person; they assume that normal humans come with the equipment needed to detect and respond to social conditioning. For that reason, we sometimes refer to them as “big E” meta-theories (for their overriding emphasis on the “E”nvironment).

Organismic meta-theories assign great weight to the organism (as might be inferred from the name of the meta-theory) but, since the organism’s goal is to adapt to the environment, these meta-theories assign a more important role to the environment. For that reason, we sometimes refer to them as “big O-little e” meta-theories (for their emphasis on the “O”rganism without forgetting the “e”nvironment). Contextual meta-theories, as the name implies, assign great weight to the context but, since the individual is considered to be an active agent that selects, initiates, and responds to the environment, these meta-theories view the person as also playing an important role. For that reason, we sometimes refer to them as “big E-little o” meta-theories (for their emphasis on the “E”nvironment without forgetting the “o”rganism).

Insert Figure 8.1 about here

How do the two meta-theories that focus on the organism differ from each other?

As depicted in Figure 8.1, two meta-theories, namely Maturational and Organismic, fall to the extreme right of the figure, indicating that both of them are “big O” meta-theories that assign a primary role to the person in shaping development. How then, do these two meta-theories, which both prioritize the organism, differ from each other? First, as shown by the difference in their positions in Figure 8.1, Organismic meta-theories assume a relatively greater role for environments than do Maturational meta-theories. The importance of the environment is visible, for example, in Piaget’s theory of cognitive development. According to this perspective, the contents of logico-mathematical thinking, such as conceptions of time and causality, have specific universal properties because they are constructed based on interactions with objects that are governed by the specific universal laws of physics; it is likely that the contents of development would be completely different if humans were to construct their schemas and logical operations on planets where these laws did not apply. In such a radically different environment, the basic organismic processes of adaptation, assimilation, accommodation, (dis)equilibration, and (re)organization, would lead to very different developmental outcomes.

A second set of differences between Maturational and Organismic meta-theories are listed in Figure 8.2. Because Maturational meta-theories assume that biology and genetics are running the show, they do not view humans as active or agentic in their own development. (No act of will can force a tulip bulb to produce an iris.) It may seem confusing to argue that Maturational meta-theories assume that people are passive and reactive, when all the developmental action seems to be located right there inside the person. However, the director of this action is the person’s biology—their genes and neurophysiology—over which the person does not exert direct control.

Insert Figure 8.2 about here

To borrow another metaphor, in Maturational meta-theories, the person (or more precisely, the agentic self) is *not* in the driver's seat. The pickup truck of development is driven by the genetic program. The person him or herself is in the passenger's seat, just along for the ride. What about theories focused on personal attributes that seem closer to the agentic self, like those that concentrate on brain systems, personality traits, or intellectual abilities? Some of these theories can be considered Maturational—if they assume that these characteristics are fixed or immutable—and thus not open to influence from the agentic self. In contrast, one of the most notable features of Organismic meta-theories are their assumptions about human nature—they assume that people are active, curious, goal-directed agentic beings.

A second difference between Maturational and Organismic meta-theories centers of the issue of continuity versus discontinuity. Because Maturational meta-theories assume biological priority and immutability of personal characteristics—this implies two kinds of continuity in development. On the one hand, it is assumed that there is great *stability* in people, based on their fixed biopsychological attributes. Attributes that were seen in newborns should continue to be apparent in young children, older children, adolescents, and adults. On the other hand, *explanatory continuity* is also assumed because development can be fully understood by investigating an individual's biology. The search for causes of development privileges the territory covered by genetics and neurophysiology.

In contrast, a distinctive feature of Organismic meta-theories is their assumption of discontinuity. They assume *descriptive discontinuity*, because development is seen as the emergence of a series of qualitatively new reorganizations. They also assume *explanatory* *discontinuity*, because each successive reorganization is built on the unique configuration of the previous level of development, in combination with new ingredients and activities. As a result, no developmental step can be reduced to any previous steps.

How do the two meta-theories that focus on the organism differ from each other?

The Mechanistic and Contextualist meta-theories, as can be seen from their position at the top of Figure 8.1, are both “big E” meta-theories that have in common the assumption that the environment is has a primary role in shaping development. As can be seen by the differences in their position, one distinction between these perspectives is their view about the relative importance of the person. Mechanistic meta-theories require only an “average expectable” organism, who is capable of detecting and responding to social conditioning, whereas Contextualist meta-theories assume an goal-directed agentic person, who is an active partner in selecting contexts, and in initiating and eliciting interactions.

A second difference, as listed in Figure 8.3, involves the issue of continuity and discontinuity. Because Mechanistic meta-theories assume that all the developmental action is contained in the efforts of the environment, it assumes that changes in the individual are in quantity and not in kind, that individual development can be steered in any direction, and that, with the right environmental input, the direction of development can be reversed or rerouted. In contrast, Contextual meta-theories, because the include a role for the active individual, assume that the nature of humans makes an intrinsic contribution to development and places constraints on the potential effects of the environment. In the metaphor of the dance, each dance is unique—based on the two partners and the specific chemistry. From this perspective, some developments are seen as qualitative and very difficult or impossible to reverse. Hence, new developments are not reducible to environmental programming.

Insert Figure 8.3 about here

Are there other ways to compare and contrast the four meta-theories?

These four meta-theories can be distinguished based on their views about the role of the person (whether people are seen as active versus reactive) and the role of the environment (whether it is seen as active or passive). As pictured in Figure 8.4, Maturational meta-theories posit that development unfolds from a reactive person in a passive environment, whereas Mechanistic meta-theories see development as driven by an active environment operating on a reactive person. Organismic meta-theories argue that development emerges from an active person making use of a passive environment, whereas Contextual meta-theories see development as arising from active people negotiating with their active environments.

Insert Figure 8.4 about here

When arranged this way, it also becomes clear that meta-theories that focus on different active ingredients, such as Maturational and Mechanistic, have in common a view of people as reactive, whereas Organismic and Contextual meta-theories view people as active and agentic. The analysis of the difference between Maturational and Mechanistic models, on the one hand, and Organismic and Contextual models, on the other, reveals a deeper issue underlying these models—that many theorists assume refers to the most important meta-issue in developmental science, namely, dualistic versus relational meta-theories.

What do Maturational and Mechanistic meta-theories have in common?

As depicted in Figure 8.5, the fact that Maturational meta-theories posit that development is the product of genes and neurophysiology (i.e., biological determinism) whereas Mechanistic meta-theories posit that development is the product of social conditioning (i.e., environmental determinism) often lead students to focus on the differences in these two meta-theories (nature versus nurture). However, these two meta-theories also have in common several underlying assumptions—that people are passive and reactive, that people are static and at rest unless moved by efficient causes, that development is driven (by either biology or environment), and that development shows great continuity with changes that are largely quantitative and in amount.

Insert Figure 8.5 about here

Perhaps most fundamentally, these two meta-theories agree that nature can be understood and studied *separate* from nurture. Although the two meta-theories differ about the part that can be relegated to the status of background (with Maturational dismissing nature, and Mechanistic dismissing nurture), they share the core notion that person and context can be considered separate *parts* of the developmental equation. The view that nature and nurture can be dis-assembled and analyzed for their individual contributions reflects a basic underlying assumption that is sometimes referred to as “dualistic” or “reductionistic.” Maturational and Mechanistic meta-theories have in common that they are dualistic and reductionistic world views.

What do Organismic and Contextualist meta-theories have in common?

As depicted in Figure 8.6, the fact that Organismic meta-theories emphasize the role of the organism in development whereas Contextualist meta-theories emphasize the role of the context should not obscure the several assumptions that these meta-theories have in common:

that the person is inherently active and agentic, that change and activity are the natural state of affairs, that development is always co-constructed by interactions between co-active people and their multi-level contexts, and that quantitative changes and qualitative transformations of both are not only possible but likely.

Insert Figure 8.6 about here

Perhaps most fundamentally, these meta-theories share the assumption that, although people can be *distinguished* from their contexts, they cannot be separated, without distorting or destroying both. At the most basic level, the notion that nature and nurture are parts of the same whole and so can only be understood and studied in their combination or interaction reflects a basic underlying assumption that is sometimes referred to as "relational" or "interactionist." Organismic and Contextual meta-theories have in common that they both are relational and interactionist world views.

What is the point of these two "meta-models"?

At the risk of piling "meta-s" upon "meta-s," we add one more layer of "meta-models." We are convinced (consistent with many other developmentalists) that the most important distinction to be made among meta-theories is not based on their relative emphasis on nature versus nurture, but instead on their views about whether the universe (including people and their contexts) are made up of dis-sociable parts or of synchronized wholes. These meta-models are pictured graphically in Figure 8.7. On the left side are meta-theories, like Maturational and Mechanistic, that are dualistic or reductionistic; on the right side are meta-theories, like Organismic and Contextual, that are interactionistic and relational.

Insert Figure 8.7 about here

In their chapter, Reese and Overton (1970) refer to the two sides of this assumption as "elementarism versus holism" or assumptions about whether (1) a part can be considered a meaningful unit in itself so that it can be removed (disassociated) from the whole and understood by examining only the material identity of the part; or (2) a part derives its meaning from the whole and so part processes can only be understood in the context of whole. In meta-theories that assume elementarism, it is considered reasonable to isolate and focus on individual parts, and to consider as similar two parts that look the same, whereas in meta-theories that assume holism, parts must always be considered in the context of their functioning in the whole, and so two parts, even if they appear to be similar, should not be considered the same if they function as parts of different wholes.

The "parts" that can be considered, shown on the left side of the figure, include "nature versus nurture" and all its variations, as well as "person versus context" and "body versus mind." As can be seen on the right, relational meta-models reject the very idea that these are dualisms, arguing for the use of "and" instead of "versus," because development is always nature *and* nurture, person *and* context, and body *and* mind. However, these meta-models go further, positing that the lines implied by "and" should be recognized as artificial, as dotted lines—permeable boundaries--at best, in that minds are *always* embodied, humans are essential parts of their ecologies, and, through their own actions, people are continuously (and some would argue catastrophically) changing their nature and their nurture, even going so far as to change their local micro-climates through the effects of their body temperatures and by breathing in and out.

We find that this feature of meta-models, namely, the assumption of non-duality or holism, is the most difficult one for students to grasp, so we will provide a few examples here and then revisit the issue repeatedly in subsequent chapters as we discuss meta-theories that take this issue as their centerpiece (e.g., developmental systems, dialectic-transactional, and relational meta-theories). The central point of "non-dualism" is that the two "parts" that we try to separate and that we then rejoin with "versus" or "and," actually require each other to exist. They are mutually constitutive. A simple example is that of "inside" versus "outside." The very existence of "inside" depends on the existence of "outside." If there were no "outside," nothing could be inside—the idea of a boundary requires the existence of two territories, without both territories, the boundary and the distinction between the territories would not make sense. So it is with, for example, the mind and the body. The mind cannot exist without the body, and the body, without the mind, is a qualitatively different kind of body, it is a cadaver.

> "When we try to pick out anything by itself, we find it hitched to everything else in the universe."
>
> --John Muir, *My First Summer in the Sierra*

Where do developmental systems meta-theories fit on this meta-map?

We view developmental systems meta-theories as interactionistic and relational meta-theories that posit development as the outcome of exchanges between "big-O and big-E." This idea is pictured graphically in Figure 8.8, in which both Organismic and Contextual meta-theories are in the same quadrant in which importance is given to both person and environment, even though, as their names suggest, Organismic assigns relatively more weight to the organism, and Contextual to the context. We are interested in that corner on upper right, where we have placed Developmental Systems meta-theories, and we have selected the larger orientations which we will present and discuss in subsequent chapters based on the extent to which we judge that they can help us think about and study our phenomena using the precepts the take us ever farther into this corner of the meta-map.

Insert Figure 8.8 about here

References

Lerner, R. M. (1977). The organismic and the unity of science philosophies. In R M. Lerner (Ed.) *Conceptualizations and theories of human development* (pp. 19 - 45). Reading, MA: McGraw-Hill.

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Activity 2: Developmentally Systematizing a Phenomenon

One of the challenges we set for ourselves was to encourage each student to work on the target phenomenon of their choice, with the assurance that we would help them “developmentalize” it, whatever it was, so that it would be suitable for framing within a variety of systems orientations. This offer was made with the conviction that, since everything really *is* developmental (i.e., everything really is active, moving, changing, transforming), the process of uncovering or converting a configuration and question from one sub-discipline (e.g., social, industrial-organizational, community, education) to developmental-land would be relatively straightforward. How hard could it be? As it turns out, it could be pretty hard.

At first, it was very interesting to see what kinds of phenomena students initially brought to us to be converted. It was revealing to see the features that students assumed their phenomenon would be required to possess if it was going to be able to be developmentalized. Some students tried to think of questions that interested them about babies, children, or adolescents. Some tried to think of questions that focused on adulthood and aging (e.g., the aging workforce was a prime candidate). It became clear that, for them at this point, the primary defining feature of “developmental” was the target population. It simply did not occur to them that every single phenomenon, including *exactly* the one that they were studying in their thesis or dissertation research was, from our perspective, inherently developmental, worthy of being hewn out of the static rock where it was trapped by the assumptions of its surrounding sub-discipline and set free to travel across time.

How did you help students developmentally systematize their phenomenon?

In the beginning, we had no real idea about how to accomplish this goal. We simply talked to students individually about their targets, interviewing them about their research questions and variables (which is where they were typically focused) and trying to help them "zoom out" to see the larger conceptual questions and applied problems that they cared about. We kept listening and drew pictures together and after a while something the student said reminded us of something we had once thought about a similar phenomenon and then "presto-change-o!" a sliver of developmental light began to dawn. Eventually, through these interviews, we also learned about the difficulties and barriers to developmentally systematizing phenomena, and we discovered that the barriers were not only in our students, by also in the sub-disciplines of their research questions, and in ourselves.

What were the three main barriers?

A first barrier was *limited domain knowledge*. Students picked their own topics within psychology, based on their interests and training. However, the topics differed enormously in how much had been discovered about them already. As a rule, domains in which more was known were easier to "systematize." Areas that had identified a wide range of predictors, moderators, and pathways to the target phenomenon were beginning to recognize the complexity of their phenomenon. Some of the areas that included multiple competing perspectives were beginning to realize that more than one of these perspectives was likely valid. These areas were ready for organization and integration.

In contrast, some areas were relatively less mature; they had been guided by single concepts or dominant perspectives. Some of these areas were beginning to wonder whether their approaches might be dead ends; however, most were questioning the specific approaches rather than searching for larger frameworks that would incorporate them. The biggest problem was what Giggerenzer (1998) refers to as one of the "surrogates for theories," namely, "one word explanations." These are "theories" in which all of students' knowledge could be encapsulated by a single concept—like “emotion regulation,” “self-efficacy,” or “racial stereotype.” These concepts actually refer to a broad range of fully-baked theories, but students often did not know about those theories or their near-neighbors. Hence, a barrier to developmentally systematizing a phenomenon is lack of rich domain knowledge.

A second barrier was an over-riding *focus on the individual*. Some students had trouble getting outside of the individual. When asked for a list of the predictors of their phenomena, it was not uncommon for every element on the list to come from *inside* the person (e.g., personality, temperament, skills) and often from inside their *cognitions* (e.g., appraisals, values, self-efficacy, perceptions of social support). When we asked for descriptions of dyadic, group-, or organization-level constructs, we were lucky to get two or three candidates, and they were typically from a narrow band of constructs. We viewed this bias as reflecting the dominance of cognitivist metatheories in psychology today. Hence, a second barrier to developmental systems thinking is impoverished knowledge about theories and constructs outside the individual level.

Finally, a third barrier was *specialization*. Students had a hard time seeing how conceptualizations and research outside their own sub-areas (or even their individual sub-sub-areas) could be relevant to them. For example, as we discussed the issue of levels in organizations, some developmental students tuned out. What did the workplace have to do with children? Or when we discussed attachment, community psychology students focusing on support groups failed to make any connection. We could see that their disinterest reflected the compartmentalization of the field of psychology today. Research topics and fields have evolved in relative isolation from each other. Hence, a third barrier to developmental systems thinking is the headset that researchers are responsible only for the knowledge inside their narrow specialization.

In facing the limitations experienced by our students, we faced the limitations experienced in the field of psychology as a whole. As a field, we tend to work in relatively compartmentalized areas, learning only occasionally about the constructs and perspectives outside the traditional boundaries of our topics. Since the individual is the focal unit for psychologists, we tend to over-emphasize that level, looking for our answers *inside* the person and remaining less knowledgeable about theories and constructs from higher and lower levels of analysis.

How did you help students overcome these barriers?

We tried to develop a series of activities (short writing assignments and discussions) that could help students begin to see their target phenomena, as well as the theorizing and studying they were doing about it, as objects of reflection outside of themselves. The activities are listed in Table 8a.1. As described previously, we started with each student's "elevator speech" in class, followed by the paragraph outlining the problem statement. The next assignment was to write a brief (1-1.5 pages) summary of describing "traditional" research on their target topic. This usually consisted of two parts. The first was a list of predictors, which for some topics had been classified into "good news" (e.g., protective factors) and "bad news" (e.g., risk factors), and for others had been classified by level (e.g., personal vs. social factors).

Table 8a.1. List of Activities to Help Students begin to Developmentalize their Phenomena.

Activity	***Length***
1. Elevator speech in class	2-3 minutes
2. Problem statement	1-2 paragraphs
3. Configuration paper	1-1½ pages
4. Summary of traditional research	1-2 pages
5. Picture with antecedents and consequences	½ page

The second part was a list of models or conceptualizations used on the topic. Sometimes models consisted of putting all the factors in boxes and connecting them with arrows, and sometimes more complex relationships (containing mediators or moderators) had been suggested. Although lists of predictors could be very long, rarely did any area have more than two or three alternative conceptualizations or models. Some of the more mature areas had review articles in which these predictors and models had been collected. These descriptions of "traditional research" were subsequently used as summaries of domain knowledge for each topic.

How did this assignment help "developmentalize" students' phenomena?

This assignment served three functions. First, it encouraged students to see the current research on their topic as "traditional" and not as "correct." For many students, this was the first moment that it occurred to them that what seemed to be "known" about their phenomenon at this moment was not a representation of the static "truth," but a moving window of the current working model of the area. This loosened their hold a bit on the status quo.

Second, it encouraged students to consider the many different lenses that had already been used to capture pictures of their targets, also suggesting to them that multiple perspectives could be useful. If by chance students didn't know about all the perspectives that were currently employed to study their phenomenon, this exercise gave them the chance to go and learn about them (usually by talking to their faculty mentors and getting recommendations form them about good reviews or historical chapters). Moreover, as was sometimes true, if their topics were dominated by a single theory or perspective, this exercise also gave students the opportunity to realize that work on their topic was not currently informed by multiple perspectives—and so they could reflect on what might be missing from their topic areas.

Third, these brief summaries were a big help to us, their instructors, so we could learn the basics about each of their areas—especially ones with which we were not particularly familiar. These short papers also provided the puzzle pieces that we wanted students to use in the next steps of developmentalizing and systematizing their phenomena.

What were the next steps?

The next step was for students to turn what they knew about their target phenomenon into a representation of a process, by using the "understanding a theory" process they had learned about previously. For this exercise, students used a rubric like the one pictured in Figure 8a.1 and could basically "fill in the blanks." Students could fill out as many of these as they needed to complete all the different theoretical frameworks that had been used to conceptualize their target phenomenon. One thing that filling in the blanks allows students to do is notice when they are missing information. The "one word explanations" masquerading as theories began looking less like theories when they came to an end after the concept name was placed in the box labeled "Target."

Insert Table 8a.1 about here

This representation also allowed students to make decisions about where they wanted to focus their attention. When students wanted to develop intervention and optimization strategies, and the "target" was the desired outcome, they sometimes decided to focus on figuring out how to change the target's antecedents and so added a box to the left representing the antecedents of the antecedents. For example, a student who is initially identifies as their target "Work-family balance" may decide that an important antecedent is "supervisor support," but as soon as they want to create an intervention to optimize supervisor support, they need an antecedent to this antecedent to figure out how to improve it.

Where's the development in all this?

Together, as we regarded students' initial representations of their phenomena as a process, we asked a series of questions. First and foremost, we wondered --which of these constructs is changing? There are two likely suspects, of course—the target should be changing as a result of the application of the antecedents, and the consequences, both short and long-term, should be changing as an effect of the target. In many cases, this sequence could be considered a "micro-developmental" process and we could ask, what accumulates as these episodes unfold over time. We began to think of the applied problem—what an optimization process would, in this case, produce or prevent. We started to talk of "the dial," as in whether these episodes cumulatively were "moving the dial," and of what the dial might be an indicator. We looked at the long-term consequence as one option and began thinking about whether it could be described as a trajectory—of good news or bad news.

Then we began questioning, not insisting just questioning, whether the antecedents themselves might also be in motion. Here, we took up any constructs, like personality traits or contextual factors, that are typically assumed to be immutable, or at least stable, and suggested that we should keep an open mind as to whether they might themselves be changing, or if not in motion, whether they might be malleable. It was as if we started oiling all the joints around the constructs so that they could move more freely. We started thinking about feedback loops, whether there might be any return arrows—from the consequences to the antecedent or the target. We didn't draw any yet, but we traced where they might be with our fingers. We started to see in these process representations the potential of cycles, and how each cycle might "move the dial" just a bit.

We spent a bit of time speculating about "what is on the arrows," and we noticed that there were lots of arrows and that they, in most depictions of current theories, were largely blank. We noted the many blanks. Finally, we considered those aspects of the process that we felt were likely to remain fairly stable, and instead of skipping over them, we looked them in the eye and asked them how they managed this—what was happening on the arrows, or what was acting as a counterforce to what was on the arrows, that would allow them to hold there place in the rushing stream of developmental change. They usually didn't know at this point, because they were simply *assumed* to be static, but we told them to be patient. We would think about the hard work of staying the same, that is, the dynamics of stability, by and by.

We did not, at this point in the class, ask students to pull back and look at the whole picture, all that was drawn and all that was implied, and query these parts through the most developmental of questions, namely, how is this phenomena organized-- and how does this specific pattern of the coordination of these parts (this organization) serve a specific set of functions, that is characteristic of a particular point in time, whether that "time" is calibrated to age (e.g., an essential characteristic of "ten-ness), to the beginning of a developmental task (e.g., identity development), to a transition in competence (e.g., novice or expert) or circumstances (e.g., a divorce)? The notion of discontinuity and qualitative stages or states-- this is a fundamental concept that we would have to work our way toward very carefully, or we would lose students on the path.

Table 8a.2. Potential Questions to ask one's Phenomena when Beginning to Convert it to a Developmental System.

1. Which of these constructs is changing?
2. How is the target changing as a result of the antecedents?
3. How are the short-term consequences changing as a result of the target?
4. Can these constructs be seen as creating an "episode"?

5. How could they create “good news”? “bad news”?
6. Do these episodes suggest that they might accumulate —that is, “move the dial”?
7. What is on “the dial”? Long-term development?
8. What constructs does optimization suggest we might consider as outcomes that we could try to change? What options should we be trying to improve, produce, or prevent?
9. Could the antecedents be changing? Could they be malleable?
10. Are there potential feedback loops? Hints of “cycles”?
11. What could be on the arrows?
12. What constructs are likely to be stable? What could be keeping them stable?

Questions for later

13. How are these parts organized, and how does this coordination serve specific functions?
14. How is the whole picture (the whole system) embedded in a larger stream of time—and what are some options about how to think about the kind of “time” that marks systems’ changes? What about— “age,” “beginning,” “ending,” or “transitions”?

Did students “get it”? Did they start using developmental systems thinking?

Not yet. At this point, all we were hoping to do was help students open up their minds a bit. We wanted to challenge students’ views about what constitutes a “developmental phenomena”—to rework the assumption that it’s about an age group (i.e., children or the elderly). We were explicit with students that we were going to evangelize about developmental systems, but we did not want them to obediently comply with our meta-theoretical preferences; we wanted them to be able to see the “new world” for themselves and then decide. We even came up with a term to describe whether we thought that each student “got it” yet. It was like popcorn: Students were kernels and the class was the oil and the pan, heating up slowly. We were helping students to “pop,” that is, to spontaneously begin to see the world through the lens of developmental systems meta-theoretical assumptions.

We saw the work of developing the class as creating a set of experiences that would consistently help students to “pop.” It needed to work for students who were uncomfortable with complexity as well as those who were uncomfortable committing to a specific empirical study. It needed to work with research questions drawn from domains in which complex knowledge structures were not yet available as well as from those in which they currently existed. For the former domains, we needed to identify a set of principles for generating complexity; for the latter domains we needed principles for dealing with it. We needed a set of activities that, working from the inside out, could produce an elaborated conceptualization as well as a series of manageable feasible designs for research that could be accomplished using either standard data collection and statistical methods, and/or current data sets. We saw the course as a microcosm embedded in our own developmental systems meta-theoretical assumptions—so we were using all the principles that we wanted students to consider to help them intentionally shift their way of thinking toward an appreciation of developmental systems meta-theories.

How else did you help students become more aware of the developmental aspects of their phenomena?

We assigned them a “Background paper” in which they were asked to write a short summary of the major developmental issues faced by the people in their configurations (see Table 8a.3). The goals of the paper were twofold: (1) to help them become aware of the “whole persons” they were studying; and (2) to make clear to them that people of all ages have key developmental tasks, and developmental changes in their biopsychosocial characteristics, roles, and relationships. Students who are studying adults often ask us what they should be including in their papers, and are somewhat taken aback when we plonk down whole textbooks on “Adult Development and Aging.” They are only required to read the chapters in lifespan textbooks on their particular age group, but even these chapters provide a great deal of information about the multiple issues their participants are negotiating in the "background," in addition to whatever target issue the student is focused on in the "foreground."

Insert Table 8a.3 about here

Table 8a.3. Background Paper

Goal	To begin to think about people as "whole persons" (that is, as more complex than the particular part you are focusing on). To give you a fuller picture of the developmental tasks and issues with which the people of your developmental level are engaged.
Activity	Write a summary (1 to 2 pages double-spaced) of the main themes in the developmental period of your configuration and phenomenon. If you have a big developmental period (e.g., all of adulthood), it may be longer.
Source	Developmental textbooks.
Content	About 25% of the paper covers the development of your target phenomena (e.g., cognition) and about 75% covers other areas of development (e.g., biological, physical, social, personality development). Consider people as integrated bio-psycho-social beings, so be sure to cover (1) biological characteristics (e.g., neurological, temperament, physical, perceptual, health conditions); (2) psychological characteristics (e.g., cognition, attention, personality/ identity, emotion, regulation/volition, moral/ character, motivation); and (3) social relationships (e.g., parents, family, friendship, peers, intimacy, co-workers, own children).

What are some Examples?

Your target phenomenon is cognitive development during adulthood. You write about major developments in cognition during adulthood (25%) and also about major developments in other domains during the same age period: biological/ physical, personality, social (e.g., work, family), etc. (75%).

Your target phenomenon is families and abuse. You write 25% about the normative developments in the family life cycle (e.g., marriage, establishing the family, child-rearing, divorce, etc.) and also 75% about the other major developmental tasks of the individuals (biological/ physical, cognitive, personality, social, etc.). If you are focusing on the parents, use developmental tasks of adulthood. If you are focusing on the children, use developmental tasks of childhood.

SECTION III:

DEVELOPMENTAL SYSTEMS PERSPECTIVES

Lifespan Approaches

Ecological and Bio-ecological Models

Transactional Dialectic Models

Relational Systems Models

Nonlinear Dynamic Systems Models

Chapter 9. Lifespan Developmental Perspectives

The 1970s saw a paradigm shift within developmental psychology, a shift that transformed the name and the scope of the field. Prior to that time, the field was governed by what now is referred to as the "traditional" view, encapsulated by long-standing confidence that the label "child psychology" or "child development" was adequate to capture the scope of the entire field, which focused on development from conception until it stopped in late adolescence or early maturity. This view has been more or less completely replaced by a view whose name -- "lifespan" or "life-course" human development-- reveals its fundamental assumption that development proceeds from conception to death, or as it is sometimes laughingly expressed-- from "womb to tomb" or "sperm to worm."

To accomplish this transformation, lifespan researchers needed to challenge the very definitions of development that dominated the field at the time. Many proponents of a lifespan view came from a newly emerging field, called gerontology, that studied aging and the elderly. They realized that prevailing definitions which (as will be explained in more detail) viewed all development as normative, progressive, irreversible, and universal, justified the exclusion of adults and the elderly from the domain of developmental study. If these criteria are applied, lifespan researchers had to agree that traditionalists were likely correct—these kind of age-graded changes do not occur with any regularity (or maybe at all) following early maturity. They certainly are not found in old age. An analysis of the lifespan movement is instructive for two reasons: it propounds a view of development that is consistent with the assumptions of the larger meta-theory of developmental systems, and it reveals *how* paradigm shifts can be intentionally created.

What was the "traditional" view of development?

In the 1970s, "traditional" views of development were maturational and organismic. Both of these meta-theories (despite their important differences) had in common several key assumptions. Because these views are not as common today (and students often ask us who in the world would ever buy onto such a view), we will try to explain its principles and its appeal. Although it was never officially stated, these views had in common a metaphor—the idea that psychological development has many of the same features as *biological* development—say the development of "height." This metaphor can be used to answer core questions about development, such as "When does development start?" and "How does development proceed?"

The answers to these questions, from the traditional and lifespan perspectives, are depicted in Table 9.1. For the traditional view, the answer to the first questions, "When does development start?" and "When does development end?" are simple: Biological growth clearly starts at conception and ends with late adolescence or early adulthood. Adolescents may long for some extra inches after they turn 20, but by the middle of adolescence the rate of growth has slowed and by the mid-twenties, it has definitively stopped. Adult height has been reached and remains stable across the lifespan. The next question, namely, "How does development proceed?" refers to the extent to which it is age-graded, that is, proceeds at a pace that can be calibrated to chronological age. In that sense, psychological growth, if it is modeled about biological growth is definitely "normative." In fact, height is so normatively graded that at well-baby check-ups, pediatricians usually provide parents with a chart of norms, and indicate their own baby's place on that chart.

The question "What direction does development proceed?" is also easily answered by traditionalists who use height as an analogy. Development is "unidirectional" and "progressive:" People grow in only one direction—they get taller (they do not get shorter) and they make progress, that is they get “better” or taller. The question “How open to change is development?” has two meanings—to what extent can individuals steer or direct their own development, and to what extent can development be reversed? Despite adolescents’ forlorn hopes that, through force of will, they can acquire the physiques of basketball players or models, the analogue of physical growth suggests that the nature of development seriously limits their options —it is irreversible and not directly open to manipulation through individual efforts. The sixth core question “How universal is development?” is also easily answered by simply looking around—we all get taller, everyone, even the shortest person, is much taller at 20 than they were at birth. So the clear answer is that development is “universal.”

Table 9.1. Assumptions from the Traditional and Lifespan Perspectives

View of development	*Traditional*	*Lifespan*
1. When does development start?	Conception	Conception
2. When does development start?	Maturity, late adolescence	Death
3. How does development proceed?	Normative	Individual
4. What direction does development go?	Progressive Unidirectional	Gains & Losses Multi-dimensional Multi-directional
5. How open to change is development?	Irreversible	Plastic
6. How universal is development?	Universal	Embedded in Context & History
7. What causes development?	Genes &Environment Maturation &Learning	Age-graded History-graded Non-normative
8. What disciplines study development?	Psychology	Multi-disciplinary

According to this perspective, the factors that shape development include nature (that is genes, or the heritable component of height) as well as nurture (environmental contributions, such as availability of protein in the diet and exposure to stress and disease). And because all information about psychological growth can be found inside the person or in their local conditions, then the study of development can be completed from within psychology; no other disciplines are needed. Although if they were, the candidate discipline would, not surprisingly, likely be biology.

Why was the traditional view so appealing?

Any generalizations are unlikely to capture the full allure of this view (but see Cairns & Cairns, 2006, for an analysis of its historical roots in embryology and evolutionary psychology), but, we can see two attractive features-- in addition to the general benefits accrued by borrowing features from the “hard” sciences (like biology), which enjoy greater status than psychology. On the one hand, traditionalists could locate many phenomena which met these criteria, that would be tractable with scientific tools and interesting to study. These would include near neighbors, such as motor, perceptual, language, and cognitive development, and the several offshoots of cognitive development, such as problem-solving and moral reasoning. These topics were of great interest to child psychologists of that era.

A second attractive feature of traditional views was that they were very definitive about what developmentalists should *not* be studying, what they could dismiss. Many psychological phenomena, even during childhood and adolescence, do not show patterns of age-graded change that are normative, progressive, irreversible, and universal. These “messy” phenomena, such as might be included under the rubric of emotional, social, or motivational development, the development of peer relationships, and developmental psychopathology, could safely be ignored. Developmentalists could know what was inside the scope of the field, and what was outside, and any disputes adjudicated by empirical findings. Does the disputed phenomena show normative, progressive, irreversible, and universal age-graded change? If the answer is yes, it qualifies as development; if not, it does not.

And in fact, the study of many topics within child and adolescent psychology that sis not meet these criteria were, for many decades, difficult to study and to publish in developmental journals. For example, many topics that now fall within the purview of "developmental psychopathology," were at that time excluded from the domain of development; instead they were relegated to "abnormal" psychology and child clinical psychology. So, as many have argued, the dominant meta-theories in developmental psychology (just as in all other sciences) have the effect of privileging certain topics as central to the discipline, and consigning others to the periphery, or on the other side of the disciplinary boundary. And, of course, in the case of the "traditional" views that we are discussing here, these definitions also firmly located the study of the last hundred years of the lifespan (ages 21-120) as outside the scope of developmental psychology.

What did the lifespan perspective offer as an alternative view of development?

Proponents of the lifespan perspective within psychology and of the life-course perspective within sociology did not see the lifespan approach as a "theory," but instead as an orientation or converging set of propositions, as explained by Paul Baltes (1987) in one of his seminal papers on the topic,

> For many researchers, the life-span orientation entails several prototypical beliefs that, in their weighing and coordination, form a family of perspectives that together specify a coherent metatheoretical view on the nature of development. The significance of these beliefs lies not in the individual items but in the pattern. Indeed, none of the individual propositions taken separately is new… Their significance consists instead in the whole complex of perspectives considered as a metatheoretical worldview and applied with some degree of radicalism to the study of development. (p. 612)

In this same paper, Baltes (1987) offers a set of key propositions or scripts for a family of perspectives that characterizes the lifespan approach. They are listed in Table 9.2, and can be contrasted with the traditional approach (see Table 9.1). Although the general aim of lifespan proponents was to expand the scope of developmental psychology (and sociology) to include the study of adult development and aging, it turned out that the re-definition of development entailed in making progress towards this goal also ended up transforming the ways in which researchers viewed and studied children and adolescents, and so as we examine each proposition, we explore its implications for the conceptualization and study of development across the full age range.

Table 9.2. Key Propositions of Lifespan Perspectives

1. **Lifespan** development: Ontogenetic change is a life-long process.
2. **Multi-directionality**: Development is multi-dimensional and can proceed in many different directions.
3. Development at every age includes both **gains and losses**.
4. Much intra-individual **plasticity** or malleability is found in psychological development.
5. **Historical embeddedness**: Ontogenetic development is shaped by historical and cultural conditions and changes.
6. **Contextualism as paradigm**: Development is the result of the interactions among three systems of influences: age-graded, history-graded, and non-normative.
7. The field of lifespan development is **multidisciplinary**, and requires the participation of researchers from the natural and social sciences.

Adapted from Baltes (1987).

What are the key features of the proposition that "development is a life-long process"?

The idea that development continues past late adolescence is, of course, the key argument of the lifespan approach, and the proposition from which it takes its name. This assertion opened up the discipline of developmental psychology, creating the study of "adult development" and incorporating the nascent field of aging or gerontology. It also implies that no point in the lifespan is more important than any other in regulating the nature of development. This idea ran contrary to conventional wisdom that, because development is cumulative, early development would be most important to study and optimize. Life-span researchers argued that at every age, developmental processes are cumulative and continuous, but they are also innovative and discontinuous as well. This suggests that processes of change can originate during any portion of the lifespan. Moreover, this proposition also contains the assumption that change *and* stability are within the provenance of developmental psychology and that *both* need to be explained. This challenged the prevailing thought that the domain of development was concerned only with change; that stability was given and therefore needed no explanations; and that any age phenomena or period that showed relative stability (which are more likely during adulthood than during childhood) is not of interest to developmentalists. This assertion took aim at the most basic assumption in developmental psychology—and argued that the name of the field should by changed--- from “child development” to “lifespan development” or “human development.”

Advocates of the lifespan approach argued, however, that it entailed more than simply grafting the study of adulthood and old age onto research about child and adolescent development. A lifespan view would situate the study of *all* aspects of development in the study of development from birth to death (see box), and so would transform the sub-disciplines of *both* gerontology and child development. Especially important was the search for guiding principles that could explain how development was organized across the lifespan. Hence, we highlight those principles (e.g., relative balance between gains and losses, shifts in the allocation of resources) in our discussion of the basic tenets of the lifespan approach.

What are the goals of life span developmental psychology?

“Psychology deals with the scientific study of mind and behavior, including the practical applications that can be derived from such scientific inquiry. Within this substantive territory of psychology, the objectives of life span psychology are: (1) To offer an organized account of the overall structure and sequence of development across the life span; (2) to identify the interconnections between earlier and later developmental events and processes; (c) to delineate the biological, psychological social, and environmental factors and mechanisms which are the foundations of life span development; and (d) to specify the biological and environmental opportunities and constraints that shape life span development of individuals including their range of plasticity (modifiabiity). With such information, life span developmentalists further aspire to determine the range of possible development of individuals, to empower them to live their lives as desirably (and effectively) as possible, and to help them avoid dysfunctional and undesirable behavioral outcomes" (Baltes, Lindenberger, & Staudinger, 2006, p. 570)

What is the point of "multi-directionality"?

The notion of "multi-directionality," which can be contrasted with traditional views that development is normative and unidirectional, has several implications for the definition of development. First, it suggests that "life-long development is a system of diverse change patterns that differ… in terms of timing (onset, duration, termination), direction, and order" (Baltes, 1987, p. 613), of which "normative" or "typical" development is only the most common. This proposition explicitly added to the goals of developmental science the study of "inter-individual differences in intra-individual change" (Baltes, Reese, & Nesselroade, 1977).

Second, "multi-directionality" implies that *within* individuals and at every age, different developmental patterns might be found for different aspects of development—functioning in some domains might be relatively stable or changing at a slower rate, while in others it might be increasing or curvilinear. Third, it suggests that *multidimensionality* characterizes all developmental phenomena, so that even within the *same* domain of functioning (e.g., intellectual development), different dimensions might show differing normative trajectories (e.g., cognitive mechanics could sharper declines during old age than do cognitive pragmatics) as well as differing degrees of diversity in the spread of individual differences (e.g., cognitive pragmatics show a wider range of potential pathways during old age than do cognitive mechanics).

An important lifespan principle that follows from the idea of "multi-directionality" is the notion that the extent of multi-directionality or diversity of life paths increases across late adolescence and all of adulthood. The basic ides is captured in the concept of the "incomplete architecture of human ontogeny" (Baltes, 1997), which posits that neither evolutionary nor cultural forces have had "sufficient opportunity to evolve a full and optimizing scaffolding (architecture) for the later phases of life" (p. 367). Biological systems shaped by evolution are inherently incomplete because they are concerned with reproductive fitness, and so should not have extended programs that optimize post-reproductive fitness or successful aging. Cultural systems are incomplete because they have not had sufficient historical time to create structures to deal with the sweeping demographic changes in life expectancy in the last 100 years. The inherent incompleteness of biological and cultural architecture has many implications for development (Baltes, 1997), but one of the most important is the increasing diversity and vulnerability to biological and cultural stresses that characterizes the latter portion of the lifespan.

What are the implications of the proposition that development includes both "gains and losses"?

This assertion was in direct opposition to the then prevailing notion that infancy, childhood, and adolescence are times of growth and progress whereas adulthood is best characterized by stability, followed by aging which represents a period of loss and decay. Up until this point, gerontologists had largely been documenting declines during old age—losses, for example, in biological systems (like vision, hearing, muscle mass), memory, perceptual speed, intelligence, and so on. This proposition encouraged researchers to consider an alternative view—the possibility that old age includes *gains*. In fact, the lifespan movement was one of the factors that opened up the search for aspects of functioning that improve with age—such as the study of expertise, cognitive pragmatics, spirituality, moral development, and wisdom.

Perhaps surprisingly, this proposition also spoke to developmentalists studying childhood and adolescence—suggesting that researchers entertain the possibility that these age periods, always assumed to be times of unmitigated progress, might also include *losses*, or aspects of functioning that deteriorate or decline. Although this suggestion did not spur the same surge in research apparent in the search for gains during adulthood and old age, it did sensitize researchers, making it easier for them to recognize losses that they might otherwise have overlooked-- for example, the losses in potential that accompany neural pruning during the first 3 years of life, or the losses in intuitive and magical thinking when children achieve concrete operational reasoning, or the losses in confidence that often accompany increases in the capacity to imagine what others' are thinking during early adolescence. These examples also point out that gains and losses may be intertwined, such that most gains involve losses, and many losses have the potential to bring some gains with them.

However, the notion that changes in all age periods involve gains and losses, does not imply that both are distributed equally across the lifespan (Baltes, 1987). Indeed, as Baltes suggested, and even in light of subsequent research looking into gains during adulthood and aging, the relative balance seems to shift, so that infants, children and adolescents typically experience relatively more gains than losses, until by old age, losses outweigh gains. This is one reason that shifts can be seen in the allocation of resources across the lifespan—from the dedication of resources to growth, then to maintenance (including repair and recovery), and then to regulation of loss (Baltes & Smith, 2004).

What is meant by the notion of "plasticity"?

This optimistic proposition suggests that individual development is not fixed, irreversible, or fully determined by past experiences, but instead is dynamic and inherently retains a great deal of malleability or modifiability. Moreover, this openness to growth and change can be found at every period of the lifespan. Up until this point, the assumption that "you can't teach an old dog new tricks," had prioritized childhood (and the earlier the better) as the most important site for intervention efforts. To examine this proposition, researchers conducted training studies for the elderly in multiple domains, such as performance on tasks tapping intelligence or memory, often using a “testing-the-limits” approach that provided training in effective strategies and encouraged massive practice until peak performance was reached. These kinds of studies revealed two features of aging. On the one hand, at every age, significant improvement was possible—in fact training gains were sometimes so large that they completely reversed age-related declines. On the other hand, however, the benefits from training that registered in the performances of elderly participants were consistently smaller than those accrued by younger adults—leading researchers to conclude that reserve capacity, that is, the reservoir of untapped potential, decreases with age in some domains, placing increasingly greater constraints on plasticity, or the extent to which performance can be improved, as people age. This is one reason why lifespan proponents conclude that optimizing development requires proportionately more effort and resources as people reach the fourth quarter of life (Baltes & Smith, 2004).

In discussions of lifespan scripts, proponents also point out that individuals can take advantage of the plasticity inherent in development to intentionally shape their own pathways, through general-purpose mechanisms of adaptive functioning referred to as *selective optimization with compensation* (Baltes, 1997). As explained by Baltes and Smith (2004), “[t]his *selection* process refers to a specification and narrowing down of a range of alternative outcome-oriented pathways that the scope of biocultural plasticity would permit in principle” (p. 133); two kinds of selection can be distinguished: an elective one based on voluntary preferences among alternative pathways and one based on losses, for example, losses or limits in resources like time, energy, and capacity. *Optimization* refers to the “acquisition, application, coordination, and maintenance of internal and external resources (means) involve din attaining higher levels of functioning" (p. 133) whereas *compensation* focuses on means that "serve to counteract losses in specific means previously used for goal attainment by using alternative (substitutive) means to maintain functioning" (p. 133). Together these processes are posited "(a) to account for the realization of development in general; … (b) to specify how individuals can effectively manage the overall lifespan changes in biological, psychological, and social conditions that for opportunities and constraints on levels and trajectories of development" (p. 133); and (c) to suggest an effective way of allocating and reallocating resources among the three developmental functions of growth, maintenance, and loss.

What are the implications of the proposition of "historical embeddedness"?

The notion that development is fundamentally shaped by societal, cultural, and historical contexts was one of the most controversial postulates of the lifespan movement, because of its conceptual and methodological implications. It directly contradicted the hitherto largely unchallenged presumption that development was a universal phenomenon. If accepted, it also demolished the hopes of long-term longitudinal studies (such as the Berkeley Growth Study or the Fels Longitudinal Study) to be able to provide definitive accounts of lifespan development. Instead, researchers would be required to acknowledge that, despite investments of 30 or more years of their professional lives, their studies could only provide a description of *one* birth cohort or generation, which might or might not generalize to other cohorts.

What is a cohort effect?

A "birth cohort" is a group of people who were born about the same time. In common parlance, we call these "generations" and we often give them names, like "the greatest generation," "the silent generation," "baby boomers," "gen-X," or the "millennial."

A "***cohort effect***" is the cumulative effect of growing up during a specific historical time. Once an individual is born, they are embedded in the historical stream of events starting in the year of their birth, and their own age changes unfold in the successive contexts created by historical and societal changes.

So for someone born in 1929, "cohort effects" would include the cumulative effect of being born during the Great Depression, being 5 when the Depression started to recede, being too young to be drafted for World War II (but old enough to be drafted for the Korean War), starting college in 1947, when the GI Bill brought thousands of veterans to universities, getting married and starting a job and/or family in the 1950s, being mid-thirties when the Civil Rights movement was most active, turning 40 during the Women's movement, and so on. (For a sociological perspective, see Ryder, 1965.)

The concept of "cohort" was introduced about this time (see box) as shorthand for the idea that each generation grows up within a specific historical and societal context, and the pathways that their development takes are shaped by the times they live through. During period of great social upheaval, this proposition seems more obvious, but even the idea of specific age periods has changed over historical time—with the emergence of the concept of "adolescence," the recent addition of the idea of "emerging adulthood," and a historical shift in life expectancy sufficient to allow for the study of "centarians" as a group.

What are the implications of "Contextualism as paradigm"?

One of the major goals of lifespan approaches was to articulate a new meta-theory to add to the set that was currently dominating child psychology, which included Maturational, Mechanistic, and Organismic. This "new" approach (which had long roots in developmental psychology in Europe; see box), focused on the interaction of biology and environment as the basic determinants of development, but argued that these factors are channeled and shaped by three kinds of influences: (1) normative age-graded; (2) normative history-graded; and (3) non-normative life events. As pictured in Figure 9.1, it is the interaction among these influences that is assumed to give rise to both commonalities and differences in pathways of development.

Insert Figure 9.1 about here

"Normative age-graded" influences refer to both biological and environmental influences that exert similar pressures on all people and shape when developments will begin, the shapes their trajectories will take, and how long they will last. Examples of normative age-graded *biological* influences include maturational forces involved in brain and motor development, or the onset of puberty. Normative age-graded *environmental* influences would include age-graded developmental tasks or the "social clock," in which societies prescribe age windows during which certain tasks (such as completing an education, getting a job, getting married, and starting a family) should (and should not) be accomplished. These clocks identify people who are "on-time" and "off-time" in their development.

"Normative history-graded" influences, both cultural and biological, are forces based in societal and historical changes that typically shape development quite broadly. A wide range of cultural changes can be identified that exert normative pressures, for example, the rise of modernity, increases in globalization, the onset of recession or war, the legalization of marijuana, increases in maternal employment and income, changes in educational policies, or more strict enforcement of immigration law. Just as normative age-graded influences come to mind more easily for biological than for environmental factors, so too do normative history-graded influences come to mind more easily for environmental than for biological influences. However, a wide range of history-graded changes in the *biological* forces that shape development can also be identified—including changes in biology brought about by historical shifts in contraceptive use, the emergence or eradication of diseases, healthcare reform, improvements in public sanitation, increases or decreases in exposure to environmental toxins, famine, and so on.

"Non-normative life events" refer to conditions and experiences that are not tied to a particular ages or historical moments, and so create more individual and idiosyncratic life paths.

These events can range from chance encounters and coincidence, to specific circumstances, such as being a redhead or an only child, to unemployment, divorce, illness, accidents or the untimely death of a spouse, parent, or child.

One of the foundational assumptions of contextualism is that all developmental trajectories are the result of the combination of these forces—that is, they are *always* a product of the interactions among biology and environment, and the age-grade, history-graded, and non-normative factors that shape them. This was one of the reasons that, as the lifespan approach itself developed, the higher-order paradigm in which advocates preferred to locate it also changed—from “developmental contextualism” to “ontogenetic and cultural contextualism” to “developmental biocultural co-constructivism.”

When did the lifespan movement start?

Proponents of the lifespan approach trace its history back at least to the work of Johann Nicolaus Tetens, a German philosopher and scientist, whose two-volume classic, entitled, *Human Nature and its Development,* published in 1777, covered the entire lifespan from birth until old age. These volumes also presaged many of the signature themes of the lifespan movement, including the elaboration of development as “a process that entails gains and losses, a process embedded in and constituted by sociocultural conditions, and as a process that is continuously refined and optimized… by societal change and historical transformations” (Baltes et al., 2006). These historical roots, combined with close connections between philosophy and the humanities in the study of psychology, are factors that contributed to a long-standing view in Europe of development as a lifelong process embedded in societal, cultural, and historical changes; in contrast, the affinity found in England and North America between developmental psychology and developmental biology and embryology, focused psychologists on biological analogues suggesting that development ends with physical maturity, assumptions which were not overturned in the United States until the 1960s and 1970s (Baltes et al., 2006).

See also: Charlotte Bühler, Erik Erikson, Robert Havinghurst, Bernice Neugarten, Hans Thomae.

Why is the study of development a “multidisciplinary” affair?

When lifespan researchers posited that people’s development is shaped by historical and societal contexts, it implied that development is the study of "changing people in changing contexts." The view that development arises from the interaction among factors from the levels of biology, psychology, social relationships, society, and culture carries with it the imperative that researchers, if they wish to understand development, must incorporate knowledge from multiple disciplines in addition to psychology, including developmental branches of genetics, biology, biochemistry, neuroscience, medicine, sociology, anthropology, economics, education, and history. This is one of the factors that have led lifespan researchers to increasingly refer to their discipline, not as "developmental psychology," but instead as "human development" or "developmental science," a sobriquet that signals its increasingly multidisciplinary character. In fact, an important factor in the success of the lifespan movement was the strong support for its principles from sociology, specifically the "life course" perspective (Elder, 1998; Riley, 1986) (see box).

What is the life course perspective?

Started mostly in sociology, but influencing the development of the lifespan movement and ecological models in psychology, *life course theory* focuses on the links among social and historical change, life pathways, and individual development, guided by four principles:

1. ***Historical time and place***: the life course of individuals is embedded in and shaped by the historical times and places they experience over their lifetime
2. ***Timing in lives***: the developmental impact of a succession of life transitions or events is contingent on when they occur in a person's life
3. ***Linked lives***: lives are lived interdependently, and social and historical influences are expressed through this network of shared relationships
4. ***Human agency***: individuals construct their own live course through the choices and actions they take within the opportunities and constraints of history and social circumstances.

Did the lifespan perspective demonstrate that old age is a period of plasticity filled with gains?

No. And, believe it or not, that is not the goal of any meta-theory. Assumptions do not "demonstrate" anything -- because they do not produce findings. They encourage researchers to go and *look* for things that they might have previously overlooked. The fundamental optimism of a lifespan approach got researchers to start thinking about aspects of functioning that *might* improve with age and to study them to see whether they do. It also encouraged researchers to create interventions designed to optimize development and "test the limits" of functioning. However, a set of assumptions does not dictate what researchers will actually see when they carry out these studies and interventions.

The optimism of the lifespan approach did seem to be warranted for the "young old" (ages 65-85), where much plasticity, compensation, and improvement and seemed to be within reach. However, starting with the "old-old" (ages 85-100) and clearly apparent in the "oldest-old" (ages 100-125), even though these elderly are highly selected for histories of good genes, supportive environments, and luck, the biological limits of optimization seem to be reached-- at least with the technologies we have available in the current historical period. From the perspective of those of us who will be fortunate enough to reach old age, the good news is that, despite real and permanent losses in biological, psychological, and social reserve capacity, subjective life satisfaction typically remains high—even for the oldest old. In terms of our discussion of meta-theories, the key point is that meta-theories can help us to open our eyes, but they do not dictate what we will see.

Table 9.3. How did this paradigm shift take place?

The lifespan approach itself would posit that, in addition to a variety of historical factors (such as demographics changes which highlighted the importance of studying aging and gerontology), the paradigm shift towards a lifespan perspective was aided by active individuals and cooperative groups who were intentionally working to shift the course of the field. As described by Paul Baltes (2000) in his autobiographical reflections, "It is difficult to identify the institutional origins of a given field. When it comes to lifespan thinking in developmental psychology, however, it seems fair to argue that the lifespan developmental psychology program that evolved at West Virginia University from 1968 onward was the main catalyst during the 1970s, at least in the United States. This faculty, with its critical and collaborative mass of expertise and concentration on the entire life span, was unique and had immediate impact… The program presented itself in a more public manner for the first time when Larry Goulet and I organized in 1969, with strong administrative support from Warner Schaie, the first West Virginia Conference on Lifespan Developmental Psychology. It was for that conference that we made the first effort (Baltes & Goulet, 1970) to define and explicate the term *lifespan developmental psychology*. During my tenure at West Virginia University, we held two more conferences, one on lifespan methodology organized and published in 1973 by Nessleroade and Reese, the other on personality and socialization organized and published in 1973 by Baltes and Schaie." (p. 15)

What are the most important take-home messages of lifespan developmental perspectives?

We would suggest four. First, it ***rejects definitions of development*** that limit it to normative, progressive, irreversible, and universal patterns of qualitative shifts. Instead, and this would be the second take-home message, the lifespan perspective considers development to involve a ***wide range of differing intra-individual trajectories*** that consist of multiple dimensions that travel in many directions, including gains, losses, and stability. As a result, development occurs ***across the entire lifespan***, from birth to death. Third, individual lives are ***embedded in historical time***, and so they are shaped by the societal conditions and changes they live through; as a result lifespan research requires the participation of sociologists, anthropologists, and historians, or more general, ***interdisciplinary perspectives***. Fourth, each developmental trajectory represents only one of a number of possible pathways that resulted from the confluence of a particular set of ***age-graded, history-graded, and non-normative factors***—as a result, development, at any age, contains much ***plasticity*** and the potential for improvement.

What are the most important critiques of lifespan developmental perspectives?

The two most important critiques of the lifespan approach focus on its conception of development and the larger framework of "contextualism"—one critique targets what is too inclusive about its definition, and one targets what may be missing. The first critique is that this new conception of development—as gains and losses, changes and stability across the lifespan--

seems to conceptualize the study of human development as the study of "everything;" and since it was a lifespan view, it could also be labeled as the study of "everyone." In essence, a lifespan perspective not only incorporates child development (birth through adolescence) and gerontology (old age), but the study of adult development (and stability) as well. So lifespan has claimed the territory of *all* of psychology—it is the movie for which the rest of psychology has been producing the stills.

The second major critique of the contextual meta-model can be heard in its name—it focuses too much on the context and not enough on the organism; it can be considered a "big-E" "little-O" meta-theory. The individual is active and agentic, to be sure, selecting contexts and social partners, initiating and repelling contacts, and in all other ways being a good tennis partner. However, the individual does not seem to be bringing with it any fundamental "organismic" characteristics that would dictate what all contexts *must* provide (the psychological equivalent of demands for food and water) or that would act as checks and balances for the effects of environmental forces, or otherwise setting limits on plasticity and guiding development. This critique was addressed in future iterations of the lifespan movement itself (as it shifted from developmental contextualism to developmental biocultural co-constructivism; Baltes, Reuter-Lorenz, & Rösler, 2006; Baltes & Smith, 2004; Li, 2003; Li & Freund, 2005). We will also meet these critiques again when we discuss other meta-theories from the contextual family, and we will see some of their resolution in other developmental systems extensions of lifespan and other contextual approaches.

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Chapter 10. Ecological Model: Nested Contexts

> Much of contemporary developmental psychology is *the science of the strange behavior of children in strange situations with strange adults for the briefest possible periods of time*. --- Bronfenbrenner, 1977, p. 513

When Urie Bronfenbrenner began writing about the ecological model in the mid-1970s (Bronfenbrenner, 1974), the field as a whole generally endorsed practices dictated by an experimental view of the study of child psychology. Bronfenbrenner argued that the conditions of this research were so different from those in which children naturally develop (see Table 10.1) that studies conducted in this mold must be considered "ecologically invalid." He explains that "[b]y removing the child from the environment in which he [or she] ordinarily finds himself and placing him [or her] in another setting which is typically unfamiliar, short-lived, and devoid of the persons, objects, and experiences that have been central in his [or her] life, we are getting only a partial picture both of the child and his [or her] environment" (Bronfenbrenner, 1974, p. 3-4).

Table 10.1. Contrast between the Conditions in Research and the Conditions in which Children Actually Develop.

	Experimental Child Psychology	**Ecological Perspective**
View of:	***Conditions in Research***	***Conditions of Development***
Child	"Subject"	Developing person
Social partners	Single stranger Two-person system	Multiple familiar, enduring relationships
Direction of influence	Unidirectional, from adult to child	Reciprocal
Effects	Direct effects	Second-order effects
Tasks	Unfamiliar, artificial	Familiar, meaningful
Settings	Laboratory	Daily life
Time	Ephemeral, Short-lived	Enduring
Other settings	Isolated from other contexts	Profoundly affected by other social systems

From that time until his death in 2005, Bronfenbrenner worked to create a paradigm shift in developmental psychology, encouraging fellow researchers to conduct “ecologically valid” research, which he viewed as essential for informing debates and decisions about public policy. He devoted much of his professional life to writing and speaking about an “ecological perspective” and its implications for studying “the developing child in context.” In his efforts to change the field, he provided bold and often provocative theoretical statements, mentored students who would go on to become leaders in their areas, and championed and acquired funding to support other researchers whose work took multi-level contexts seriously. Looking back now it is possible to conclude that he succeeded in leading a movement that revolutionized the field.

What is an ecological perspective?

The first generation of ecological models focused on bringing the context of the child into research on development—essentially redefining the target of study to include not only the child him- or herself, but also the multi-level contexts of daily life. According to Bronfenbrenner, “the ecology of human development is the scientific study of the progressive, mutual accommodation, throughout the life span, between a growing human organism and the changing immediate environments in which it lives, as this process is affected by relations obtaining within and between these immediate settings, as well as the larger social contexts, both formal and informal, in which the settings are embedded” (1977, p. 514). This perspective provided a broader and more differentiated conception of “context,” including not only the typical face-to-face settings of family, school, and neighborhood, but also the higher-order contexts that shape and constrain what can take place in these more proximal settings. For this purpose, the model focused on the “ecological environment” which identified four nested levels at which contexts operate, and named them generically for their distance from the developing person, as the microsystem, mesosystem, exosystem, and macrosystem (Brim, 1975). See Table 10.2 for definitions.

Table 10.1. Definitions of Levels of Contexts

1. ***Micro-system:*** "patterns of activities, social roles, and interpersonal relationships experienced by the developing person in a given face-to-face setting with particular physical, social, and symbolic" (Bronfrenbrenner, 1994, p. 1645).
2. ***Mesosystem***: linkages, processes, and "interrelations among major settings containing the developing person at a particular point in his or her life" (Bronfenbrenner, 1977, p. 515). Hence, a mesosystem is a system including two or more microsystems.
3. ***Exosystem***: "the linkages, processes, and relationships taking place between two or more settings, at least one of which does not contain the developing person, but in which events occur that influence processes within the immediate setting in which the developing person lives" (Bronfenbrenner, 1993, p. 24). Hence, an exosystem is a system including at least one microsystem and one related setting.
4. **Macrosystem**: "the overarching institutional patterns of the culture or subculture, such as the economic, social, educational, legal, and political systems, of which micro-, meso-, and exosystems are the concrete manifestations. Macrosystems are … carriers of information and ideology that, both explicitly and implicitly, endow meaning and motivation to particular agencies, social networks, roles, activities, and their interrelations (Bronfenbrenner, 1977, p. 515).

What is a "microsystem"?

A *microsystem* is a standard face-to-face setting in which developing people spend their time, settings like home, school, and the peer group, or more specifically, the kitchen or living room of the family home, a classroom or the lunchroom at school, or the park or a street corner in the neighborhood. According to Bronfenbrenner, "a setting is defined as a place with particular physical features in which the participants engage in particular activities in particular roles (e.g., daughter, parent, teacher, employee, etc.) for particular periods of time. The factors of place, time, physical features, activity, participant, and role constitute the elements of a setting" (1977, p. 514).

These settings are filled with familiar people with whom the target individual has different kinds of relationships. An early tenet of the ecological perspective was that the large numbers settings and social partners create streams of influence on development that are more complex than those examined in standard studies, which typically focus on unidirectional direct effects from a single adult (e.g., mother or teacher) to the child. In the actual ecologies of children's lives, these relationships comprise reciprocal connections among multiple interaction partners that are both direct and "indirect" or "second-order," in that the participation of some partners can modify the nature of the influences of other partners.

For example, research on the effects of teaching typically considered the unidirectional direct effects of a teacher on a child's development. From an ecological perspective, such a study could be expanded to see the classroom as a differentiated microsystem which includes not only the teacher and child, but also other adults (like a teacher's aid or student teacher) and at least 20 classmates structured into subgroups of friendship and peer groups, all of whom have the potential to reciprocally influence each other and to modify the connections between other interaction partners. Examples of "second-order" effects in the classroom could include the possibility that a teacher deals differently with a student's misbehavior under the watchful eyes of the rest of the class than if the two of them were alone in the classroom; or a student expresses his enthusiasm about an academic task differently depending on which of his friends are present that day.

What is a "mesosystem"?

Every developing person spends time in a large number of different microsystems or settings. For children, these would typically include the family, school, and peer microsystems, as well as additional microsystems more specific to an individual child, such as grandma's house, church, soccer practice, the creek, best friend's family, and so on. For an adult, like a teacher, these microsystems would also include the classroom (as workplace), family, friends, hobbies, sports activities, and so on. A *mesosystem* is a system of microsystems, and describes the interrelations (connections, interactions, linkages, exchanges) between two or more microsystems (as pictured in Figure 10.1).

From an ecological systems perspective, a key question is whether and how these microsystems are interconnected, integrated, or aligned. Sometimes, the developing person him- or herself is the only link, and so carries something (e.g., information, attitudes, stress) from one setting to another. For example, a child brings home information about what is required at school (such as homework, materials, or signatures for field trips). Sometimes there is direct communication between settings, such as when parents and teachers meet and discuss or exchange notes about how the child is doing and support that may be needed. And, sometimes settings are coherent and well tuned to each other, so that the activities in one microsystem (e.g., nutrition and sleep at home) create a positive effect on the activities in another microsystem (e.g., paying attention in school). However, it is also possible for a mesosystem to be poorly aligned so that the activities in its constituent microsystems are antagonistic—such as when school obligations interfere with family activities, or vice versa.

Insert Figure 10.1 about here

This idea opened up the study of the "multiple worlds of childhood" and encouraged researchers to look more closely at how children's experiences in multiple microsystems accumulated and worked together, to form either a complementary or conflicting pattern. It seemed possible that children who were "at risk" based on their social address (e.g., poverty) not only face cumulative risks from the problems in their individual microsystems (e.g., a chaotic home life that interferes with completing homework assignments or poorly trained teachers at school) but are also forced to deal with friction created by the lack of alignment *between* microsystems—for example, if conformity to demands for compliance in the classroom leads to ostracism from peers.

In the same vein, it seemed that children from privileged backgrounds not only receive more academic support from each of their individual microsystems (e.g., academic involvement from parents, higher levels of engagement in peer groups, more qualified teachers) but they also benefit from the frequent, open, and positive communication among microsystems, for example, when their parents are in close touch with teachers, participate in school activities, and arrange peer contact with their friends' parents. These mesosystems work together in ways that are synergistically positive for target children's academic and social development.

Table 10.3. Is a School a Microsystem or a Mesosystem?
A school building is probably best conceptualized as a *mesosystem* because it contains multiple potential microsystems, including all the different classrooms, study hall, the lunchroom, gym, teachers' lounge, main office, playground, parking lot, and so on. Even the bus could be seen as a related microsystem. When considering an individual student as the target developing person, many of these settings can be identified as microsystems-- because they contain the specific student. This conceptualization brings several features of schools to researchers' attention: (1) the effects of schools can be found in influences *outside* of the classroom, for instance, in the lunchroom and the parking lot; (2) when children transition to middle school and to a format that includes multiple teachers, they suddenly have to deal with many more microsystems-- with their different social partners (teachers and classmates) and demands; and (3) for any specific student, their constellation of microsystems may be more or less positive and coordinated in their effects, and this (mis)alignment may be an important influence on their development, over and above the additive effects of the support provided in each microsystem.

What is an "exosystem"?

An exosystem is a system that involves the connection between at least one microsystem and at least one setting that does *not* contain the developing person (as shown in Figure 10.1). As explained by Bronfenbrenner, these “other specific social structures, both formal and informal, that do not themselves contain the developing person but impinge upon or encompass the immediate settings in which that person is found, and thereby influence, delimit, or even determine what goes on there. These structures include the major institutions of the society, both deliberately structured and spontaneously evolving, as they operate at a concrete local level. They encompass, among other structures, the world of work, the neighborhood, the mass media, agencies of government (local, state, and national), the distribution of goods and services, communication and transportation facilities, and informal social networks” (1977, p. 515).

This was one of the most fascinating implications of the ecological framework, namely, that events taking place in settings that had *no* direct contact with the developing person could nevertheless exert powerful influences on his or her development, for example, by influencing the people who subsequently enter his or her microsystems (e.g., a stressful marital interaction at home could lead a teacher to be more controlling with students at school) or by otherwise influencing that setting (e.g., the passage of a bond issue could support field trips or enrich academic materials in the classroom). These exosystem effects could be seen as contributing to conditions that either enabled or constrained what was happening in the proximal microsystems that did contain the developing person.

The idea of the “exosystem” opened up the possibility that the settings and adults in children’s lives were themselves shaped by higher-order forces—forces that typically were not considered by developmental psychologists. Up until this point, most developmental researchers tended to assume that “the buck stops” with the adults in children’s lives, and if microsystems were in disarray, it was the adults’ fault and their responsibility to provide a remedy. However, the notion of exosystem factors introduced the thought-provoking idea that adults (or social partners of any kind) and settings were themselves developing and changing, and an analysis of the higher-order systems (with their pressures and supports) that contributed to these developments and changes would be useful for creating a fuller understanding of the causal factors leading to the current state of affairs. So, for example, researchers could examine whether parents, teachers, and bosses were authoritarian in their styles of relating to their offspring, students, and employees, not because (or not only because) they possessed authoritarian personalities but also because they were subjected to external pressures from above (e.g., to produce passing scores on standardized tests or to meet production quotas).

The analysis of exosystem factors also has important implications for intervention and optimization. These factors have the potential to serve as alternative levers for intervening into the system, in ways that could enhance the effects of exosystem forces, and through them, contribute to the improvement of children's microsystems. Examples of such interventions would be ones in which the marital relationship is targeted for improvement, with the goal of reducing stress on both spouses, so that they can provide more supportive parenting; or targeting the quality of leadership and professional development opportunities in a school, so that teachers can provide more effective instruction in the classroom. Of course, it is crucial in such interventions to follow the chains of effects, in order to see whether exosystem improvements do eventually make their way to the microsystems that contain the development person

What is a "macrosystem"?

A *macrosystem*, as the name implies, depicts the larger overarching societal and cultural systems that surround the systems from all the other levels (see Figure 10.1). At the same time, it has its own special features. As Bronfenbrenner explains,

> a macrosystem differs in a fundamental way from the preceding forms in that it refers not to the specific contexts affecting the life of a particular person but to general prototypes, existing in the culture or subculture, that set the pattern for the structures and activities occurring at the concrete level. Thus, within a given society, one school classroom looks and functions much like another. The same holds true for other settings and institutions, both informal and formal. It is as if all were constructed from the same blueprints. These 'blueprints' are the macrosystems. Some actually exist in explicit form as recorded laws, regulations, and rules. But most macrosystems are informal and implicit—carried, often unwittingly, in the minds of the society's members as ideology made manifest through custom and practice in everyday life (Bronfenbrenner, 1977, p. 515).

If developmentalists were unfamiliar with the kinds of exosystem factors that might be shaping lower-order microsystems and the social partners, materials, and activities they contain, as psychologists, we were even less equipped to think about macrosystem factors—these considerations had usually been the provenance of sociologists, anthropologists, or historians (Brim, 1975). As a result, colleges of human ecology or human development often became multidisciplinary in their focus. Table 10.2 contains a few examples of potential exosystem and macrosystem influences. As a tireless advocate for children, Bronfenbrenner made clear his opinion about the obligations of society and culture to their youngest members: "What place or priority children and those responsible for their care have in such macrosystems is of special importance in determining how a child and his or her caretakers are treated and interact with each other in different types of settings" (1977, p. 515).

Table 10.3. Illustrations of Exosystem and Macrosystem Influences
"Such encompassing systems include the nature and requirements of the parents' work, characteristics of the neighborhood, transportation facilities, the relations between school and community, the role of television (not only its direct effects on the child but in its indirect influence on patterns of family and community life), and a host of other ecological circumstances and changes which determine with whom and how the child spends his time: for example, the fragmentation of the extended family, the separation of residential and business areas, the disappearance of neighborhoods, zoning ordinances, geographic and social mobility, child labor laws, moon-lighting, supermarkets, welfare policies, age segregation, the growth of single-parent families,

the abolition of the apprentice system, consolidated schools, commuting, the working mother, the delegation of child care to specialists and others outside the home, urban renewal, or the existence and character of an explicit national policy on children and families" (Bronfenbrenner, 1974, p. 4).

Did the ecological perspective reject experimental designs and lab-based studies?

Although ecological research benefits greatly from naturalistic designs and observational methods, it is important to note that Bronfenbrenner remained enthusiastic about research conducted in the laboratory and about experimental methods. The lab, he pointed out, can be an important context for study, "provided the enduring aspects of the child's environment, especially what George Herbert Mead called the "significant others" in his life, are brought into the laboratory setting and engaged in activities that bear some meaningful relationships to their roles" (Bronfenbrenner, 1974, p. 4). Moreover, field experiments (both by nature and by design) figured prominently in his vision for an "experimental ecology of human development" (Bronfenbrenner, 1977), with the idea that attempts to compare different existing configurations or to change these nested systems would yield highly useful information.

So what? Did an ecological perspective change anything for developmentalists?

The assumption that development takes place within multiple nested contexts transformed the way that developmentalists thought about their targets. Following the publication of Brofenbrenner's treatise, researchers began to publish reviews of important developmental phenomena, such as child maltreatment or divorce, that used the ecological perspective to integrate research from different disciplines and sub-disciplines within psychology that had examined the factors from many levels that contribute to the onset of these events and how they affect children. Importantly, all these reviews went beyond the characteristics of parents as predictors of abuse and the effects of divorce. For example, James Garbarino published a series of papers on the ecology of child maltreatment (1977) and the role of high-risk neighborhoods and families (Garbarino & Sherman, 1980). Jay Belsky also wrote a series of reviews on the factors that contribute to the etiology of maltreatment (1980, 1993), using an ecological framework to integrate alternative models that proposed seemingly "divergent etiological viewpoints, which stress psychological disturbance in parents, abuse-eliciting characteristics of children, dysfunctional patterns of family interaction, stress-inducing social forces, and abuse-promoting cultural values" (1980, p. 320).

At the same time, Larry Kurdek (1981) proposed an integrative model of children's adjustment to divorce that considered the "interaction among four components: (a) current beliefs, values, and attitudes surrounding modern family life (the macrosystem), (b) social supports available to reduce stresses associated with single parenting and the stability of the postseparation environment (the exosystem), (c) the nature of pre- and postseparation family functioning and support systems available to the child (the microsystem), and (d) children's individual psychological competencies for dealing with stress (the ontogenic system)" (p. 856).

Bronfebrenner himself presented an integrative model for the "experimental ecology of education" (1976) in which he proposed that "whether and how people learn in educational settings is a function of sets of forces, or systems, at two levels: (a) The first comprises the relations between the characteristics of learners and the surroundings in which they live out their lives (e.g., home, school, peer group, work place, neighborhood, com-munity). (b) The second encompasses the relations and interconnections that exist between these environments" (p.5). Bronfebrenner (1986) also proposed an ecological model for the family that integrated research on the influence of external environments on their functioning. Together, these papers and the ecological model which inspired them, opened up the study of higher-order factors outside of the family or school proper, that nevertheless have a major impact on what happens to children inside these microsystems. As one example of this expansion, the *Handbook of Parenting* now contains an entire volume devoted to the higher-order factors that shape the family and parenting (Bornstein, 2013).

Perhaps the most important (and sobering) integration of research on the multiple contexts of childhood was undertaken by Gary Evans in his seminal paper on “The Environment of Childhood Poverty” (2004) which examined the pervasive effects of poverty on the quality of all of children’s microsystems—family, school, neighborhood, peer group, healthcare, and so on. This review put on notice all researchers who study the effects of poverty (or race, ethnicity, or immigration status—since these are closely tied to socioeconomic class in the United States) that the examination of the effects of any facet of a child’s context (be it teachers, parents, or peers) on that child’s development must take into consideration the current reality that the effects of poverty touch every aspect of that child’s daily life, including the many contexts that are not under investigation in a particular study. Perhaps the size of the impact of the ecological framework on psychology can be gauged by the fact that three of these integrative reviews (Belsky, 1980; Evans, 2004; Kurdek, 1981) appeared in the *American Psychologist* and one appeared in *Psychological Bulletin* (Belsky, 1993) in three successive decades; these are the premier journals, not just of developmental psychology, but of psychology as a whole.

In-class Exercise: Mapping the Environment

1. Using Figure 10.1 as a starting point, students worked in pairs to generate maps for their phenomenon that included the four levels suggested by the ecological model.
2. The first level is identified by starting with the target developing person. The settings in which that person directly participates are candidate *microsystems*.
3. Although the target person participates in many microsystems, only a subset of these are important to the target developmental *phenomenon*. These are the ones to depict.
4. After most or all of the relevant microsystems have been identified, it is time to stop and draw a circle around all these microsystems. This circle contains the

mesosystem.

5. Things are happening outside this circle that shape what is happening inside the microsystems. Many of these are happening in settings that do not contain the developing person. These settings are called *exosystems*. The exosystems to include are the ones that have the most important effects on the microsystems.
6. Around all these systems is a big circle that is labeled the *macrosystem*. It is living at the level of the community, society, or culture.
7. Students drew their ecological maps all over the board and we looked at them carefully, impressed by their complexity. We were also interested to note that this way of mapping the ecology brought a similarity in representation and conceptualization to the very different phenomena on which students were focusing.

What use were these environmental maps?

In the process of drawing these maps, some students began to reconsider their target developing person. Students who were focused on the developmental outcome of employees began to be interested in the many microsystems that were influencing bosses; students focusing on the developmental outcomes of children began to be interested in the many microsystems that were influencing parents or teachers. At the same time, students who thought that they were interested in target people began to reconsider whether they were really more interested in target contextual systems. For example, in studying work-family stress, which had originally been conceptualized as taking place *within* the individual, the new maps made clear that these phenomena actually originate at the "mesosystem" level: something taking place in one setting (e.g., work) were causing problems in another (e.g., home). They could also appreciate the merit of the relatively new distinction in the literature of work-to-family versus family-to-work effects, based on the direction of effects across microsystems.

Suddenly "meso-system" phenomena became visible: the effects of parent involvement on children's school performance, the effects of a batterer intervention program on intimate partner violence, the effects of preparation at school on learning during a field trip to a museum.

Almost all interventions could be conceptualized as meso-system phenomena, in which interventionists were trying to introduce changes in one microsystem (e.g., the professional development setting for teachers or the training for supervisors) that they were hoping would be carried over and utilized in another microsystem (i.e., the classroom or workplace), and it became clear that the problem of "transfer" or "generalizability" of skill training was a mesosystem problem.

"Exo-system" phenomena, although not as common, also began to be visible, and additional as yet unstudied linkages suggested themselves. For example, the effects of wives' accomplishments at work on husbands' job performance are one form of positive spillover effects from work-to-family (to work). The important puzzle of mesosystem and exosystem phenomena was highlighted: How do the effects leap from one microsystem to another or from one setting that does not even contain the target unit to another that does?

What are the most important take-home messages of the ecological perspective?

We would highlight four. First, proponents of ecological approaches ***reject*** the basic proposition of experimental child psychology-- the notion that ***everything you need to know about development is contained in the child***. Instead, and this is the second take-home message, they insist that the ***local face-to-face contexts and the social partners*** they contain are essential to explanations of development. Moreover (third message), the ***higher-order contexts*** in which these face-to-face settings are embedded still influence development by enabling and constraining what happens to children in those more immediate settings. Fourth, the ***overall societal and cultural context*** exerts a downward pressure on the working of lower-order contexts by containing formal and informal "blueprints" or "prototypes" of how they should be structured and how they should work.

What are the most important critiques of the ecological perspective?

The major problem with early versions of the ecological perspective, as articulated most clearly by Bronfenbrenner himself (e.g., Bronfenbrenner & Morris, 1998), was that in its attempt to bring the context into the foreground of developmental study, it inadvertently relegated the developing child (or person) and his or her development to the background. Subsequent iterations of this perspective, as described in the next chapter, were designed to squarely address this problem.

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Chapter 12. Bioecological Model: Proximal Processes

Meta-theories evolve and change over time -- both in response to critics and as reconsidered by proponents. Nowhere is this development clearer than in Bronfenbrenner's own thinking about the ecological perspective. He provided one of the strongest critiques of this perspective in 1986, "For some years, I harangued my colleagues for avoiding the study of development in real-life settings… In place of too much research on development 'out of context,' we now have a surfeit of studies on 'context without development'" (p. 288). At about the same time, he also provided a remedy, in a reformulation of the model, which "represents a marked shift in the center of gravity of the model, in which features of the earlier version are first called into question, but then recombined, along with new elements, into a more complex and dynamic structure" (1998, p. 993).

What is the reformulated ecological model?

The reformulation, referred to as the "Bioecological Model," begins with a definition of development as "stability and change in the biopsychological characteristics of human beings across generations" (Bronfenbrenner & Morris, 1998, p. 995). The model preserves the notion of ecological contexts, but incorporates it as one of four key components: Person, Process, Context, and Time (PPCT). "Person" refers to the developmentally-relevant characteristics of the target person. The notion of "Process," or more specifically "proximal processes," refers to the interactions between individuals and their environments over time. "Context" refers to the four levels of environmental contexts, and "Time" to the time periods over which development takes place. According to Bronfenbrenner and Morris (1998), "development is a function of the joint, interactive, synergistic, reinforcing interrelationships among the four principal antecedent components of the model" (p. 996).

The good news about this reformulation is that it allows researchers to build on the context maps created by earlier versions of the ecological model, such as those pictured in Figure 10.1 and in students' own maps of the relevant micro-, meso-, exo-, and macrosystems. These maps can now be populated. Before, they contained the developing person. Now the developing person can be filled with attributes—what Bronfenbrenner refers to as forces, resources, and demand characteristics. The microsystems can be filled with the many interaction partners that the developing person encounters in each setting—most importantly other people-- but also a variety of objects and symbols. These people, objects, and symbols can also be filled with their own attributes. The settings themselves are no longer just hollow shells; they now have characteristics (like order and chaos) that shape what is happening in them. The notion of exosystems suggests additional settings that contain people, symbols, and objects of their own (although not the developing person) and add the idea of connections between these settings and the many microsystems. The reformulated bioecological model is filled with content, with developmental forces, and with complexity.

The bad news is that this complexity, at least as we first encountered it with our empty ecological maps and the hundreds of possibilities we could imagine for populating them, was simply overwhelming. There seemed to be an infinite number of person characteristics, social partners, objects and symbols, characteristics of these social partners, processes that connect them, and "joint, interactive, synergistic, reinforcing interrelationships" among them. Students started calling this model "Bronfenbrennarian hyperspace" to signal that the complexity implied by this conceptualization was out of this world.

How can some clarity be brought to this complexity?

Of the four elements in the bioecological model, namely, Person, Process, Context, and Time (PPCT), “Process” or more specifically, “proximal processes,” are the most important. They take on an organizing role in the PPCT model because they are posited to be “the primary mechanisms producing human development” (Bronfenbrenner & Morris, 1998, p. 994). Clarity can be achieved by focusing on the proximal processes that are relevant for generating one’s target developmental phenomenon, and then prioritizing, selecting, and building out from there. To accomplish this, however, it is important to thoroughly understand the notion of “proximal processes.”

What are “proximal processes”?

Proximal processes are interactions between the target developing person and their social partners. Interaction partners include other people, but also objects (such as books, toys, musical instruments, work tasks, or academic activities) and symbols (such as rules, curricula, or procedures), and parts of the natural environment (such as trees, stones, or clouds) (see Table 11.1). In psychology, these have also been referred to as social interactions, person-context interactions, activities, engagement, participation, involvement, and experiences. They are called “proximal” because they refer to interactions with partners that are present in the immediate face-to-face setting. They are called “processes” because they refer to strings of interactions that take place over time—they are ongoing extended, prolonged, or repeated episodes of transactions. The prototypical proximal process is a series of social interactions with another person—for a child, these might include interactions with a parent, grandparent, sibling, friend, or teacher. These interactions are assumed to be reciprocal, in that the developing person shapes the responses of the social partner.

Table 11.1. What is the definition of “proximal processes”?
"[H]uman development takes place through progressively more complex reciprocal

interactions between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment. To be effective, the interactions must occur on a fairly regular basis over extended periods of *time*. Such enduring forms of interaction in the immediate environment are referred to as *proximal processes*" (Bronfenbrenner & Morris, 1998, p. 996).

AKA: social interactions, person-context transactions, exchanges, experience, engagement, participation, involvement, cycles
"conversation," " communication," "tennis game"

What are some examples of proximal processes?

At first, the idea of "proximal processes" can seem highly conceptual and somewhat vague. When we ask students to name three proximal processes that are relevant to their target phenomena, many of them are unsure what we are looking for. It typically turns out that some students actually have proximal processes for their target phenomena, for example, anyone who is studying parenting, teaching, counseling, mentoring, and so on. These students often recognize that their phenomena—by definition-- describe interactions between people and their immediate social partners. "Parenting" describes parents interacting with their offspring, "teaching" teachers interacting with their students, "counseling" counselors interacting with their clients, and so on.

Once the idea of proximal processes becomes clear, it can be seen in many areas. For example, attachment describes many proximal processes (bidding, seeking proximity, comforting) that make up "sensitively responding," the key determinant of the development of dyadic attachments. Leader-member exchange theory describes proximal processes, such as delegating, trusting, and performing, that depict interactions between supervisors and workers. "Coping" and "engagement" describe people interacting with events and tasks. "Coping" depicts people interacting with stressful life events, and theories of coping use proximal process constructs to describe their categories (e.g., negotiating, seeking support, problem-solving). "Engagement" describes people interacting with tasks, for example, academic engagement depicts students interacting with learning activities; and work engagement depicts employees interacting with job-related tasks. Theories of play and support groups, of marital relationships and the development of children's friendship relationships, all contain descriptions of supportive and unsupportive proximal processes.

In a flash, it dawns on the class that *proximal processes* are not rare and amorphous creatures-- they *verbs* and they are everywhere. Basically, a proximal process can potentially be described by any active verb that implies an object, such as comforting, arguing, learning, and so on. We often fill the chalkboard with them (see Table 11.2 for some examples). At this point we sometimes notice that, because researchers typically assume that they are studying "variables," our theories saddle us with variable names, which are predominantly nouns—static labels for persons, places, or things. The focus on proximal processes directs our attention to verbs, to movement, to ongoing and changing exchanges between people and their social partners. So we decided that we should try, as often as possible, to convert concept labels, like "engagement," "imitation," or "resilience," to their active counterparts, namely, "engaging," "imitating," and " bouncing back."

Table 2. Examples of proximal processes that shape development.

Advising	Confronting	Helping	Negating	Sharing
Aggravating	Conversing	Hoping	Negotiating	Showing
Allowing	Cooperating	Ignoring	Observing	Solving
Annoying	Delegating	Imitating	Persuading	Studying
Arguing	Demonstrating	Inspiring	Playing	Succumbing
Balking	Directing	Interfering	Practicing	Suggesting
Bickering	Discouraging	Intruding	Problem-solving	Supervising
Bullying	Discussing	Keeping a secret	Punishing	Supervising
Caring	Doing homework	Learning	Questioning	Supporting
Cleaning	Dreaming	Liking	Questioning	Teaching
Balking	Eliciting	Losing hope	Reading	Thinking
Coercing	Encouraging	Loving	Repelling	Trusting
Comforting	Explaining	Mentoring	Requesting	Trusting
Commanding	Fighting	Missing	Seeking information	Worrying
Complaining	Forgetting	Modeling	Seeking support	Writing
Confiding	Grieving	Monitoring	Setting limits	Yelling

Are the interaction partners in proximal processes always other people?

No. Bronfenbrenner's definition includes interactions with objects and symbols as well. To call to mind examples of such *objects*, we can look around the settings in which developing people spend their time—the games, building blocks, and swing sets at home; the textbooks, computers, and microscopes at school; the swimming pools and basketball courts at community centers. These settings are filled with objects. We take many of them for granted, and do not typically consider them as interaction partners—objects like chairs, tables, pencils, spoons, eyeglasses, beds, stairs, doors, windows, and so on. However, these could be called "social objects" in that they are created by other people and they contain "social messages" about how we are supposed to interact with them—they influence the way we sit, eat, read, and so on. Our microsystems are also filled with *symbols*—things that stand for other things, such as words, clocks, and other symbolic representations such as photos, drawings, stories, songs, TV, Youtube, and so on. We interact with these symbols when we read a book, listen to a story, visit Facebook, or sing a song. These are not real objects or people, but we can still interact with them.

Although Bronfenbrenner did not explicitly mention this, we also decided that we felt comfortable expanding the definition of "social partners" to include pets and animals of all kinds, as well as "objects" that are not made by people, natural objects, such as rocks, trees, waterfalls, rainbows, the sky, the ocean, stars. It seemed clear to us that we interact with these kinds of partners daily and that they can influence our development. We did begin to wonder whether interactions with objects and symbols could be seen as "reciprocal," which seems to be a defining feature of proximal processes. We did not see that books or chairs changed in response to the actions of developing people, at least not in the same way that living beings like other people or animals clearly do. So we speculated that some of the "reciprocity" may be a function of how we view and interact with the objects and symbols as we ourselves change—using them and relating to them in different ways as we develop.

Is everything we do a "proximal process"?

Kind of. Once you grasp the meaning of "proximal processes," it is easy to see that people's lives are filled with them. We busily spend most of our waking minutes interacting with people, objects, or symbols, both natural and man-made. The class typically starts wondering where the boundaries of the concept of "proximal processes" can be meaningfully located. For example, is "prayer" a proximal process? It seems clear that it would be if one considers God as a supernatural being who is real. What if we consider him or her an internal representation—are we then interacting with a symbol? As another example, what about an internal debate about whether to have more ice cream? Or meditation? Or daydreaming? Are these still proximal processes—exchanges between partners, and if so, who are the partners? "I" and "me"? Between different parts of the self?

What about our interactions with rules, routines, expectations, normative pressures? Do these cultural constructions also fall within the category "symbols"? If so, then who are the interaction partners? They are obvious when these prescriptions are enforced directly by specific individuals—when teachers tell students to quiet down or bosses tell employees to smile at their customers. But what happens when the interaction partners are one's own conscience-- the internal transcriptions of this advice? Are these more exchanges between "I" and "me" ? We could feel our discussions stretching (and perhaps deforming) the definition of "proximal process" to cover every meaningful person-context interaction. We tried to distinguish prototypical exchanges, typical proximal processes, from ones that required us to release some of the definitional constraints before they could be included.

Are all proximal processes good news for development?

We also started thinking about the additional distinctive properties that Bronfenbrenner argued gave “proximal processes” their specific meaning—as listed in Table 11.3. It seemed to us that these properties, like “increasingly more complex” and “objects that invite attention, exploration, manipulation, elaboration, and imagination,” characterize proximal processes of a specif kind—those that promote competence or protect from dysfunction. In that sense, these seem to be features of “good” proximal processes. However, if development can go in many different directions, then we should also be interested in what characterizes “bad” proximal processes—ones that undermine competence and promote dysfunction. These might include social interactions that are absent, or deadly dull, or chaotic, or abusive, or with social partners who do not like, appreciate, or respect the developing person. We critiqued Bronfenbrenner’s more limited definition and expanded it to include social interaction processes that shape development *in any direction*.

Table 11.3. Distinctive properties of “proximal processes.”

For development to occur (Bronfenbrenner & Morris, 1998):

1. Person must engage in an activity.
2. Activities must take place on a fairly regular basis over an extended period of time.
3. Activities must become increasingly complex.
4. Activities must be bidirectional.
5. Interactions with objects and symbols that invite attention, exploration, manipulation, elaboration, and imagination.
6. Become more extensive and complex as children’s capacities increase in level and range (p. 996-997).
7. Activities include "one or more persons with whom the child has a strong, mutual, irrational attachment" (p. 1015).

Why are proximal processes so central to this reformulation?

In the Person-Process-Context-Time bioecological model, the Process component is the central organizing element because it is proximal cause of development. The central conceit of proximal processes is quite far-reaching, as least as we read it: Not only do proximal processes cause development, they are the *primary* causes or maybe even the *only* causes of development. This means that every developmental trajectory that ever existed is the product of proximal processes, that is, of ongoing social interactions. It means that in every model of the antecedents and consequences of any target phenomenon—the substances on every arrow are proximal processes. Any other causal factor gets into the act only by shaping proximal processes.

Moreover, all interventions that have the goal of optimizing development must exert their effects by changing proximal processes—strengthening or improving the supportive ones and weakening or compensating for the unsupportive ones. The assertion that proximal processes are central to development also implies that all research programs should be focused on key proximal processes—on identifying the ones that promote and undermine the target developmental outcome. In this sense, they become an umbrella concept encompassing important mechanisms of social influence (see Table 11.3).

Table 11.3. Proximal Processes that are Mechanisms of Social Influence
1. Brute force, coercion, threats
2. Persuasion
3. Contingencies: Reinforcement, punishment, withdrawal of affection
4. Imitation, modeling
5. Explanation, provide information, teaching
6. Identification
7. Internalization

How do proximal processes fit in with the other components of the model?

All the other components of the model, all those people, objects, and symbols with their attributes, and the micro-, meso-, exo- and macrosystems with their attributes, that were swimming in front of our eyes as we contemplated our empty context maps, can only make it to Bronfenbrennarian hyperspace if they can prove their worth in shaping proximal processes. This means, on the one hand, that the effects of the person and the context are funneled through, or mediated by, proximal processes. On the other hand, this means that attributes of the person and the context may make a difference to proximal processes: They can shape them directly, or they can modify their effects. In other words, “the form, power, content, and direction of the proximal processes effecting development vary systematically as a joint function of the characteristics of the *developing person*; of the *environment*- both immediate and more remote- in which the processes are taking place; the nature of the *developmental outcomes* under consideration; and social continuities and changes occurring over *time* through the life course and the historical period during which the person has lived” (p. 996). As a nod to previous ecological models, Bronfenbrenner explicitly notes that proximal processes have stronger effects than the contexts in which they occur.

What are the person characteristics that shape proximal processes and their effects on development?

Because proximal processes generate development, the characteristics of the person that are of greatest interest are those that are “relevant” to the proximal processes—that is, those that influence the power and direction of the proximal processes and their consequences for development. The bioecological model considers three kinds of characteristics: (1) Developmentally generative versus disruptive dispositions that influence whether the person will initiate and sustain proximal processes; (2) Resources that influence the individual’s capacity to engage in or benefit from effective proximal processes; and (3) Demand characteristics that invite or discourage social interactions from interaction partners (see Table 11.4).

Table 11.4. Person Characteristics that shape Proximal Processes (PPs)

Forces	***Generative***: Dispositions that set PPs in motion and sustain their operation (e.g., curiosity, responsiveness). • *Selective responsiveness*: attraction to and exploration of context. • *Structuring proclivities*: tendency to engage in progressively more complex activities. • *Directive belief systems*: convictions that the self is efficacious and context is responsive. ***Disruptive***: Dispositions that actively interfere with, hinder, or prevent PPs (e.g., poor regulation, apathy).
Resources	***Assets***: Capacities that allow PPs to have their effects and extend the domains in which PPs can do their constructive work (e.g., abilities, skill, openness to new experiences) ***Liabilities***: Characteristics that limit or disrupt functional integrity and so interfere with the capacity to benefit from PPs (e.g., prematurity, hyperactivity, neurological damage).
Demand	***Foster***: Characteristics that invite reactions from the context that foster psychological growth (e.g., attractiveness, sociability). ***Disrupt***: Characteristics that discourage positive or invite negative reactions from the context (e.g., negative emotionality, passivity).

What are the characteristics of the context that shape proximal processes and their effects on development?

In conceptualizing the context, early versions of the ecological model focused much more on the settings themselves than on the *attributes* or *characteristics* of the settings that promote or undermine proximal processes. In the reformulation, the definition of microsystem is expanded to include "a given face-to-face setting with particular physical, social, and symbolic features that invite, permit, or inhibit engagement in sustained progressively more complex interactions with, and activity in, the immediate environment" (Bronfenbrenner &Morris, 1998, p. 1013). Some examples of these features, taken mostly from the work of Theodore Wachs (e.g., 1992) are listed in Table 11.5).

Table 11.5. Environmental Characteristics that shape Proximal Processes (PPs)

Developmentally generative features	Physical set-up permits exploration Objects and areas that invite manipulation and exploration Physically responsive environment

	Presence of sheltered areas High degree of temporal regularity, routine Stability Low levels of noise and confusion
Developmentally disruptive features	Chaos Instability Lack of clear structure Unpredictability of events Low degree of temporal regularity

How do I select the PPCTs that are important to study?

The process of selecting and hypothesizing about proximal processes, people, contexts, and times can be seen as a series of steps. It may seem to start with proximal processes, but if we think about it long enough, we realize that there are an infinite number of proximal processes. How do we select those for any given conceptualization? They are identified based on their relevance for promoting and undermining the *target developing attribute*. So the first step is getting clear on the target outcome and then identifying the proximal processes that promote and undermine its development. Unfortunately for our students, however, many of their target phenomena came with conceptualizations that contained not a single clue about the proximal processes that might contribute to them. At this point it became clear that psychology is relatively poor in explanatory theories (Gigerenzer, 1998). Often it was necessary to borrow from other theories or to guess at the proximal processes by working backwards from the target and forward from its more distal predictors.

The other elements of the model, namely, person, context, and time, are selected based on the extent to which they shape proximal processes (Bronfenbrenner & Morris, 1998). From the variety of social partners, those are selected who participate in the relevant proximal processes. From the range of attributes of the developing person, its social partners, and the context, those are selected that shape (facilitate or hinder) the relevant proximal processes. From outside the microsystems, the exosystems are selected that have the greatest impact on the target person. But the idea of proximal processes tell us that, to be relevant, they must "get into the envelope" of the microsystems surrounding the target person. Otherwise they cannot have an impact on the target developmental outcome. Hence, proximal processes also depict the sole pathway through which all distal environmental attributes, as well as all distal social partners and their attributes must traverse to get to the focal unit—they must have an effect on the relevant proximal processes.

Where is the target developing person located in this map?

As explained by Bronfenbrenner, the target person occupies two locations on this PPCT map. On the one hand, they are gripping firmly to the developmental outcome—which they embody. This developing person, or at least the developmental trajectory of the attribute that is the target of study, is the ultimate consequence that a conceptualization is trying to explain. The variety of possible developmental pathways this outcome can follow (and which take the developing person along for the ride)—these are the individual differences in intraindividual development that anchor the "description" portion of any developmental theory. However, at the same time that the person is present in the developmental outcome, the person is also busy elsewhere in the model—as a key interaction partner in all the proximal processes that provide an explanation for how and why the target is developing. But-- how is it possible for the person to be both the cause and also the outcome of development?

For this to make sense, the notion of *time* needs to be introduced. The person is part of the developmental outcome at time t_n. The person is part of the explanatory process at time t_{n-1}. The person (along with all the other PPCTs) at time t_{n-1} create the attribute at time t_n. Suddenly, the apparent paradox makes sense: The child yesterday is part of the family system that created the child today. The worker yesterday is part of the organizational system that produced the worker today. The addition of time allows this representation to depict situations in which individuals (or any other units) contribute to their own development (Brandtstädter, 1998; Lerner & Busch-Rossnagel, 1995).

An example of a blank map is depicted in Figure 11.1 for three microsystems. The attributes for the target person and for Social Partner # 1 in Micro-system #1 are also depicted in Figure 11.1. The mesosystem is composed of the three micro-systems. One exosystem is shown that involves Social Partner #1 from Microsystem #1. Time is also depicted as Micro-time within each proximal process, and as Meso-time across episodes. Notice how the developing person appears twice, in two places and two times, in this PPCT map.

Insert Figure 11.1 about here

In-class Exercise: Creating a PPCT Map of Bronfenbrennarian Hyperspace

The class uses the concepts of Proximal processes, People (i.e., social partners and personal attributes), Contexts, and Time to fill out the context maps. See Figure 11.1 for an example. Working together, students follow these steps:

1. Select the target developmental phenomenon and write it in the top corner.
2. Describe development. Identify the range of individual developmental trajectories of interest.
3. Explain development. Identify the proximal processes that influence the target trajectory. Inside each microsystem, draw all the proximal processes, as reciprocal arrows between the target person and the social partners (including social objects).
4. Explain each proximal process:
   a) Inside the target person and the social partners, draw the attributes that create or shape the effects of the proximal process.
   b) Identify key attributes of the context that create or shape the effects of the proximal process.
5. Posit how the proximal processes operate across time.

What use are PPCT maps?

The resulting PPCT maps look like complicated Venn diagrams, organized into functional microsystems, containing the target person and his or her social partners, each linked by a list of possible proximal processes that could promote or undermine the focal attribute. The maps were multi-level, multi-dimensional, process-oriented explanatory theories that had integrated pretty much everything students currently knew about their phenomena of interest. They provided a complex account of many of the multiple systems that give rise to development. Each map can be thought of as a "menu" from which to select when designing a study, as well as a reminder of the wholistic picture to keep in mind when choosing to look at any one part. Many of these theories were more advanced that any framework currently in use on a topic in the field.

So what? How can a bioecological analysis move research on a topic forward?
In their chapter focusing on research on the effects of *preschool programs* for young children, Mashburn and Pianta (2010) used the bioecological model to bring clarity to debate about how to design and structure programs to maximize opportunities for children to learn and develop. In many decades of research on this topic, two points seemed clear: First, almost complete consensus existed that the potential benefits to children depend on the quality of the preschool program. Second, almost no consensus existed about how to recognize, measure, and optimize quality. As explained by Mashburn and Pianta, "Policy makers are currently debating decisions to invest in specific program features intended to optimize outcomes for children, such as requiring teachers to have a bachelor's degree or specialized training in early childhood education, mandating small class sizes, adopting intensive professional development programs, and instituting systems of program quality monitoring. These decisions have implications for both the costs of providing preschool programs and the benefits for children who attend" (2010, p. 243). From the variety of program features put forward by researchers, Mashburn and Pianta reach in and pull out high-quality proximal processes, explicitly using the bioecological model to argue that "children's interactions with physical and social resources are the direct mechanisms through which preschool programs transmit benefits to children" (p. 250). These interactions can be distinguished from "classroom characteristics (e.g., class size, child:teacher ratio, and curriculum) and teacher characteristics (e.g., level of education and field of study) [which] may have indirect effects on children's development to the extent that they have direct impacts on the quality of interactions with physical and social resources that children experience within the classroom" (p. 250). These kinds of conceptual analyses have the potential to align an area of study around its essential elements, and allow research to be more fully integrated and therefore more useful to educators, parents, and policy makers.

Other examples: For a similar set of arguments about research on academic motivation and the role of "engagement" in capturing essential proximal processes that can help align and integrate this work, see Skinner, Kindermann, Connell, & Wellborn (2009).

What are the most important take-home messages of the bioecological model?

We would highlight four. First, at the heart of this model are the ***engines of development*-- *proximal processes***, which describe the "reciprocal interactions between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment." Second, this concept organizes the rest of the model because it directs our attention to the ***features of the person and the context that promote and undermine proximal processes***, and the ***time scales*** along which they are effected. Third, ***person characteristics*** that shape proximal processes include generative and disruptive forces, assets and liabilities, and demand characteristics that foster and disrupt interactions. Fourth, the most important ***contextual characteristics*** are ones that are developmentally generative or developmentally disruptive.

What are the most important critiques of the bioecological model?

The most significant critiques continue to focus on the "development" part of the model. The concept of "proximal processes" requires some reworking to incorporate the "bad news" facets of development—both the kinds of proximal processes that undermine positive developments and the kinds of proximal processes that contribute to the development of problems, disorder, and psychopathology. Moreover, although the bioecological model has "bio" in its title, the "biology" of the organism is not very well represented—it is only explicit role tis to influence the proximal processes and the developmental outcomes, and impose imperatives regarding the environmental conditions (Bronfenbrenner & Morris, 2006, p. 997). Finally, no mention is made of the possibility of qualitative shifts in development. For these reasons, the bioecological model might also be considered as an example of a "Big-E"-"Little-O" contextual meta-theory.

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Chapter 12. Dialectic and Transactional Perspectives

In his 2010 paper entitled "A Unified theory of Development: A Dialectic Integration of Nature and Nurture," Arnold Sameroff offers a historical-developmental perspective on how the dominant developmental meta-theories have changed over time. He argues that historically the field has swung from a preference for nature to one for nurture and back again (see box)-- based largely on (1) scientific advances in the biological sciences (e.g., discoveries in behavioral genetics and neuroscience) which have contributed to a focus on nature, and (2) societal shifts in the social sciences (e.g., interest in Freud or consideration of the effects of poverty) which have shifted attention to nurture. Sameroff argues that over the historical arc of these pendulum swings, two very interesting developments have been occurring.

Rough History of Nature and Nurture (from Sameroff, 2010)

Historical Era	*Predominant*	*Empirical Advance*	*Differentiation*
1880-1940s	Nature	Inherited differences Instincts	
1920-1950	Nurture	Reinforcement history Psychoanalytic theory	
1960-1970s	Nature	Ethology-species differences Behavioral genetics Cognitive revolution	
1980-1990s	Nurture	Poverty Social ecology	
2000-2010s	Nature	Cultural deconstruction Molecular biology Neuroscience	

First, developmental science has been developing a more differentiated picture of what we mean by both "nature" and "nurture." Starting in the lab of Francis Galton (the originator of the phrase "nature versus nurture") in the late 19th century, multiple facets of nature have been successively distinguished:

> what began … as a catalog of measurable differences in behavior was reconceptualized as really being differences in neurological electrical activity, and then as really being differences in neurotransmitter activity, and then as really

> being differences in genomic activity, and most recently as really being differences in epigenetic activity.
>
> Analogously, there was also a historical differentiation of nurture where an early romantic conception of the power of mother love was reconceptualized as differences in the pattern of reinforcements provided by the parent, and then reconceptualized when it was discovered that differences in social circumstance constrained the patterns of reinforcement available to the child, and then reconceptualized when social circumstance was differentiated into the subsystems of the child's social ecology, and then reconceptualized when it was realized through social deconstruction that the effects of social ecology were constrained by the meanings that families and cultures imposed on behavior. (Sameroff, 2010, p. 11)

Second, as these new differentiations have been integrated with existing views, the pendulum swings have gotten shorter and shorter, and they have brought successively more of their putative opposite into their own target. So, for example, researchers studying genes have learned more and more about how intimately environmental factors are tied to genetic expression. And those studying the effects of environments have become increasingly aware that individuals select their contexts, elicit reactions from them, and are differentially susceptible to these effects. In fact, Sameroff argues that the field is ready to dispense with the concept of "nature versus nurture" and turn to the obvious conclusion that all development is "nature *and* nurture," or to move beyond that idea to the dialectical notion that nature and nurture may seem like opposites, but in development, we find the unity or interpenetration of these opposites, which actually mutually constitute each other.

What are we talking about now? Have we left the realm of psychology and landed in philosophy?

The discussion of metatheory lives on the rim of psychology and philosophy, and sometimes we have to peer into philosophy just a bit to get our bearings. Although there are multiple versions of dialectical psychology (Hinde, 1997; Riegel, 1975, 1976; Wozniak, 1975), Sameroff selected to focus on one important idea—the idea of interpenetration and unity. In its simplest form, this is the notion that when one considers any two things which are opposites, and so seem to require us to select one or the other, these opposites are inextricably bound to each other—in order to exist, each requires the other and together they actually create a whole. An example of opposites mutually constituting each other can be seen in a consideration of the two opposites: “inside” and “outside.” “Inside” requires “outside” (and vice versa) because if outside did not exist, there would be no inside. They come into being together and remain bound to each other.

According to Sameroff, “the dialectical perspective on nature and nurture is that they mutually constitute each other. There is *unity of opposites* in that development will not occur without both, and there is an *interpenetration of opposites* in that one’s nature changes one’s nurture and conversely one’s nurture changes one’s nature…[W]ithout the one the other would not exist” (p. 9). As a result, the target phenomena in development is the connection, relationship, or transaction between these opposites. As Sameroff explains, “at the most fundamental level of the universe there are no ultimate units, only ultimate relationships” (p. 9). That is why this approach is sometimes called a “transactional perspective.” (This label also sidesteps some of the other principles typically included in dialectical meta-theories, such as contradiction and conflict; Reigel, 1976.)

What is a “transaction”?

For our students, these transactional ideas can sound strange, and so we like to think through some examples together. One can be found in the idea of “proximal processes,” which we can borrow from the bioecological model. This concept refers to the interaction between a target developing person and the partners (other people, objects, symbols) in his or her immediate face-to-face setting. By this time, we have a good grasp of the idea of proximal processes—their ubiquity and their importance to development. However, if we would try to decompose a proximal process, and look only at one part of it—the target person or their partner--- we would destroy it. The two opposites (person and environment) are both required, they mutually constitute the transaction, the proximal process. If one tries to study a tennis game or a conversation by observing only one partner, one will badly misunderstand what is happening. The indissociable target is the relationship, the exchange, the *transaction*, between partners. A basic tenet of the transactional model is that "the development of the child is a product of the continuous dynamic interactions of the child and the experience provided by his or her social settings. What is core to the transactional model is the analytic emphasis placed on the interdependent effects of the child and environment" (p. 16).

What are the components of the transactional perspective?

One way to see this perspective is as the integration of four complementary models: (1) the personal change; (2) the contextual; (3) the regulation; and (4) the representational models, as defined in Table 12.1. Let's briefly consider each one and then look at them all together. The *Personal Change* model (Figure 12.1), which is the target of all developmental theories, depicts the pattern of an individual's change over time. One way of conceptualizing individuals is as unchanging, composed of a set of stable traits; from this perspective a developmental theory is not needed. If one does conceptualize individuals as changing beings, two patterns of change can be considered: (1) "growth" which refers to quantitative change and (2) "development" which refers to qualitative change through a series more complex, adaptive, and encompassing stages. Sameroff clearly prefers this latter model, since it is the only one he labels as "development," and his focus on qualitative changes or shifts sets this approach apart from the other perspectives we have considered thus far (lifespan and ecological models).

Insert Figure 12.1 about here

Table 12.1. Four models integrated within the unified theory of development (from Sameroff, 2010).

Model	***Definition***
Personal change	How a child changes over time; the complex of psychological and underlying biological change. • *Trait*: set of unchanging characteristics • *Growth*: quantitative change based on "classic epigenetic explanations in that all the parts are there to start with and it is their interactions that produce the changes in the phenotype, or it can be considered experience dependent but only as nutrition for the unfolding maturation process" (p. 12) • *Development*: stage process in which there is a "period of stability of functioning followed by a transition to a structurally different period of stability presumed to reflect more encompassing cognitive and social functioning" (p. 13)
Contextual	"the constellation of environmental influences that have general effects on child development, fostering child development at one end and inhibiting it at the other" (p. 14); including family, school, and community; including changing settings over time and changing characteristics of individuals within a setting.
Regulation	developmental changes as the "balance between other-regulation and self-regulation shifts as the child is able to take on more and more responsibility for his or her own well-being" (p. 15)
Representational	Development of the "encodings of experience" or the "more or less elaborated internal summary of the external world" (p.16)

What is the Contextual model?

The *Contextual Model* (see Figure 12.1) contains the same essential elements as Bronfenbrenner's ecological framework—it knits together the multiple social settings of childhood (e.g., family, school, and community) with their own systems properties, which are "all intertwined in explaining any particular child's progress" (p. 13). These contexts change over time as do the characteristics of the people within them. One of Sameroff's great contributions to developmental science has been to provide methods for capturing the complex effects of participation in multiple environmental settings. He and his colleagues create indicatojrs of multiple or *cumulative risk* or *promotive factors*, in which threshholds are generated for a variety of factors in each setting which can be considered “good news” and “bad news” for a specific developmental outcome or set of outcomes, and individual development is charted as a function of the total number of these (multiple or cumulative) risk and promotive factors present across the settings of each child’s life (Furstenberg, Cook, Eccles, Elder, & Sameroff, 1999).

What is the Regulation model?

The third component of the unified theory is the *Regulation* model, which is focused on how the child actively and successively comes to take on responsibility for his or her own functioning and well-being. As opposed to many models of the development of self-regulation, which see this largely as an individual process, Sameroff’s regulation model posits that “‘self-’ regulatory capacities are heavily influenced by the experience of regulation provided by caregivers,” in that “the capacity for self-regulation arises through the actions of others” (2010, p. 15). Sameroff offers the visual representation of an *ice-cream-cone-in-a-can* (see Figure 12.2) for how this development takes place.

Insert Figure 12.2 about here

The *can* represents the protective envelope provided by caregivers’ regulation of the child’s interactions with the environment: “This regulation by others provides the increasingly complex social, emotional, and cognitive experiences to which the child must self-regulate and the safety net when self-regulation fails” (p. 15). These caregiver-curated experiences create a zone of proximal development that provides just manageable challenges to safely draw the child out toward practice and consolidation of their own regulatory capacities. The *ice cream cone* inside the can represents the ever-expanding capacities of the child to competently take on more self-regulatory activities and hence more responsibility for their own development. This model includes a series of double-headed arrows right on the boundary between the ice cream cone and the can—these represent the ongoing transactions or exchanges between the child and the environment established by the caregiver. The arrows out to the environment are children's active attempts to regulate their interactions, and the arrows in from the environment are the feedback the environment provides about the effects of those efforts. As can be seen by the expanding cone, this process leads, over time, to increasingly more competent and more wide-ranging self-regulation on the part of the developing child.

What is the Representational model?

The fourth component is the *Representational* model, which is based on the assumption that children during their transactions with the environment are busily constructing mental maps of these experiences, including the "cognitive representations where the external world is internalized, the social representations where relationships become internal working models, the cultural representations of different ethnicities or social classes, and the developmental theories discussed here" (Sameroff, 2010, p. 16). In the graphic of the Regulation model in Figure, these representations are depicted as changing "thought bubbles" that arise during transactions, which cumulatively and selectively summarize the external world. These representations have "an adaptive function of bringing order to a variable world, producing a set of expectations of how things should fit together" (p. 16). In this way, they guide interpretations of transactions and shape expectations of future events—both of which contribute to subsequent actions. An important component of representations is their coherence or "meaningfulness"—"individual well-being is also a result of meaningful cultural engagement with desirable everyday routines that have a script, goals, and values" (Sameroff, 2010, p. 16).

How do these four components fit together into a unified theory of development?

According to Sameroff, the components of the personal and contextual model can be combined into a structural formulation, as depicted in Figure 12.3. The personal model, or self, includes a set of interacting psychological processes, from the cognitive, emotional, and motivational realms (pictured as overlapping gray circles) and the biological processes that interact with and subserve them (pictured as black circles), including for example, neurophysiological and neuroendocrine subsystems. Together these comprise the *biopsychological self system*, a self-regulating system that interacts with the other-regulating system, depicted by white circles that represent the multiple interacting settings of the social ecology—from the micro- to the macro-system. These three sets of overlapping circles, taken together, compose a *biopsychosocial* model of the individual in context.

Insert Figure 12.3 about here

What use is the unified theory of development?

The schematic depiction of the unified theory of development provides an integrated way of looking *at* things, but also *for* things (Sameroff, 2010, p. 20, italics added).

The top-down theoretical stance is that researchers need to be aware that they are examining only a part of a larger whole consisting of multiple interacting dynamic systems (p. 19).

What is the process formulation of the unified theory?

To the cone-in-the-can of the regulation model, the personal change model adds the notion of the nature of change over time. Changes in regulation can be thought of as basically linear growth in quantity, as depicted by the smooth slanting surface of the cone in Figure 12.2. In contrast, the developmental model adds the notion of *qualitative stages* as depicted by bumps or jumps in the cone's surface in Figure 12.4. These nonlinear changes represent qualitative shifts in organization in which there are changing relations among the biopsychosocial aspects of the self-in-context. The smooth surfaces on either side of the bumps suggest a kind of "punctuated equilibrium" in which the periods of linear change are underlain by a balance (or equilibrium) that is being maintained between the person and their contexts that can accommodate some amount of variation in functioning or quantitative change in either.

Insert Figure 12.4 about here

Then, based on changes of sufficient magnitude in either partner or the addition of novel elements or tasks, an imbalance or disequilbrium is created that destabilizes the system and creates pressure on the current organization (the punctuation phase). From this period of disequilibrium, a new re-organization emerges that can better accommodate the changes and better serve the new tasks. This steady-state can maintain a more adaptive balance and restores equilibrium; hence a period of relative stability ensues. Some of these qualitative reorganizations seem to be keyed to specific age-grades, such as the 5-to-7-year shift (Sameroff & Haith, 1996; White, 1965) and the transition to early adolescence or to emerging adulthood. Although researchers tend to consider these shifts as properties of the child (because they are visible in the child and because they are indexed by the child's age), Sameroff points out that "it is the relation between shifts in the child and shifts in the context that mark new stages" (2010, p. 19). Since these reorganizations should require shifts in the context to accommodate children's emerging capacities and desires, it is probably helpful to point out that the bumps in the ice cream cone correspond to bumps in the interface between the cone and the can. If these bumps are sufficiently large, it might be useful in future graphics to include nonlinear changes in the outer surfaces of the can.

Where is the representational model in the unified theory?

Representation "suffuses every aspect of the model in the interacting identities, attitudes, beliefs, and attributions of the child, the family, the culture, and the organizational structure of social institutions" (p. 19). To represent the part of the representational model that belongs to the child, we have added thought bubbles to the regulation model, that is, to the bumpy ice-cream-cone-in-a-can graphic (Figure 12.4). We increased the sizes of the thought bubbles as children moved to adolescence and then to adulthood, to depict the general trend in which children's representational systems become more and more elaborated, complex, and reflective as they age.

Any clues about what prompts development in the unified theory?

Sameroff assumes that the dynamic dialectical interplay between opposites provides the source of development. To represent this process, he uses the idea of a double helix, or two spirals proceeding in opposite directions, but inextricably tied to each other—like day and night, in which the dawning of the day and the receding of the night are proceeding in opposite directions but are happening at the same time, and mutually constitute each other. In development, the two opposites of greatest interest are "differentiation" and "integration," as formulated in Werner's orthogenetic principle: "Whenever development occurs it proceeds from a state of relative globality and lack of differentiation to a state of increasing differentiation, articulation, and hierarchic integration" (1957, p. 126). Globality or diffusion provides the materials to be differentiated, and this differentiation creates the materials to be integrated, and so on. As a result, development can be thought of as spirals of differentiation and integration, in which material from the same domains (e.g., representation or relationships or identity) are recycled and revisited again and again at higher and higher levels.

What are other views of the dialectics of human development?

One of the strongest advocates of a dialectical view of human development was Klaus Riegel (1975, 1976) who argued for meta-theory that would use dialogic interactions or conversation as its primary metaphor. "Dialogues" include the idea of exchanges between a proponent and an opponent across time, in which each must listen to the other, and then coordinate their own point of view and argument with their opponent's point of view and message. He thought that these exchanges or arguments, in which both partners are both changing and attempting to change each other, were an excellent metaphor for how development proceeds, and were much better than metaphors that emphasized equilibria, balance, and stasis.

A dialectical theory of human development involves simultaneous movement within and between at least four levels: (1) inner-biological; (2) individual-psychological; (3) cultural-sociological; and (4) outer-physical. Whenever progressions within one particular or between two different dimensions are not synchronized, a "crisis" can occur. These crises can be can be constructive confrontations leading to productive arguments and new developments. In fact, "developmental leaps are brought about by lack of coordination and represent major forms of reorganization…[T]hey provide the fundamental basis for the development of the individual and for the history of society" (Reigel, 1976, p. 695). "Development requires a delicate synchronization between progressions along the different dimensions. Synchronization is comparable to balance, but it is a balance structures in time…Such a temporal balance can be understood only if the state of imbalance is simultaneously taken into consideration. Balance an dimbalance are dialectically determined, and their relationship changes continuously" (Reigel, 1976, p. 697).

In class exercise: Drawing a Theory

The complex ideas of Sameroff with their multiple graphic representations provide a good segue into an activity that students often resist, namely, learning how to draw their theories. It could be that the idea of "drawing" runs up against the assumption that artistic talent is required, but it is not. Much can be represented using boxes, circles, arrows, and stick figures.

Students read Gould (1995) to get an idea of the importance of drawings or “icons” in communicating our theories. If the canonical icons (i.e., the standard representations) do not correspond to the theory, then our understanding is impeded—we tend to stick to the (incorrect) pictorial representations. Gould illustrates this point with the canonical icons used to represent the theory of evolution, but we can illustrate it a little closer to home, using Bronfenbrenner’s ecological model. The four levels of context are often represented by four concentric circles that look like a target. However, this drawing is wrong: Mesosystems are *not* nested inside exosystems. By definition, mesosystems *always* contain the developing person, whereas (also by definition) exosystems *never* contain the developing person—so mesosystems are not inside exosystems. A better representation of the four levels of context is presented in Figure 10.1.

Our in-class drawing exercise starts by considering different ways to represent the notion of “transaction” and allows us to reflect on the canonical representations used most often in psychology.

1. We start by defining “transaction” as “a reciprocal interaction between a person and their environment.” Each student draws his or her own picture of a transaction, using circles and arrows.
2. We compare pictures. Most of them look like the drawing at the top of Figure 12.5. We discuss where this common representation comes from—and discover that most of our drawing in psychology takes place in quantitative classes. Statistics tends to dictate our canonical representations-- of reciprocal effects (based on correlations), processes (based on mediational analyses), and differences in processes (based on moderators).
3. We consider alternative representations of a transaction, including the one offered by Sameroff himself in Figure 12.2. Students are often surprised how many different ways there are to draw the same thing, as shown in Figure 12.5. We usually end up being most satisfied with the drawing at the bottom—which is similar to the one suggested by Riegel for “dialogic interactions” (1976, Figure 1). We can use these pictures to compare and contrast the concepts of “transactions,” “dialogic interactions,” and “proximal processes.”
4. We suggest that students consider the representations in Figure 12.6 as ways to start the pictures of their phenomena. Somehow it is easier to start with these templates and modify them, than to start with a blank page.
4. These templates also help students break out of the “multiple regression” representation—in which all the predictors are lined up in a column on the left and the dependent variable is on the right. We have come to call this the “laundry list” representation, because the whole explanatory theory is piled up as a list on the left.
5. In trying to flexibly consider alternatives, we find it useful to have students prepare a “deck of cards” for their theory—a stack of index cards that has one key construct written on each of them. This allows us to rapidly try out a variety of representations, by jointly arranging the cards-- either on the table in front of us or on the whiteboard using magnets to hold the cards in place. Just getting all the

cards sorted by model component (e.g., the contextual features all in one stack and the personal features in another) or in temporal sequence (with antecedents coming before consequences) allows students to start bringing some order and structure to their theories.

6. We also try to encourage students to see the parts of our meta-theories that may be missing from their theories, noting, for example, if there are no biological or contextual constructs in their theories.
7. Once students start to draw, they become more critical of the canonical icons that that researchers use to represent their theories graphically in chapters and publications, and sometimes suggest improvements to better capture the theory's actual postulates.

What are the important take-home messages from dialectical-transactional meta-theories?

The most important ones are found in the idea that the unified theory of development can integrate the four models in entails. First, the person is considered as an integrated ***biopsychosocial whole*** who shows multiple different kinds of changes—of special interest are ***developmental changes or qualitative shifts***. Second, such development is produced by the ***transactions*** between this *active person* and their multiple *organized social contexts*. In order to ***promote development***, these social partners provide a protective proximal context that constructively regulates the child's activities while also drawing out the child's capacities and withdrawing its own regulatory activity so the child can slowly take over. Third, a key part of this process involves children's ***representations*** of these transactions which they use to derive their meaning for current and future encounters. And, fourth the developmental mechanisms that lead to major reorganizations are the complementary processes of differentiation and hierarchical integration.

What are the important critiques from dialectical-transactional meta-theories?

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Chapter 13. Relational-Developmental Systems Meta-theories

Over the last 20 years, a group of theorists and researchers has been making a bid to supply developmental science with a new organizing paradigm. Referred to by several different labels and arising from several different corners of scientific study across several different disciplines (as befits the rising wave of a paradigm shift), one of the core features of this movement has been the active rejection of the fundamental defining assumption underlying the meta-theory that had been dominating developmental science—that of dualism or "splitting." Tracing its origins to Descartes (Overton, 2006, 2007), the dualistic perspective's central idea about reality (i.e., its basic ontological assumption) is that everything in the world is made up of separable parts that are added together (like bricks used to build a house or threads woven to create a piece of cloth). Hence, the way to understand the world (i.e., its basic epistemological assumption) is to take things apart, to decompose these aggregations down to their smallest units or atoms, so that, when one studies the underlying pieces or elements, one can understand how the combinations are created and how they function (i.e., in our example, to take apart the house in order to study the bricks, or to unravel the cloth in order to examine the threads).

In contrast, proponents of this new paradigm argue that dualisms or splitting are just plain wrong and not useful to the study of development (or science in general). Instead, this worldview holds as its central ontological assumption the idea of "holism," namely, that the world is organized into integrated systems, that have parts (or subsystems), but the parts take their meaning and function from their participation in the whole, and so cannot be decomposed; to remove them from the whole, to split them off for study, is to destroy them. From this view, it is the *relations* among parts and their wholes that should be the target of study. So this worldview has come to be called “Relationism” and the meta-theory for developmental science “Relational-Developmental-Systems” (Lerner, 2012; Overton, 2006, 2007, 2013; Overton & Lerner, 2014).

Illustration of how Wholes take their Meaning from their Parts and Parts take their Meaning from their Wholes

The standard illustration of the ways that parts and wholes give each other meaning is the relationship between words and the sentences of which they are parts. It is clear that sentences take their meaning from the words that create them (and somehow it is easier to recognize that wholes take their meaning from the parts that compose them). At the same time, however, the meaning of words also depends on the sentences in which they are used. For example, it is impossible to determine the meaning of the word “fly,” whether it refers to an insect or an airplane or a state of anger (i.e., “fly off the handle”), whether it is even a noun or a verb, without the rest of the sentence to anchor its definition and usage.

What are the key differences between “split” and “relational” worldviews?

As always, the two kinds of worldviews present different versions of reality (i.e., ontological assumptions). A Split worldview assumes that there exists a stationary and fixed absolute reality that is composed of additive combinations of separate elements, whereas a Relational worldview assumes that reality at its base is a spontaneously moving set of relational forces that are always in a process of change. Split worldviews focus our attention on “things” and “being,” whereas Relational worldviews focus our attention on “connections” and “becoming.” The most important differences between these worldviews are listed in Table 13.1 (see also Lerner & Overton, 2014; Overton, 2006, 2007, 2013).

Table 13.1. Key differences between Split and Relational worldviews.

Split or dualistic families of worldviews	Relational or systems families of worldviews
Cartesian thought	Aristotelian, Kantian thought
Atomistic reductionism	Holism
Separate elements	Analysis in the context of synthesis
Objectivism versus subjectivism	Multiple perspectives
Primacy of ontological fixity and stasis	Primacy of ontological spontaneous activity and change
Substance	Process
Cartesian being	Becoming while being while becoming
Split analysis	Relational analysis
Dichotomous either/or analysis	Indissociable complementarities

Dualisms	Opposites of identities Identity of opposites
Foundationalism: absolute reality	Probabalistic emergence
Additive combinations	Syntheses of wholes
Efficient and material cause	Multiple simultaneous forms of determination: material, efficient, formal, and final causes
Contingent change	Dialectic and necessary change
Contingent organization	Necessary organization
Strict additivity	Additivity and nonadditivity
Strict linearity	Linearity and nonlinearity
Cartesian split interaction	Coaction
Privileged explanatory base: Activity in the here and now	Activity as complementary to the whole organism
Action as motor activity, states and movement	Action as goal-directed expression of an organized system, intentional activity

Why is the difference between Split and Relational metatheories important?

One extremely interesting difference can be seen in the way that the two families of worldviews treat our favorite perennial debates, such as “nature versus nurture,” “biology versus culture,” or “mind versus body” (Table 13.2; see Overton, 2013, Table 1, for more examples). We are used to the way that split meta-theories look at these issues—from this perspective, they represent dueling assumptions, fundamental antimonies or opposites. Over time, we have seen progress in our delineation of these issues. Although science used to be focused on the question of “which one?” (as in “Is identity an individual or a cultural phenomena?” and “Is intelligence a product of inheritance or environment?”), we have grown up and now accept that the question is no longer a choice *between* them (as implied by the “versus”), but is typically couched as an attempt to gauge how *much* of each is involved (as in “Is identity *primarily* an individual or a cultural phenomena?” and “How much of intelligence is due to inheritance and how much to environment?”). At its heart, however, we can see that this way of thinking is still asking us to “split” or decompose our target phenomenon—into the parts (or proportion) that are due to nature and the parts (or proportion) that are due to nurture.

Table 13.2. Fundamental antimonies or false dichotomies?	
Nature	Nurture
Biology	Culture
Genes	Environment
Person	Context
Mind	Body
Brain	Body
Mind	Brain
Stability	Change
Continuous	Discontinuous
Quantitative	Qualitative
Cognition, reason	Emotion
Universal	Particular

Relational meta-theories refuse to cooperate with this way of thinking. They start by labeling all of these "versus" issues as false dichotomies. They say things designed to make scientists raised in the Cartesian worldview scratch our heads, things like—"nature and nurture *are* opposites, but they are *not* opposites." This may remind us a bit of the time we spent with dialectics—where contradictions not only abound, but they are good news-- designed to be synthesized into new wholes. From a relational perspective the perennial issues in Table 13.2 are *false* dichotomies, because they are actually *complementarities*—meaning that they are two sides of the same coin. So "heads" *is* opposite from "tails;" but at the same time, they are also *not* opposites—they are two sides that are inextricably tied to each other, and actually require each other as two poles in a higher order thing called a "coin."

Believe it or not, this is the way that relational meta-theories see all these complementarities. When you ask a question like "What part of this speech act is *biological*?", the answer is 100%-- speech is fully embodied and every bit of it requires the vocal apparatus, the brain, the facial expression, the sound production. At the same time, the answer to the question "What part of this speech act is *psychological*?" is also 100%-- speech is an intentional act that requires ideas to be expressed, goals for the communication, a vocabulary, and so on. At the same time, the answer to the question "What part of this speech act is *social*?" is also 100%--speech is an interpersonal act that requires a consideration of the listener, previous communications, and so on. You can probably already guess the answer to the question "What part of this speech act is *cultural*?"; of course, the answer is also 100%-- the very language used for the speech act as well as conventions like how loudly one speaks or how long one waits for an answer are completely culturally dependent.

How can everything be 100% biological, 100% psychological, 100% social, *and* 100% cultural?

The core idea of relational meta-theories is just like the dialectical meta-theories we covered in the previous chapter. These seeming opposites *are* opposites, but they are not *just* opposites—they are also complementarities. "Life" is the opposite of "death" all right, but they also take their meaning from each other (try to explain "death" without reference to "life" and you will see what we mean) and together they mutually constitute the "circle of life." "Confusion" and "clarity" are opposites, but they are also integral parts of a process we call "learning" or "understanding." We sometimes tell our students that "confusion" is the dawning of understanding, just as "clarity" is a temporary state from which we can learn more until we become confused again.

In fact, interestingly enough, all of these bipolar opposites are continually waxing and waning at the same time (Sameroff, 2010). A good example of the simultaneity of opposites can also be seen with aging, as codified by some birthday cards, which cheerfully state on the front—"Happy birthday—this is the oldest you have ever been" and then on the inside console you with "and the youngest you will ever be." We laugh because this seeming paradox is so obviously true. "Day" and "night," "dark" and "light," and all our favorite opposites also fit together to make a whole of which each opposite is a defining feature, and which are always both moving together in opposite (complementary) directions. Proponents of relational meta-theories are always saying mystifying things like "the mind is part of the body and *more* than the body" or "culture creates personhood and people create culture."

They even conclude that "people are completely biological *and* completely psychological *and* completely social *and* completely cultural," using hyphenate expressions like "biopsychosociocultural" to emphasize the interpenetration of these forces. What allows them to say this with a straight face and mean it, is the realization that these attributes are not mutually exclusive characteristics of some pure underlying elements. If we use split thinking and consider them as mutually exclusive attributes, it's like asking the question—"Which of our bricks are rectangular, which are square, and which are round?". We can put them in separate piles and count. However, from a relational perspective, the attributes of "biological," "psychological," "social," and "cultural" are *not* mutually exclusive. They are *complementary*—because we say something is "biological" does *not* mean that it is *not* "cultural." It is as if, when looking at our bricks, we are asking "Which ones have a shape?," "Which ones have a color?," "Which ones have a texture?". We cannot put all the bricks with a shape in one pile and those with a color in a separate pile. They all have 100% of all of these attributes.

Does this mean we are always studying "biopsychosociocultural" globs?

Well, yes. But they are not really "globs"—they are organized wholes. And we can get some purchase on them by studying them from different "standpoints" or "perspectives" (Overton, 2013). We can focus on the aspects of our phenomena that are "biological" as long as we remain mindful that this phenomena, whatever it is, is also completely psychological, social, and cultural at the same time. So we can study a part of the brain as long as we keep in mind that it is fully embodied and is constituted by and functions through interactions with other parts of the brain, the rest of the body, the psyche, other people, and the cultural context. From this perspective, we have to re-conceptualize all of our phenomena, so that we no longer see ourselves as studying separable parts or "variables," like cognitions, emotions, beliefs, or relationships, but instead realize that we are studying facets of an organized biopsychosociocultural whole; and that these facets may be better referred to as the cognitive, emotional, belief, or relationship "subsystems." From this perspective, we can never understand the facet we are interested in by looking *only* at that facet. It is as if we get to study the elephant's tail as long as we keep in mind that it is part of the elephant and not a "rope."

Where does Relationism fit on our meta-theory map?

Overton (2006) argues that relationism represents the principled combination of organicism and contextualism, and so takes us farther into the upper right quadrant of our meta-theory map (see Figure 8.9). That Overton sees relationism as a combination of other meta-theories may seem surprising, since in earlier chapters it seemed like we were not allowed to simply pick our favorite parts of each meta-theory and create an "eclectic" mix for our own use. This prohibition seemed to be based on the idea that, because each meta-theory is made up of interlocking assumptions about reality and ways of knowing, the resultant idiosyncratic combinations would likely be incoherent systems of thought-- "Franken-meta-theories." In fact, Overton agrees that this is typically the case--in previous attempts to combine organismic and contextual worldviews, for example, this was accomplished by starting with one of these meta-theories as whole, primary, and correct, and then distorting the other subservient meta-theory so that this deformed version can easily be grafted onto the "primary" meta-theory. This is why such attempts have been so unsatisfactory—especially to those whose meta-theory is considered subservient.

In contrast, in Relationism, these "opposing" meta-theories are seen as complementary—each is "right" and "whole" in itself but incomplete; and they are indeed opposites; but they can also both fit together as parts within a larger whole; in fact, they need each other to create this *more* complex and complete whole. But they can only be combined if they share some common overarching principles. What the two "opposites" of organicism and contextualism have in common is that they do not assume a "split" worldview. They both agree that the world is not composed of smaller elements that are additively combined. Organicism differs from Maturational meta-theories in that it refuses to privilege the genetic program and assert that development is a process of preformistic unfolding. And Contextualism differs from Mechanistic meta-theories in that it refuses to privilege the environmental program and assert that change is a process of contingent responding.

What are the principles that allow organism and contextualism to be unified?

The integration relies on two basic principles (Overton, 2007). The first principle is "holism," or the idea that systems are organized and integrated wholes, and not just collections or aggregations of parts. Since people are a great example of systems, it follows that people, too, are organized and integrated systems whose wholes are greater than the assembly of their parts. The second principle is that living systems are inherently active or dynamic; they are open systems that exchange energy and nutriments across their boundaries with their environments. Again, as applied to people, this means that humans are inherently active and naturally initiate exchanges with their contexts.

In fact, the organism, its action, and its context can be considered a relational dynamic system. As explained by Overton (2007), when we focus on the *organization* or *structure* of this system, we are using the organismic lens within the relational meta-theory: From this perspective action is an *expression* of the underlying organismic system and "the system is self-organizing in the sense that through its actions it *transforms* its organization in a non-linear dialectic fashion… A basic category of organicism is change – development – but it is change of organization – transformational change – that is the focus of interest here" (p. 157).

At the same time, these actions serve an instrumental function in moving outward and contacting the world. When we focus on the *instrumentalities* or *functions* of this system, we are using the contextual lens within the relational meta-theory. The effects of actions always depend on "particularities" of the specific acts in relation to their local settings and contexts. As explained by Overton,

> A central feature of any part-act is that it is 'linear' in that it has "a point of *initiation* [the organism in our integration], a transitive *direction*, and achieves an ending or *satisfaction"* [Pepper, 1942, p. 252]. When settings or context 'block' part-acts from achieving an adaptive ending behavioral variation or 'disorder' results, 'order' being a completed adaptive act. The variation arising from blocking – the 'dispersion' or differentiation of contextualism– identifies the central category of 'change' in contextualism, and it yields an 'emergent' 'novel' act which again moves towards the adaptive goal.
>
> The relational integration of organicism-contextualism becomes complete when it is recognized that the novel act that achieves the adaptive goal in turn feeds back to the self-organizing system and provides the nutrients for further system reorganization and transformation. Thus, the movement from system to acts to system constitutes the 'circular causality' of the dynamic systems perspective. The circle, of course, is in actuality a spiral as the movement towards increasing states of adaptation is an endless dialectical process in the development of living systems. (p. 158)

Within the Relational worldview, Organicism (with its focus on the structural connections between the person and their actions) and Contextualism (with its focus on the “dance” between acts and their contexts) seem like opposing perspectives, as depicted in the first rows of Table 13.2. Organicism focuses on the universal, the necessary, structure, and organization, whereas Contextualism focuses on the particular, the contingent, effective action, and functionality (Overton, 2007). Of course, they *are* opposites, and (by now we should be used to this), of course, they are also *complementarities*: They each take change as a given, assume holism, and focus on emergence and novelty through processes of differentiation and integration. How they instantiate these propositions differs, as depicted in the bottom rows of the table, but they work together to create the whole—the nonlinear dynamic system that is developing.

Table 13.2. Principled integration of organicism and contextualism.

Organicism	**Contextualism**
AS OPPOSITES	
Universal	Particular
The necessary	The contingent
Structure	Acts in context
Form-pattern	Functional Cause
Integration-differentiation	Differentiation-integration
AS COMPLEMENTARITIES	
Change as categorical	
Transformational change	Variational change
Holism	
Parts-whole of self-organizing system	Parts-whole of the adaptive act
Emergence and Novelty	
Emergence of system properties in the transition from one state to another	Novel acts that arise during variational activity in dealing with “blocks” to goals
Integration and Differentiation	
Self-organizing system’s movement from integration to differentiation to increasingly adaptive states of integration	Variational differentiation engendered by resistance ultimately leads to the integrated adaptive act with more differentiated flexibility

What does the relational meta-theory offer in terms of causal explanation?

In relationism, it is hardly surprising that causation is found in the simultaneous working together of these facets of the organism, their actions, and their contexts. As Overton explains,

> the concepts *reciprocal determination* (Overton & Reese, 1973); *co-action*, (Gottlieb et al., 2006), *fusion*, (Greenberg, 2011; Partridge, 2011) as well as *relational bidirectional* (<–>) *causality* (Lerner, 2006), *relational causality* (Gottlieb, 2003), and *circular causality* (Witherington, 2011) are relatively similar terms used to differentiate the positive and negative feedback loops of relationism from additive (even bidirectionally additive) causality of the Cartesian-Split-Mechanistic worldview (2013, p. 99).

The core explanatory process begins with the reciprocal exchange between the active intentional person and the integrated local (often social) context in the here-and-now, which proponents of relationism refer to as *experience*, or "embodied organized intentional action" (or for levels below the goal-directed person, "activity") (Gottlieb, 2006; Lerner & Overton, 2014). This process is both organized and dynamic. It takes its *organization* from several sources: locally from the goals of the organism, the affordances in the context, and the sequence of exchanges in the episode; as well as globally from the current developmental state of the organism, the history of previous exchanges, and the relationships of the individual with the social partners in with this context. The process gets its *dynamics* from the exchanges or the "dance," as individual goal-directed actions meet (often goal-directed) affordances or resistance from the context, and individual and contextual goals or agendas are realized or stymied, then pursued more vigorously, modified, or abandoned.

Co-Action in Probabalistic Epigenesis

A depiction of such co-action, provided by Gilbert Gottlieb in his ground-breaking work on developmental psychobiology (1992, 1996, 2006, 2007), can be seen in Figure 13.1. This figure contains three important messages about how development works. First, from a psychobiological systems perspective, "individual development [i]s hierarchically organized into multiple levels (e.g, genes, cytoplasm, cell, organ, organ system, organism, behavior, environment) that can influence each other" (Gottlieb, 1996, p. 63). Second, these co-interactions are both horizontal (from part-to-part on the same level of organization) *and* vertical (from whole-to-part and part-to-whole across different levels of organization). "The traffic is bidirectional, exclusively neither bottom-up nor top-down" (p. 63). Third, based on the system's organization, the vertical "co-action" of any given set of elements is constrained to neighboring levels-- the level immediately above and immediately below the one where the elements reside. As can be seen in the figure, the vertical arrows only go up one level and down one level. All their effects on nonadjacent levels are mediated by the levels between them.

These ideas (and the innovative research that underpins them) have revolutionized our understanding of the functioning of genes. As might be expected, a psychobiological perspective argues that genes are an integral part of all human systems. However, the standard view held by many psychologists about how genes participate—in which genes work exclusively from the bottom up and directly express psychological characteristics—has turned out to be wrong. Instead “their activity (i.e., genetic expression) is affected by events at other levels of the system, including the environment of the organism” (p. 63). And the immediate effects of genes are limited to the production of proteins. These activities must make their way to the level of the cytoplasm, where they are combined with the effects of higher and lower level activities.

As a result, the “genetic program” is not a program or a blueprint at all. The activity of genes or cells or any parts of humans systems their cues from their local environment. A fascinating example can be found in Gottlieb’s research in experimental embryology. In this work, researchers transplanted cells from one part of the embryo to another, and observed that the same cells, if transplanted to the back would develop as back tissue, whereas if they were transplanted to the wing, they would develop as wing tissue (i.e., they would differentiate according to their new surround). This led researchers to the concept of “*equipotentiality* of cells,” meaning that cells were not preprogrammed to become one kind of tissue or another, instead they were available to develop in many different directions depending on their interactions with their local context. One of the most interesting parts of this work was the issue of *timing*. If the cells were transplanted early enough, they would develop into tissue according to the new surround. However, if they were transplanted later, they would grow into tissue from the original surround, and wing tissue would appear on the back or vice versa. So there seemed to be some kind of a threshold or point of no return, after which the cells had been “committed” to a particular developmental pathway that was no longer as flexible.

Thus, as concluded by Gottlieb almost 20 years ago, “the concept of the genetic determination of traits is truly outmoded” (1996, p. 64). Or as we might say in the vernacular, “Genes do *not* cause blue eyes.”

Insert Figure 13.2 about here

Overton and Lerner (2014) summarize the relational meta-theory very neatly:

[T]he relational developmental systems paradigm characterizes the living organism as a spontaneously active, self-creating (autopoetic, enactive), self-organizing, and self-regulating nonlinear complex adaptive system. The system’s development occurs through its own embodied activities and actions operating in a lived world of physical and sociocultural objects, according to the principle of probabilistic epigenesis. This development leads, through positive and negative

> feedback loops created by the system's action, to increasing system differentiation, integration, and complexity, directed toward adaptive ends. (p. 64)

What is the idea that humans are "active" such a big deal?

Agency
Believe it or not, the postulate that humans come with intrinsic motivations, with inherent

Where do all these new terms come from?

Mostly from philosophy and philosophy of science. Although we have tried to explain these ideas using everyday language and common sense examples, we also provide an index of some of these terms in Table 13.3, for those who want to be able to read original sources on these ideas. Once you become accustomed to their meaning and usage, they may come in handy to frame discussions of our own assumptions and ideas. In class, our students have been known to react to others' theories with comments such as, "How reductionistic!"

Table 13.X. Glossary of Terms for Relational-Developmental Systems (from Overton & Ennis, 2006)	
Ontology	View of the nature of reality. The philosophical study of the nature of being, becoming, existence, or reality, as well as the basic categories of being and their relations.
Epistemology	View of the ways of knowing. The philosophical study of the theory of knowledge, especially with regard to its methods, validity, and scope.
Splitting	Separation of components of a whole into mutually exclusive pure forms that are taken to describe basic elements (p.145)
Foundationalism	View that there is ultimately a rock bottom unchanging nature to reality
Atomistic	View that this rock bottom is composed of elements (the atoms of atomism)- pure forms- that preserve their identity regardless of context (p. 145)
Simple complexity	All complexity is simple—any whole is taken to be an additive combination of elements (p. 145)
Reductionism ***Analytic attitude***	Decomposition is the best method for understanding—breaking an aggregate down to its smallest pieces

Reassemble	Unidirectional and linear (additive) associative or causal sequences All determination is efficient cause, acting alone or in conjunctive plurality (i.e., additive) (p. 145)
Dualism	Fundamental antimonies or incompatibilities between pure forms (p. 146)
Holism	Assertion that the identities of objects and events derive from the relational context or system in which they are embedded. Whole is an organized and self-organizing system of parts, each part being defined by its relations to the other parts and to the whole (p. 146)
Organized complexity	Whole is product of nonlinear dynamics. Whole of system is not decomposable into elements arranged in additive linear sequences or cause effect relationships (p. 146)
Identity of opposites	Fundamental opposing parts are the same because they both represent a differentiated co-equal bi-polarity of a unified inclusive whole (p. 147). These parts mutually define and interpenetrate each other (p. 148)
Opposites of identity	Opposing parts each exhibit unique, exclusive, and individual features that differentiate each from the other as complementarities (p. 149)
Standpoints ***Points of view*** ***Lines of sight***	Engaging fundamental bipolar concepts to create stable frameworks that act as platforms for launching scientific inquiry (p. 149). Points of view on an object of inquiry that has been both created by, and will only be fully understood through, multiple viewpoints (p. 150).
Synthesis of wholes	Recognition of novel higher-order systems that will coordinate the two contradictory bipolar oppositional (sub)systems.

Where did the relational meta-theory come from?

According to Overton, “Relationism finds its historical origins in Aristotle’s insistence that form and matter cannot be separated into two discrete elements, and later in Kant’s attempt to reconcile empiricism and rationalism and in Hegel’s elaboration of dialectical logic” (2013, p. 97). Current proponents of this view can be found across the spectrum of the social and natural sciences (see Lerner, 2006, 2011, 2012; Overton, 2006, 2013; Witherington, 2007, 2011, for examples). In recent western science, Lerner (2012) traces the history of relational developmental systems meta-theories from the late 1800s to the present time, and argues for the emergence of this view from a variety of clusters of theory and research in philosophy, biology, sociology, medicine, and economics, as well as in psychology—based on approaches as varied as lifespan development (Baltes, 1987), action theory (Brandtstädter, 2006), ecological systems (Bronfenbrenner & Morris, 1998), developmental systems (Ford & Lerner, 1992), and probabilistic epigenesis (Gottlieb, 2006, 2007). Perhaps the most widespread family within relationism can be found in nonlinear dynamic systems (Fischer & Bidell, 2006; Greenberg, 2014; Hollenstein, 2011; Spencer et al., 20006; Thelen & Smith, 2006).

What is "action theory"?

Action theory is an approach with a long European tradition (Brandtstädter, 2006). One of its most important tenets is that the unit of analysis for developmentalists is *not* behavior, but "action" which refers to goal-directed emotion-infused behavior. The idea is that the same behaviors can have different meanings depending on the intentions of the actors (e.g., waving one's hand can mean "good-bye" or "there is a fly bothering me"). "Actions" are the means through which an individual interacts with the social context, as well as the targets to which the social and physical contexts respond. So action theorists do not think it is useful to divide up behavior, emotion, motivation, perception, attention, and cognition, because all of these together are coordinated to create wholistic "actions" expressed in specific contexts.

As explained by Brandtstädter, "through action and through experiencing the consequences of our actions, we construe representations of ourselves and of our material, social, and symbolic environments, and these representations guide and motivate activities, which shape and influence our behavior and personal development. Action thus forms development, and development forms action: The individual is both the active producer and the product of his or her ontogeny" (2006, p. 516).

In the larger picture, "[t]he actional stance seems to offer a vantage point for integrating developmental and cultural perspectives. In fact, the concepts of development, culture, and action are intrinsically related… Development, as the result of personal and collective activity, is essentially a cultural product… Conversely, actions, and self-regulatory activities are dependent on developmental change; the goals, values, and beliefs that motivate and direct such activities change under the joint influence of ontogenetic and cultural-historical factors. Similar conceptual and functional links also relate the domains of action and culture. Cultures are the collective result of individual actions and decisions, even though the long-term and cumulative dynamics of cultural evolution and chage generally are beyond the grasp of any single individual… On the other hand, cultures form action spaces… that shape possibilities, outcomes, and meanings of actions, and cultural institutions consititute certain types of actions" (Brandtstädter, 2006, p. 517).

What are the take-home messages from relational meta-theories?

We would highlight four points. First, relational meta-theories explicitly ***reject dualisms*** or “splits”—they view apparent opposites (such as nature vs. nurture or mind vs. body) as false dichotomies that are *not* mutually exclusive, but instead are mutually constitutive complementarities. Second, relational meta-theories are a ***principled combination of organismic and contextual meta-theories*** that views each one as “whole” and “correct,” but also as complementary parts of a greater whole, that share common core assumptions of holism, change as a given, emergence, and the dialectic between differentiation and integration. Third, development is assumed to emerge from an active agentic biopsychosociocultural person interacting with an organized “agenda-fied” social cultural context through a ***process of “action” or “activity.”*** Fourth, proponents of relational perspectives argue that this meta-theory is an ***umbrella home for a wide variety of approaches***, including all the meta-theories we have explored so far in this section—lifespan and life course perspectives, ecological and bioecological models, transactional, dialectic, and Werner’s organismic approaches, action theory, probabilistic epigenesis, developmental systems, and nonlinear dynamic systems.

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Chapter 14. Nonlinear Dynamic Systems Meta-theories

Although we developmentalists seem to be able to keep ourselves busy finding and answering a multitude of interesting questions, at the heart of developmental study there is only a single million-dollar question, one that has proven so challenging that we often forget that it is the one we should be trying to answer. The core question is one of qualitative change, novelty, or *emergence*—stated colloquially, “How (in the world) does something come from nothing?” We look at the sperm and the egg, at the fetus, the newborn, the 4-month-old, the 4-year-old, the 14-year-old, and so on, and we think, “If someone came from a different planet and looked at each of these different creatures—would any of our visitors even *guess* that these beings are all the *same* organism, just at different points in their development?” The organisms captured in each of these snapshots seem so *fundamentally different* from each other, not just in amount or size, but in *kind*, that no one could possibly imagine that they are all stills from the same movie.

Moreover, however these new qualitatively different forms are being created, they seem to be constrained to a pretty narrow prototype. In the vast majority of cases, the humans that are created from egg and sperm look remarkably like each other (and not like dogs or our alien friends), just as the 4-month-olds are so similar we can compare them on motor and behavioral “norms” (and be assured that none of them are playing sonatas on the piano); the 4-year-olds are similar enough that we can teach a pack of them in the same classroom with the same sets of activities (and agree that none of them can be trusted to drive a car); and if we looked at their silhouettes or writing samples, we could pick out the 14-year-olds from the 4-year-olds without any difficulty whatsoever. And so, the million dollar question is not only why *novel* forms emerge, but also why the novelty that does continually emerge is not just any old novelty, but a *regular range* of novel forms.

Proponents of nonlinear dynamic systems (NLDS), more than any other meta-theory, have taken on this question, and they contrast their answers to those of alternative metatheories, whom they depict as ascribing to assumptions of “design.” “Design” notions hold that the new development, the novelty, is so remarkable and at the same time so regular that it must be based on a pre-existing internal or external plan, pattern, or template (the “design”) that gets activated at a specific age. One kind of meta-theory that entails design is called “pre-formist” because researchers assume that the specifications for these new developmental forms are contained (“pre-formed”) in some part of human biology—a favorite location is the genes (e.g., genetic blueprints) or other parts of neurophysiology (e.g., biological predispositions). This assumption can be seen very clearly in the “seed” metaphor of maturational meta-theories, in which instructions for the design and the timing of all new developments are contained in the person’s nature (their seed), and these patterns unfold according to plan as long as the environment provides its background nutriments (analogous to soil, sun, and water).

A second kind of meta-theory that includes the notion of pre-existing design assumes that the instructions for the new pattern or form are located in the environment—in the goals and plans of socialization agents and culture. According to this perspective, “information” and “structure” from the context are internalized or imported to the inside at certain key ages, and used by the organism as a template for the new development. These ideas can be found in mechanistic meta-theories, which assume that environmental programs create the pre-specified pattern of behavior changes according to culturally established “social clocks.” From this perspective, it is as if external agents have previously written the musical score for the new development, and the individual just plays along as instructed by teacher according to the notes on the page and the conductor.

Okay, if there is no design, then what is there?

Proponents of NLDS and other forms of relationism decisively reject these kinds of design assumptions. They argue that there is *no* pre-existing design—none, anywhere—not in the gene or biology nor in socialization or culture. And, by the way, the guiding question is not “How does something come from *nothing*?” but “How does something new come from *something else*?” From this perspective, the “something else” is the complex system made up of the organized integrated biopsychosociocultural person and their interactions with the organized integrated environment. NLDS and other forms of relationism assume that such systems are actively “self-organizing,” in that from the functioning, or working together, of the parts of this system (its dynamics), the “something new” (the nonlinear change) spontaneously arises—without prior planning or design. As explained by Marc Lewis,

> Dynamic systems theorists claim that all developmental outcomes can be explained as the spontaneous emergence of coherent, higher-order forms through recursive interactions among simpler components. This process is called *self-organization*, and it accounts for growth and novelty throughout the natural world, from organisms to societies to ecosystems to the biosphere itself. According to principles of self-organization, these entities achieve their patterned structure without prespecification by internal rules or determination by their environments (2000, p. 36).

How does this happen?

Lewis goes on to explain that, “When these systems are far from equilibrium (and this is inevitable in biological systems), the rapid flow of energy links their elements into orderly arrangements (Prigogine & Stengers, 1984). At the same time, such links give rise to positive feedback cycles which amplify local patterns into macroscopic regimes” (2000, p. 38). *Emergence* is the term NLDS theorists use to refer to “the coming-into-existence of new forms or properties through ongoing processes intrinsic to the system itself” (2000, p.38). It is the spontaneous recursive interactions among the parts of the system, in the service of a function (e.g., a goal or activity of the system) that allow this new form to be assembled, used, practiced, and refined.

At the same time, the higher-order organization that emerges also acts to constrain and shape the lower-order elements that gave rise to it. As Lewis explains,

> this pattern of coordination is recruited in the service of a unique function, and this maintains and reinforces its links over time. New macroscopic forms and new patterns of microscopic coordination *cause* one another in self-organizing processes (Haken, 1987), providing nature with a marvelous means for creating what was not previously there. Thus, structure does not have to be imported into a system from outside, as presumed by learning approaches, nor preordained from within, as presumed by nativist approaches. Structure is emergent.
>
> Self-organizing systems [also] become more complex. Their increasing orderliness means that they can maintain a more sophisticated arrangement of coordinated parts or processes, and they do so spontaneously in the service of adaptive functions. From the [dynamic systems] perspective, it is no accident that increasingly complex developmental forms are also increasingly functional, because new functions are precisely what are needed to maintain new coordinations (2000, p. 39).

These top-down processes are called *entrainment*, because the emergent higher-order organizations constrain the lower-order elements they contain, selecting which ones will be recruited and shaping how they will interact. As Lewis explains, “new forms spontaneously appear with time, entraining the interactions of the elements that give rise to them” (2000, p. 39). For example, as explained by Bowlby’s theory, the lower-order interactions between a typical caregiver and her newborn, over time, give rise to a feeling of *attachment* or love; in turn, the emergence of this higher-order feeling of affection shapes the subsequent functioning of the very interactions that gave rise to it. From this perspective, as pictured in Figure 13.2, self-organization involves two processes: a bottom-up process of *emergence* and a top-down process of *entrainment*. This is an example of the kind of dialectic that relationism seems to favor. In answer to the question—“Is self-organization a process in which parts shape their wholes or a process in which whole shape their parts?"—the answer is "Yes."

Insert Figure 13.2 about here

What are some examples of "emergence" in psychology?

Once you get the idea, they are everywhere. Just think of any of the proximal processes were discussed in the bio-ecological model. Remember how they influenced development? Then think of how that development, once it emerges, can shape the proximal processes that gave rise to it. For example, let's say that I am interested in teacher burn-out, and so I identify a whole raft of social interactions that teachers have that may contribute to burn-out—interactions with students in the classroom who are disaffected, with parents who are unhappy, with peers who are mean, with principals who are demanding. If I keep my teachers in this toxic proximal process stew for very long, they are more likely to become burned out. The teacher started their career enthusiastic and excited about teaching, but over time, a qualitatively new state appeared- burn-out. That's the bottom-up process of emergence—from the working together of the "workplace system" of the teacher, a state of teacher burn-out emerges. Something new from something else, right?

But let's keep going—what happens when a teacher is burned out (defined as emotionally exhausted, helpless, and starting to depersonalize their students, parents, and colleagues)? A burned-out teacher, who sees her job as one weary impossible demand after another? In the classroom an din interactions with parents, colleagues, and administrators, she may become mentally absent, stop exerting effort, only go through the motions, become irritated and abrupt, or otherwise show emotional distress. This new state of burn-out, once it emerges, starts to shape all the proximal processes that led up to it, through a top-down process, it is *entraining* them, and consolidating or amplifying the negativity in the interactions, and likely exacerbating teachers' burn-out.

Other examples of emergence and entrainment can be found in research on appraisals, like self-efficacy and learned helplessness. When people (or any mammals for that matter) spend time in interactions with the environment where their behaviors are not contingently connected to desired outcomes (i.e., prolonged experiences of noncontingency), they eventually come to believe that their actions are ineffective and the environment is nonresponsive. These kinds of proximal processes (non-contingency) lead to the bottom-up emergence of a particular pattern of appraisals (learned helplessness). In turn, these convictions lead to expectations of non-contingency that then shape (i.e., entrain) future interactions with the environment. Specifically, when they run into any resistance, people are likely to give up, even when contingency is objectively available. Giving up, of course, cements or intensifies the experience of noncontingency, that is, of helplessness.

And do all NLDS approaches agree on how self-organization happens?

No. A very interesting area of contention can be detected about the crucial issue of *explanation* or *causality* (Witherington, 2007, 2011). Although proponents of NLDS all agree on the idea that the emergence of qualitatively new higher-order patterns or organization of wholes is caused by the bottom-up working together of their parts, they disagree about the extent to which this kind of development requires any *top-down* processes. David Witherington provides a cogent explanation of the two camps involved within the dynamic systems perspective (DSP) and even provides them with labels:

> Two camps do indeed characterize the current DSP landscape, but these camps adopt fundamentally distinct world views regarding the nature of causality and explanation. As Lewis [2000a; see also Kelso, 1995] suggests, the principle of self-organization is foundational to the world view the DSP promotes, but the specific nature of self-organization involves different ontological premises depending on the camp involved.
>
> One DSP camp, purely contextualist in orientation and associated most clearly with the writings of Thelen and Smith, weds its analysis to action in the context of the here-and-now, rejects higher-order forms as explanatory in the sense of formal and final cause, reduces developmental time to real time, regards as illusory the orderly, directional flow of development viewed in macroscopic terms, treats emergent patterns as epiphenomenal, and regards the process of self-organization in exclusively bottom-up terms. The other DSP camp represents an integration of metatheoretical approaches, specifically the contextualist and organismic world views, and finds its most cogent instantiation in the writings of Marc D. Lewis and Kurt Fischer and his colleagues [for a discussion of contextualist and organismic world view integration, see Overton & Ennis, 2006]. This camp, by virtue of its world view merger, fully admits higher-order forms into its explanatory framework, integrates the emergent pattern into the nexus of causal relations, embraces all forms of causality – efficient, material, formal and final – as distinct but legitimate types of explanation, considers developmental time as emergent from but irreducible to real time and regards the process of self-organization in both bottom-up and top-down terms via circular or interlevel causality (2007, p. 129).

This organicism-contextualist camp, also referred to as relational-developmental, is adamant that *both* bottom-up *and* top-down processes are essential in creating development, and they label the kind of causality that goes in both directions as "*circular causality*." As Witherington explains,

> Circular causality assigns causal status to both bottom-up and top-down processes and in particular highlights the distinct mechanisms of cause involved in each. Bottom-up processes involve part-part interactions, in which components interact with one another to generate a higher-order system or whole. This is the hallmark of emergence. Top-down processes, in which the emergent form organizationally frames the very parts that give rise to it, exist at the level of whole-part relations and operate in terms of constraint: emergent wholes constrain and regulate their component parts. Once a novel whole emerges, the very natures of the components that comprise the whole must always be defined, at least in part, in terms of the higher-order whole in which the components are embedded (2007, p.

138-139).

Why is "circular causality" so important?

Witherington speaks for organismic-contextualists when he argues that,

> In essence, taking emergence through self-organization seriously requires a full appreciation of the reciprocal structure-function cycle that is circular causality [Juarrero, 1999; Lewis, 2000a]. As a fundamental feature of complex systems [Kelso, 1995], circular causality involves a perpetual and simultaneous bottom-up and topdown rendering of emergence through self-organization, or in Thompson's [2007] words, both 'local-to-global determination (the formation of macrolevel patterns through microlevel interactions) and global-to-local determination (the constraining of microlevel interactions by macrolevel patterns).' (2011, p. 336)

He tries to explain how "strict-contextual" perspectives on dynamic systems were waylaid in their rejection of the top-down or "whole-to-part" side of circular causality. Contextualist views are focused on only two kinds of causality—"material cause" in which the substance of a system influences how it functions; and "efficient cause," or generative transmission, in which antecedent forces exert a "push-from-behind" to influence subsequent effects. Organismic-contextualists differ from contextualists because they also include the other two kinds of causes described by Aristotle, namely, "formal" cause which refers to the causal influences of the organized whole, for example, the current developmental level of an organism; and "final" cause which refers to the future ends, purpose, or function served by the system.

Aristotle's Four Kinds of Causes of Change

Cause	***Definition***	
Material	"that out of which"	Substance of which an element is composed.
Efficient	"the primary source"	Generative transmission, in which an antecedent exerts a force to produce consequence.
Formal	"the form of what-is-to-be"	The complete nature or structure of which an element is part.
Final	"that for the sake of which"	The end, aim, purpose, or function.

However—and here's where they go wrong-- contextualists back-translate the meaning of these kinds of more abstract causes through the lens of material and efficient cause—for example, they turn a formal abstraction like a developmental structure, into a material object in the child's head or brain that produces behavior; or they convert the abstract notion of a developmental progression into an efficient cause that is posited to pull an organism along a predetermined pathway. Then contextualists soundly reject both of these kinds of causality because they imply preexisting designs—in the head or in the future plans of the organism.

But organismic-contextualists see this as seriously reductionistic- because they believe that contexualists are reducing formal and final cause to material and efficient cause, and because they are reducing transformational development to an accumulation of sequences of real-time change. Organismic-contextualists see "downward causality" as the other half of the causal loop that makes circular causality, and so see formal and final cause as essential causal forces that can't be reduced, and that are both opposite and complementary to the "upward causality" created by material and efficient causes.

If downward causality doesn't push or pull anything, how does it influence development?

Higher-order structures influence development through the organizing effects that wholes can exert on the parts they contain. Using terms like "constrain" and "entrain," the core idea is that a higher-order pattern *selects* which parts of a system will be active and how these parts will interact with each other. In other words, it selects the substances that will be in play (and so shapes material cause) and the interactional possibilities that will be realized (and so shapes efficient causes). The same lower-order constituents can participate in creating many different higher-order wholes. As Witherington (2011) explains,

> A system's organization affects the distribution of its components by activating certain lower-order processes and not others; thus, the nature of local interactions cannot be fully understood in the absence of the organizational whole in which they are embedded [Murphy, 2009]. The components of a system take on new

> identities by virtue of their part-to-whole embeddedness in the system qua unified system, not solely through their part-part interactions with other components of the system. (p. 75)

There are many examples of how higher-order wholes shape the lower-order parts that comprise them. A classroom at school is a whole that is made up of the teacher and students it contains (its parts). At the same time, each class as a whole takes on its own personality or climate—certain properties that distinguish one class from another (e.g., its warmth, its focus on academics, its competitiveness). The exact same student will develop differently depending on the different kinds of classrooms in which he or she is placed. The student (the part) will be changed based on nature of the class (the whole) in which they participate. The class climate will draw out different features of the student (e.g., their kindness or competitiveness) and will also shape the way that the student interacts with other students and with the teacher. A particular classroom climate can change the very *identity* of the student, as a person who belongs in school or one who is academically incompetent.

Businesses, families, neighborhoods, peer groups, sports teams, army units, and so on, all have higher-order holistic characteristics, personalities, or climates, and these have effects on their members, by selecting who is allowed to participate, by entraining certain capacities of these members, and by constraining how the members are allowed to interact with each other. All of these are examples of "downward" causality. These principles operate at all levels of systems. When an individual is considered as the target "whole," then holistic attributes like the person's competence or personality constrain the nature of the parts that are available for participation in any activity, which ones will be recruited and how they will work together.

Okay, then how do these four kinds of causes work together?

By now we may be getting used to the reply "All of the above—and simultaneously!"

Witherington quotes Thompson (2009), who wrote “the whole entangled system moves at once and always as a result of both local interactions and the way the system’s global organization shapes the local interactions” (2011, p. 75-76). As a result,

> Aristotle’s four modes of explanation – formal, final, material, and efficient – represent unique, equally legitimate, and simultaneously applicable perspectives from which to understand change in natural phenomena. Each causal perspective characterizes a self-contained explanatory set in its own right and is consequently irreducible to all other casual perspectives. Similarly, no one perspective constitutes the gold standard of understanding; only when brought together as four unique vantage points taken relative to a phenomenon will the phenomenon be open to complete understanding…
>
> Within the Aristotelian framework, fully explaining how a phenomenon comes into being requires a multifaceted understanding of its form and its function, its material substrate and the surrounding contexts in which it is embedded, its antecedent circumstances and the processes that initiate its becoming. (Witherington, 2011, p. 73)

Why do books and papers on NLDS seem like they are written in an alien language?

All systems approaches have the assumption and the goal of unifying science across disciplines. The good news for psychologists is that this opens us up to the wide world of insights and tools from the many underlying and overarching disciplines that are directly connected to the phenomena we target at the psychological level. The bad news for psychologists is that this community does not speak our native language, namely, “psychology-lese” (or any other disciplinary jargon). It uses terms, like “system” that can apply equally to a drop of water or a civilization. So it has its own unfamiliar multidisciplinary vocabulary. We found that exposing students to some of its key terms, like *state*, *state space*, *control parameter*, and *phase transitions,* using examples from psychology (see box) created a temporary bridge to help them over the concept divide, so they could peruse the many fascinating ideas awaiting there.

NLDS vocabulary: States, control parameters, state space, and phase transitions.
States of a system. An idea central to exploring the ‘dynamics’ of dynamical systems is that of *state*, which is a means for describing a system’s current condition. One way to apply the

concept would be to think of a person as a system, and consider how we could describe a person's current state. There are an infinite number of terms that might be used, such as tired, happy, confused, worried, restless, or alert. In a state representation, we can distinguish between a general state (a characterization of a person's overall condition), and state variables or the multiple component dimensions. A person's general state, for example, their overall good or bad mood, can be described along several component dimensions (state variables), including physiological, behavioral, and emotional aspects. These state variables interact to yield the person's overall condition or state, in this case, their mood.

Changing states. Moreover, the state of a system, like the mood of a person, may change over time. A person can be engaged, then disengaged, then bored, then engaged again. Some of these changes may be gradual (e.g., winding down) and some may appear abrupt (e.g., capturing someone's attention). The progressive history of such changing moods may be plotted, like a series of frames in a movie. In terms of the state representation, this is depicted as a *sequence of states*, and when plotted as a trajectory (in an appropriately defined "state space"), can be particularly useful for characterizing the system's dynamics.

Stable and unstable states. Under certain conditions, many feedback loops are present and the state may be "stable" or likely to persist. In fact, we have names for some of these persistent states, like "rumination." Sometimes the duration of these states makes it appear as if they were enduring traits, but they are continually recreated or maintained by the recursive relationships among the elements. However, some states are not likely to persist, so they are called "unstable" states. Some states are hard to maintain. It is hard to maintain interest in a boring lecture; it is hard to stay mad at a baby; it is difficult to be reasonable when confronted with an unreasonable spouse. Some states are changed intentionally. When in a bad mood, people can work to dispel it: they actively distract themselves, call up a friend, count their blessings. The feedback loops in these states are not reinforcing, they are sometimes called countermanding or countervailing.

Control parameters. However, these state changes, like mood changes, do not happen randomly. They can be caused by physical factors, like exhaustion or hormones; by thoughts and behaviors, like stress or remembering a past slight; by external environmental or social factors, like a good friend coming over or an interesting topic; or by the moods themselves, such as when anger is spent or euphoria wanes. So the concept of state leads to the idea that there are many factors that might work together to shape the state of a system. In fact, states are likely composed and influenced by all these factors at the same time, as they interact with each other. Some of the feedback loops among elements reinforce each other.

So the concepts of ***state, state variables, and relevant environment*** provide a means for representing/modeling the idea that there are factors that determine the possible states of a system. On the one hand, there are factors that are internal to the system, and describe constraints placed on the values some state variables can take based on the values of the other state variables. For example, if one gets too excited, it is hard to also be sad; or if one gets too tired it is hard to remain interested. In this case, the state variables interact, and how they 'work together' is captured via model equations that include coefficients (typically called model *parameters*) for each state variable. In psychology, states and the state variables that compose them are often called multidimensional constructs, and the way they work together is referred to as the "structure" of the construct (e.g., bipolar). On the other hand, some of the factors that influence the states of the system are external, and come from the relevant environment. In psychology, these would be called explanatory factors (or causes or independent variables) and changes in the values they take on would predict or cause changes to the system. These are sometimes called *control parameters*; this terminology expresses the operational aspect that it should be possible to "control" or influence the state of the system by changing this factor.

All constructs are states. The notion of states makes intuitive sense when thinking about a person as the system and their moods as the system's states. However, it is a leap for most students to consider that all systems, whether at the level of the individual, dyad, group or organization, can also be thought of in these terms. For example, the morale in a psychology department can be considered a state of the system that creates it. The productivity of an organization, the quality of a neighborhood, the way a married couple communicates, all can be considered states of the systems that created them. In psychology, we are used to thinking about differences between states as differences between units, inter-individual differences. It required a headset shift to think of different states as changes *within* a single unit over time.

State space. Some of the most interesting states to consider are the states described by proximal processes. If the behaviors of the target person are considered as one state variable and the behaviors of the social partner are the other, these two dimensions can be used to create a surface, along which the movement of the proximal process can be charted. Consider, for example, coercive proximal processes between a parent and a child. If the x-axis is the oppositional behavior of the child and the y-axis is the harshness of the parent, the current state of the (dyadic) system can be plotted as a combination of the parent's and the child's behaviors. Then at the next minute, another combination can be plotted and an arrow, indicating time, can be used to connect the two. A series of these would inscribe a trajectory for the time progress of the proximal process.

Attractors and repellers. It seems as if these trajectories could go in all directions, but they do not. For example, research shows that in dysfunctional families, coercive interactions intensify (Patterson & Banks, 1989): When parents are harsh, children become more oppositional; and when children are uncooperative parents become harsher. Even if one partner begins more positively, the other will take offense and begin to escalate. The fact that these interactions stay in the quadrant where both are negative can be captured descriptively by the idea of an "attractor;" this is an "as-if" device used to describe a set of trajectories that occupy only a portion of the possible state space.

This pattern of change in proximal processes is very different in high-functioning families. In such families, parents are typically firm and respectful in their demands and children typically cooperate. Their trajectories stay in the more positive quadrant of the interaction surface. In fact, when one or the other partner does become negative (either a parent is sharp or a child uncooperative), the other partner does not respond in kind. The child looks surprised or the parent becomes firm, and then the first person looks sheepish and behaves more appropriately. These interactions do not escalate. In fact, the partners buffer each other's negative behavior; they countermand it with positive responses. The attractor for these families seems to be in a different spot.

This system could be described as having two stable states—coercive and cooperative. If families start in the coercive part, they will tend to stay there; and if they start in the cooperative part, they will tend to stay there. There are an infinite number of possible combinations, but the system does not "visit" them—because they are constrained by the dynamics within the proximal processes. It is very hard to remain firm and reasonable when your child is being oppositional; it is also hard to remain hostile when your child is looking at you in shock. These combinations are not stable, over time these interactions will switch: either the reasonable parent will lose it or the oppositional child will cooperate. Over time, repeated interactions will also give rise to the emergence of dyadic states such as liking, attachment, and trust (or dislike, detachment, and distrust). These attributes further constrain (entrain) the operation of the system that created them. Hence, many proximal processes could be depicted with two stable

states, essentially, good news and bad news.
System topography. In considering their state space plots, we asked students to make decisions about the "topography" of the system by describing features of the attractor and repeller states, such as their location, number, size, depth, the steepness of their sides, the height and width of the ridges separating them and so on. They made such maps for the typical state of affairs, and then for a good news system and a bad news system. A good news system has a wide deep well of attraction in the good news location, with steep sides, so it is easy to get in and hard to get out, a tall ridge in front of the bad news well, with gentle sloping sides so it is easy to get out, and maybe some channels running out back to the good news portion. Then students free-associated ideas for what might create a bad news or good new topography for their system, based on the features of interaction partners, contexts, and higher-order units (e.g., exo- or macro-system features) that shape their proximal processes. These were candidates for control parameters for their systems.
Intervention levers. As the role of time was expanded in our discussions, students became aware of the critical role of transitions in understanding the directionality of systems. At certain time points, small differences in a few conditions could have a decisive role in where the system would settle. And once the system had settled into a stable state, with all its attendant interactions and emerging higher-order qualities, even enormous efforts might not dislodge it. So the possibility of searching empirically for those key windows became an appealing research idea, and one that would have important implications for prevention and intervention efforts.

What are our "take-home" messages about nonlinear dynamic systems perspectives?

There are four. The first is that NLDS theorists take on the central challenge of development- the ***explanation of qualitative shifts*** in functioning. Go, NDLS. The second take-home message is that, in explaining qualitative development, they completely ***reject the idea of "design."*** They argue that, based on the *regularity* with which *similar* higher-order organizations appear, other meta-theories either explicitly or implicitly slip in the idea of a "plan," "pattern," or "blueprint" to account for this, sometimes contained inside the biology of the person (called "preformist" because genes or neurophysiology contain the template for future forms) and sometimes contained in the environment (called "pre-programmed" because they contain the information the individual will directly import). NLDS just says "no" to every hint of design.

Instead, and this is the third take-home message, NLDS insists that these ***emerging novel states can be explained by processes of "self-organization."*** Living systems (in our case, the person) are inherently active (i.e., goal-directed) and so are always trying to accomplish something (i.e., a function). This intrinsic motivation creates a flow of energy toward the goal that serves to assemble, from the inherently complex existing system, a wide array of lower-order parts needed to carry out this particular activity at this particular time in this particular context (which is why actions are so variable, flexible, and exquisitely attuned). This is called “emergence” because this organization appears spontaneously and without any design, based on the goal (function), the parts that are available to the organism, and the conditions in the local environment. As this assembly is exercised and practiced, it creates and consolidates a higher-order of organization among the parts, which in turn *entrains* the subsequent functioning of these parts. This organization is novel, wholistic (in that it cannot be reduced to any of the parts), and more complex and adaptive, because it has been tested out and honed through interaction with the context. That’s it—no design. Just spontaneous self-organization—through processes of emerge and entrainment. These dynamics (working together of lower-order parts) spontaneously produce nonlinear changes (qualitative shifts) toward greater complexity and more adaptive functioning, hence the name “nonlinear dynamic systems.”

The final take-home message is that within the advocates of NLDS meta-theories (who are very open about their desire to foment a paradigm shift in developmental science, in fact across all of science), there is still a major disagreement-- about the importance (or even existence) of the downward causality of entrainment. All NDLS theorists are on board with the idea that causality operates from “parts to whole” (emergence through material and efficient causes) but only a subset are convinced that causality operates from “whole to parts” (entrainment through formal and final causes). This subset insists that ***self-organization, by definition, requires “circular causality” that goes in both directions continuously and simultaneously,*** making all four kinds of causes (material, efficient, formal and final) *essential* to a complete explanation of development. As you can surmise by reading this chapter, we are proponents of that flavor of NLDS that insists on circular causality, a kind of NLDS that currently goes under the hyphenate labels of organismic-contextual dynamic systems or relational-developmental systems.

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Chapter 15. Three Big Ideas of Developmental Systems:

The Big Ideas of Levels and Proximal Processes

In many ways it is surprising to see a textbook like this one, whose goal is to advocate for a systems view of developmental science. The principles of a systems approach are not new (Bertalanffy, 1950, 1968) and they are not even particularly controversial. Many social scientists would agree that "everything is a system," and that to understand any phenomena, one must study the systems that give rise to it. All sociological and psychological phenomena worth studying take place at many levels and unfold across many time scales. In fact, the social sciences themselves are organized according to levels: biological and physiological processes; individual processes such as cognition, motivation, personality; dyadic and group level processes such as family relationships, classrooms, work groups; organizations and institutions like businesses and education; society, and culture.

At all of these levels, social and psychological phenomena are structured. At the same time, they evince patterns of change and novelty, as studied in the fields of lifespan development, family development, organizational development, and so on. To some extent, systems principles have reached the status of truisms. A list of systems concepts that are common in in the social sciences, depicted in Table 15.1, illustrates this point. And yet, systems meta-theories have not swept through the social sciences (Greenberg, 2014; Hollenstein, 2011). Despite the significant contributions of systems concepts to many areas, no claims can yet be made about a paradigm shift. There seems to be particular resistance to many of the concepts contained in nonlinear dynamics (van Geert, 2013).

Table 15.1. Some approaches and concepts in the social sciences that are informed by systems meta-theories (in alphabetical order).

Systems Approaches	**Systems Concepts**	
		Micro-, macro-

Adaptive systems	Adaptive, maladaptive	Openness to influence
Developmental systems	Amplifying reactions	Organization
Dissipative systems	Change over time	Patterns
Dynamic systems	Compensatory reactions	Qualitative shifts
Ecological systems	Components	Reciprocal relations
Evolutionary systems	Differentiation	Resistance to change
Family systems	Disorganized	Self-organizing
Living systems	Embedded	Self-perpetuating
Open systems	Emergence	Self-sustaining
Social systems	Feedback, feedback loops	Structure
	Functional	Time dependency
	Hierarchy	Trajectories, pathways
	Individual-level, group-level phenomena	Unit of analysis
	Integration	Vicious cycle, Virtuous cycle

What is holding up the revolution?

We think that one rate-limiting factor is that relational dynamic systems meta-theories seem to be full of contradictions—they are both intuitively obvious and completely foreign; they are both very attractive and very confusing; they seem like the logical next steps along the pathway that developmental science has been taking for the last 100 years and terrifyingly different from everything we thought we knew about our phenomena and our science. Students often feel as if they have wandered into a philosophical or science fiction universe with terms like “mutually constitute,” “strange attractors,” “interpenetration,” “assembly,” and our favorite--“identity of opposites,” and “opposites of identities.” These ideas make it sound like there is no “there” there, that objects are blinking in and out of existence, and the things we are supposed to be studying aren't really things at all. Even the students who love this stuff, often love it at the meta-theoretical or theoretical levels. They could discuss it forever, but they are not really ready to use the ideas to design research or interventions.

Although wrapping our heads around relational dynamic systems meta-theories and *methods* may be a big challenge (hello difference and differential equations!), we believe that the greatest challenge to those of us who share its ontological assumptions about the nature of reality, is in the *research*. The greatest challenge is to work out its epistemological implications—its ways of knowing. That is, how can we use these ideas and tools to actually *look* at our phenomena? If you remember, we argued in previous chapters that scientists really only have two jobs: thinking and looking. We need to think in a way that keeps our minds open to what we are really seeing, and we have to look in a way that can get us to revise our thinking or change our minds all together. So far, visiting the systems meta-theories described in previous chapters have brought into our thinking a large number of fascinating points of view. As a next step, we want to turn these into "vantage points" that can help us focus on bringing interesting views of our target phenomena into our lines of sight. To help our students with this, we often begin by saying that all the interesting ideas in the previous chapters are background (Overton, 2012) and we can consider them as a whole based on three essential relational dynamic systems principles.

What are the essential elements of "systems" approaches?

Books have been written about systems approaches, but in their essence, they are remarkably simple. First and foremost, systems approaches are a way of thinking. They are based on the recognition that everything can be regarded as a system. Structurally, this can be captured by the "Janus principle," namely, that everything can be considered both a part *and* a whole. On the one hand, everything is a whole, in that it is made up of parts that work together to manifest the attributes of the whole. A person is an excellent example of a living system that is made up of many parts. And these are not just any old parts; they are defined by the whole—they are every single part that is required to constitute this particular whole—this person. And they are not put together in any old way. To make a person, they must be organized and work together in very specific ways—exactly the ways that are required if a person is to result. This is what systems scientists mean when they say that “the parts give meaning to their whole.” Any other set of parts would produce a different whole. Since these parts are wholes as well, they can be referred to as subsystems.

On the other hand, everything is a part, in that everything is embedded in other larger wholes. A particular part works together with other subunits to create attributes that emerge at higher levels. People are also great examples of parts; they are parts of couples, families, classrooms, teams, communities, societies. And the person’s identity changes depending on which whole they are part of. As parts of couples, a person becomes a “girlfriend” or “husband.” As parts of families, a person becomes a “sister” or “grandfather.” As parts of classrooms, a “student” or a “teacher’s aide.” As parts of teams, a “forward” or a “running back,” and so on. This is what systems scientists mean when they say that “the whole gives meaning to its parts.” These wholes, since they include many other systems, can be called suprasystems.

Interestingly enough, parts and wholes have the kind of relationship that we are always trying to wrap our heads around—mutually constitutive. The key idea is that a part can only be considered a “part” if it has a whole to be a part of; it needs a whole if it is to be regarded as a part. By the same token, a whole can only be considered a “whole” if it is made up of parts; it needs its parts to make it a whole. Definitions of “system” explicitly incorporate the notion that every unit considered a system has simultaneously two *distinct* characteristics: “whole-ness” and “made up of part-ness” (Lendaris, 1986). Sometimes terms like “holon” are used to refer to the fact that everything is *both* a part *and* a whole.

The basic idea of systems thinking is simple, but the implications are enormous. We sometimes refer to them as the three “big ideas” in developmental systems meta-theories (Skinner & Lendaris, 2007). The first and easiest implication to understand is the idea of embeddedness or *levels*. This is the structural part of a systems perspective. The second idea is that of "working together," or understanding how the structured parts of a system function together. We call this step "*proximal processes*." The third, and most complicated idea, is that this structured working together takes place over time and can generate novel or new forms in unpredictable ways. This is the *dynamics* part of a systems perspective. These are three essential elements of relational dynamic systems meta-theories.

So in creating this class, we took each "big idea," one step at a time, each step building on and incorporating the one before. We intentionally selected systems perspectives that emphasize each of these "big ideas" and focused on the parts of these meta-theories that illuminate its assigned "big idea." The next step is to think about all these ideas at once, as a whole, when creating theories, designing studies, or testing interventions. But before we can do that, we need some tools for keeping our balance in the active world of relational dynamic systems meta-theories.

What are the key tools for keeping our balance?

Systems thinkers want both complexity and clarity. Complexity is easy to accomplish: embed everything in everything else, start them interacting with each other over time, and step back. Clarity is more difficult to achieve. At each step, we suggest strategies for "complexifying" phenomena as well as for "clarifying" this complexity. Probably the most important tool that systems perspectives can add to a researcher's toolbox is "mindfulness." Keeping in mind the embeddedness of every unit under consideration allows the researcher to examine the parts of a system while at the same time being mindful of the whole; or to examine the attributes of the whole while keeping in mind the supra-system of which they are part.

A second important tool of systems thinking is the recognition that any system is defined relative to the perceiver, in this case, the theorist or researcher. We select the target unit and its attributes for conceptualization or study. For psychologists, the focal units are usually people or collections of people, and the focal attributes are usually psychological processes. Once the focal unit and focal attribute(s) have been identified, the psychologist can then see the unit as a system by defining it relative to its external environment and by defining the subunits that work together inside it to create the attribute(s) of interest. Systems views makes clear the inherent interdisciplinarity of the natural and social sciences. The target phenomena of psychologists are embedded in the target phenomena of sociologists, which are embedded in the target phenomena of anthropologists, and so on. Just as the parts of which the anthropologists' phenomena are composed are studied by sociologist, whose parts are studied by psychologists, whose parts are studied by neuroscientists, whose parts are studied by biologists, and so on. The "mindfulness" created by the recognition of this state of affairs, which—once seen cannot be unseen—is the greatest gift of developmental systems meta-theories.

Lessons from teaching a graduate class on systems science and psychology.

The construction of this course benefitted from our experience teaching a graduate course on research in systems science and psychology—actually a course that was co-taught by a psychologist and a systems scientist (Skinner & Lendaris, 2007). From the successes, but especially from our failures, in this course, we learned a great deal about the "zone of proximal development" for uptake of dynamic systems concepts. The most important lessons were:

1. ***The "exposure" model is not effective for helping psychologists appreciate systems meta-theories.*** Although students may see merit in systems principles, it is easy to become intimidated by or lost within the complexity that these principles always bring with them. Hence, we decided that a great deal of preparation is needed to get students ready for the most interesting and relevant systems concepts. Our best ideas about how to do this are contained in the current course and the current textbook.
2. ***Dynamic systems is no place to start*.** Both instructors of the systems science and psychology course felt that dynamic systems perspectives contain some of the principles most likely to be useful to students, so we loaded up the first course with empirical articles based on dynamic systems concepts. The first time our students encountered these articles, no learning took place. Students not only didn't understand the concepts (e.g., attractor states, phase space, bounded vectors), but they didn't even see why anyone would *want* to understand the concepts. Some of the most exciting ideas in dynamic systems are so foreign to our current ways of thinking that we feel we would need to re-

train (especially in mathematics) just to follow them, and although we can see that systems concepts have been very useful in other topics, it is hard to imagine how to begin to use them from within our own research, especially if we are not keen to collect enormous amounts of new data. So one of our goals for the current course is to get students *ready* for dynamic systems ideas—to build out a zone from which dynamic systems seems like a possible direction for future learning.

3. ***Complexity can be overwhelming*.** Some students had negative reactions when faced with the possible complexity of their target phenomenon. For example, when they digested the fact that their target phenomenon was on a level that was embedded in other levels that were infinite in number both upward and downward, many students were overwhelmed. This reaction was especially strong in connection with designing research. Who wants to plan a study that takes 20 years and costs 20 million dollars? For their dissertations, many students planned to conduct analyses on data sets that had already been collected. Did systems perspectives have anything to offer researchers who already had data? Hence, a key goal is to show students how to use systems principles to develop theories and design research and interventions that are both complex and manageable.
4. ***Complexity can be seductive*.** Some students embraced complexity, especially those who had been studying (or living) their phenomenon for a long time. They could easily see the multiple levels and factors involved. However, they had trouble identifying an empirical question and selecting a perspective from which to view it. A variety of questions and issues whirled around in their heads. Hence, an important goal of the course is to help students move from meta-theories and theories to empirical studies and interventions.
5. ***Research ideas can't develop from the outside in*.** In reading the empirical articles we had chosen as a set, we realized that many psychologists who were avid systems scientists had made the connection between the two fields from the outside in. That is, they had discovered certain systems science concepts that they really liked, such as the cusp catastrophe or the o-jive, and had then shopped around in psychology until they found a phenomenon that could be well-modeled by that concept. This is a great strategy for *illustrating* systems science principles, but it is not a *generative* process. Most psychologists already have commitments to certain topics and they need a process whereby principles can be discovered that work to elucidate the targets they have already identified. So we decided we wanted to help students learn the principles from the *inside*—based on the study of the phenomena that were of burning interest to them already.

BIG IDEA #1: LEVELS

What is the "big idea" of levels?

The larger principle of a systems way of thinking embodied by the idea of nested contexts (which is presented most clearly in lifespan and ecological systems frameworks) is that of *levels*. The genuine part-ness and whole-ness of things lends them some organization, structure, or order, from which are derived the ideas of components (looking at the parts of a whole), embeddedness (looking at the wholes of which other wholes are a part), multiple levels (considering wholes as higher-order than their parts), and hierarchies (considering many nested parts and wholes). The idea of levels is intrinsic to systems thinking and has been articulated many times for psychology (e.g., the eight levels of living systems suggested by Miller & Miller, 1992). The simplest form of this distinction is the macro- and micro- distinction, which reminds researchers that whatever level they are considering, there exists a level above and a level below. Levels of embedded or partially embedded systems have been described for decades in organizational, educational, family, community, and developmental psychology.

✓ **In-Class Exercise: Making a Levels Map**

We have created an in-class assignment to help students apply the idea of levels to their own phenomenon. They pair off and worked together to draw "maps" of the multiple levels related to their target phenomena. For a systems thinker, it is clear that there are infinite levels upward and downward, but for a psychologist, levels are more circumscribed. Psychologists are interested in people, so they rarely look at units below the level of biological structures or above the level of culture. Hence, a good place for most psychologists to start in creating levels for their phenomena would be the nine presented in Figure 15.1. Many researchers are familiar with such multi- level structural maps. They have been used to integrate research on topics that have considered predictors from many levels (e.g., Belsky, 1980 or Lerner et al., 1995).

Insert Figure 15.1 about here

How do students like their maps?

They love their maps while they are working on them. They are pleased at the way they are able to find a home for all the constructs they have been thinking about and how the blank spots draw their attention to levels they have not yet considered. As soon as we mention the word "empirical study," however, the maps stop students cold in their tracks. The empirical examination of all these levels and units as they interact over time represents the 20-year 20-million-dollar study that students fear is being planned for their dissertation.

Several ideas help clarify the use of this map in generating research. First, the concept of *mindfulness* helps put this map in perspective. The map provides an overview that researchers should be mindful of as they make their decisions and selections. It is (a portion of) the whole of which their conceptualization and study will always be a part. Second, although it is important to be mindful of infinite embeddedness, pragmatically, *five* levels is a good number to start with. In fact, five levels are the number required to consider a system, and its attendant supra-system and subsystems (Lendaris, 1986). Three levels are needed to define a system: its whole-ness requires a consideration of the unit and its environment; and its made-up-of-part-ness requires a consideration of the unit and its parts. So these three levels could be called parts, system whole, and environment, as shown in the left panel of Figure 15.2.

Insert Figure 15.2 about here

However, for the parts to themselves be considered subsystems and not just parts, the researcher must step down a level and consider the part as the focal unit, in order to observe its whole-ness and to observe the parts that make it up. In a similar fashion, for the system to be considered a part of a supra-system and not just part of its environment, the researcher must step up a level to consider the environment as the focal unit, in order to observe the whole of which the system is part and to observe the other systems which work together with the target system to manifest the attributes of the supra-system. So this requires five levels: (1) parts of subsystems; (2) whole subsystems; (3) system whole (made up of subsystems); (4) systems that make up the supra-system (of which the target system is one); and (5) Suprasystem whole (made up of multiple systems), as shown in the right panel of Figure 15.2.

Any five levels are candidates for inclusion. So, using the map as a menu, we assign students to first identify their focal unit and its level and attributes; and second, to identify any two higher levels and any two lower levels. We then assign them to identify at least two units at each level, including at least two more units at the same level as the target unit (horizontal), and to suggest at least three attributes of each unit.

What do students learn from this?

The problems students experience in identifying units and attributes are very instructive. They fall into two main categories: too many candidates and no candidates. To deal with too many candidates, we can introduce the clarifying idea of *relevance*. At every level, there are virtually an infinite number of possible units and attributes. That is, inside every system are virtually an infinite number of subsystems and their attributes. However, luckily, not every subunit nor every attribute is relevant to the target phenomenon. Not everything about supervisors is relevant to their relationships with workers. Not everything about the neighborhood is relevant to the functioning of the family. The researcher selects from the menu those characteristics that are hypothesized to be relevant to creating the target attribute of the focal unit. Students can draw from their synthesis of traditional research when selecting levels, units, and attributes relevant to their target phenomenon. A more challenging problem is blank spaces, denoting levels at which few or no attributes have been identified in traditional research.

At this point, it is common for students to change their focal level, usually upward. I/O students interested in employee turnover, realize that they are not interested in individual decisions to quit, but in turnover rates at the store level. Developmental students interested in closing the achievement gap realize that they are not interested in factors that protect individual children at risk for school failure, but in school factors that allow groups of at-risk students to succeed. The shift upward to the group or organizational levels opens the door to research examining the factors at that level that could be optimized in interventions.

What do instructors learn from this?

From these discussions, we have learned many important lessons. Although identifying the levels above the individual seems uncontroversial, we typically have hefty discussions about how the levels *below* the individual are organized. Some systems thinkers delineate these levels according to structures and so designate the level below the organism as the organ (e.g., Miller & Miller, 1992), but this seems to us to be missing some intermediate levels likely of interest to psychologists (e.g., Ford & Lerner, 1992). For example, it seems possible that some regulatory processes (like attachment or coping) can be considered at a level higher than their component processes (e.g., emotion, cognition, attention); or it seems possible than some temperamental dimensions (like surgency or effortful control) would be at a level below some behavioral phenomena (like aggression). One thing we can all agree upon is that the organism is a structured organized whole, with neurophysiological subsystems at the bottom and interpersonal social relationships at the top (Brantstaedter, 2006: Gottlieb, Wahlsten, & Lickliter, 2006; Magnussun, 2001).

Who is doing what to whom?

When the maps are completed, it becomes clear to students what is meant by terms like "horizontal" vs. "vertical" effects, or "bottom-up" vs. "top-down" effects (e.g., Kozlowski & Klein, 2000). At a glance are revealed many linkages that have taken psychology years to detect, for example, the bottom-up effect of children on the quality of their relationships with parents and teachers, the bottom-up effect of the number of employees on the quality of supervisor feedback, or the top-down effect of poverty on schools, families, and peer groups. The idea that effects can come from any level and go to any level allows students to appreciate the complexity of the systems they have identified.

My brain is full. Why can't we just stop with the "levels" principle?

The multi-level structural maps do serve many important functions: They help students integrate research findings from all the research they discover on a given topic, locating a place for every predictor and revealing the organization among them. Their previous "traditional" conceptualizations now look "flat." They have been replaced by "pop-up" pictures of multi-dimensional frameworks, constructs, and assessments; effects can be horizontal or vertical, top-down or bottom-up. Most importantly, blanks are revealed. Individualistic biases of traditional approaches become apparent; students face questions about units and attributes at lower and higher levels. Research at neighboring levels and disciplines suddenly becomes interesting.

At the same time, however, the limitations of a levels approach also become apparent. In the end, there is no getting around the fact that this is a *structural* map, a complex multi-level, multi-unit, multi-attribute description of hierarchically organized parts and wholes, to be sure, but "only" structural, nevertheless. It provides a good picture of the complexity of our target phenomena, but it is essentially static. In fact, we explicitly instruct students to freeze their phenomena so they can get a clear snapshot. But when we want to "unfreeze" the system and get it moving, to "see the movie," so to speak, it becomes clear that the concept of levels by itself contains no organizing principle for how these parts "work together."

In fact, when researchers use structural maps to generate functional hypotheses, the result is often confusion. Every attribute of every unit at every level is a candidate for a causal arrow, all aiming at the focal unit and focal attribute. Describing such models accurately by level, for example with the label "mixed-level determinants model," does not clarify the situation. There are an infinite number of arrows and, since they can all interact with each other, there are an infinite number of causal possibilities. This is complexity, but without clarity. We conclude that despite the fact that structural maps are useful devices for integrating existing research findings across a topic area, they are not sufficient to generate an explanatory theory or a program of research or intervention that builds on that integration. For this, an organizing principle that describes functions, that describes how the parts of the system work together, is needed.

Delving more deepely into the Levels Principle: At its core the levels principle holds that all psychological phenomena can be considered *embodied* and *contextualized* subsystems.

*Psychological phenomena as **embodied**:*

1. All psychological phenomena are ***embodied*** by lower-order multi-level integrated ***neurophysiological subsystems***.
2. All psychological phenomena are themselves ***wholes*** made up of multiple integrated ***psychological subsystems*** (e.g., perception, attention, motivation, emotion, cognition, appraisal, etc.).

*Psychological phenomena as **contextualized**:*

3. All psychological phenomena are ***parts*** of a multi-level integrated ***whole person***.
4. All psychological phenomena are embedded in higher-order multi-level integrated ***contextual suprasystems*** (e.g., social, environmental, and cultural).

BIG IDEA # 2: PROXIMAL PROCESSES

What is the "big idea" of proximal processes?

Functionally, the parts (or subsystems) of a whole (or system) work together to manifest attributes of the whole. This "working together" implies interactions or cause-effect relations among the parts. How parts work together can be shaped (enabled and/or constrained) by other features in the system, from the higher-order features (top-down effects), from the lower-order features (bottom-up effects), or from features at the same level (horizontal effects). By continuing to work together over time, these interactions shape the components that participate in them. These ongoing reciprocal "workings together" also provide both function (activity) and internal order or organization.

It turns out that, perhaps surprisingly, all the systems meta-theories that we have reviewed so far depict the same notion of “working together” in human systems. In explaining the source of development at the level of the person, they all argue for same causal process: *reciprocal exchanges between the active intentional person and the integrated local (often social) context in the here-and-now*. This process is known by many different names (including proximal processes, action in context, coaction, transactions, activity, experience, exercise, practice, and embodied organized intentional action) and depicted by many metaphors (including “the dance,” “the conversation,” “the jazz band,” “the improvisation”). However they are labeled, these exchanges, carried out in service of the organism’s functions or goals, are the recursive “workings-together” of the lower-order components of a system that cumulatively lead to the emergence of higher-order more adaptive patterns of organization, that is, development. (For a seriously detailed description of “the dance,” see Piaget, 1976, 1978.)

To describe this big idea, we decided to use the term “proximal processes” (Bronfenbrenner & Morris, 2006)—but it could just as well be any of the terms listed about. Paul van Geert (1998) lays out the essential elements of these reciprocal exchanges very clearly in his seminal paper on dynamic systems modeling of developmental mechanisms. He argues that the grand developmental theories of Piaget and Vygotsky (and all major developmental theories) share a set of common understandings about the *causes* of development:

> First, the theories implicitly or explicitly imply that the explanation of development requires a distinction between some internal and some external domains, whatever their respective natures. The internal domain is where we project the person's knowledge, skills, motor system, or whatever specifies the contents and developmental level of the person's current cognitive system. The external domain contains the sources of information, help, resources, models, and so forth. Development comes about as a result of transformations applied to contents from the internal and from the external domain. Theories differ as to the

relative importance they ascribe to either of the domains.

Second, developmental theorists accept that the internal and external domains communicate with one another, that there exist links of various kinds between them. For instance, the notion of *experience* implies that something in the external domain has a relation of condition, cause, or content to something in the internal domain. The notion of *action* implies that a subject can alter properties of the outside world. The discussions among theorists are about the nature and not about the principle of that link or connection. (p. 638)

The key idea is that "proximal processes" can be used as a generic term to describe those reciprocal exchanges between the agentic integrated person and their organized social and physical contexts.

Whys is this principle helpful to us in constructing theories, research, and interventions?

Because the idea of proximal processes organizes and prioritizes our thinking, it can help clarify our research and interventions. Systems perspectives are good at making us aware of the complex nature of our phenomena: Our levels maps showed us that there are an infinite number of interactions among potentially infinite units with potentially infinite attributes at potentially infinite levels. Our Bronfenbrennarian hyperspace maps revealed potentially infinite contexts with potentially infinite social partners involved in potentially infinite proximal processes, including a potentially infinite number of attributes of (a) the target person and the social partners, and (b) the contexts in which the proximal processes take place.

Okay, now I am ready for some clarity. How does proximal processes help me with that?

They tell you that all good developmental theories and research are going to be focused on one target-- proximal processes.

Why do you keep saying there are "infinite" everything?

It is a bit confusing, we know. It is not as if when you peek into a classroom or office, there is a giant crowd of an infinite number of people inside. Or that children are visiting an infinite number of different buildings each day. The idea is that all "things" are made up of attributes (i.e., characteristics or features) and have functions (i.e., things you can do with them), and it is these attributes and functions that interact with each other. It turns out that all “things” have potentially infinite attributes and functions. As soon as you think about naming all the attributes of anything (e.g., a person, one of their interaction partners, a setting, a transaction), you can see that you would be at that job for a very long time. After a couple of pages of listing the features of a person, it would be clear that you would never be able to throw down your pen and say “Done—I have listed them all!” Someone could always think of more attributes (so they are virtually or practically limitless).

At the same time, if you would try to list all the things that you could *do* with an object, even a single object, like your hand, say, or a pencil, or a puppy, you would also soon realize that the list was never going to come to an end. Whenever you stopped, it would just be because you ran out of ideas and not because you had named every one of their uses. And another more creative person could keep listing functions. Have you heard of the television show “*MacGuyver”* or the *Saturday Night Live* satire “*MacGruber”*? That detective was famous for taking household objects, like gum, string, and hairpins, and using them as ingredients to do things like launch a rocket. That character (or his writers) could provide a great example of the potentially infinite uses of objects.

If you start thinking about it that way, when you peek into a classroom, you will see that it actually does contain an incredible number of potential interaction partners—from people (with all their attributes and functions), to the light switch, lockers, posters, white boards, windows, books (with their infinite pages, words, and ideas, and so on). And the school itself comprises so many microsystems. It contains not only the classroom (with its “sub-micro-systems” like the reading area, the back of the classroom, the window-sill-with-plants, the dreaded desk next to teacher’s desk, and so on) but also lots of other microsystems outside of the classroom, like the front steps, the principal’s office (both the waiting area outside and inside the office itself), the gym, the locker rooms, the bathrooms, the lunchroom, the halls, the bus, the parking lot, the playground, the woods beyond the playground. That is how a systems perspective opens our minds to infinite possibilities—that is, to complexity.

Yes, but I have the feeling that there are infinite of those, too. So how do we figure out which ones to focus on?

Secretly, you know this—based on the target developmental outcome. You—the system “beholder”-- start the ball rolling by declaring your interest in the development of *something*. Since ours is an applied program, our students basically all have the same kind of target—to make the world a better place, to produce a “*good thing*,” like engagement or mastery or good performance or well-being or relationship satisfaction (which, following Alfred Hitchcock, can be referred to as the “MacGuffin”) and to halt the production of the “anti-MacGuffin,” like disaffection, drop-out, failure, misery, or relationship distress. And so their research questions all have the same basic structure, namely, to identify the proximal processes that promote and undermine the MacGuffin as well as those that promote and undermine the anti-MacGuffin. Once these four kinds of activities have been identified, the rest of their research is dedicated to trying to figure out what kinds of things (e.g., contextual factors, personal attributes, timing) support and undermine the occurrence of each one of them.

For example, for someone who is interested in whether aggression at work is driving qualified nurses from the profession (or qualified teachers, truck drivers, high teach workers, and so on), the MacGuffin is a trajectory of continued "job satisfaction, productivity, and persistence" and the anti-McGuffin is a trajectory of "dissatisfaction, burn-out, and desistence." So research is focused on identifying the kinds of day-to-day interactions at work (or home or anywhere else) that create professional satisfaction and success as well as the kinds of interactions that create professional frustration or failure, and then exploring the features (of the nurse her or himself, their patients, tasks, co-workers, supervisors, workload, and the nurse's point in their professional development) that might be shaping those proximal processes and where aggression fits into this picture.

How does the idea of proximal processes help me select among the infinite settings, interaction partners, and higher- and lower-order attributes?

It's kind of like a set of dominos, that's the idea of prioritizing. Only a subset of proximal processes influence the development of the MacGuffin and the anti-MacGuffin (the target developmental outcome), so we start with those. Only a subset of settings (namely microsystems) contain the developing person, so among all those microsystems, we select the ones where the proximal processes are taking place. Only a subset of social partners are involved in those proximal processes, so we select them. Only a subset of the attributes of those people and contexts shape (positively and negatively) the relevant proximal processes, so we select them.

Can you provide some examples of how this would lead to concrete research questions?

If proximal processes are the primary generators of target outcomes in face-to-face settings, then the identification and assessment of proximal processes is of critical importance. Hence, useful studies would be those that identify and validly measure (through self-reports or observations) a set of proximal processes that promote and undermine the development of the MacGuffin and the anti-MacGuffin. Moreover, if proximal processes act as mediators for almost all factors that predict the MacGuffin, then studies could examine how attributes of the target person and their social partners shape relevant proximal processes, and whether these proximal processes in turn mediate the effects of these attributes on the MacGuffin.

Another important avenue of study would be descriptive: to depict the set of proximal processes that characterize specific macrosystems or niches. For example, it has been extremely useful to know that poverty, a macrosystem attribute, creates a package of proximal processes that should not be considered in isolation when trying to study their effects (e.g., Evans, 2004; Huston, McLoyd, & Coll, 1994). Children in poverty experience poor nutrition, stressed out parents, poorly paid teachers, disruptive peers, dangerous neighborhoods, and few community activities (e.g., clubs or team sports). Hence, poverty has effects on the quality of parenting, quality of teaching, quality of medical care, etc., that children receive. In studying how poverty can shape children's development, the examination of its massive effects on proximal processes seems like a good place to begin. Such studies about the packages of proximal processes that tend to co-occur in certain niches would be a useful beginning in creating higher-order characterizations of the “riskiness” or “stressfulness” of certain macrosystems.

Delving more deeply into the Proximal Processes principle: All development is caused by episodes or exchanges that are mutually constituted by the ***actions*** of individuals and the ***affordances*** in the context.

1. ***Episodes*** are bouts or sequences of real-time exchanges organized along an arc created by the goals of the person and their social partners. Because they are time-ordered, episodes are linear in sequence and have beginnings, middles, and (temporary) resolutions, as goals are reached, abandoned, replaced, or modified.
2. ***Action***: the organized multi-level system that is the person gives rise to “action” in the form of motivated emotion-flavored behavior in service of a goal or function.
3. ***Affordance***: properties of an object or environment that offer or allow an action possibility (Gibson, 1977). For example, a spoon affords scooping, banging, and dropping, or a handle affords grasping.
4. ***Action and affordance***: these are the features of the person and the environment that interact during proximal processes.
5. ***Meaning:*** as episodes unfold people are taking explicit or implicit “notes” about the meaning of these exchanges, interpreting and learning from them—both to direct current action and cumulatively as a guide for subsequent interactions.

I understand the concept of individual “action,” but what is an environmental “affordance”?

A very cool idea that came out of work on perceptual development. An affordance is an attribute of an object or an environment that allows you to do something with it (Gibson, 1977). For example, a staircase affords walking up, or sitting on, or bouncing a slinky down. A blanket affords covering up, or making a roof out of, or having a picnic on. A bush affords berries, or hiding behind, or branches for making tools. The idea is that humans, because we are active and agentic beings who are always wanting to *do* something, perceive the environment not in terms of “things” but in terms of what we can *do* with things, *uses* for objects and environmental features. So when a baby is sitting in a high chair and spies a spoon, she does not see a smooth plastic object with a flattened curved end. She sees a “chew-able,” “scoop-able,” “bang-able,” “drop-able,” “reach-farther-able,” “fling-able,” and so on. She sees what she can *do* with the spoon, its action possibilities, or affordances. And if you watch the baby interact the spoon, you will see her actively explore those action possibilities, as she busily chews it, bangs it, throws it, and so on. It is as if she is finding out all she can about its uses for future reference. These actions are considered intrinsically motivated and typical of the "active agentic" individual depicted in relational meta-theories.

The excellent thing is that learning about this object also requires the baby to modify her actions to fit the objective characteristics of the spoon. Based on its size and shape, she has to modify her grip, where she is holding on to it, how far she has to extend it to get a good "drop" (over the edge of the high chair tray), and so on. So learning about the object also results in learning about one's own actions, and using the specific affordances as instructions about how to modify one's actions to be more effective in using the objects.

What do you mean by the idea that actions and affordances 'mutually constitute" each other?

Remember that we are in dialectical or relational meta-world here. The infinite action possibilities of the person and the infinite acted-upon possibilities in the environment are both potentials until they meet each other. People's goals determine the set of environmental affordances that are relevant in a given encounter. For example, if a person is hungry, they focus their attention on locating and obtaining the "eat-ables" in the environment. A very cool idea is that the affordances in an environment are also shaped by the developmental level and competencies of the person (Gibson, 1969, 1982). For example, imagine that you hand an encyclopedia volume to a baby. To the baby, it might represent a "chew-able" or a "push-able" or, if the baby is old enough, a "sit-able." But if you hand the encyclopedia to an adult, it becomes a "read-able" or an "inform-able," unless the encyclopedia is in Czechoslovakian and we can't read that language. Of course, if the adult wants to press flowers, then the encyclopedia can become a "squash-able." So the affordances of all object and environmental features depend completely on the goals, developmental level, and competencies of the person.

At the same time, objects and environments have real physical properties that determine their potential range of uses or action possibilities. It is not easy to use a tennis ball as a doorstop or to eat soup with a shoelace. Only a subset of things are drink-able or read-able or stand-on-able. So the actual properties of the context constrain and enable the uses that they afford. As a result, the nature of every action depends completely on the features of the context in which it takes place—that is the core idea of "adaptation," which, in real time, means that human action is readied based on the organism's understanding of contextual affordances and requirements, just as it is refined based on feedback from these interactions. So by *mutually constitute*, we mean that, from the infinite pool of possible actions and affordances, the actions and affordances that are actually instantiated mutually select and shape each other: People's goals determine the set of actions and affordances that are functionally relevant. Moreover, people are developmentally able to perceive and act on only a subset of the affordances in the environment, these become the subset of affordances that are relevant; and people can only use some of their possible actions based on the objective properties in a specific context, these become the subset of actions that are relevant.

How do these exchanges actually produce development?

That's the million dollar question, right? You got an inkling of the process while we were watching our baby play with her spoon. The basic idea is that out of these exchanges between actions and affordances comes new information that was not contained in the action or in the affordance before. The organism applies an action in a specific context with the goal or intention of producing a particular outcome. However, the *actual* outcome is not determined by the individual's goal—it is created by the actual action and the actual affordances. Pop! This is the new information. van Geert describes this process, as part of Thelen and Smith's (1994) dynamic systems theory, "The fundamental dialectic here is the one between the ongoing action and the possibilities that action retrieves from the environment as it acts on the latter. Because the subject incorporates these possibilities into the ongoing action, the way of acting changes and thus leads to new skills" (1998, p. 369). The capacity and desire to incorporate the new action possibilities into ongoing efforts to reach a goal is the essence of being human, and the new ways of acting (with the next set of action possibilities they bring) are development.

Why is "agency" so important to development?
The assumption of an "agentic" individual means that people are inherently active intentional beings who formulate and pursue their own goals. They are "agents," who come with the desire and capacity to express their preferences and they expend effort to realize them. (One never needs to tell a newborn, "Please let me know if you want something." They are on the job starting at birth!) These intrinsic motivations provide energy and direction for people in their interactions with the social and physical contexts throughout life. People's goals organize their actions as well as the whole arc of episodes of proximal processes—these episodes start when a goal is initiated or activated, and they persist until the goal is fulfilled or abandoned, or replaced by another goal.

My brain is infinitely full. Does that mean we can we stop?

Adding proximal processes serves many important purposes, as we saw back when we were making our Bronfenbrennarian Person-Process-Context-Time (PPCT) maps (as shown in Figure 11.2). PPCT maps captures the organization of parts and wholes as depicted by embedded contexts and then expand them to include the organization of parts and wholes as depicted by multiple microsystems full of generative proximal processes. It not only has a place for every element, but it also highlights the blanks— the discipline still needs more thick and rich descriptions of the proximal processes that shape and are shaped by the person, their social partners, and contexts over time.

And yet…

In working with our PPCT maps, the limitations of the proximal process approach also becomes apparent. Try as we might, the PPCT maps do not help us see how the many proximal processes we have drawn work together over time. There is no place on the map to depict how the proximal processes are themselves changing, and how they are changing the person, the social partners, and the contextual features that initially created them. In fact, we note that in our PPCT maps, the representation of the focal unit and each social partner is a single circle. But we will eventually require moving, changing representations. When all the proximal processes are working, we want to step back and "take our hands off the system" and see what it would do.

All the research that has looked directly at proximal processes suggests that they have their own reciprocity and directionality. For example, not only do oppositional children tend to elicit harsh parenting, but harsh parents tend to antagonize their children, so that over time, these proximal processes amplify each other, creating coercive cycles (e.g., Patterson & Bank, 1989). Such reciprocal person-context interactions, as described by proximal processes, give rise to higher-order dyadic properties (e.g., dislike, estrangement, mistrust) that themselves come to shape subsequent proximal processes. Hence, it seems that the initial phases of a proximal process might be key in establishing the direction interactions would take. It is clear that we need an organizing principle that can help us deal with the dynamic properties of systems.

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Chapter 16. Three Big Ideas of Developmental Systems: The Big Idea of Dynamics

So far, we have tried to integrate and clarify the many systems theories that we read about and discussed, by identifying their three core "big ideas," namely, levels, proximal processes, and dynamics. They have helped us see the complexity of our phenomena in their potentially infinite everythings: infinite levels downward into the organism toward their neurophysiology as well as upward into the social context toward culture; infinite attributes, social partners, and settings; and infinite proximal processes. And we appreciated the clarifying ideas as well—the proposition that five levels is plenty, because they are all that is needed to create an integrated biopsychosociocultural person and their organized contexts; and that we can safely focus on the subset of proximal processes that influence our MacGuffin (our target developmental outcome) and the attributes of our developing person, social partners, and settings that shape them, as well as the higher-order contexts that enable and constrain what happens in these immediate face-to-face settings.

Although it may still seem a little metaphysical, we get the idea of actions and affordances as the parts of people and their contexts that are interacting in these proximal processes, and we see how, under the guidance of people's goals, activities, or functions, these two features mutually call to and constitute each other. We love the idea of "taking our hands off" of our pictures of Bronfenbrennarian hyperspace and watching the system move on its own. We are hoping that the big idea of dynamics will help us do this without being overwhelmed by the hurtling proximal processes and the spiraling MacGuffins.

BIG IDEA # 3: DYNAMICS

What is the "big idea" of developmental dynamics?

The big idea of dynamics, as you may have guessed, is based on *self-organization*. The workings together of all the proximal processes we have identified as relevant to our MacGuffin create an orchestra of movement with its own directionality. Developmental dynamics is the principle that is trying to explain that *directionality*. As you might guess form the idea of circular causality, it includes the structure from the *levels* principle, in which both individual and context are integrated and organized, and combines it with the movement from the *proximal processes* principle that describes the recursive workings-together of the person's actions and affordances from the context. Both levels (or structure) and proximal processes (or function) are incorporated into higher-order organizational frames—these frames distinguish "change over time" from "developmental transformation," even though both processes are in play at the same time. Levels and proximal processes are incorporated into higher-order organizational frames by doing that thing we love about self-organization—they both create higher-order organizational frames and they are enabled and constrained by the higher-order organizational frames—simultaneously and continuously entangled.

Speaking of "circular causality" -- I can see the bottom-up effects of proximal processes and the "pop" of new actions, but where is the top-down stuff?

Good question. And an important issue because it is here that some proponents of dynamic systems part ways with each other (Witherington, 2011). For our part, we see "formal" and "final" cause as crucial-- both to the actual activity-in-the-making that produces development and to scientists' capacity to make sense of its meaning. Perhaps the easiest place to start is with the idea that the developmental level of the person (i.e., their "formal" organization) not only captures an important descriptor at the individual *level* but also constrains everything about the way that person can participate in *proximal processes*. All the parts of proximal processes we have considered so far, including the goals people set, their action possibilities, their perceptions of affordances, and what they can see and learn from their interactions, are all decisively shaped by their current developmental level.

As Witherington (2011) explains more generally: “The very nature of the task itself and the functional significance of an organism’s action in the task context derive meaning from that organism’s particular level of developmental organization. Thus, every action of the organism speaks both to task-specific adaptation and to organism-specific organization” (p. 85). In fact,

> Organization at the level of the organism – by its very nature abstract and formal – transcends the particularities of real-time contexts and actions and constitutes the background of meaning against which all of the particularities of action in context are foregrounded. Some level of organization – more or less stable – always characterizes the organism qua organism and serves as the only means by which we can render the organism in unified whole terms, in terms of invariant identity maintained across actions and contexts. Thus, full appreciation of the meaning of an organism’s activity within its world requires an embedding of that activity in the current, dynamically maintained structure or organization of the organism, taken as a whole across contexts. (p. 84)

Is there such of a thing as higher-order organization of the *context* as well?

Yes. Just as organisms represent organized wholes, so too do their contexts or environments. Contexts don't have what we would call “developmental levels” like organisms do, but we can call these contextual organizations “culture” and of course cultures change over sociohistorical time. The idea of culture is that the social context has integrated sets of values, norms, agendas, timetables, and views of the world that shape the affordances that are provided to individuals as well as their timing and attunement to the individual’s needs and current developmental level (Valsiner, 1997). In our levels principle, these are seen most clearly in the downward causality exerted by *macrosystems* on pretty much every feature of how microsystems are organized and function.

Sociocultural approaches to development help articulate the role of culture in structuring proximal processes by describing development as the result of individual participation with others in cultural practices. As explained by Raeff (2011),

> [F]rom a sociocultural perspective, human behavior and development are taken to occur in the context of cultural practices, which are situated in physical environments and institutional settings. The forms of complex action that comprise cultural practices are further ‘invested with normative expectations and with meanings or significances that go beyond the immediate goals of the action’ [Miller & Goodnow, 1995, p. 7]. Accordingly, cultural processes refer to common and contested cultural beliefs, values, goals and ways of understanding the world that are enacted in cultural practices, as well as the cultural tools or mediational means [Wertsch, 1998] through which action is achieved. Cultural processes also include aspects of societal functioning, such as the institutional settings in which cultural practices are situated, as well as political and economic factors. These varied processes shape culturally specific ways of structuring or organizing the constituents of action within cultural practices. In turn, development involves the differentiation and integration of culturally specific ways of structuring or organizing action constituents. (p. 14)

As explained by Bruner (1990), as he describes the role of culture in the paradigm shift that he wishes for psychology:

> What was obvious from the start was perhaps too obvious to be fully appreciated, at least by us psychologists who by habit and by tradition think in rather individualist terms. The symbolic systems that individual used in constructing meaning were systems that were already in place, already 'there', deeply entrenched in culture and language. They constituted a very special kind of communal tool kit whose tools, once used, made the user a reflection of the community... As Clifford Geertz puts it, without the constituting role of culture we are “unworkable monstrosities... incomplete or unfinished animals who complete or finish ourselves through culture'.’ (pp.11-12, quoting Geertz, 1973, p.49)

Can you give some examples?

Locally, some of the most interesting organizing forces from the culture can be seen in “opportunity structures.” Psychologists (especially those of us from privileged backgrounds) don't typically spend a lot of time thinking about these structures, but sociologists and anthropologists do. They argue that societies have hierarchical structures, organized according to big categories like class, race, and gender, that create a set of actual resources, relationships, risks, and opportunities that can be collectively described by terms like “disadvantage” or “privilege.”

Brandtstädter (2006) explains this idea as an important counterpoint to a central notion of action theory—namely, that individuals through their actions and interpretations shape the course of their own lives. He writes, “This should not imply that individuals are the sole or omnipotent producer of their biography. Just like any other type of activity, activities related to personal development are subject to cultural, sociohistorical, and physical constraints that lie partly or even completely outside of one’s span of control but decisively structure the range of behavioral options. Action-theoretical perspectives on development must therefore consider not only the activities through which individuals try to control their development over the life course, but also nonpersonal or subpersonal forces that canalize such activities” (2006, p. 618-517).

Why do we care about the higher-order organization of the context?

The core idea is that, just as the set of possible actions that an individual brings to their proximal processes is not an accident but is established by their current developmental level or organization, so too-- the set of possible *affordances* that are available to participate in these proximal processes cannot be considered an accident. Instead they are demarcated by the individual’s culture and location in his or her society’s opportunity structure, something that Bronfenbrenner calls the developing person’s “social address.” The study of the cultural practices and social capital available to different members of society reveals that material resources and social goods (e.g., the quality of educational, health care, or recreational systems) are not distributed equally across its members. From these cultural practices and opportunity structures come the social partners and proximal processes that are available to individuals, and that differ systematically based on the individual’s culture and their relative positions within that society.

Okay, so formal cause is a property of individuals and environments-- but what about "final cause"-- "teleology"?

Yes, development in living systems does possess an inherent directionality. Through the recursive interactions of lower-order constituents, even without design— living systems intrinsically and inherently develop toward greater complexity and greater functionality-- a more adaptive future system.

But what is this "more adaptive future system"? Is it a better self?

Typically but not necessarily. The future self typically is better, in that development normatively involves progression toward more "mature" states, more differentiated and integrated states, that entail better functioning (i.e., actions that are more effective, flexible, pro-social, self-determined, far-seeing, and so on). When we compare the typical newborn and the typical 25-year-old, the improvements in organization and functionality are obvious. But the more adaptive self is *not* necessarily better—because other pathways are always open (you guessed it—infinite other pathways!). "Good news" pathways often emerge, not because they are pre-planted by organismic or environmental designs, but because active agentic people with intrinsic motivations are interacting with caring social and cultural forces, who both have an interest in maintaining development within a range of functioning, and provide the self-righting tendencies and cultural scripts to continuously nudge them back onto a positive path.

But how could a "more adaptive" future self ever be "bad news"?

We can be easily confused by the term "adaptive" which we often take to mean "good," in that by "adaptive functioning" we often mean "good functioning." But "adaptive" really has a more specific meaning, it means "more effective in a specific context." As Rutter argued, we have to be careful what kinds of contexts we put our children into, because they will adapt to them. And these local adaptations may be "bad" for future developments.

For example, consider how the stress reactivity system of newborn adapts itself to the environment it encounters. Typically newborns experience safe and trustworthy caregiving envrionments, and so their stress reactivity systems go into a period of hyporesponsivity (Gunner & Quevado, 2007), which allows them to use their energy for exploratory interactions with the social and physical contexts. However, if newborns experience highly stressful caregiving, their neurophysiological stress reactivity systems will adapt to this danger by going into high alert: They become highly reactive—monitoring danger, startling at every possible signal, sending out strong stress reactions, and not stopping until they are taken care of. This high reactivity may be locally and temporarily adaptive, but it is very expensive developmentally—not only because of the exploratory interactions the infant misses out on, but also because of the kinds of harsh caregiving that these hyper-reactive stress systems can subsequently elicit from caregivers.

As another example, consider how the motivational system adapts to the kinds of schooling its receives. If a student experiences a learning context in which the whole point seems to be to prove how smart you are on meaningless activities that are assigned by a controlling and uncaring teacher, and any efforts that you exert only seem to make it clearer to everyone how "stupid" you are, then children will adapt—they will withdraw their effort and stop caring about their performances. This disengagement is temporarily and locally adaptive—it protects the child from grueling interactions and punishing self-appraisals. However, it is not developmentally adaptive, because it cuts the child off-- from real learning, from supportive teachers, and from acquiring social capital, and it puts the child at risk for drop-out and delinquency.

What is the difference between *locally* and *developmentally* adaptive?

The difference is in the two time scales—real-time episodes versus developmental pathways. Children (and people in general) typically adapt to local contexts and pressures, but if these adaptations are not aligned with desirable future pathways, they can spell potential trouble. Not *determine* it, because plasticity and multiple alternative trajectories are always available, but increase its probability and make it harder to escape from the developmentally maladaptive pathway. Sometimes in dynamic systems models, these ideas are drawn as a series of channels that get deeper and deeper the longer a marble (i.e., a person) is in them. It is still possible for the marble to travel onto any part of the entire surface, but the depth of the channel that the marble currently occupies makes it harder and harder (and so less probable) to escape.

Is there any developmental directionality implied by the idea of culture?

Yes, just as there are two levels in individual development, one in episodic and one in developmental time, there are two levels to cultural movement. One is local and relative to the the overall goal of moving individuals in the direction of specific standards, norms, and ideas for what kinds of actions and outcomes the (sub-)culture prefers. Individuals have goals for themselves and their social partners, and social contexts have goals for individuals and for themselves. These are lower-order constituents that create the push-pull or lower-order dynamics we see in proximal processes. However, at a higher level, cultures are also interested in sweeping individuals in a general direction—from peripheral to central membership, and from peripheral to central participation. A great deal of the agenda of the context can be understood by examining these presses and pulls.

Do these cultural forces mean that development can go in any direction, depending on the culture's picture of a standard or ideal person?

Yes and no. The "yes" comes from one of the most important messages of the sociocultural approach—that there is a much wider range of variability in developmental paths than we would imagine if we stayed within one cultural frame. Within a single higher-order frame, because cultural assumptions and beliefs are so ingrained, we have the feeling that our culturally prescribed pathways are not just “typical” or “*our* way,” they are morally right and the *only* way. It is not far from this perspective to the conviction that our way is the only way that humans *can* develop. So cross-cultural analyses are essential in reminding us that a wide variety of developmental norms and social clocks exist, and that children can drive tractors at age 5 or operate businesses at age 8 or run families at age 10 or any number of things that we would consider “impossible” from our limited mono-cultural experiences.

However, the “no” comes because the range of plasticity is not infinite. Cultures are constrained in how they can ask people to develop based on the biopsychosociocultural beings that they have to work with. Cultural practices and norms have evolved in conjunction with the humans who instantiate them. All cultures have to provide certain things-- clothing and shelter for “naked apes” to protect us from local weather; ways of caring for newborns without which they would not survive. One of our favorite examples involves diet. On the one hand, eating is a universal cultural activity—because humans need food to survive. On the other hand, cultures solve this universal task in such an incredible variety of ways that when we visit other cultures, we sometimes cannot operate the eating tools and can have difficulty enjoying or digesting the food that is prepared.

On the third hand, and this is a controversial idea in some sociocultural corners, there is such of a thing as a “healthy” diet—one that provides energy and meets all the needs of a growing and well-functioning human body. And, cultures differ in the extent to which the diets they offer their members are “healthy.” In contrast to radical relativistic cultural positions in which no cultural goal or practice is considered better that any other, a relational meta-theory might suggest that cultures (or really cultural practices) can be analyzed with respect to the extent to which they meet basic fundamental human needs. From this perspective, cultures create people and people create culture over time.

These final causes or teleological forces—How do they work? Didn't we decided that they do *not* actually pull the organism down a predetermined path?

Right, these are not efficient causes, so they do *not* pull organisms along pre-designed trajectories. Instead, you can think of them as pictures that are painted behind our organisms as they carry out their daily goal-directed proximal processes. These pictures are like the "double-exposures" we were envisioning when we were thinking about local and developmental adaptiveness at the same time. We were *looking* at the local proximal processes, adaptations, and developments, but we were also *thinking* about the long-term alternative developmental sequences. And we were using these sequences to evaluate the meaning of the particular step we were focusing on, whether it was a productive step down a fine set of positive alternative pathways, or a trivial step not really that important, or a harmless detour that could easily be self-corrected, or a turning point that makes problematic development more likely.

Without this larger developmental picture, we cannot make sense of our individual's current activity, we cannot see where it is going. We also need that picture to understand where our organism has *been*, what has happened along the pathway so far. This is an essential role of developmental scientists -- we will interpret the *meaning* of the organism's activity based on their previous and future developmental journey. As explained by Witherington (2011), this is the beating heart of a developmental perspective:

> The study of development embeds an organism's current level of organization within a transformational sequence of prior and subsequent levels of organization across developmental time. To study a phenomenon developmentally means, first and foremost, to embed that phenomenon in time. But simply studying

> phenomena temporally does not yield developmental study any more than equating the process of development simply with 'change over time'. It is the embedding of a phenomenon in *sequence* that is fundamental to the explanatory framework a developmental perspective provides [Mascolo, Pollack, & Fischer, 1997; Murray, 1991; Overton, 1991, 2010]. A developmental context is a context of *temporal sequence*, of *structured* time, so to study a phenomenon developmentally means to place it in the context of previous or prior forms and potential subsequent forms. Note that simply establishing a history for a given phenomenon is insufficient to fully establish a developmental perspective. Embedding a phenomenon in sequence requires giving the phenomenon a future as well. A developmental perspective thus entails first charting the sequential transformations that characterize organizational change in a phenomenon over developmental time, and by this an interpretive framework is established for organizing what organisms do in their real-time encounters with specific contexts.

Okay—I can see the higher-order organization of person and context and the paintings on the wall behind the person and the context, but then what causes the movement or directionality in development?

We know that you will not be surprised to hear that the answer is "self-organization," but for people and their development, the specifics of the process are best captured by developmental mechanisms from the "grand theories" of development, namely, those of Vygotsky, Piaget, and Werner (see box). When looked at individually, these mechanisms can seem like fans and snakes, not part of the same elephant at all. However, when they are looked at from the same larger developmental frame, they start to make sense as describing different parts of the same process (van Geert, 1998).

Mechanisms of Development: It's not a very long list.	
Vygotsky	*Actual developmental level*: Performance diagnosed by tasks the child can currently solve independently.
	Potential developmental level: Performance diagnosed by tasks the child can solve under the guidance of a more competent other.
	Zone of proximal development: distance between the child's actual and potential development.
	Scaffolding: Guidance provided by cultural tools or social partners.
Piaget	*Assimilation*: "integration of external elements into evolving or completed structures of an organism" (Piaget, 1970, p. 706-707).
	Accommodation: any modification of an assimilatory scheme or structure

	by the elements it assimilates (Piaget, 1970, p. 706-708).
	Adaptation: dialectic between assimilation and accommodation.
Werner	*Differentiation*: successive separation and articulation of constituents from an integrated more global or diffuse whole.
	Hierarchical integration: successive incorporation of differentiated constituents into more complex and effective wholes.

As pointed out by van Geert (1998), despite their differences, all of these theorists share a common set of assumptions. First, they assume that the organism can be characterized by its current organized and integrated developmental level. For Vygotsky, this current level is what anchors the zone of current development and determines the range of potential development. For Piaget, this current level describes the ways of thinking (schema, procedure, strategy) that will be activated and consolidated during assimilation as well as the way of thinking that will be changed during accommodation. For Werner, the current organized whole is the result of previous integrations and contains the constituents that will be differentiated and further integrated.

Second, they all see as inherent in the current developmental level the potential for future development. They argue that the opposing forces they have articulated are complementary and so act together in a dialectical process. For Vygotsy, the tension between the child’s current and potential level creates the zone of proximal development, to which the more competent other must attune their scaffolding. For Piaget, assimilation creates the need for accommodation, because “[h]owever much the view of reality is shaped into the form of the child's current form of understanding, there is always an aspect that resists the transformation, in that the assimilating scheme must adapt to the exigencies and particularities of reality” (van Geert, 1998, p. 637), calling for accommodation. For Werner, “In principle, only action constituents that are differentiated can be coordinated or integrated. Thus, integration is derived from differentiation. In turn, integration of current constituents provides a basis for the differentiation of new constituents, making for ongoing interrelations between differentiation and integration" (Raeff, 2011, p. 12).

Is that dialectical interaction what is causing the movement?

Yes. van Geert (2000) considers the orchestration of movement to be the result of one of the most basic principles governing complex dynamic systems: the tension between a "*conservative force* that increases the strength of whatever internal procedure is activated in a particular activity or experience" and a "*progressive force* that increases the strength of the internal procedure that falls at the intersection of novelty and familiarity as defined by the currently activated procedure" (p. 66). Novelty and familiarity are important to progress because novelty invites new more advanced actions: Humans are intrinsically motivated to explore and play with new affordances—but familiarity is also key because too much novelty can provoke fear and make it hard for the organism to recognize potential affordances.

van Geert views this as an essential principle found in all grand developmental theories:

> [T]here exists a fundamental dialectic between a primarily subject and a primarily object-driven force, which constitutes the motor behind the developmental process. This dialectic involves a tension between a consolidated, current level (which is the primarily subject-driven aspect of an activity or experience) and a potential, future level of development (which is the primarily object- or environment-driven aspect of an action or experience, although it is still confined by the current state of the subject). For Piaget, this dialectic takes the form of assimilation and accommodation. Vygotsky conceptualized it as the distinction between actual development and proximal development... The basic dynamic model resembles Gibson's (1979) notion of action and perception potentialities and the affordances of the environment that eventually change these potentialities. (1998, p. 639)

As explained by van Geert (1998), "Piaget's (1937/1954) developmental mechanism of adaptation is a specific example of a mechanism that combines a conservative with a progressive tendency: "Assimilation is conservative and tends to subordinate the environment to the organism as it is, whereas accommodation is the source of changes and bends the organism to the successive constraints of the environment" (p. 397). Assimilation is conservative in that it consolidates the current state of intellectual functioning of the child: Every encounter with reality confirms that the child's current understanding is useful” (p. 637) whereas accommodation creates new action possibilities.

Say more about these *forces*.

It may be easier to understand the *conservative* force, in that, when an action is exercised (which agentic humans are intrinsically motivated to do, remember, both for fun and to reach their goals), it is obvious that practicing that particular action or pattern of actions consolidates and strengthens them (or the constituents or their coordination)—as seen, for example, in increases in speed, accuracy, efficiency, automaticity, or range of applicability. So it is easy to see how the conservative force keeps itself busy.

What about the progressive force?

Yes, the idea of the *progressive* force is a bit trickier. It is as if, when current actions are not immediately effective (when the context puts up “resistance”) or when current affordances suggest a new action possibility (the right blend of novelty and familiarity) or a cultural guide or tool offers some attuned help, then a little force field of “just manageable challenge” is created around the organism. This imaginary bubble (the zone of proximal development) contains a host of new action possibilities that the organism can realize through their own exertions or coping efforts (stretching), or through the use of cultural props (tools) or the participation of more competent others (scaffolding). The range of action possibilities in the bubble is decisively enabled and constrained by the organism’s current developmental level—it is like the bubble is elastic and can only stretch so far from the current state. At the same time, however, the new action possibilities in the bubble have the potential to extend the organism’s range of action beyond its previous repertoire, and so the force field is like a series of alternative future developments open to the organism—a progressive force.

This sounds like a fight between "conservative" and "progressive" forces. Can that be good for development?

Yes. In fact, that developmental organization we were talking about with "formal cause" describes what the "conservative force" is trying to maintain, and proscribes the zone within which the "progressive force" can operate; it dictates the action possibilities inside the bubble of future selves. In fact, although it sounds tiring, it actually makes sense that people need tension--between forces that maintain their current "structure" or "being," as well as forces that press them into "becoming" or change toward the individual's more adaptive "future self." These forces work simultaneously and continuously. In fact, the idea of living systems, which are open systems that exchange matter and energy with their surrounds, is that this tension is not only productive, it is essential. Self-producing or self-constructing systems, like people, are forever working to maintain their organizational integrity while all the parts are being renewed or changed out and while new parts and new relationships are established and incorporated. If change happens too quickly, it can lead to loss of organization or structure, producing chaos, and loss of developmental potential; at the same time, if the system resists change too much, it can lead to rigidity and a loss of flexible and adaptive functioning, again missing out on developmental opportunities.

Lewis (2000) explains it this way,

> [S]elf-organizing systems are both intrinsically sensitive and intrinsically stable. They are exquisitely sensitive to aspects of their environments because of their propensity for feedback and coupling with other systems… Yet the internal closure of developing systems is actively self-perpetuating, partly because recurrent patterns of coordination increase the likelihood of their own recurrence. (p. 39)

Are we close to understanding the “big enchilada” or qualitative shifts?

Yes, “final” cause helps us recognize them when we see them. “Formal” cause describes the “initial state” of the system that we are sending into the proximal processes, where developmental mechanisms that are operating should contribute to a developmental transformation or “phase transitions.” Lewis (2000) explains that,

> global reorganizations occur at *phase transitions*, points of instability and turbulence where old patterns break down and new ones appear. Phase transitions are both global and abrupt, indicating that new configurations require the cooperation of all system components; they cannot remain at in-between states of partial reorganization. This idea has two ramifications: (1) New levels of complexity appear discontinuously… passing through a period of extreme variability while doing so. (2) Development is strongly influenced by small effects at these junctures, such that new forms are not *determined* by their precursors... Taken together, the properties of phase transitions ensure that novelty is progressive, discrete, idiosyncratic, and unpredictable. (p. 39)

It is easy to lose track of what is emerging in these self-organizational processes. Are these phase transitions more that the accumulation of all the “pops” we have been hearing during the proximal processes?

Yes, it can be confusing. New organizations are emerging, but they are at at least two levels. Those “pops” are lower-order emergences of new actions. So they are real and they are novel, but they do not necessarily mean that a phase transition or qualitative shift is in progress or eminent. Depending on the overall organization of the current developmental level, the same emergent acts will have different signal value with respect to overall organismic reorganizations. As Witherington (2011) explains,

> [F]rom the vantage point of the organism qua organism, some changes in acts point to new, emerging levels of developmental organization in the organism itself – to a *developmental* transition between levels of organization – whereas other changes in acts point to an established, stable level of developmental organization – *real-time* transitions from one act to another within an organizationally invariant repertoire of acts. A visually guided reach of a 3-

> month-old – for whom reaches that terminate in grasps are novel – signals a transformation and new level of emergent organization in the organism in a way that a visually guided reach of a 5-month-old – for whom reaches that terminate in grasps form a stable part of her/his action repertoire – does not. (p. 86

So an organism can be showing a new emergent act at the lower level of "action-in-context" but not undergoing a developmental shift. In fact, most of the time, that is exactly what is happening: Our development level remains stable while we are busily consolidating old means and discovering new means to carry out our goal-relevant tasks. The big old qualitative shifts in our overall development are relatively rare—maybe we get a half dozen in our lifetimes if we are lucky. The ones that take place in our subsystems—neurophysiological, perceptual, attentional, cognitive, motivational, social, and so on—may occur more often, but still they are still relatively rare. Most of our progress is continuous-- we get better and better at organizing our actions so that we can do more and more faster and faster with the same old stuff. We only achieve "new better stuff" from time to time.

But these shifts are very cool beans. They include the shift that Sameroff talks about—from being regulated by others to being regulated by our own selves; the shift from living in the here-and-now to using symbols to represent the past and future; the shift in which we become able to think about our own thoughts, emotions, and motivations, and so can reflect on our own development; and the shift (after 10,000 hours of practice) from novice to expert. Big life-altering shifts. Witherington tries to explain how the two levels differ,

> Any given act, when viewed from the level of action in context, will always constitute a new, emergent form, but when viewed from the level of the organism qua organism, may or may not constitute a new, emergent form, though its content relative to a context is newly emergent. Every act thus exists both as a whole with respect to the part-part relations between organism and environment and as a part within the whole that is the organism qua organism – both defined in terms of the organism and definitive of the relation between an organism and its environment. Emergent form at one level of analysis is perfectly compatible with organizational stability at another level, and both represent distinct, equally legitimate ways of explaining the action of a system. (p. 86)

And Witherington brings us back to the idea of circular causality by pointing out that they are happening simultaneously, when he write that “[d]evelopmental-time-organized process both emerges from real-time-organized process and constrains in circular causal fashion, via formal and final cause, the very real-time dynamics that gave rise to it” (2011, p. 87).

If there is no design, why are the emergent developments so regular in form and timing?

First of all, they aren’t so regular. There is enormous variability in our infinite everythings— organizations, proximal processes, pathways, timing, and so on. If we would quit calling this variability “error variance” and instead agree that it is an inherent and fascinating part of how complex systems function and develop, they would become more visible to scientists (Nesselroade). Second, even when people have available to them a higher-level of organization, they do not typically lose access to the constituents that make up these more integrated wholes. So people can operate at many developmental levels, based on local conditions and their own local state (e.g., when they are tired or stressed), and after a while some of this level switching can become voluntary and intentional. But, yes, there is also some regularity to the developmental pathways—toward greater complexity and more adaptiveness.

Why?

Because living systems are active and goal-directed, and so they try out different ways of combining their actions (constituents) and the affordances in the environment. Remember, they are “taking notes,” first implicitly and later explicitly, about the results of these excursions. The ones that work, those couplings or combinations are used more often, so they get stronger, and so become more effective, and so are more likely to be exercised. Feel that spiral coming on? The great developmental scientists, like Werner, Piaget, and Vygotsky, have described the processes creates—through which emerge greater levels of complexity and greater levels of functionality, namely, toward greater differentiation and hierarchical integration.

Raeff (2011) provides an overview of Werner's perspective,

> Defining development in terms of differentiation and integration focuses attention on the increasing differentiation of action into constituent parts, as well as on the increasing interrelatedness of those constituent parts. … Differentiation among action constituents can also include the refinement or improvement of action constituents, which in turn allows them to be integrated into new forms of action. (p. 10)
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> Hierarchic integration means that previous, and also less differentiated and integrated, modes of action are reorganized as subordinate constituents of new modes of action. Thus, 'as a rule the lower level is not lost. In many instances it develops as an integral part of a more complex organization in which the higher process dominates the lower' [Werner, 1940/1980, p. 216]. (p. 11)
>
> In addition to the differentiation and integration of action constituents, Werner also focused on the differentiation and integration of action in relation to context... According to Werner, as infants and children transition from sensorimotor functioning, to concrete cognition, to abstract thinking, action becomes increasingly differentiated from the immediate, concrete context. In addition, there is differentiation in an individual's understanding of how contexts differ from one another. As action is differentiated from the context in these ways, a person can employ varied means to achieve varied goals. Of course, organismic-developmental theory's systems assumptions hold that action is always embedded in context, and thus action and context do not become wholly differentiated or separate. Thus, along with differentiation, action becomes more effectively integrated with the context as differentiated ways of acting are employed to fit particular contexts. (p. 12)

These more adaptive reorganizations are typically more functional because these are the ones that are kept. In developmentally promotive contexts in which social partners and affordances are aligned with organismic priorities, this development is toward systems that are transformed, as Werner (1940) tells us, from diffuse/global to differentiated, from fused to articulated, from rickety (or labile or transitory) to sturdy and durable (or stable), from rigid to flexible. As explained by Raeff, "Action that is flexible is relatively differentiated from a specific context, meaning that a person does not resort rigidly to one form of action in a particular context. Flexible action also occurs when differentiated action constituents can be assembled or integrated in varied ways to meet the demands of a specific situation. In other words, ‘multiple means become available for the achievement of a particular goal, and multiple goals can be served by a single means’ [Glick & Zigler, 2005, p. 326]” (2011, p. 13). For example, children come to successively defuse their actions from reactivity to local contexts and differentiate strategy packages into constituents, while at the same time successively combining constituents into new packages and applying them in ways that are more attuned with both immediate contextual demands and long-term goals—making their actions potentially more effective, autonomous, and socially integrated.

How to build a better coping system An example of how a more complex system is also more functional can be found in this description of a coping system that has reached its full developmental potential (Skinner & Zimmer-Gembeck, 2007): “These developmental potentials depict a system that can increasingly monitor and appropriately appraise more (current and future) demands using its own and other’s “radar;” maintain composure under higher levels of appraised threat with more capacity to withstand multiple demands and better “fallbacks”; respond increasingly in measured socially competent ways that reflect integration of ongoing emotional, attentional, and motivational reactions; more flexibly adjust actions to meet changing environmental demands without losing sight of genuine priorities; recover more quickly from setbacks; and at the same time take more away from stressful encounters, learning how to prevent and deal with future challenges and how to deploy coping in line with future goals” (p. 136).

Take home message from the principle of Developmental Dynamics: Developmental transformation and maintenance of stability are caused by individuals who are wholistically organized at a specific developmental level and social contexts who wholistically organized according to cultural specifications. They participate in proximal processes (or cultural practices) though dialectical processes that act as conservative and progressive forces. These forces, operating as circular causality over time, create immense variability and plasticity as well as successive order that tends toward more central cultural participation, higher levels of complexity, and greater functionality.	
1.	*Conservation force*: interactions that preserve “being,” that is, the current mode of functioning and organization.
2.	*Progressive force*: interactions that encourage “becoming,” that is that encourage a

	higher level of functioning and organization.	
3.	*Dialectical process*:	• Zone of proximal development: Current and potential level of functioning.
		• Adaptation: Assimilation and accommodation
		• Hierarchical organization: Differentiation and integration.
4.	*More adaptive:* Toward greater articulation, durability, flexibility, coherence, reach; cultural and social integration, effectiveness, and autonomy.	

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Activity 3. The Observation Project

All the systems meta-theories point to the same causal explanation for the source of development: reciprocal exchanges between the active intentional person and the integrated local (often social) context in the here-and-now. So we wanted our students to go and look at these most fundamental and important of processes, right where they are happening, which is the real world-- hence, the observational project. However, we discovered that it is one thing to understand proximal processes in principle, but it is quite another to recognize them when one meets them on the ground.

Given their ubiquity, it might seem that anywhere students would go, they could not *help* but encounter proximal processes. And you would be correct—every bus, street corner, office, playground, and classroom is packed with them. In fact, they are pretty much all everyone does all day every day. However, we are not interested in any old proximal processes, we want to find *our* proximal processes, that is, the ones we think might be shaping *our* MacGuffin, that is, our target phenomena. Of the infinite number that are rocketing by at any given moment, how do we recognize the ones that are meant for us?

We found that figuring this out this required quite a bit of planning, pre-structuring, and thinking ahead on all of our parts. So a big part of preparing the Observation Proposal (see Table 16a.1) is helping students frame their activities in a way that, when they go into the field, they can make sense of what they observe. The first step, as you can see, is to articulate their goals for the project.

What are examples of the kinds of *goals* students identify for their observations?

At this point in the class, all of our students' phenomena have been "developmentalized," so their goals for the observation project all have the same basic structure, namely, to identify the proximal processes that promote and undermine their MacGuffin (developmental target) as well as those that promote and undermine the anti-MacGuffin. Their project goals typically include: (1) *description*- to try to identify these four kinds of proximal processes; and (2) *explanation*- to try to figure out the likely attributes of the person, social partners, and context that support and undermine the occurrence of each one of them. Sometimes these goals are embedded in (3) *optimization* in that the student is interested in understanding how an ongoing intervention works, in terms of promoting proximal processes inside the intervention itself or promoting proximal processes in the actual setting.

As an example, say a student is interested in improving young children's school readiness by promoting the development of their self-regulation, and they wonder if the exercise of fine motor skills might aid in this regard. Then their MacGuffin is the development of self-regulation (often considered the result of the development of executive functions) and the anti-MacGuffin is impulsivity or lack of self-control. The target proximal processes are young children's play with small objects—the exercise of their fine motor skills. So then the student is interested in the interaction partners (especially the kinds of small objects, like markers or Leggos, that require fine motor skills to operate) as well as the social partners (e..g, teachers and peers) and contextual factors that might influence a child's participation in the proximal processes.

As another example, say a student is part of a larger intervention project that is designed to improve the support supervisors provide when their employees experience work-family conflicts. So the student is interested in understanding the kinds of proximal processes in the intervention that promote uptake of the more supportive practices (the short-term MacGuffin) and their use in the workplace (the long-term MacGuffin). So they are interested in the attributes of the social partners and contexts that might influence these proximal processes.

Table 16a.1. Observation Proposal (approximately 2 pages).

1. ***Goal*** of the observation.
2. Brief description of the (imaginary) ***perfect observation***. What would be the study target and design?
3. The specifics of the proposed (actual) observation.
   Setting description.
   Description of ***participants***.
   Observation schedule, specifying "for how long" and "when" observations will be conducted.
4. What is your ***target developmental trajectory***? Describe the phenomenon that is the focus of your research. There may be a short-term developmental outcome as well as a long-term developmental outcome. Describe any parts of these that are observable. Include the target constructs as well as any specific categories and their definitions.
5. What are your ***target proximal processes***? Describe the kinds of proximal processes that may be observed. Include a list of proximal processes that should facilitate the development of your target phenomenon and a list of processes that should hinder its development.
6. ***Overview of the design.***
   Describe the ***contrast***. All observations must include a contrast design. Contrasts can be between:
   (1) kinds of people (e.g., age groups or other individual difference features);
   (2) kinds of contexts (e.g., settings or other context features); or
   (3) points in time.
   Any project that relies on self-reports should contrast other sources of information.
7. Describe how the proximal processes may ***differ*** according to time, context, or person characteristics.
8. Description and rationale for obtaining ***informed consent***.
9. ***Attachments***.
   9a. ***Observation schedules and/or interviews.*** For interviews, include an exact copy of the ***protocol*** that you will use to interview participants and a description of how you will code their answers. (If you will be exploring themes, explain the themes).
   9b. Copy of ***modified*** permission forms or letter for subjects or setting supervisor. (If you are using the sample copy provided, you do not need to include it.)
10. As soon as your proposal is approved, you should immediately conduct a ***pilot observation*** to find out if it is feasible.

Why do students need to describe the "*perfect*" observation?

Students show a lot of hesitation about planning this project. They seem to be apprehensive about the amount of work it could take to get into the actual target setting, and they worry that we are going to ask them to knock on doors or push their way into locations where they are not wanted. So we have found that it loosens them up to just get in touch with their "perfect observation"—the observation they would happily carry out if there were no constraints of time, work, or access. Then they can freely imagine where they would go and what they would see. For example, they imagine going with young children to their pre-kindergarten classes, starting on their first day, and watching which activities they select and whether they get better at the ones they select or they select ones they are already good at; or following supervisors out of their training and onto their real jobs-- day after day, as their employees request time off and their bosses give them crap for not making their quotas. This helps students realize when and where their target phenomena are *really* happening—whether they can get access to them or not. Their proximal processes are not living in their surveys or secondary data analyses, but in the multiple settings (mesosystems) that their participants visit every day, and in the many many social interactions they have there.

Once students can imagine their "perfect observations" (and they are typically planned to last for months if not years), it becomes clear how much we could learn from visiting them, and these become the standards by which they judge their typical methods of getting information. They can see that their surveys, computer assessments, and measures of bio-markers are poor substitutes, or at best good supplements, for direct contact with their phenomena of interest. At this moment, many students decide to take classes on observational or participant-observational methods, so they have the option of looking directly at their proximal processes.

What are the *specifics* of the actual observation?

These are the deign elements that answer the questions of "where," "who," "when," and "for how long." Since this whole project happens relatively quickly (in a single quarter or semester), we often have to be creative in our selection of participants and settings. Through their mentors' research, students sometimes have direct access to the very people and settings that would be "perfect"—to a classroom or nursing station or preschool playground or intervention-in-progress. Sometimes, again through their mentors' research, they can't get into the setting itself, but they have access to videos of the perfect setting. Other times, the people and proximal processes we want to observe take place in public settings where we (or anyone) can see them without getting special permission—we have had students who are interested in parent-child interactions observe in parks and grocery stores; who are interested in adolescent peer groups observe in malls and lunch spots near high schools; who are interested in work stress observe restaurants during rush hours and the service counter in big box stores; who are interested in health behaviors observe at gyms and community centers; who are interested in the treatment of homeless people observe in the parks they frequent. Sometimes students have personal connections that let them get into the homes or workplaces of friends and family-- to observe the assisted living centers where their grandparents live, or dinner time or homework at their friends' house, or truckers at rest stops or new employee orientations.

What if you can't get into any settings that are of interest?

About a quarter of the time, we are stumped in finding a good setting that students can get into relatively quickly. So then, and only then, we allow students to talk to "spies." These are people who *do* have access to the settings we are interested in, people who may have spent hours and hours, or even months and years, in them. These spies, whether they know it or not, have already observed thousands of proximal processes, and so students end up focusing their projects on these helpful "spies" and conducting open-ended interviews designed to elicit information about the proximal processes they have observed. Sometimes students' mentors, as parts of larger ongoing research projects, have conducted such open-ended interviews—for example, with teachers leaving the profession or prison guards or spouses of seriously ill patients. And so, if these interviews are rich enough, they can also be a source of information about proximal processes.

What about the design elements "when" and "how long"?

Lots of times students who have never been involved in observations before don't understand the need to make decisions about "when" or "how long." It only slowly dawns on them that the proximal processes they are most interested in are not homogeneously distributed across time and space--they are more likely to happen on certain days and at certain times. If one wants to see stressful work interactions, then rush hours are best. If one wants to see parents and children talking, then dinnertime is better than during TV watching. If one wants to see fine motor activities, then free play is better than circle time. We typically ask students to conduct a little pilot, in which they try to discover the best days and times to observe. If they see big differences in the kinds of proximal processes they are observing on different days or at different times, they can use this as one of the "contrasts" in their design (see below).

Why is the "target developmental trajectory" part of the observation plan?

Students are asked to describe their MacGuffins and anti-MacGuffins, not only because they determine the proximal processes that will be relevant, but also because we want to think though whether any parts of them might be observable. Perhaps surprisingly, bits of them *are* often visible. For example, if a student's anti-MacGuffin is teacher desistence, it is true that they will not be able to observe a teacher actually quitting, but once we reflect together on the observable precursors to quitting, like teacher disengagement, disaffection, or burnout, it becomes clear that we can troll for any signs of this in our observations. We are so used to thinking of our MacGuffins as *psychological* phenomena (like appraisals or esteems or well-beings) that we often forget that they are all embodied and therefore sometimes observable.

This is the point in writing the proposal at which students start making lists. They list their target developmental constructs and their definitions, and then generate a series of possible codes for observing them. For example, if they are interested in the development of self-regulation in preschoolers (their MacGuffin), then they start listing self-regulated actions, like minding the teacher, following the rules, doing things without being asked, and so forth; as well as indicators of their anti-MacGuffin, like breaking the rules, not minding, not responding to requests, and so on. Or if they are interested in student engagement, they start listing things like listening, raising one's hand, reading the book, offering an opinion; and indicators of the anti-MacGuffin such as looking out the window, talking to a friend, doodling, or ignoring instructions. Again, these activities are supposed to help our students get mentally ready to recognize their MacGuffins and anti-MacGuffins when they see them, but there is nothing like getting into the setting to learn what is really visible and what is not.

It is also correct that we are not in our observational settings long enough to view *real* development taking place (alas!), but even that awareness sometimes inspires students to want to be part of longitudinal studies so that they could eventually capture the kinds of changes and transformations they have grown to love and respect.

How do we generate lists of our potential proximal processes?

Some students lucked out in that they had theories that were chock-full of proximal processes. Self-determination theory has rich descriptions of the kinds of interactions that promote and undermine engagement. Theories of leader-member exchange have long lists of supervisor and employee interactions. Theories of parenting, teaching, and mentoring include "good practices" that depict proximal processes. Theories of coping include lists of ways to interact with stressful events. At the same time, however, sometimes when students went to make lists of supportive and unsupportive proximal processes, they became frustrated—some of their theories never got much beyond the *label* “supportive,” as in “supportive teachers” or “supportive supervisors” or just “social support”—as in the answer to the question- “Do your parents let you know that they love you?”, “Is your boss supportive?”, and “Do you have the support you want from your family and friends?”. Students were surprised that they could not find much *there* there. So we begged, borrowed, and stole from other analogous theories. And when we ran out of theories, we also used our imaginations.

We also tried to jog our creativity by interviewing ourselves about the four kinds of proximal processes mentioned previously—ones that promote and undermine the MacGuffin as well as ones that promote and undermine the anti-MacGuffin. One theme that we noticed is that the kinds of proximal processes that promote the anti-MacGuffin do not always even have the anti-MacGuffin as their intended target. So, for example, the kinds of parent interactions that can make kids feel neglected are ones where they are preoccupied with work. Or the kinds of supervisor interactions that lead employees to feel coerced are ones in which the supervisor is trying to please *their* supervisor.

Why do you have students spend so much time making lists of proximal processes before they do their observation? Why don’t they just go look?

Yes, it seems like the answers to all our list making would be in the target settings. However, and perhaps surprisingly, we found that students had to have some basic constructs, some rudimentary categories, some partially-baked expectations before they could see *anything*. Even if what they saw was—“Nope, that is not what’s happening here,” it was as if looking for something and then *not* finding it was more helpful as a frame to make sense of what they *did* see than starting with no expectations, no frame, at all. We also found it helpful to describe this project to students as one in which they were supposed to *create* an observational coding system for their proximal processes, rather than one in which they were supposed to be collecting data using a pre-existing coding system. That seemed to relieve them of the pressure of producing numbers, and just let them focus on finding the best constructs to capture their proximal process instead.

What is the idea of a "contrast" design?

One key feature of this project that helps make things more visible is to compare and contrast how proximal processes *differ*, according to the (1) kinds of people involved; (2) the kinds of contexts in which they take place; or (3) the points in time. For example, students planned observations to contrast the proximal processes used by teachers who had been teaching different amounts of time, or who were teaching in the classroom versus in the gardens, or who were teaching 4th versus 6th graders. We had students who contrasted the proximal processes in preschool shown by girls versus boys, by older versus younger children, during different activity periods, or indoors versus outdoors. Students contrasted the greeting behaviors in airports at different times of day; the proximal processes in supermarkets and gyms in rich versus poor parts of town; of couples on Valentine's Day versus a regular weekday; of interactions among math study groups for beginning versus advanced classes.

It turns out to be much easier and more interesting to describe the proximal processes according to what is similar and what is different across these contrasts. We think that contrasts must add the magic ingredient of "now you see them, now you don't." By seeing proximal processes appear and disappear, or just morph, students also learn how much proximal processes are shaped by the partners that participate in them and by the contexts in which they are embedded, as well as how much they differ as a function of their social address or time of day. It was also fascinating to discover what kinds of proximal processes were consistent or similar across contrast conditions and time. So we worked with students to create a contrast that we all thought would be enlightening.

We also decided that any "observation" project that relies on open-ended interviews should contrast the self-reports with other sources of information. So if someone is interviewing supervisors, they also need to interview employees. Or if they are interviewing young adults about stereotypes, they also have to watch some movies or TV to examine stereotypes; or if they read open-ended interviews with prison guards, they have to find some Youtube clips in which inmates are interviewed. Some of the most interesting projects *combined* observations and interviews. One student, whose anti-MacGuffin was the kind of "resistance" to supervisor training that can be generated by mandating attendance, sat in on several training sessions with an experienced trainer and then interviewed the trainer for her take on sources of resistance. Another student who interviewed long-distance truckers then observed the dispatcher talking to the truckers while they were driving. Anther student who observed complaints at the service desk then talked to customers for a few minutes after they were done with their interactions.

What makes a good open-ended interview?

The central idea is that we are trying to get our "spy" to reveal what is on their videotapes from the time they spent in our target setting. But the problem is, the spy did not know that their videotapes were going to be requested, so they need help in figuring out which ones to access. And furthermore, the spy is naturally protective about releasing these tapes to us and especially if they contain any scenes that might put them in a bad light or be embarrassing to them or their friends. So we have to be careful how we structure the interview so that the spy feels well-informed about what you want to know, as well as safe and comfortable in divulging as much information as they wish.

The interviewer also needs to create a mindset for him- or herself about the conversation. As with the observations, we have found that it is important to go in with clear expectations, as well as healthy skepticism about those expectations. This tension (where the interviewer is neither trying to pretend to be a blank slate nor dedicated to verifying previous expectations) is surprisingly useful in creating an open curiosity about what is really there and a clarity in perceiving it. One student offered a helpful analogy—"It's like making a documentary about a subject that you have been thinking about for a long time. You know some things but your goal is to document accurately what is actually going on."

How can you explain to them what you want to know?

Our students, who as rule have not done much interviewing, often have the feeling that a good interview is like a set of questions posed by a computer—same questions, same order, same inflection, no reaction. They are sometimes surprised to hear that a good interview is like a good conversation that one would have with a friendly stranger on a train or plane: natural, easy, following the flow of information wherever it goes. At the same time, it is more than a conversation. The interviewer has ideas about the proximal processes that he or she thinks should be relevant, and he or she wants to create an opportunity for the respondent to speak to those issues. At the same time, however, the interviewer doesn't want to put words in the respondent's mouth, any more than an observer would try to direct the actions of the people in the context they are observing.

It's a balancing act, trying to create a naturalistic conversation on purpose. The exchange needs to be open enough that you can learn what don't know already, and structured enough that the respondent can understand what you want to know, and provide information about their actual authentic experience in the setting.

Okay—so how do you direct the conversation without directing the conversation?

We think that the right metaphor is herding or funneling. The interviewer starts generally and then slowly circles back around, bringing the respondent along to successively more specific topics and questions. Say that you are interested in teacher stress and coping, and so you want to discover the kinds of interactions teachers have with students that are stressful to them; from yur reading and experience, you think that student disengagement and disaffection should be stressful to teachers. That's one of the proximal processes on your list. So—do you start the interview with the question—"Do disengaged students stress you out?" Of course not. You start out with, "Thank you for agreeing to talk to me. I am talking to several middle school teachers because I am interested in learning more about what teachers find stressful and rewarding in their jobs. Would you be okay to talk about that? For about 45 minutes to an hour?" There—you have given the respondent an overview of where you are going together.

Then can I ask what stresses them out?

Not yet. You start gently warming up the respondent and building rapport by getting non-threatening background information. "What grades and subjects do you teach? How long have you been teaching? Where was you first position?" and so on. If your contrast is beginning versus more senior teachers, you can focus in on their first position (beginning teacher) and ask more about where the school was located, what it looked like, their earliest memories, their first day on the job. After a while you can start asking about the kinds of things that they found rewarding (because they are easier to describe than the stressful things—unless the stressful things come up first naturally).

This is a surprising moment for our students—to realize that one of the things they are doing in their open-ended interview is to see whether their respondent brings up the hypothesized proximal process without any prompting. So interviewers who talk to teachers are quite surprised to learn that their most stressful proximal processes are not with students, and not even necessarily with their bosses, but with their fellow teachers and (surprise!) with students' parents. Just as nurses' most stressful interactions are not with patients (as we might expect) and not even with their supervisors, but with the patients' families and with (surprise!) doctors. However it turns out, in open-ended interviews, a very revealing piece of information, that can never be captured by surveys, is what the respondents bring up on their own.

Then what happens?

You are looking for proximal processes—episodes, stories about what happened. Of the sort that start "Tell me about a time…" Once you get a category of proximal processes, based on interactions and interaction partners, then you want to ask for the videotape—more examples of the "he said she said" variety. There are several prompts in Table 16a.2 that are helpful for letting the respondents know what kind of information you are seeking. In these interviews, it is also revealing to see how fast an dhow many examples the respondent can come up with to fill in their general impression. For example, if the respondent says that when students learn something it is very rewarding, but can't think of a specific time that that actually happened, it seems that those proximal processes might not be very common or recent.

A particularly important stance to convey (and to believe) is to position your person as an expert on their experience, which they are, of course. They are the ones who were there and have the tapes. If you want someone to stop talking openly to you, a good strategy is to dismiss or question their versions. Comments like "Oh, really" "Come on now" or "Did that *really* happen?" have a chilling effects. You can always ask for more details or more examples. And if they seem to want to defer to you or ask your permission, you can always say "How did it seem to you?" or "I am interested in *your* opinion" or "*your* take on things."

How much is the interviewer supposed to say?

Just enough to keep the respondent comfortable and on track. Otherwise the respondent should do as much of the talking as possible. We had one student who was interviewing workers on their lunch breaks and became so sociable that the majority of the time was spent exchanging views, instead o learning what the workers thought. He ended up having to go back and interview more workers to get any information! In that way, an interview is not exactly like a conversation. It's like a conversation with someone who is the best listener ever. Good practice for real life.

How do we stop?

When about 10 minutes are left in the agreed upon time, it is always good to say "We are coming to the end of our time. Is there anything else you want to say that I didn't ask? That you think it would be helpful for me to know?" It is always surprising to discover what our interviews have shaken loose in respondents' experiences. These can be some of the juiciest nuggets, so we want to allow time for those thoughts to be expressed. If you have a card, you can also invite respondents to e-mail you any additional thoughts that come up. Sometimes people can have a delayed response or find it easier to express their experiences in writing, rather than face-to-face. And of course, we always end with a sincere appreciation. If the interviews are done well, respondents often thank us as well—for the opportunity to talk to someone who values their experiences and insights. An interview can be a constructive proximal process itself!

Table 16a.2 What makes a Good Open-ended Interview?
Describe and Explain Stability and Change

- *Can you tell me what it was like?*
  - *Was it always that way?*
  - *Why is that?*
- *Has it changed? When?*
  - *How has it changed?*
  - *Why do you think that is?*
- *If you had to do it all over again, what would you do the same or differently?*
- *If you were giving someone advice, what would it be?*

Capturing Proximal Processes

- *Can you tell me about a time…*
- *Can you tell me what happened? Then what happened? What happened next?*
- *Can you give me an example?*
- *Can you describe what that looked like right there (in the classroom, street, playground)?*
- *Did (proximal process) ever happen at your work/ living room/ math class?*
  - *What do you do? What were you thinking?*
  - *What did he/she/they do? Why do you think he/she/they did that?*
  - *Then what did you do? What were you thinking?*
  - *How did it end?*

Posing the Questions

- Is not overly abstract in concept
  - *(not: "What do you think about societal stigmas?")*
- Is not overly complex in structure
  - *(not: "What do you think about your sexuality, ethnicity, and religion?")*
- Affords possibility for variability of response
  - *(not: "Do you have good and bad days at work?")*
- Does not telegraph a desired response
  - *(not: "How much did you like the nurse?")*

Probes

- *"Can you give me an example of that?"*
- *"Could you say a little more about that?"*
- *"That's interesting, what happened next / before?"*
- *Some people think X, others think Y, what do you think?*
- *"Are there things I should be asking about to get your perspective that I haven't asked?"*
- *"What did you learn from that?"*

Acknowledgements

- *"Uh-hum, I understand."*
- *"I can appreciate that."*
- *"I see."*

What does the final report look like?

The final report is 15-20 pages long (see Table 16a.3). When students see the assignment, they sometimes gulp in trying to imagine what they could possible see that would fill all the pages. By the time they are done, however, most of them have more difficulty condensing everything they have to say about what they see *down* to 15-20 pages. The report is divided into four sections: (1) introduction (taken from the project proposal); (2) description; (3) analysis; (4) critique; and (5) comparison.

Table 16a.3. Field Observation Project Report

Goals: These observations are meant to be exploratory and generative. They are meant to help you recognize the richness and complexity of ***proximal processes*** as they unfold in the natural settings of daily life. They are also meant to give you practice with some tools to help you make sense of the observations. The observations focus on several general issues that have been emphasized throughout the course:

1. The active participation of social contexts in all psychological phenomena.
2. The active participation of the individual in all psychological phenomena.
3. The centrality of proximal processes (social interactions) in shaping change.

Activity: Total of 10 hours conducting observations in the setting. In addition to your presentation of the observation, please turn in your field notes. The notes you take in your field setting should be organized to include the following kinds of information.

Report: The report should be about 15-20 pages of text, but it can be shorter. It should cover the information from the observation proposal. About half of the report should be clear descriptions of what you observed, including concrete incidents and quotations. This part of the report should be like a summary of a videotape, enabling the reader to envision what you saw. The other half should be analysis, reflecting an attempt to make sense of what you saw using concepts from class. Analysis should also include a critique of your observation and a comparison with the literature in the area.

Follow the outline carefully; be sure to include headings and questions in your text.

Introduction (1-3 pages). (Information can be taken from your observational proposal.)

1. Goal of observations.
2. The specifics of the observations.
   - Setting description.
   - Description of participants, including information about their age(s) and social address(es).
   - Observation schedule, specifying “for how long” and “when” observations were conducted (classic design paragraph).
3. Overview of the design.
   - Describe the *contrast*.

- Describe how the target construct or proximal processes were expected to *differ* according to time, context, or person characteristics.

4. Describe your participation in the setting.

Description of observations. (5-8 pages). Include specific actual incidents and specific actual contextual and personal characteristics. This part of the report should be like a summary of a videotape or a screenplay, enabling the reader to envision what you saw; include concrete incidents and quotations. Be sure to mention which descriptions were seen in which contrast conditions.

Examples of questions to help flesh out description:

1. What kinds of interactions were the person and social contexts having (actual visible exchanges)?
2. What were the target individuals like? What did they do?
3. What were the social partners like? What did they do?
4. How was the target construct manifest? Did it appear in different forms? Did it change?
5. What were the contexts like? What did they do to the interactions?
6. Describe in broad terms the major differences you saw between the contrast conditions.
7. Did any of these features (i.e., individuals, partners, social contexts, target constructs, contrast conditions) look like “good news” or “bad news” with respect to future development?

Analysis of observations. (5-8 pages). This part reflects your attempt to systematically make sense of what you saw (and what you did not see) using your theory and concepts from class. Include general constructs, processes, and features of person and context.

1. What kinds of target behaviors were observed?
2. What kinds of *proximal processes* were observed?
3. What kinds of social partners were involved in these proximal processes? How were they involved?
4. What features of the context shaped the proximal processes? Mention factors from at least three of Bronfenbrenner’s levels.
5. What features of the target individual shaped the proximal processes?
6. How did the contrast conditions make a difference to what you saw and what you didn’t see?
7. Use a table like this one to systematize your comparisons:

	Contrast Condition A	Contrast Condition B
Target construct		
Proximal processes 1 Proximal processes 2, etc.		
Social partner 1, 2, etc.		
Context feature 1, 2, etc.		
Person characteristic 1, 2, etc.		

8. Could you see any feedback loops?
9. Can you imagine how the target constructs might develop as these proximal

processes continue over time?

Critique of observations (1-2 pages).

1. What were the greatest strengths of your observation?
2. What were the limitations?
3. What additional information would you have wanted for your observations?
4. What additional observations would be helpful as next steps?

Comparison of observations with readings (1 page).

1. How were your experiences in the setting similar or different from your expectations based on reading the literature?
2. What are the greatest differences? What did you see that you were not expecting? What did you expect to see that was not there?
3. What did you *learn* from the observations? What are the biggest new questions that they brought up?

References

What goes is the description section?

This is the section that is about clarity of perception. This is a drect report of what happened-- the part that corresponds to Joe Friday's request when he was interviewing witnesses on *Dragnet*, "Just the facts, ma'am." Just as it is important for students to go visit their phenomena in the settings where it is active, so too is it important for them to bring back a report that is as low-inference as possible. We call this "descriptive"—"like a summary of a videotape or a screenplay, enabling the reader to envision what you saw; include concrete incidents and quotations." Some students find this very hard to do. They need practice separating what they are seeing from what they are thinking. If we had plenty of time, it would be fun to send two students into the same context and have them compare the descriptive parts of their reports.

What is the analysis section?

This is the part of the report in which students practice using the concepts from the course to make sense of or interpret what they saw (and what they did not see). This is the part where the contrast conditions come in very handy for structuring analysis of the similarities and differences in the proximal processes, social partners, and contexts.

What goes in the critique?

One of the most important things students learn from the observational project is what went wrong and what they could do better next time. In line with a developmental spirit, we always refer to these two areas as “strengths” and “areas for improvement.” So we consider setbacks and “failures” as important lessons. And since we always work so closely with students in planning their projects, we always share in the missteps and surprises they invariably encounter. We always like to focus on what would be useful next steps.

What goes in the comparison?

The last section in the write-up is a comparison of “book-learning” to learning that takes place in the field. We use students’ theories and prior research to set up our expectations in the field, and then use what we learned in the field to go back and enrich or revise our theories.

What did students learn from the observation project?

On the last day of class, students present the results of their observational projects to each other and it is always one of the most interesting and informative class sessions. The list of what students learn is long, but the most important lesson, we think, is an appreciation of how complex their phenomena is and how many moving pieces it involves—as well as how much can be learned by going into the wild to visit it for ourselves.

SECTION V. The Study of Development: Description

Chapter 17. From Meta-Theories to Methods

> We are not yet what we shall be, but we are growing toward it, the process is not yet finished, but it is going on, this is not the end, but it is the road.
>
> — Martin Luther

Our goal in creating this class and this textbook is to encourage developmental scientists to become more fully aware of their assumptions about the nature of humans and the nature of development, including what causes it and how to optimize it. In teaching about meta-theories, we used to have a “live-and-let-live” policy in which we thought the end-game of the class was for students to recognize and explicitly articulate their own views. The co-instructors put their own assumptions on the table. Since we were trained in a variety of approaches (including behavioral, organismic, lifespan, contextual, transactional, and systems perspectives), we could highlight our own differences to demonstrate not only the intensity but also the irreconcilability of these different belief systems. By the end of the quarter, we were satisfied with a “you-show-me yours-I’ll show-you-mine” attitude, in which we were very careful to reiterate that “there is no single correct view of development,” and that, even though everyone always believes in their heart of hearts that their own view is the correct and true one, we have to fight against that tendency, and agree to disagree.

As you can tell by this point in the book, we got over that. Two experiences changed our minds. First, we discovered that most students, when asked about their naïve definitions of development and their own observations and experiences in their daily lives actually started out (with no coaching) relatively close to interactionist and systems ways of viewing the world. No one argued that development ended at 21; they all felt that they were still developing (and since we were catching them in their first or second year of graduate school, they were experiencing lots of changes). They didn't think all of the changes could be called gains—they worried about losing their friends, their hobbies, or their physical fitness now that they were concentrating their energies on growth in one dimension. When we got to the lifespan perspective, we ended up having to spend more time explaining to students why anyone could possibly believe in the "traditional approach" that lifespan replaced and needing less time to outline lifespan's propositions. So for most students, the process was one of articulating an already complex naïve meta-theory and coming to see how current theories in psychology were unsatisfactory in mapping the territory covered by that nascent meta-theory.

The second set of experiences that started us down this path originated in arguments we kept having among ourselves about what we owed students in the class. Was it really true that the whole point of the class was to help students be clear on what they already knew all along? Or was it to take them deeper? To penetrate further into the mystery of development? Among the five of us, we had over 100 years of experience in psychology—had we not learned anything more about how to "think" and "look" into development? So we decided to continue the arguments among ourselves: Based on years of co-instructing we could feel ourselves shifting and sense that some overlap was emerging. So we decided to bring students along with us on the journey, and that gave rise to the class as it now exists and the book you are reading.

We will admit that it does take students a while to penetrate all the way to the ontological and epistemological assumptions of split and relational meta-theories, but mostly we discovered that if we all hold hands and go together, when we get to the well, we can all peer in and try to make sense of the deep assumptions we see there. Students can understand that marbles provide a very different fabric for the foundation of the universe than do webs, and they are actually very good sports about discovering that on the one hand, there is only *one* system—which incorporates everything we know (and everything we don't know), and on the other hand there are *infinite* systems composed of infinite everythings that are shrouded in the mists of potentials until we go in with the flashlights created by our own goals, and then we get to behold a system that is actually only held together by our own perspectives or lines of sight. We typically came out the other side of this part of the course a little dizzy but clear-headed about our once and future assumptions.

What are the meta-theoretical and theoretical issues that now seem clear to students?

Students typically think that it is a good, even obvious idea, to move toward a view that acknowledges that development happens across the life span, can include gains and losses, involves potential for improvement at any age, can go in different directions, and is embedded in lots of layers of contexts (dyads, groups, institutions, neighborhoods, communities, societies, cultures, and historical periods), is knit together by proximal processes that involve actions and affordances, during which people take representational notes on what is happening, and in the long-term, development evinces qualitative shifts, like toward more internal regulation, that emerge from bottom-up and top-down causal processes.

At the *theoretical* level, it becomes a bit more nerve wracking to deal with all the complexity that that this perspective generates, until we find some strategies for prioritizing the construction of our conceptualizations: (1) identify the target developmental trajectory that you are interested in, both the MacGuffin and the anti-MacGuffin; (2) focus on the proximal processes that are promoting and undermining those guys; (3) organize all your person, context, and time constructs around factors that shape those proximal processes; (4) incorporate the representational system as part of people's appraisals or interpretations of their participation in proximal processes; (5) sandwich your system in both bottom-up proximal processes and top-down developmental organizations (such as competencies, identities, working models and relationships) and cultural opportunity structures; and (5) look for beginnings, and other perturbations, that mark likely time windows for qualitative shifts. Pretty soon, everyone's theories start taking on a similar structure—there is a definite family resemblance-- if not twins, then at least siblings or cousins. See Figure 17.1.

Insert Figure 17.1 about here

If students have come this far, why doesn't the book and the class give them a break, and just stop?

Because we are not just interested in changing (i.e., opening) students' minds, we want to change their actions—by infusing and informing their research and interventions with these applied developmental systems ideas.

Why don't you just say, "Please be sure to keep these things in mind as you go about conducting your research and interventions"?

Yes, it seems like once one's assumptions are enlightened and enriched, one's actions should immediately snap into alignment. However, we discovered that students cannot independently discern the methodological implications of a relational developmental systems worldview. In fact, when we asked them to weigh in on whether the current methods that are most common in psychological research would be useful for studying systems, they looked at us blankly and said "Of course." We became aware that the assumptions baked into our standard methods exert a powerful bottom-up influence on our students' actions (research) and thoughts (theories) (see Figure 17.2).

Insert Figure 17.2 about here

I thought that meta-theories shape theories and methods. Now you are saying that methods shape theories and meta-theories?

It became clear to us that methods *embody* meta-theoretical assumptions. Methods are like the tools that a culture gives people to use to reach their goals. Encoded in these tools are the culture's assumptions about how we should interact with the world and what those interactions mean. As the old saying goes, when you give a person a hammer, everything starts looking like a nail. So the idea is that our students (and our science) have inherited a toolbox full of methods to use in looking at our phenomena. When we accept and use these conventional tools, we unintentionally swallow whole all the assumptions that they contain. So, for example, if it is conventional to design and conduct studies in which all observations are taken at only one time point, then that convention seems right to us, and we do not necessarily realize that we have just swallowed the assumption from our prevailing scientific culture that everything you need to know about a phenomena can fit in a snapshot—in other words, the belief that change may be happening but if it is it doesn't matter.

Are assumptions baked into *all* our methodological tools?

Yes, they are everywhere. They are living in measurement—for example, in the idea that applying a measure at two time points is an index of "test-retest reliability," and unless the coefficient is high, the measure is bad; this assumes that the phenomenon is supposed to be fixed rather than changing, and forgets that such coefficients also includes an index of the *stability* of the phenomenon. Assumptions are found in our preferences for sampling—with the idea that more useful information is generated by looking at many people at one time point than by looking at one person at many time points. They can also be seen in our decisions to conduct analyses that are variable-centered rather than person-centered. Assumptions adhere to decisions about longitudinal designs-- which seem to suppose that times of measurement should be equally spaced and about a year apart. Assumptions are found in decisions about how to handle time—for example, even if one is lucky enough to get one's hands on data from in vivo observations or daily dairies, the typical next steps are to collapse the information across time in order to create an indicator of an average interaction or an intraindividual correlation. Assumptions are found in statistics—in which regressions assume change that is linear, and that the source of variability is error.

This does not sound good.

No--relational and developmental systems methodologists are tearing their hair (e.g., Lewis, Magnusson, Nesselroade, van Geert, etc.), essentially pleading with researchers—"If this is what you *really* believe, how can you possibly keep *doing* the opposite in your studies?"

Why is there such a big disconnect?

We can think of at least two major reasons. First, the dominant meta-theories of psychology, with their assumptions of parts and stasis and linear cause-effect relationships, have actually produced exactly the kinds of tools that such a culture needs. They are just right for scaffolding the kinds of actions that this dominant perspective dictates. The problem is that, if one wants a culture shift (or a scientific revolution), it turns out that those tools act as a powerful conservative force. It took each of us a lot of training to figure out how to use these hammers, and they feel very comfortable in our hands. We become frustrated when we are told that what everyone has been pointing at and telling us are nails-- are *not* nails—or not *only* nails. We do not want to retrain. And all the new tools that are being suggested, either look ridiculously trivial—squiggly lines describing one dyad along a crooked path—or ridiculously intimidating—rolling windows of what? So the methodological culture shock derails the revolution.

The second factor has to do with our quantitative methods. We think that the development of quantitative methods in mathematics and statistics has been on its own trajectory, which is coupled with but largely independent of the field of psychology (or the social sciences in general). Progress in these disciplines and in this work has its own inner logic (see box). For example, the conversion in psychology from analysis of variance to multiple regression was not due to the field's meta-theoretical awakening to the problems with the assumption, inherent in analysis of variance, of decomposition. It was based on the discovery of the general linear model. The field can influence how fast new tools are adopted—so for example, the genuine hierarchical structures of schools and businesses sped up the widespread use of hierarchical linear models. But the tools that will be adopted likely depend on how similar new versions are to current tools—the more familiar, the more easily assimilated.

A brief history of quantitative methods.

So is this part of the book full of new tools and (gulp) equations?

No, it is not. We are all fascinated by new tools and some of us are even working on new (differential) equations, but we decided that we wanted to help students through the revolution by suggesting new uses for current tools, and the more concentrated use of some old tools that are not currently very popular. We secretly hope that we are also bringing students to the point at which they can stop being afraid and start being attracted by new tools, or start being frustrated at methodologists and so work with them to create better tools—ones that better serve our new purposes and goals.

How much will we be visiting statistics during our taxi ride?

Not as much as you might expect, given how important it is to use sound statistical methods to test our ideas. We will be focusing largely on issues of design. We will mention some statistical ideas as they crop up, with the goal of explaining how they fit into the larger puzzle of developmental systems research and of motivating students to learn more about them. However, right at the outset, we want to be clear that the million dollar question hovering over all developmental researchers is how to get a handle on these nested time scales—real time, the episodic dynamics of causality, and developmental time. We do not pretend to have cracked the nut, but we will offer one statistical word of advice at this point, to which we will return in later sections. As in the movie *The Graduate*, when Mr. McGuire takes Ben (played by Dustin Hoffman) aside and tries to give him the secret to a better future, by saying "I want to say one word to you. Just one word: Plastics," we will take you aside at this point and mention just one idea, one statistical idea, and that is "latent change score models." And when Ben asks "Exactly how do you mean?", Mr. McGuire answers, "There's a great future in plastics," we will cryptically indicate that "There's a great future in latent change score models," a theme which we will revisit in discussions of methods for exploring description, explanation, and optimization of developmental relational systems.

So what *are* we going to talk about?

We'll look at the same old stuff that all psychologists worry about in designing their research and interventions: the who (sampling), what (measurement), when (design), where (field or lab setting), and how (experimental or naturalistic) of methodology. But instead of discussing the parts of these procedures that preoccupy everyone (e.g., representativeness, validity, causal inference, generalizability, and control), we will focus on the extra problems that we have created for ourselves by thinking about things from a developmental systems perspective. We will also go beyond the standard methodological concerns to ones that keep developmental systems researchers awake at night while the rest of the world is sound asleep, such as how to cope with trajectories that cross developmental periods, how to look at a lifespan that is embedded in historical time, how to examine the effects of causes that cannot be manipulated, how to capture proximal processes, how to incorporate representational systems, how to deal with the organization within people, how to deal with a changing person in a changing context, how to look at both bottom-up and top-down effects, and in general how to deal with a crazy little thing called “time” (Stover, 2011).

How does time enter into our methodological decisions and strategies?

Well, quite frankly, it is everywhere. Time—it is the gift and curse of developmentalists. It is the reason that most of us went into the business. Time is a gift because it is the canvas on which the whole pageant of development is painted. However, it is also a pain in the neck. Among its many problems is that it has so many different meanings. Time itself is one of those hierarchical things that systems scientists are always going on about—multiple embedded time scales (see Table 17.1 for examples). There is real-time, tick-tock, microtime, while we sit there and watch our observations unfold; and its big sister, calendar time, regular time spans marked by days, weeks, months, years, which we use to organize our participants’ daily diaries and our own longitudinal repeated measures. There is episodic time, a story arc with a beginning, middle, and end, which we see in “bouts,” “rounds,” “conversations,” “fights,” and “attempts,” and who reveals itself in mesotime, during class periods, support group meetings, and coping transactions, and whom we capture in open-ended interviews and narratives, and in our observations if we are clever enough to parse them.

Then there is developmental time, the god him- or herself, living in accumulated episodes but not only in accumulations, where you are not sure you have driven far enough until you see the signpost of a seismic shift, the famous but elusive “emergent reorganization.” Time is there in age—in years since birth. Even in death, since after it arrives, we can use it to position events in their countdown to death. It is there subjectively, feeling one’s age, not feeling one’s age, feeling the shift in the middle of life when there are fewer years to come than have gone before. The “eddies in the time continuum” (*Hitchhiker’s Guide to the Universe*) as we round the last bend and the passage of time accelerates. Youth—when the days are short but the years are long, and old age—when the days are long and the years are short.

And it is all embedded in societal time, the parade over the many years of social movements and backlashes, recession, the draft, medical breakthroughs, and stagnant minimum wages. Which itself is embedded in historical time, the eras we always try to label but usually only recognize in retrospect--- ah, that’s what was happening, we were headed into industrialization, globalization, demographic shifts, the collapse of the ecosystem--who knew? And if we have the eyes to see, all this is also embedded in evolutionary time, too slow to experience directly, but moving inexorably and leaving its footprints just the same.

Table 17.1 Illustrations of the different meanings of time.

Real time	Clock time. Minute to minute and moment to moment. Now.
Calendar time	Round the sun time. Day to day, week to week, month to month, year to year.
Episodic time	Process time. Story time. Bouts, event arcs, attempts, beginning-middle-end.
Developmental time	Individual time. Span over which systematic changes, dynamic stabilities, and reorganizations emerge.

Age	Chronological time. Birthday time. Time since birth.
Subjective time	Psychological time. Individual awareness and experience of all forms of time.
Biological time	Neurophysiological time. Internal organic timing, chronological aging, and the biological clock.
Societal time	Sociological time. Collective social and economic changes, often counted in decades.
Historical time	Anthropological time. Widespread cultural movements, often counted in eras.
Evolutionary time	Paleontological time. Species time. Scales to capture changes in species and ecosystems.

Is there a first step in thinking about time as part of developmental methodologies?

Yes, let's start with the idea proposed by Catell (1946) many years ago and brought back to our minds by lifespan researchers (Baltes et al., 1977), namely, the data cube, an idea that enshrines time as an inherent axis of study. As pictured in Figure 17.3, it builds on the standard data-matrix—a square that includes our participants down one side and our variables down the other. We usually spend all our time on this surface; this is where our correlations, regressions, structural models are built. However, the data cube reminds us that there is a third dimension to the information we can collect—the dimension of time. That is the dimension that Catell refers to as "occasions" and the lifespan methodologists call "times of measurement." This third dimension, which is the one that defines developmental science, opens up all kinds of possibilities and all kinds of challenges for researchers.

Insert Figure 17.3 about here

So, as we take a quick taxi ride through developmental methodology, we will bump into time again and again, from encounters in which time seems to be our friend—for example, in causal inferences, because causes precede their effects—to encounters of the other kind, where time's goal seems to be to confuse us, and we have a hard time untangling it--- for example, in growth curves where we want to follow its as a trajectory and use it as a rolling window—we would like to have our time and eat it too. Time is the leitmotiv in the goals of developmental science, remember? Description—of intraindividual change, change with age, trajectories of change over time as well as interindividual differences in those trajectories; their explanation and optimization. We will start with the task of *description*, including the classical developmental designs and issues of developmental equivalence; then move to *explanation* and how to think about causal inference and capture proximal processes and intraindividual change; and end with *optimization* by examining the malleability of the neurological and contextual levels that we generally think of as fixed.

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Phenomena lost- Cairns chapter in Valsiner book about methodological problems
Experimental method

Activity 4- Study Sketches for a Program of Research: Makin' a List, Checkin' it Twice

The final activity that we ask students to complete is the creation of a "wish list" of seven studies organized around their target MacGuffin. Instead of asking Santa for these studies, however, we began to think about the ideas that their lists contained as a set of notes to "future self." The activity has two goals. The first is to give students something concrete to do with all the methodological options that are going to come their way. It is one thing to say "and we are sure this applies to you, too." It is another to ask students to think through for themselves how different, and sometimes unfamiliar, methods might be useful to them in their research in the future. So we see the list as a way to motivate students to try on for size the different methods we are going to be covering, and to, as a group, generate ideas for ways these methods could be adapted to inform all the different topics that students are interested in.

The second goal is for students to create for themselves a concrete visual for the idea of "multiple lines of sight" on a phenomenon that matters deeply to them. We believe that such a list can help students remain open to multiple methods and multiple strategies for using each method. This seems especially important during the middle of the current paradigm shift, when conventional methods are operating as a significant constraining force. We think that, for most researchers, the motivation for learning new methods (and fighting to get studies that use those methods published) is the conviction that they allow us to see parts of our phenomena that would otherwise be obscured or completely hidden. We see these lists as real guides to future potential studies.

Do students have to write seven study proposals?

Absolutely not! They are better described as "study sketches" that might each take up 250 words or less, like a study abstract or set of bullet points. Most important, of course, are the research questions, but in the sketches we asked students to focus on the elements that we cover in the next sections: sampling, measurement, design, and analysis.

Why do students have to write seven? Why not just two or three?

One reason focuses on the students, the other on the meta-theories. In terms of the students, we have noticed that, despite their curiosity and courage, students are deeply embedded in the research programs of their mentors, and so have a hard time imagining any other kind of study besides the exact one (with its specific methodology) that they are industriously working on. We want to challenge them to build out from the familiar and make plans to study their phenomena in ways that they have no idea how to actually accomplish at the moment. Most students, if pushed, can think only about one next study.

What's wrong with one study idea at a time?

It tends to create a linear view of the phenomena. We call these kinds of studies "n+1" studies, because they tend to come from the discussion sections of the previous study, and tend to be focused on replicating and extending current work. So if we ask students for two study designs, they are likely to give us study n+1 and study n+2. Replication and extension are critical, of course, for programmatic research, but our goal is to help students create 360° lines of sight all around their target, so they could *think* in 360° right now. We find that once students have to generate more that three study ideas, they tend to break through the linear n+1 barrier to the spherical space beyond. They count, "1, 2, 3 (gulp!), infinity."

What is the meta-theoretical reason for seven studies?

We want students to directly experience the "infinite" everythings promised by a relational developmental systems meta-theory—the infinite systems and subsystems, attributes and proximal processes, bottom up emergences and top-down organizations. We want them to get a taste of the generativity of their conceptualizations. Again, we find that, with two or three ideas, students tend to huddle inside the familiar parts of their theories, but after that they need to venture out toward the edges, where they can discover all the new insights that are waiting for them at the borders.

So what is included in a study sketch?

The assignment starts with the rationale for the topic, what the overall aims of the program of research might be and why the issues are important (see box). Then, for each study, students sketch out a research questions, and provide bullet points for the study sample, measurement, design, and analysis.

Examples of three study sketches on the topic: Development of teachers' coping with student disengagement.	
Rationale: One aspect of teaching that educators consistently rate as stressful involves student disengagement: When students do not show sufficient effort and follow-through on their school work, give up when faced with challenging or tasks or setbacks, appear bored or disengaged in class (i.e., are not interested and attentive), or become actively disengaged and disruptive. How teachers deal with disengagement (e.g., whether they withdraw and become coercive or show increased warmth and involvement) can make a difference, not only to the subsequent motivation of the individual student, but also to the climate of the classroom and the teachers' own engagement and well-being. Hence, an examination of the factors that allow teachers to cope constructively with student disengagement would be useful for the development of students and teachers alike.	
1.	***Research Question***. How do teachers typically respond to students' disengagement? Do these responses differ depending on the grades that they are teaching, i.e., does disengagement become more prevalent and teachers' responses more negative as students transition to middle school?
	Sampling: Students in grades 3, 5, and 7. Teachers: new and experienced.
	Measurement: Observational study using continuous real-time coding of teacher student interactions, triggered by students' off-task or disengaged behaviors. Also student-report and teacher-reports of their aggregate appraisals of the quality of these same kinds of interactions. GPA.
	Design: Cross-sectional, contrasting teacher-student interactions in grades 3, 5, and 7.
	Sequential probability analysis: Examine teacher behaviors that are likely to follow student disengagement. Also look for subsequent student engagement behaviors. Examine the connections between observations and self-reports; see if self-reports predict GPA over and above observations. Look for different patterns for teachers and students in different grades.

2.	***Research Question****.* Why do some teachers react constructively to student disengagement whereas others do not? Is this more difficult as students get older? Are interaction patterns established in the first few weeks of school? Do the change over the school year?
	Sampling: Locate teachers in grades 3, 5, and 7 who react constructively while teaching. Use principal nominations and follow-up with informal in-class observations to locate such teachers.
	Measurement: Observe in class, follow-up with open-ended interviews. Focus especially on appraisals and coping strategies for dealing with disengaged students. Be sure to note student disengagement behaviors.
	Design: Longitudinal case study of these teachers, two in each grade. Start at beginning of year and follow for 6 weeks, return at end of year and follow for 6 weeks.
	Analysis: Generate hypotheses about attributes of students, teachers, and context that seem to be shaping teachers' responses. Compare teachers and students in different grades; compare teachers and students at beginning and end of school year.
3.	***Research Question****.* Can mindfulness training help teachers to respond and cope more constructively with student disengagement, based on increasingly benign appraisals and lower emotional reactivity? Is the intervention more effective for teachers with younger students?
	Sampling. Recruit 4 new and 4 experienced teachers in grades 3, 5, and 7.
	Measurement: Conduct observations prior to, during, and after interventions to see whether teacher responses change over the course of the intervention and are sustained afterwards. Include daily diaries of teachers' appraisals and emotional reactions; and weekly assessments of students' emotional and behavioral engagement.
	Design: Intervention with interrupted time series. Be sure to provide top-down supports from principals and instructional leaders.
	Analysis. See whether teachers' reactions and students' engagement differ before and after the intervention. See whether these differences are mediated by changes in teachers' appraisals and emotional reactivity. See whether intervention is more effective for teachers working with younger students.
4.	***Additional study ideas***
	Cross-lag effects. Using survey and observational data from fall and spring of the same school year (in grades 3, 5, and 7), examine student engagement as a predictor of changes in teacher involvement, structure, and autonomy support.
	Student perspective. Focus groups with disaffected students from grades 3, 5, and 7 to find out about their feelings about their connections with teachers and peers in the classroom.
	Preventing disengagement. Literature review of prevention strategies for engaging students in grades 3, 5, and 7, and for strategies that work to reengage students who are already disaffected.
	Development of coping. Longitudinal study during teachers' first three years of teaching to see how strategies for coping with student disaffection develop. Be sure to include appraisals, self-efficacy, and student perspective.

	Preservice training. Visit teacher training programs to see what is included about student motivation and dealing with disaffected or disruptive students.
	Workshops and follow-ups. Offer pre- and in-service workshops about project-based and other engaging forms of instruction. Follow teachers back to class to see how strategies work out. Provide coaching and support.

Do students have difficulty coming up with study sketches?

At first. As we go through each chapter on methods, we allow time in class for students to use their MacGuffins and their conceptualizations to generate examples of study sketches. To get things started, the instructors may make some suggestions at first, but as the class proceeds, students quickly become capable of throwing ideas out to the group and working on them together.

Any common barriers?

Some of the barriers we see are methodological and some are conceptual. Methodologically, students often get blocked by their lack of knowledge about the nuts and bolts of a design or analysis strategy, thinking, for example—How can I plan a time series study when I don't know how to analyze daily diary data? We help them work through their reservations by reassuring them that all they need to know for the sketch is to have a general idea of the kind of information that all these new (to them) methods can generate. We encourage them that the research question “horse” comes before the methodological “cart,” and that the questions drive (or, if we stick with the horse and cart analogy, “pull”) their interest in and decision to become an expert (or find an expert) in the methods that are best able to help them answer their questions.

Conceptually, we find that students need some support in “lifting off” the drawings of their theories and to fully come to grips with the idea that the focus of their scholarly agenda is not their theory of hypotheses, but the “phenomena,”that is, the applied problem that there are dedicated to working on. It’s just a leap for some students (or most students at the beginning) to let go of their variables. It is as if they want to keep a finger on each construct and move around this as if it were a collection of variables, rather than a (temporary) working model of a complex dynamic system that they are trying to interview, so they can figure out how it is working to shape the development of its inhabitants, and how it can be shifted and reorganized to function better in optimizing all their developmental pathways.

Are there other sources of ideas?

Yes—we find that, because students are also conducting their observations during this time, they start using what they are seeing in their applied settings or open-ended interviews to flesh out interesting study sketches. Once they get started, they typically find fodder for ideas lurking everywhere—in talks around the university, conversations with family, television programs on related topics. As students become more and more mentally able to whiz around their applied problems and look at them from one side and then the other, from above and from below, and then from the perspectives of different participants and stakeholders, they find inspiration and insights from a wide variety of sources.

Did the process ever get to be enjoyable?

Oh, yes. Very--fun is had by all. Some of the most exhilarating moments involve lobbing study ideas around at each other. Students become good idea generators for other student’s agendas as well. Right now, to start, all students need to do is formulate the rationale for the applied problem and its research agenda (one paragraph, maybe taken from their configuration proposal) and then create a system for jotting down ideas. Some students use a little journal or an actual sketchbook (get it, study sketches?). It is fine to use electronic gadgets, of course, but it is truly helpful to have a way to *draw* pictures as well—some of the ideas are best represented graphically. Then students keep their lists handy as we go through these sections on methods in relational and developmental systems science. Many students tell us that, even after class is over, they end up keeping these journals with them to capture study sketches as they come flying in to them from all directions (i.e., from 360º).

Chapter 18. Developmental Designs: Cross-section, Longitudinal, and Cross-sequential

Not the intense moment
Isolated, with no before and after,
But a lifetime burning in every moment.
— T.S. Eliot

Let's start with the classic developmental designs, which are concerned with three kinds of time. The first is *age*, the big A, chronological age or time since birth, and all it markers—developmental level, the ages of man and woman (infancy, toddlerhood, early, middle, and late childhood; early middle, and late adolescence; emerging adulthood; early, middle, and late adulthood; and the young-old, the just plain old, the old-old, and the centenarians), maturational clock (walking, talking, self-regulation, puberty), the social clock (driver's license, voting age, drinking age, married, kids). The second kind of time found in standard developmental designs is *historical time*, societal or socio-historical time—societal events that affect all people at the same time, like economic depressions, affirmative action, integration of the schools, World War II, the war on poverty, or the rise of daycare, the internet, cell phones. The third kind of time is "now," *time of measurement*, the day the snapshot was taken, the moment in sociohistorical time to which our data are fastened.

What are developmental designs?

Developmental designs are ways of collecting data (information) about people that allow researchers to learn about how people change with age. There are two simple or standard developmental designs: *cross-sectional* and *longitudinal*. Just to give you a rough idea, about 80% of the studies that are published in developmental journals, when they are focused on development, utilize cross-sections designs and about 15% use longitudinal designs, making them the most common designs. We'll look at each one, define it and analyze its advantages and disadvantages with respect to the goals of developmental science (see Table 18.2). Then we'll consider their fatal flaws and how to fix them using one non-standard design, the *cross-sequential* design. Sequential designs resulted from confusion and dissatisfaction with the two standard designs, and their principled critique gave birth to the lifespan movement (Baltes, 1968; Schaie, 1965; Schaie & Baltes, 1975).

Table 18.2. Goals of developmental designs

1. How do people change as they age? (intra-individual change)
2. How can we chart different pathways of development (inter-individual differences in intra-individual change)?
3. How can we examine the sequence of events in people's lives—whether what came before predicts what came after?
4. How can we study changing people in a changing world?

Why is it challenging to figure how people change with age?

It is challenging because people's lives are always embedded in historical time. As soon as a person is born, he or she is inserted into a specific historical moment. And, as the person ages and changes, society is changing right along with them. For example, if you were born in 1990, I know exactly how old you were when the Twin Towers fell, when the Great Recession hit, and when iTunes opened. From a research design perspective, we can say that people's development is *confounded* with historical changes (that is, with the specific historical events and general societal trends that occur during their lifetimes). The problem with either of the simple developmental designs is that they do not allow clear inferences about (1) whether differences between age groups are really due to *age* or to *historical* differences, or (2) whether changes in people over time are really due to *age* changes or to *historical* changes. That is why lifespan researchers, or anyone else who assumes that contexts matter to development, need to use designs that give them more information than just simple cross-sectional or longitudinal studies do, such as *sequential* designs.

What is the cross-sectional design?

A *cross sectional design* collects information (a) at one point in time (one time of measurement) on (b) multiple groups of people who are different ages. For an example, see Table 18.3. This is a study conducted in 1960 that includes eight age groups, ranging form age 10 to age 80

Table 18.3. Design for a cross-sectional (CS) study: (a) conducted in 1960, using (b) eight age groups.

	Time of Measurement					
	1960					
	10					
	20					
	30					
	40					
	50					
	60					
	70					
	80					
	CS					

What is the *fatal flaw* with cross-sectional designs?

Because developmentalists are fundamentally interested in how people change with age, the key sticking point for a cross-sectional design is the question: "Can we infer that the pattern of age *differences* found in a cross-sectional study are substantially the same as the pattern of age *changes*"? For a long time (and even still today), developmental researchers assumed that the answer to this question was "yes," that age differences corresponded more or less exactly to age changes: the 10-year-old of today would be at 20 (10 years in the future), just like the 20-year-old of today. The fatal flaw is that this inference is wrong: *Differences* between age groups are *not* necessarily the same as age *changes*.

Why not?

Because differences between age groups could be *generational* differences. What looks like *age* differences could really be *cohort* differences. As we pointed out in the chapter of the lifespan approach, generational or birth cohorts are groups of people who were born during the same historical period. They are sometimes just called “generations” and have been given labels, like the baby boomers, generation X, the millennial generation, and so on.

Can you remind me about the definition of *cohort* effects?

As we mentioned in the lifespan chapter, “cohort effects” are the lifelong effects of growing up across specific historical periods. They reflect the idea that historical time is flowing past, and as soon as a person is born, they are popped into a specific historical moment and their own development proceeds in synchrony with the stream of subsequent historical events (see Figure 18.1). As members of a specific birth cohort or generation, people’s developmental pathways differ are shaped by the cumulative effects of these historically-graded experiences. The flip side of cohort effects is the idea that specific historical events and trends have a different impact on people depending on how old they are. The Great Recession may have a very different effect on your development if you were 8 or 18 or 28 or 80. “Cohort effects” are the idea (now confirmed in a wide variety of programs of research) that that individuals’ developmental pathways differ depending on the year they were born.

What problems do cohort effects create for cross-sectional designs?

The problem is that the people in the different age groups also belong to different cohorts. In cross-sectional studies age is always *confounded* with cohort. Differences between the groups could be *age* differences or they could be *cohort* differences. You can see this confounding in the cross-sectional study depicted in Table 18.4. The participants who are 10 belong to the 1950 birth cohort; the participants who are 40 belong to the 1920 birth cohort, and so on. If we know the person’s age and the time of measurement, we can figure out their birth cohort.

Table 18.4. A cross-sectional design showing that, when time of measurement is held constant, age is completely confounded with year of birth (cohort).

COHORT	Time of Measurement					
	1960					
1950	10					
1940	20					
1930	30					
1920	40					
1910	50					
1900	60					
1890	70					
1880	80					
	CS					

Developmental researchers want to know if people differ according to their *ages*. But the *fatal flaw* with cross-sectional studies is that any differences between the groups in this design could reflect *either* age differences *or* generational (cohort) differences *or* some combination of *both* (i.e., an interaction between age and cohort). Ages are completely confounded with cohorts (years of birth or generations). Any cross-sectional study could also be called a *cross-generational* study. This is a problem of internal validity—since age and cohort are confounded, researchers cannot assume that age differences are the same as age changes.

Historical embeddedness suggests a second *fatal flaw* of cross-sectional designs. Even if the pattern of age differences in my study does reflect age changes, this pattern of differences may only obtain for this particular time of measurement, for example, in the cross-sectional study depicted in Table 18.4, for a study conducted in 1960. If I repeated my cross-sectional study in 1970 or 1980, I might not get the same pattern of age differences. This is a problem of *external validity*—whether I can generalize the findings of my age differences to other historical periods (and other sets of cohorts).

Are there other disadvantages of the cross-sectional design?

Most definitely. In addition to issues of sampling and measurement equivalence (which are discussed in subsequent chapters), the biggest problem with cross-sectional studies from a developmental perspective is that they don't provide any information about the thing we are most interested in, that is, *change*. Cross sectional studies provide no information about (1) about how people change, (2) about pathways (or trajectories) different people take; or (3) about how earlier events or experiences predict later functioning. For this we will need to include time in our studies—by using the longitudinal design.

What is a *longitudinal* design?

It's a study that examines (a) one group of people (b) repeatedly over multiple time points. Table 18.5 depicts an example of a longitudinal study that measured participants six times at 10-year intervals, starting when they were 10 years old and following them until they were 60.

Table 18.5. A longitudinal (LONG) study design that includes six times of measurement.

COHORT	Times of Measurement						
	1	2	3	4	5	6	
1950	10 →	20 →	30 →	40 →	50 →	60 →	**LONG**
1940							
1930							
1920							
1910							
1900							
1890							
1880							

What are the advantages of the longitudinal design?

The good news about a longitudinal study is that it provides information about the target to which developmentalists are the most committed-- how people *change* or develop! It also provides information about different people's pathways or trajectories. It also allows researchers to see whether earlier experiences or events predict later outcomes. That is why longitudinal designs are considered truly developmental.

BUT-- are these really *age* changes?

Good question. The key issue for longitudinal studies is “Can I infer that these changes in my group as I follow them over time reflect *age* changes?” And the answer is “No”—they could be age changes, but they could also be *historical* changes. The *fatal flaw* with longitudinal studies is that *changes* in people over time could be either due to *age* changes or to *historical* changes. As people age, the historical time they inhabit changes right along with them. Age and history are completely *confounded*, because all lives are embedded in historical time.

As you can see in Table 18.6, age change is *confounded* with historical change in longitudinal studies. In this study, people who were 10 were also living in 1960, when they were 20, they were living in 1970, and so on. So, when people were changing from age 10 to age 20, the society they were living in also changed from 1960 to 1970. Therefore, people’s changes could be due to age (i.e., development), or they could be due to historical changes, or both (i.e., interactions between age and historical period). This is a problem of internal validity.

Table 18.6. A longitudinal design showing that, when cohort (year of birth) is held constant, age changes are completely confounded with historical changes.

	TIMES of MEASUREMENT						
COHORT	1 1960	2 1970	2 1980	3 1990	4 2000	5 2010	
1950	10 →	20 →	30 →	40 →	50 →	60 →	**LONG**
1940							
1930							
1920							
1910							
1900							
1890							
1880							

Longitudinal studies have another fatal flaw—one of *external validity*. It could be that my pattern of changes are in fact age changes, but that they are only representative of the age changes for my one single cohort (in this example, born in 1950). If I would follow a different cohort-- born earlier or later, I might not see the same pattern of age changes. These age changes may not generalize to other cohorts.

Are there other disadvantages of the longitudinal design?

Yes, there are a raft of them and they are corkers (see Table 18.7). The problem with measuring people on many occasions over time is that, in the act of studying people, you may start to change them. Through repeated testing, people may get better (practice effects), figure out what the study is about (or what they think the study is about) and change their responses accordingly (reactivity), or change in unknown ways—such as to start growing attached to the research team and so trying to give them answers that will please them, or trying to stay consistent in their answers over time, and so on. At the very least, what researchers may see as age changes may simply be the effects of cumulative practice (i.e., time of measurement effects). If you imagine being in a study for 50 years, and consider that it could be a study in which your parents participated and to which your offspring will be recruited, you can begin to glimpse the potential drawbacks to all longitudinal studies.

Table 18. 7. Disadvantages of longitudinal designs.

1. ***Reactivity***: Participants are affected by repeated testing (e.g., practice effects).
2. ***Mortality or drop out***: Participants leave the study.
3. ***Selection effects***: The participants who remain are no longer representative of the whole cohort.
4. ***Aging of measures:*** The measures are no longer adequate (new constructs or better measures are developed).
5. ***Practical problems:*** Time-consuming and expensive.

Over time participants drop out of longitudinal studies: they move away, they get busy or sick, they are tired of participating. If the study goes on long enough, some of them die. Drop-out is rarely random, typically the people who want to continue participating are healthier, wealthier, and wiser, introducing a positive bias into a longitudinal sample, and one that grows the longer the study continues. Not only do participants age, so too do constructs and measures. If science is progressing, better measures and more interesting constructs are identified, and so after even 20 years, the constructs and measures that have guided the study may be considered inadequate or outdated.

A major problem is the wear-and-tear of long-term longitudinal studies on their research teams. They are not for the faint of heart. How long does it take to conduct a 50-year longitudinal study—50 years, of course. And it is not a restful 50 years: Funding must be secured, samples must be retained, data collected, entered, and analyzed; all under the ticking clock of the next measurement point. Such studies are a bad bet for anyone who is working toward tenure and all of them are beyond the lifespan of any single researcher. The great longitudinal studies have been passed down from research team to research team, true intergenerational affairs in design and execution.

Okay, I'm starting to warm up more and more to cross-sectional designs. What are their advantages?

The good news about cross-sectional studies is that we get information about differences between groups of people of different ages. These differences might give us hints about age changes that are in store or suggestions for places to look. There is no drop-out, reactivity (at least not from repeated measures), or outdated constructs or measures, and if the sample was representative at the time we conducted the study, it stays that way. And we get information about a wide range of age differences in a short period of time (one time of measurement). In principle, we can conduct a study of people from ages 10 to 100 on a Friday afternoon!

Table 18.8. Fatal flaws of cross-sectional and longitudinal designs.

Cross sectional	*Internal validity*	Group differences could be age differences or they could be cohort (generational) differences.

	External validity	Patterns of age differences may not generalize to other historical periods (times of measurement).
Longitudinal	*Internal validity*	Individual changes could be age changes or they could be historical (time of measurement) changes.
	External validity	Patterns of age changes may not generalize to other cohorts (generations).

If both of the simple developmental designs are fatally flawed, what kinds of designs can developmental researchers use?

Sequential designs are one good option. There are many kinds of sequential designs. They are called "sequential" because they add sequences to try to overcome the fatal flaws of the simple designs. They allow researchers to look at *both* age changes *and* historical changes for multiple cohorts. In this chapter we focus on the *Cross-sequential* design. It provides the most developmental information in the shortest amount of time. It allows researchers to look at differences between people in terms of cohorts, and also to examine historical changes.

What is a cross-sequential design?

Cross-sequential designs combine cross-sectional and longitudinal designs. A cross-sequential study starts with a cross-sectional study that researchers then follow up longitudinally for multiple measurement points. Table 18.8 depicts a cross-sequential design that has three times of measurement, with three cross-sections (shown in the bottom row) and eight longitudinal sequences (shown in the last column). As you can see, this study contains three cross-sectional studies conducted in 1960, 1970, and 1980 as well as eight little longitudinal sub-studies, one for each cohort from 1880 to 1950.

Table 18.8. A cross-sequential design is comprised of a cross-sectional design followed up in multiple longitudinal sequences.

	TIMES of MEASUREMENT

COHORT	1 1960	2 1970	3 1980	4 1990	5 2000	6 2010	
1950	10 →	20 →	30				**LONG- 1**
1940	20 →	30 →	40				**LONG -2**
1930	30 →	40 →	50				**LONG- 3**
1920	40 →	50 →	60				**LONG- 4**
1910	50 →	60 →	70				**LONG- 5**
1900	60 →	70 →	80				**LONG- 6**
1890	70 →	80 →	90				**LONG- 7**
1880	80 →	90 →	100				**LONG- 8**
	CS-1	**CS-2**	**CS-3**				

What are the advantages of a cross-sequential design?

The good news about a cross-sequential study is that it allows researchers to find out about the confounds that could otherwise be fatal flaws in the cross-sectional and longitudinal designs. First, it allows us to get cross-sectional information about age differences at multiple time points and so from multiple sets of generations. As a result, we can compare the pattern of age differences found in our first cross-sectional study (CS-1) with those found in our second and third cross-sectional studies (CS-2 and CS-3). In 1960, we could not tell whether the pattern of age differences in CS-1 was based on age differences or cohort differences, but see—when we compare CS-1 with CS-2 (collected in 1970), we have people of the same ages but from different cohorts, just as when we compare CS-1 to CS-2 and CS-2 to CS-3. If in all these comparisons, we see the same pattern of age differences, this suggests that we do not have cohort effects (or (sigh) if we do, they are continuing over several successive waves of cohorts, for example, as might be expected if years of school or medical improvements are linearly increasing across historical time).

The second, and more interesting advantage of the cross-sectional design is that it gives researchers longitudinal information about age changes from multiple cohorts. This allows us to compare longitudinal sequences across the same age ranges for people from different cohorts so that the sequences unfold across different historical periods. So, for example, researchers can compare what it's like to go from age 20 to age 30 from 1960 to 1970 (LONG-2) with what it's like to go from age 20 to age 30 from 1970 to 1980 (LONG-1). This way, researchers can see whether the pattern of age changes is replicated across cohorts. If it is, this suggests that the changes are not due primarily to historical changes that accompany each cohort. So the fatal flaws of both cross-sectional and longitudinal designs can be unpacked and examined using the cross-sequential design.

Most importantly, if we are true lifespan researchers, we are not necessarily hoping that our patterns of age differences replicate across other cohorts or that our patterns of age changes are the same across different historical periods. If we think that lives are embedded in historical time and that these changing social and cultural forces matter to individual development, then sequential designs allow us to look directly at our target phenomena. If we have contextualist leanings (as relational researchers), that's the phenomenon in which we are actually interested. However, we may need a historian on our team to make sense of historical and cohort effects, and we may need to collect historical information as we go.

Where did the idea of sequential designs come from?
They were the brainchild of Warner Schaie (1965, 1994). Believe it or not, they were inspired by his dissertation study, a cross-sectional study of intellectual functioning across adulthood conducted in 1956, which turned out to be the beginning of the Seattle Longitudinal Study at University of Washington (Schaie & Willis, 2010). As was typical for other cross-sectional studies at the time, this study showed a peak-and-decline function, in which cognitive performance was highest at age 35 and then showed lower and lower levels across the entire age range, as shown in Figure 18.1 for verbal performance (Schaie & Strother, 1968). As you can imagine, this developmental picture fit well with the then dominant "traditional" meta-theory which considered aging a time of decline and loss. As luck would have it, Schaie decided to follow up on his cross-sectional sample seven years later in 1963, by following as many of the original sample as he could locate and

also by recruiting a new set of cross-sectional age groups. It was after analyzing these age trends that he noticed a very peculiar thing: The pattern of "age changes" suggested by the original cross-sectional findings were replicated in the second cross-sectional study but (hold on to your hat) they were ***completely different*** from those suggested by the longitudinal follow-ups (see Figure 18.1). The longitudinal findings showed a completely different picture of peak levels and rate of decline: They suggested a long shallow *rise* in intellectual functioning until the mid-50s, followed by a plateau until the mid-60s, followed by slow declines. What could be going on? Remember—both kinds of designs were supposed to produce information about age changes.

According to Schaie and Willis (2010), these discrepancies were so marked and so unexpected that they ended up delaying the publication of the data until Schaie could figure out what could account for the differences between the patterns produced by the two standard designs. It was only when Schaie realized that the cross-sectional groups differed not only in age but also in birth cohort that he published his now classic paper in *Psychological Bulletin* in 1965 entitled "A general model for the study of developmental problems." It does not sound like a revolutionary paper, but it was. It began the overthrow of the dominant picture of aging as a time of loss, and inspired the lifespan movement.

Insert Table 18.1 about here

How big a deal are these kinds of cohort effects?

They can be a big deal. A hypothetical example is presented in Figure 18.2. As you can see, it starts with a cross-sectional design of a study that took place in 1960. The bolded line shows the pattern of age differences in performance, say on a test of intelligence. If we interpret these age differences as age changes, you can see that we would say that intelligence peaks at age 30 and then declines. But in this same chart is longitudinal data for each cohort—the dashed lines labeled according to their birth year. Each one—every one-- shows steady *increases* in intelligence (or other performance) from age 10 to age 60. There are major *cohort* differences in that each generation performs better and better (maybe due to more years of schooling or better medical care). The group differences shown in the bold line are really produced by cohort differences, and should not be interpreted at age changes. Only with a sequential design would we know what's actually going on.

Insert Table 18.2 about here

Lives embedded in history: *Children of the Great Depression.*

Some of the most interesting work showing the importance of cohort effects, and how lives are embedded in history has been carried out by the sociologist Glen Elder (e.g., 1974, 1998) who founded the "life course perspective." In the early 1960s, while working with data from several longitudinal studies that were started by the Institute for Human Development at University of California, Berkeley, Elder realized that all these participants, who were born between 1903 and 1929, experienced the Great Depression, but because the studies were started at different times, participants were different ages when the Great Depression started (1929) and when its worst effects were over (when World War II started). Some participants were very young children when their families experienced the greatest economic hardship and family strain, whereas others spent their early years in the relative prosperity and security of the 1920s and had reached adolescence by the time economic hardship started. Yet others were in their early 20s at the onset. Lifelong effects of living through the Great Depression were found for these cohorts that differed depending on a combination of individual, family, and societal factors, including participants' ages at the onset and offset of the Depression, how hard the family was hit economically (ranging from no effects to disaster), and how family members (especially fathers) and the family as a whole dealt with the challenges they faced.

Elder continued to follow up on these interesting patterns of findings by collecting longitudinal and retrospective life history accounts of the cultural revolution in Shanghai, China; and the collapse of land values in rural America in the 1980s (Elder, Conger, & Park, 2000). Based on his own research and studies by others on the effects of growing up during particular historical changes, such as mobilization during World War II and the Korean War, the collapse of manufacturing in England, the reunification of Germany, Welfare reform, and increasing urban blight, Elder concludes that, "historical forces shape the social trajectories of family, education, and work, and they in turn influence behavior and particular lines of development. Some individuals are able to select the paths they follow, a phenomenon known as human agency, but these choices are ot made in a social vacuum. All life choices are contingent on the opportunities and constraints of social structure and culture" (1998, p. 2).

Does the cross-sequential design have any disadvantages?

All the additional problems with the longitudinal design are still present in our longitudinal sequences, and conducting a cross-sequential study is even *more* complex, expensive, and time-consuming—instead of running one longitudinal study, the research team is now running three or four!

Did Schaie and Baltes get into an argument about the developmental designs?
Yes, they did. When Schaie initially wrote about the sequential designs (Schaie, 1965), he envisioned them as explanatory, quasi-experimental designs that could reveal whether a pattern of changes was due to, that is *caused by*, age, cohort, or historical moment (time of measurement). Baltes (1968) argued that sequential designs could never be considered quasi-experimental or explanatory—they were clearly *descriptive*. They only provided information about whether individual changes were age-*graded* or history-*graded*. After a few rounds, the two researchers, who were both German after all, wrote a joint paper (Schaie & Baltes, 1975) agreeing to disagree about the interpretation of age, cohort, and period (time of measurement) effects, but united in their view that the designs were descriptive. Of course, they could guide subsequent explanatory research that would focus on the factors associated with age or history that caused the pattern of individual change identified in sequential studies.

Did Schaie have any suggestions for making developmental designs more practical?

Yes, he suggested another very cool design feature. You may have noticed that in our cross-sequential design, we have several cells in which we have collected data from people who are the same age but from different cohorts. For example, we have 30-year-olds from the 1950 cohort as well as the 30-year-olds from the 1940 and the 1930 cohorts. You can see it a little more clearly if we spread out the mini-longitudinal sequences and line them up by age, as we have done in Table 18.9. If the corresponding age groups do not differ, we can zip the different mini-longitudinal sequences together. In this way, we can get imaginary long-term longitudinal information pretty quickly.

Table 18.9. Cells from a cross-sequential design arranged as an accelerated longitudinal design.

	TIMES of MEASUREMENT						
COHORT	1 1960	2 1970	3 1980				
1950	10 →	20 →	30				**LONG- 1**
		1	2	3			

		1960	1970	1980			
1940		20 →	30 →	40			**LONG -2**
			1 1960	2 1970	3 1980		
1930			30 →	40 →	50		**LONG- 3**
				1 1960	2 1970	3 1980	
1920				40 →	50 →	60	**LONG- 4**
1910	50 →	60 →	70				**LONG- 5**
1900	60 →	70 →	80				**LONG- 6**
1890	70 →	80 →	90				**LONG- 7**
1880	80 →	90 →	100				**LONG- 8**
	CS-1	**CS-2**	**CS-3**				

That's why the cross-sequential design is also called the "pseudo-longitudinal design," the "accelerated longitudinal design," or the "most efficient design." This is a very useful design for developmentalists. It is commonly used, for example, in schools, where researchers can come in one year and collect cross-sectional data on their target grades, say, Kindergarten through 12th grade, then follow up for several successive waves, and if the age groups are comparable (which they often are because the cohorts in this design only differ by one year), they have completed a pseudo-longitudinal design from K-12 in two or three years.

What can we do about the big problem in longitudinal and cross-sequential designs-- that people drop out and that we are changing people by testing them repeatedly?

The cross-sequential design provides some good options for looking directly at that. If every time a measurement is repeated, we also add a new independent sample (as would be done in the repeated cross-sections in a sequential design), we have subsamples of participants at each time point who have never been tested before. If in this new cross-section we carefully combine a small representative sample that is supplemented by an extra dollop of the kinds of participants who have dropped out from previous measurement points, we can also retain (or rebuild) the representativeness of our sample and so prevent positive biases from creeping in. These ideas are pictured in Table 18.9a for our cross-sequential study. For example, in this study, the 30-year-olds in our second mini-longitudinal sequence are tested twice by the time they arrive in 1970, so we can add a new set of 30-year-olds in 1970 who have never been tested before. We can compare the performance of this new subsample to the participants who have been tested twice, and we can also compare both of these to 30-year-olds who have been tested three times, if we include the 30-year-olds from our first mini-longitudinal sequence tested in 1980 for the third time. If we keep collecting these added cross-sections, we can look directly at the effects of repeated testing, whether they show up in the form of practice effects or other kinds of reactivity.

Table 18.9a. An accelerated longitudinal design with added cross-sectional samples to examine practice effects.

	TIMES of MEASUREMENT						
COHORT	1 1960	2 1970	3 1980				
1950	10 → tested once	20 → tested twice	30 tested thrice				**LONG- 1**
	Added cross-section	20 tested once	30 tested once				
		1 1960	2 1970	3 1980			
1940		20 → tested once	30 → tested twice	40 tested thrice			**LONG -2**
	Added cross-section		30 tested once	40 tested once			
			1 1960	2 1970	3 1980		
1930			30 → tested once	40 → tested twice	50 tested thrice		**LONG- 3**
	Added cross-section			40 tested once	50 tested once		
				1 1960	2 1970	3 1980	
1920				40 → tested once	50 → tested twice	60 tested thrice	**LONG- 4**
1910	50 →	60 →	70				**LONG- 5**

1900	60 →	70 →	80				**LONG- 6**
1890	70 →	80 →	90				**LONG- 7**
1880	80 →	90 →	100				**LONG- 8**
	CS-1	**CS-2**	**CS-3**				

Which are the best study designs?

It may seem like the cross-sequential design would always be best, and you would be right in a way-- it does indeed provide the most complete information, but it still is an enormous amount of work. Each design has its genuine limitations, but each also has a role to play in a program of research (see box). Cross-sectional designs can be a good beginning, a quick and inexpensive way to draw a rough-and-ready sketch of the possible locations of age differences that can suggest potential age changes, transitions, and turning points. This design is especially helpful in situations where the likelihood of cohort effects is minimal (for example, when birth cohorts are only one or two years apart—when researchers might call the successive samples "waves" rather than "cohorts"). Researchers can repeat the cross-sectional study again soon (creating a time-sequential study—see the next chapter) in order to see if the patterns of age differences are replicated at a different time of measurement involving a different set of cohorts. If they are, this would suggest that cross-sectional studies are providing good information about the location of potential developmental action—such as beginnings, transitions, and developmental shifts.

Once windows of potential interest have been identified, researchers can follow up with more labor-intensive longitudinal studies directly covering those windows. These are truly developmental designs, essential for developmentalists, because they provide information about age changes and differential trajectories as well as about pathways and sequences that can link early experiences and developments to later changes. If these longitudinal studies are pegged to key windows, they should not take lifetimes to complete. And they can be repeated for new cohorts across different historical periods, creating cross-sequential designs. As a matter of course, studies should be including information about historical and social changes that are co-occurring. This is the latest moment at which it becomes clear that multidisciplinary teams of researchers are needed to make sense of cohort differences in patterns of individual change.

Which are the best study designs?

1. SIMPLE DEVELOPMENTAL DESIGNS: Have their problems, but:

1a. Cross-sectional designs: Sketch in a rough map.

- Can provide a quick overview of possible age differences.
- May be helpful in collecting initial information about a new area of study because it can show where the developmental action might be.
    - May be able to locate transition points or beginnings.
- May be okay if there aren't big cohort differences (e.g., in one-year age increments in school).
- Can be repeated again soon to see if patterns replicate.

1b. Longitudinal designs: Chart differential change at specific windows.

- Then you can focus on where interesting changes are taking place.
- Are ***essential*** for developmentalists:
    - In order to see age changes.
    - In order to see different pathways or trajectories.
    - In order to see how early events shape later development.

2. SEQUENTIAL DESIGNS: Explore changing people in a changing world.
Cross-sequential designs

- Are ***essential*** for contextualists:
    - In order to see if age changes replicate over different historical changes.
    - Good to have a historian or sociologist on the team.
- Can be used to take advantage of existing longitudinal studies.
- Because of zipping, accelerated designs do not take a lifetime.

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Chapter 19. More Developmental Designs: Time-lag and Time- and Cohort-Sequential Studies

The years teach much the days never know.
— Ralph Waldo Emerson

The classical developmental designs, namely, cross-sectional and longitudinal, still have a bit of learning to do from the sequential designs derived from Warner Schaie's developmental model. There is one more simple design, familiar to sociologists and historians, but not to most developmental psychologists, called "time-lag." And just as cross-sectional and longitudinal designs can be combined to create the cross-sequential design, the time-lag design can be combined with cross-sectional or longitudinal designs to create two additional sequential designs—the time-sequential and the cohort-sequential designs. Let's look at them and then consider their uses-- the kinds of questions they would be most helpful in answering.

What is the *time-lag* design?

It is considered a simple design because it looks at people of the same age at different historical moments (different times of measurement). A great example of a time-lag study is an ongoing project by the Higher Education Research Institute at UCLA in which a nationally representative sample of incoming freshmen is surveyed every year. The study, started in1966 compiled its 40-year report in 2007 (Pryor, Hurtado, Saenz, Santos, & Korn, 2007) and just published the 2013 survey. Researchers in this project have been able to document the ways that freshpeople starting at four-year colleges and universities have changed since the Civil Rights movement of the mid-1960s—both in terms of who is going to college and how the students themselves have changed, in terms of their attitudes, values, and goals (see box). No student is surveyed twice, but these time-lag data can still tell us about change—not in individuals, who remain stuck at one age range, but in historical and social trends in the demographics and characteristics of college freshpeople, what they are majoring in, what they are worried about, how much they trust the government.

What is the annual report on "The American Freshman"?
These are trends reports from the longest continuing study of higher education in the United States, started in 1965 by Alexander Astin and coordinated by the Higher Education Research Institute at UCLA since 1973. Along with other cooperating four-year colleges and universities, UCLA implements the Cooperative Institutional Research Program Freshman Survey every fall and issued its 40-year report in 2007 (Pryor, Hurtado, Saenz, Santos, & Korn, 2007). As explained in their report, "[t]hese trends data now constitute a national treasure, documenting the changing nature of students' characteristics, aspirations, values, attitudes, expectations, and behaviors. As college participation and high school graduation rates increase, these data become ever more important in documenting the changing nature of students seeking access to higher education" (p. 1).

The time-lag design unsticks age from historical moment (time of measurement) by examining how people of the same age are different depending on the historical period during which they grew up. An example of a time-lag study is presented in Table 19.1, which is focused on 50-year-olds and assesses them at six different historical moments (times of measurement) at 10-year-intervals. Differences between these groups are typically interpreted as historical differences, and so these are the kinds of studies about which journalists conclude, "Fifty is the new 40" or "This generation is biologically younger than their parents were at 50," or "This is the first generation whose health is worse than the previous generation."

Table 19.1. A time-lag design of 50-year-olds across six decades from 1960 to 2010.

Cohort	***Time of measurement***						
	1960	1970	1980	1990	2000	2010	
1960						50	
1950					50		
1940				50			
1930			50				
1920		50					
1910	50						
1900							
1890							

1880							

What are the fatal flaws of this design?

We have a problem if we want to interpret these differences between 50-year-olds as based on cultural change. All the groups considered in a time-lag study are not only the same age at different historical moments, but because of this, they also have to be from different cohorts (or years of birth). So what our sociologist friend may want to claim are historical differences (what we have been calling time of measurement effects) could just as easily be the dreaded “cohort effects”—at each new historical moment, our samples are also from different cohorts. So the time-lag could also be called a cohort-lag design. By the same token, we have an external validity problem, in that the pattern of historical (or time of measurement) differences may obtain for that age-group only (in our example, only for 50-year-olds)—it may not generalize to any other age groups.

From a developmental perspective, however, the biggest problem is that the time-lag design captures nothing about *age* differences or *age* changes. There is change all right—in the societal or historical moment (these designs could co-opt Bob Dylan’s song “The Times They are a Changin’”)—but because each individual is measured only once and they are all the same age, no inferences can be made about individual development. That is the reason why the time-lag is often left out of descriptions of developmental designs. However, for researchers who are focused on studying “changing people in a changing world” (such as lifespan, ecological, contextualist, and relational researchers), any glimpses at how the world is changing, and how those changes have cumulatively lodged in 50-year-olds, can be of interest.

Then what use are time-lag designs?

They can be combined with cross-sectional or longitudinal designs to compensate for some of their fatal flaws—or really to allow researchers to directly examine their confounds. The two sequential designs are the time-sequential and the cohort sequential.

What is a time-sequential design?

It combines the time-lag with the cross-sectional design. Remember the fatal flaw of the cross-sectional design (pop quiz!)? Differences in age were completely confounded with differences in cohort or generation; it could just as easily be dubbed a cross-generational study. If the cross-sectional design is combined with the time-lag, however, instead of focusing on people of just *one* age and searching for them at different historical moments, in the time-sequential design researchers recruit the whole cross-section at different times of measurement. A time-sequential study is pictured in Table 19.2 which consists of three cross-sectional sub-studies (labeled CS-1-3) covering ages 20 to 80 at three points in time (1960, 1970, and 1980). With this design, age differences are unstuck from cohort differences and researchers can examine whether the same pattern of age differences is obtained at different times of measurement with different sets of cohorts.

You may also have noticed that this design can not only be described as a series of cross-sectional studies conducted at different times of measurement, it can just as easily be described as a series of time-lag studies conducted on different ages. In fact, as shown in Table 19.2, this study contains seven time-lag sub-studies (labeled as TL- 1-7) across three decades (1960, 1970, and 1980), one each for people ages 20, 30, 40, 50, 60, 70, and 80. So this design would also be able to tell sociologists and historians whether the changing times were harder (or more fun) for people depending on their ages. For example, were people of ages 20 or 30 more affected by the changes wrought by the Civil Rights and women's movement than people of age 80?

Table 19.2. A time-sequential study of three cross-sections of participants from ages 20 to 80, at three points in time from 1960 to 1980.

Cohort	*Time of Measurement*					
	1960	1970	1980			
1960			20	**TL-1:** 20-year-olds		
1950		20	30	**TL-2:** 30-year-olds		
1940	20	30	40	**TL-3:** 40-year-olds		
1930	30	40	50	**TL-4:** 50-year-olds		
1920	40	50	60	**TL-5:** 60-year-olds		
1910	50	60	70	**TL-6:** 70-year-olds		
1900	60	70	80	**TL-7:** 80-year-olds		
1890	70	80				
1880	80					
	CS-1	**CS-2**	**CS-3**			

Are there any disadvantages to the time-sequential design?

Well, you can imagine that for a developmentalist, who is obsessed with how individuals *change* over time, it would be impossible not to want to shake the researcher who just completed a time-sequential study, like the one in Table 19.2 that took two decades to complete (from 1960 to 1980) and ask them "Why or why, in 1970 when you were repeating the study from 1960 did you not look up those people who had so cooperatively provided information in 1960 and see how they were doing? You could so easily have captured how, not only the times but also the people, they are a changin'!" Since we are probably admonishing a sociologist or historian, they would likely answer, "I am not interested in individual change, I am interested in societal change, and you should not be yelling at me. Instead, you should be praising me for using the time-sequential design to explore whether these societal changes have a differential impact on people depending on how old they are. For a sociologist or historian, I am remarkably developmental!" Anyway, to actually include information about how individuals are changing, we will need to combine the time-lag with the longitudinal design.

What do you get when you put the time-lag and longitudinal design together?

The cohort-sequential design. In this design, we collect two or more longitudinal sequences, using different cohorts and conducted over different spans of historical time. We basically repeat the same longitudinal study for different cohorts. An example of this design is shown in Table 19.3 that includes three longitudinal sub-studies (L-1-3) from the ages of 20 to 50 conducted with three cohorts (born in 1940, 1950, and 1960). As you can see, it also includes four time-lag studies (TL-1-4) across three decades, one each for 20-, 30-, 40-, and 50-year-olds.

Table 19.3. A cohort-sequential study that examines longitudinal sequences from age 20 to 50 for cohorts from three birth years (1940, 1950, and 1960).

Cohort	***Time of measurement***						
	1960	1970	1980	1990	2000	2010	
			TL-1 20-yr-old	**TL-2** 30-yr-old	**TL-3** 40-yr-old	**TL-4** 50-yr-old	
1960			20→	30→	40→	50→	**LONG-1**
1950		20→	30→	40→	50→		**LONG-2**
1940	20→	30→	40→	50→			**LONG-3**
1930							
1920							
1910							
1900							
1890							
1880							

Are there any disadvantages to the cohort-sequential design?

This design has all the disadvantages of the longitudinal design (see Table 18.7) multiplied by three studies. And the time span to complete all three replications is even longer than the single longitudinal study.

Table 19.4. Kinds of sequential designs.

Sequential Design	***What designs does it combine?***	***Provides information about:***
Cross-sequential	Cross-sectional & Longitudinal	Age changes following up multiple cross-sections
Cohort sequential	Longitudinal & Time-lag	Age changes for multiple cohorts
Time-sequential	Cross-sectional & Time-lag	Cross-sections at multiple time points
Schaie's Most Efficient Design	Cross-sequential Cohort sequential Time-sequential	Age changes for 3 cohorts followed over 3 TM, with new independent samples of cohorts at TM 2 and 3.

Well, do the sequential designs at least get rid of the fatal flaws of the classical designs?

They have the potential to rule out some of the confounds, but they may not.

How can they rule out the confounds?

All the sequential designs basically take either a cross-sectional or a longitudinal study and repeat it at a different point in time. For example, in the time- sequential design, researchers take a cross-sectional study and repeat it at subsequent times of measurement. The fatal flaw of a cross-sectional study is that the age differences could really be cohort differences, so repeating the cross-section at different measurement times also repeats it for different sets of cohorts. If the same pattern of age differences are found at each new measurement point, the replication suggests that it is not tied to specific cohorts.

Likewise, in the cohort-sequential design, researchers take a longitudinal study and repeat it with different cohorts across different times of measurement. The fatal flaw of a longitudinal study is that the age changes could really be historical changes, so repeating the longitudinal sequence with different cohorts also repeats it across different historical periods. If the same pattern of age changes are found at each new cohort, the replication suggests that it is not tied to specific sequences of historical change.

So then, the sequential designs *do* compensate for the fatal flaws, right?

Ah, there's the rub. Even if researchers' cross-sections and longitudinal sequences replicate, there are limitations to what they can claim. Remember how Schaie was hoping that these were *explanatory* designs, so that such replications would be evidence for maturational or organismic explanations of age differences and age changes, and they would rule out environmental explanations? And remember that Baltes argued against these interpretations, insisting that the designs provide *descriptive* information only? The key idea is that the designs can tell us whether differences between and changes within individuals and groups are age-*graded* or history-*graded*—that is, whether they *follow* age or history, and not whether they are *caused* by age or history. In fact, developmentalists now agree that age and history, which are different markers of time, do not by themselves *cause* anything. Time is always an index for the working of something else—a proximal process or new contextual demand or reorganization—that can be considered the explanatory force.

Moreover, finding an age-graded trend does not tell us that the historical context is *not* an important player. Instead it suggests that whatever role the historical or cultural context is playing (and since we are relational meta-theorists, it is always playing a 100% role), it is not changing over the historical time span we included in our studies. And since we are interested in both stability and change, the idea that the historical factors remain stable is actually interesting and important information. The unchanging nature of the schools is as interesting a trend as the turmoil created by No Child Left Behind. And they are both likely to be important in understanding schools as contexts for the development of teachers and students—including beginning teachers' stress and engagement, changes in students' relationships with their teachers, and the development of students' academic motivation and performance.

Are there other limitations?

Yes, in the Sisyphus-ian task created by relational meta-theories: No matter how much data we collect, no matter how many times we replicate a pattern of age differences or changes across new cohorts or historical periods, our meta-theoretical assumptions of historical embeddedness still compel us to admit that we can only generalize our findings to the cohorts and historical periods that we actually included—because development could always look different under other historical and societal conditions.

And these limitations hold if we succeed in replicating our age-graded patterns. What happens if we don't?

Well, if we do not replicate, that is, if we the pattern of age differences we get in our first cross-sectional study are not the same as the one we get in our second cross-sectional study, we are back to our confounded state: those group differences could be age-graded or cohort-graded differences or one of each or both. Likewise, if the pattern of age changes we get in our first longitudinal study are not the same as the one we get with our second cohort, we also re-confounded: those group changes could be age-graded or history-graded changes or one of each or both. So our design can't help us any further.

Then what is a researcher to do?

As a relational meta-theorist, you have the option to stop thinking about history- and cohort-graded effects as a *confound* and therefore something to get rid of, and to start thinking of them as a valued part of your phenomena and something to turn *toward* rather than away from. Go looking for them. In every study of teachers, workers, and parents, treat the fact that they represent people of different ages and cohorts, and directly study how those differences (in work ethic, facility with technology, or nature of preservice training) may be shaping their actions, reactions, and interpretations. Segment data sets into "befores" and "afters" based on relevant historical events, like strikes, public policies, or lay-offs. Monitor the effects if these historical events on workload, class size, resources, public support. Organize longitudinal collections, not only around markers of individual development but also around markers of societal change. One more reason to recruit a sociologist, economist, political scientist, or historian to the research team.

Where does the language of "cohort effects" and "confounds" come from?
When these issues were originally raised in the 1960s, psychology was firmly rooted in

the quantitative strategy of analysis of variance. So these designs were described in those terms. Here are some examples:
In the ***cross-sequential design***, we could say that cohort effects can be separated from time of measurement effects (MT), under the assumption of no age effects. That is, this design measures cohort effects, time of measurement effects, and the interaction of cohort and time of measurement: (1) the main effect of cohort indicates that there are differences between people who were born in different years no matter when we look at them (MT) (and because they are at all different MTs, the cohorts are all different ages); and (2) the main effect of measurement time indicates differences between people based on the changing societal trends (MT), no matter what year they were born (cohort) (and the changes catch people at all different age ranges); and (3) the interaction between cohort and MT indicates that (a) the year someone is born (cohort) only matters at some historical moments (MT) and/or (b) societal trends (MT) register their effects differently depending on when you were born (cohort). However, *age effects* would ruin the interpretation of an interaction—with age effects, it could be that the interaction is based on age: (a) *age* (instead of year you were born) only matters at some historical moments (MT) and/or (b) societal trends register their effects differently depending on your *age* (and not when you were born (cohort)).
In the ***time-sequential design***, we could say that age effects can be separated from time of measurement effects (under the assumption of no cohort effects). That is, the design examines age effects, time of measurement effects, and the interaction between age and time of measurement: (1) the main effect MT reflects mean level differences in performance as a function of the different historical moments (MT) when you answered the questions, no matter what your age is; (2) the main effect of age reflects how performance differs as a function of age no matter when the test was taken (MT); and (3) the interaction of age and TM indicates that (a) the pattern age differences in performance differs depending on the historical moment when the snapshot was taken (TM), and/or (b) the pattern of historical or societal trends register on performance (MT) differently depending on how old you are (age). In this case, any cohort effects would interfere with the interpretation of an interaction—with cohort effects, it could be that the interaction is based on cohort and not age: it is the pattern of cohort (and not age) differences in performance that differs depending on the historical moment when the snapshot was taken (TM), and/or (b) the pattern of historical or societal trends register on performance (MT) differently depending on cohort (and not how old you are (age)).
Finally, in the ***cohort-sequential design***, we could say that age effects can be separated from cohort effects, under the assumption of no time of measurement (MT) effects. That is, this design measures age effects, cohort effects, and the interaction of age and cohort: (1) the main effect of age indicates that there are differences between people of different ages no matter what year they were born (cohort) (measured over many MTs); (2) the main effect of cohort indicates there are differences between people who were born in different years (cohort) no matter what their age (again looked at over many different MTS); and (3) the interaction between age and cohort indicates that: (a) age only makes a difference to performance for some cohorts, and/or (b) the year someone is born (cohort) only leads to differing performance at some ages. However, *time of measurement effects* would ruin the interpretation of an interaction—with MT

effects, it could be that the interaction is based on MT instead of cohort: (a) age changes are only apparent at some MTs (instead of cohorts) and/or (b) MT (instead of year you were born or cohort) only matters at some ages.
Note. We appreciate Cathleen Smith for cogently and clearly bringing these complex but important issues to our co-teaching experiences in this class

What do we think about the meaning conveyed by analysis of variance language?

At this historical moment, we can reflect on the implications of using the analysis of variance language to describe our goals and our problems. The idea that the designs can separate, for example, age from cohort effects, seems to be leading us in the wrong direction—toward decomposition or splitting. It suggests that we can isolate age effects, whereas relational meta-theories view all age-graded differences and changes as inherently incorporating the consequences of growing up during a specific historical period (i.e., cohort effects). They are not "confounded" by our *design*, there are intertwined in our *phenomena*, based on the fact that people's lives are embedded in society and history, and so they always change together (Baltes, 1987; Bronfebrenner & Morris, 2006; Elder, Sameroff, 2010).

Sometimes the age-graded changes are more systematic and sometimes the history-graded changes are more pronounced, but we are always looking at their balance. Societal changes seem to register more noticeably at certain ages—candidates are at birth, during early adolescence, emerging adulthood, and oldest age. Likewise, some age-graded sequences seem to be happy to unfold in their regular rhythms over and over again at successive historical periods, working in concert with the average expectable human environment that has been provided for much of history. The developmental designs, both the classics and the sequential combinations, are important tools for developmentalists, and we should think carefully about how we interpret the information they provide.

For developmental psychologists, the work of life course sociologists is especially instructive (Elder, 1998) and it can help us with the thoughtful use of our designs. Just as we wouldn't expect important developmental changes in all aspects of functioning to be homogeneously distributed across the lifespan, but instead we use theories and previous research to identify windows of developmental time that are likely suspects to contain developmental shifts of interest, so too should we be wary of assuming that important history-graded changes are swimming around freely in societal patterns at all historical periods. Instead of fishing any-old-where for social trends (even though we may accidently catch something big, Baltes & Nesselroade, 1972), we should use theory and research from the disciplines that specialize in these topics to help us locate likely moments when the effects of societal changes should make a marked difference to the course of individual development.

Table 19.4. An acronym for remembering the confounds of the simple designs: "ACT with TLC."

Heuristic	*What is held constant?*	*Heuristic*	*In which design?*	*What is confounded? (the other two)*
A	Age	T	Time-lag	Cohort and MT
C	Cohort	L	Longitudinal	Age and MT
T	MT	C	Cross-sectional	Age and Cohort

MT stands for measurement time. From Richardson (2004).

Which of the designs described in this chapter are most useful for developmentalists?

We want to say that the time-lag and both of the additional sequential designs have their uses (following the Ecclesiastes: 3 "To every thing there is a season, and a time to every purpose under the heaven") but we can't help it, the developmentalists in us cannot be satisfied with any design that does not provide information about individual *change*. So that means that the cohort-sequential design, which provides information on age changes for multiple cohorts, is likely to be a favorite.

What are the best kinds of statistical analyses for examining changes in mean levels over

time? And group differences in those changes?

As we mentioned previously, ANOVA was king at the time that these different designs were being created and discussed in the 1960s and 1970s. At that time, for analyzing longitudinal data, researchers typically relied on repeated-measures analysis of variance or multivariate analysis of variance. In more recent times, lifespan researchers have been enthusiastic about the potential use of growth curves to estimate those "trajectories" that we are always trying to visualize. Unlike MANOVA, these analyses estimate a trajectory for each participant so we are able to look at individual differences in slopes and intercepts. Hierarchical linear modeling allows researchers to examine changes in variables at multiple time points that are nested within participants.

In principle, all of them will give you good information about normative age-graded and history-graded changes. Repeated measures MANOVA allows researchers to examine group differences in these mean level changes. Growth curves and HLM permit this as well, but also provide information about individual trajectories and so add the possibility of examining and predicting interindividual differences in intra-individual change.

Longitudinal Methods: Methods of Analyzing Mean Level Change over Time	
1.	***Repeated measures (multivariate) analysis of variance***. Models changes in means level of multiple measures and can test for group differences in patterns of change.
2.	***Growth curves.*** Estimates normative intercept and trajectory over many measurement points. Can consider multiple kinds of slopes (e.g., linear, quadratic) and provides estimates for each individual.
3.	***Hierarchical linear modeling***. Estimates growth curves within nested models. Can consider multiple kinds of slopes (e.g., linear, quadratic) and provides estimates for each individual. Also allows inclusion of time varying covariates.
4.	***Latent change score models***. Uses structural equation modeling to estimate changes in multiple trajectories over time.

Well, which of these statistical methods should we be using?

Over the last 15 years, there have been important advances in methods for testing longitudinal models of multivariate change. A powerful and general set of models, called latent change score (LCS) models, has been worked out by developmental methodologists to allow researchers to look simultaneously at dynamic and developmental changes (Ferrer & McArdle, 2010; McArdle, 2009; McArdle & Grimm, 2010). These models provide a good basis for describing normative and differential growth and stability.

Why is this approach better that the old stand-bys?

Because we know where programs of developmental research are headed. After this section on description comes to an end, we will start talking about *explanation,* and once we open that can of worms, we will be longing for more powerful models, capable of handling the complexity of our developmental theories. And, at that point LCS will distinguish itself from all the other methods we have mentioned. So, if we are going to turn to LCS when the going gets tough, we might as well *start* with LCS, so we can build out as we go along.

Classic books on longitudinal methods.
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Chapter 20. Developmental Equivalence: Sampling and Selection

Time is a great teacher, but unfortunately it kills all its students.
— Hector Berlioz, in a letter, November 1856

When, as relational meta-theorists (or as our full name suggests, as organismic-contextual developmentalists), it becomes clear to us that we must choose as our target of study the many ways that people differ or change across chronological and historical time, it may not have been so clear to us that, with this goal, we have also bought ourselves a slough of trouble and a lifetime of creative work. In this chapter, we will consider two of those thorny problems under the rubric of "developmental equivalence," which refers to the issue of trying to establish or maintain the comparability of our samples and measures as we stretch them out over different ages and time points.

In order not to feel too foolish for getting ourselves into this swamp or too lonely in our attempts to solve the developmental equivalence puzzle, we want to immediately point out that any researchers who are interested in comparing multiple groups are facing the same set of issues. So, for example, researchers who want to conduct gender comparisons need to worry about "gender equivalence;" those interested in cultural comparisons, "cross-cultural equivalence," racial comparisons, "racial equivalence," and so on, even for comparisons that don't have neat labels, like novice and expert comparisons, comparisons between married and single people, preservice and inservice teachers, and, well you get the idea. We are not alone in dealing with the issues of equivalence or comparability.

What is the general idea of "developmental equivalence"?

Developmental equivalence refers to the comparability of something (hence, equivalence) across people who reside at different age-grades (hence, developmental). The general idea is that, when conducting developmental research, which as you know by now involves looking at people at different ages, either multiple groups of people who are currently at different developmental levels (cross-sectional design) or the same people who successively reside at multiple developmental periods (longitudinal design), or both (sequential), we want to learn something about individual change by making age comparisons. For these to be meaningful, we want our people of or at different ages to actually be *comparable* to each other, in both *who* is in our sample (developmental sampling equivalence) and in *what* we are assessing (developmental measurement equivalence).

Before we get into the details, can you provide an example?

Consistent with the idea in the Joni Mitchell song that "you don't know what you've got 'til it's gone," let's consider one of the problems we encountered with longitudinal designs, namely, selective drop-out. This was the problem that, because longitudinal studies go on for a long time, participants drop-out and, unfortunately for us, they do not drop-out randomly: In general, it's the people (or in the case of children and the elderly, the families) who have moved or are struggling (in terms of employment, health, or stressful life events) who drop out soonest. This can introduce a *positive bias* in longitudinal samples, in that the older age groups (who have been in our study the longest) are better functioning than the previous age groups, not because they are improving, but because the poorer functioning people have been successively dropping out. So the age groups lose their comparability. If we do not take this into consideration, longitudinal studies will consistently produce findings suggesting that people get steadily better with age—but it will not reflect actual improvements or age *changes*, it will be due to changes over time in *who* we are looking at-- the *membership* in our underlying samples. If we are not careful, we will lose our developmental sampling equivalence, and along with it, our capacity to provide accurate estimations of age changes.

DEVELOPMENTAL SAMPLING EQUIVALENCE

What is the goal of developmental sampling equivalence?

In a nutshell, our goal is to create groups of participants who are representative for their age groups and the same on everything but age (see Figure 20.1). We have the same goals as all researchers when it comes to wanting our samples to be representative of their underlying populations, but because we are interested in age groups, we want our sample of, say, eight-year-olds to be representative of the underlying population of eight-year-olds; our sample of 12-year-olds to be representative of the underlying population of 12-year-olds; and our sample16-year-olds to be representative of the underlying population of 16-year-olds; while at the same time we want the samples of children of different ages to be comparable—we want groups in which the only differences are based on age. That way we could say that when we look at developmental differences, all differences between the groups are due to age, and not to who we happened to include in our sample.

Insert Figure 20.1 about here

What gets in our way of creating samples that are developmentally equivalent?

A major problem we encounter is based on recruitment. Let's just start by considering the ways that we typically recruit samples for our studies and note how these strategies differ with age—and how this may unintentionally introduce bias in our age comparisons. As an in-class activity, we usually list several age groups (from newborns to centenarians) and then discuss the strategies that are typically used to recruit these age groups. For example, samples of newborns and infants are often recruited from hospitals, birth announcements, or pediatricians' offices when mothers come for well-baby check-ups and immunizations. As children get older, their parents are often recruited through childcare and preschool centers. When they enter kindergarten, children can be recruited through public schools; emerging adults in colleges; and so on.

An example of our work on the white board during this in-class activity is shown in Table 20.1, which lists several age groups and some ideas about how researchers typically recruit participants from these groups. These kinds of samples are called "convenience samples" precisely because these recruiting strategies allow us to stop off at handy locations and institutions where our participants are conveniently clustered, so we have greater concentrations of the age groups we are trying to recruit.

Table 20.1. Strategies for recruiting people of different ages and the selection biases they potentially introduce.

Age group	***Approx. Age***	***Recruitment Strategy***	***Who is Not Selected***	***Possible Selection Bias***
Newborn	0 - 3 mon.	Hospitals	Home birth	Fewer hippies
Infancy Toddler	3 - 18 mon. 18 - 24 mon.	Pediatrician Daycare	No pediatrician Home care	Lower SES Can't afford Mom can stay home
Childhood				
Young	3-5 yrs.	Preschool	Not in preschool	Can't afford Mom can stay home
Middle Late	6-8 yrs. 9-10 yrs.	Public grade schools	Private school Home school	Wealthy Religious Child attributes
Adolescence				
Young	11-13 yrs.	Public middle schools	Private school Home school Drop outs	Wealthy Religious Child attributes Poor academics
Middle Late	14-16 yrs. 17-19 yrs.	Public high schools	Home school Private school Drop-outs	Wealthy Religious Child attributes Poor academics
Adulthood				
Emerging	20-25 yrs.	Colleges	HS Drop-outs Non-college bound	Poor academics Employed Unemployed
Young	25-35 yrs.	Colleges	Drop-outs	Poor academics

		Advertisement	Non-college Don't read ads	Employed Unemployed
Middle Late	35-55 yrs. 55-65 yrs.	Advertisement Businesses	Don't read ads Unemployed Health issues	Lower SES Less education Less medical care
Old age				
Young-old Old	65-76 yrs. 77-89 yrs.	Retirement communities Assisted living	Living at home Living w family In nursing home Dead	Wealthy More independent Health issues
Old-old Centarians	90-99 yrs. 100+ yrs.	Assisted living Nursing home	Living w family Can’t follow study Dead	Wealthy More independent Health issues

Where does the problem of non-equivalence come from?

Every recruitment strategy makes in more likely that some kinds of people will be included and others will be left out. So we also include in our in-class activity our best guesses about who, when we use a particular set of strategies, we have excluded from our sample. For example, if we recruit neonates from hospitals, we have excluded families whose children were born at home. Or if we recruit toddlers at pediatricians, we have excluded families who don't have enough money for well-baby visits. Or if we recruit at center-based daycares, that includes only about 25% of kids in that age range.

If we recruit from public schools, we miss children from private schools and children who are home-schooled, and by middle school, we are missing drop-outs. If we recruit in colleges, we are missing all the high school drop-outs as well as the 50% of college graduates who didn't go to college, as well as the ones who did but then dropped out. In middle age it is almost impossible to recruit men, so middle-aged samples can be disproportionately made up of white middle class well-educated women. And so it goes. Until by the oldest ages, we are missing the vast majority of people--- who cannot participate in our studies because they are in hospitals or nursing homes or unable to make good decision about whether to participate, or mostly—because they are already dead.

This is all very interesting, but what is the point you are trying to make?

These strategies cause selection biases because the people whom we recruit are not always representative of the underlying populations to whom we wish to generalize. This is a general problem, of course, but when the strategies produce *different kinds of biases* at different *ages*, this becomes a problem of developmental sampling equivalence. To illustrate the point, let’s consider an extreme example: Say I go to tennis classes to recruit participants—we realize that all people in tennis classes are selected on some criteria, but if I recruit 10-year-olds and 90-year-olds, the 90-year-olds who are still playing tennis are much more highly selected than the 10-year-olds, because many fewer 90-year-olds than 10-year-olds even have the capacity to play tennis. So we are inadvertently adding more bias to our sample of 90-year-olds-- they will be overall much higher in their functioning relative to the population of 90-year-olds, than our 10-year-olds will be relative to their parent population of 10-year-olds.

Is there anything we can do to minimize this sampling bias?

Yes. If you frame the problem as, “people of different ages are recruited in different ways, so we end up with differential participation,” then there is a relatively straightforward technical recruiting solution, which good researchers employ. It is a lot of effort, but what we can do is work hard on recruiting the participants who our typical recruiting strategies would otherwise leave out, that is, adjust our strategies so that, in the end, our samples include infants who don't go for well-baby visits, homeschooled children, middle school drop-outs, unemployed, middle aged men, and elderly living independently or with their families. This creates age-graded samples that are more representative of their age-graded populations, so that’s good.

So if we are willing to put in the work-- are we home free?

Not yet. As you continue up the age range, you may have noticed that there are some subgroups that, no matter how much time we dedicate, we cannot recruit into our studies. These are elderly people who, because of cognitive or memory impairments, can't participate in our assessments. Or are not available because of health issues or hospitalizations, or the most difficult to recruit—due to the kind of selectivity that gave the problem of "selective mortality" its ironic kick—potential participants who are immune to our recruiting prowess because they have already died. In other words, there are some problems with recruitment that elbow grease can't solve.

But wait a minute. If as people get older, more have died, then aren't we aiming for samples that represent the still-living population?

Here's where it gets tricky. We have biases built into our underlying populations, and they increase with age. At each age, and probably even prior to birth, selection factors are exerting their effects. The issue of selective mortality, but with a capital "M," means that who dies at different ages is not random. Even the rates of infant mortality (the percent of infants who die in the first year of life), although mercifully low in the US are radically different across demographic groups, ranging from 3 per thousand live births for Chinese-American infants to 13 per 1000 for African-American infants, a difference of over 400%. So as our age comparisons move up along the axis of chronological time, we are always comparing a larger younger population to an older diminished population. As shown in Figure 20.1, our goal when we are comparing different age groups (either at the same time or over time) is to have sub-samples that are each representative of their particular age group, but who are also comparable to each other, as indicated by the horizontal arrows.

But time is not our friend in this endeavor. Even if the age-graded sub-samples are perfectly representative of their living age-graded populations (and who can do better than that?), the age-graded sub-samples are *never* comparable—because all older sub-samples are only subsets of the previous age group, or as J.K. Rowling indicated, we can only study the Harry Potters, that is, “the boy who lived.” The problem is exacerbated the longer we go—older people and the oldest-old belong to an increasingly elite club that represents lottery winners in the categories of biological (especially gender), psychological, social, and cultural resources as well as incredible good luck to be passed over by historical and non-normative events that took their compatriots.

This doesn’t sound good.

It’s not bad—it’s just true that populations of people of different ages are inherently different on important features. So if we want to compare them, we have to attend to the general issue of *selection*.

Isn’t the general issue equivalence? Why are we discussing *selection*?

We know it sounds a bit confusing. The two concepts are closely related. Our goal is equivalence or *comparability* of our age-graded samples, but what keeps tripping us up is age-graded *selection.* It is this selection that introduces bias in our samples, based on the differences between the people who are selected and those who are excluded. *Age-graded biases* are introduced when selection operates differently at different ages. We thought this through for recruitment: Age-graded differences in recruiting strategies can produce a kind of researcher-manufactured age-graded *selection* to which we can provide a researcher-manufactured solution—better strategies to include participants from the parts of our population that are normally excluded. However, there is also a part of age-graded selection that is manufactured by time and its annoying irreversibility (as Nick Hornby said in *Slam*, “I hate time. It never does what you want it to."). The issue with which we must come to grips is this: As a population ages, it loses members, these members are never replaced, and these losses are not random.

So what are researchers supposed to do about selective mortality?

There are two general approaches. The first, which seems very American, is to try to get rid of or minimize the problem. We can discover the biases by studying the differences between the people who lived and those who did not at each age. Not surprisingly, an enormous amount of this work has already been accomplished by aging researchers, who deal with this issue its most conspicuous form. These researchers routinely include measures of the big factors that predict mortality—social class, years of education, race, ethnicity, gender, supportive social relationships, mental health (e.g., depression), and physical health status. Then in making any age comparisons on a target psychological or social phenomenon, say memory, cognitive performance, moral reasoning, or wisdom, researchers statistically control for these selection factors.

Sometimes when researchers introduce these controls, age differences disappear. Does this mean that there are no age differences? Maybe-- it suggests that the differences between groups are likely due to differences in the underlying samples, and those could be cohort effects or they could be differences in these selection factors. In any case, it does suggest that these group differences are not good models for age *changes.* One cool technique is to create *matched* samples, in which researchers start with the configuration of attributes that characterize their oldest samples (e.g., white, female, well-educated, and well-off financially) and then go sorting through the larger populations (or their own samples) of younger people to locate participants who match that specific profile-- kind of like searching for younger versions of all their older participants. Age comparisons can then be made between these stratified sub-samples.

These seem like strategies for cross-sectional studies. Are there strategies for longitudinal studies?

Very good question. Yes, you can see that because age and cohort differences are confounded in cross-sectional studies, this magnifies differences between age groups. They have differences based on the typical selection of chronological time, but also ones based on selection introduced by historical time, that is, cohort effects (increasing years of education, improved health care, fewer deaths due to work accidents, and so on). So cross-sectional studies definitely suffer from problems of developmental sampling equivalence, selection, and bias. It would be lovely if longitudinal studies could escape these problems, but they can't.

In a way, some of the solutions are parallel. Just as we could solve some of our recruitment-induced age-graded biases, by doing a better job recruiting representative samples, we can apply hard work to longitudinal studies and, on the one hand, kill ourselves to retain all our participants (and researchers responsible for long-term longitudinal studies have written volumes about how to accomplish this; e.g., Ribisl et al.,1996), and on the other hand, follow Schaie's advice about sequential studies and continually replace our participants who drop out with new participants who are matched to our drop-outs on important characteristics. These new participants will be hard to recruit, because as we pointed out previously, in general participants who drop-out are not doing as well as the participants who remain in the study.

Are there other longitudinal strategies?

Yes, one of the most useful techniques is to do something that is not possible in cross-sectional studies, and that is to look right at the problem: Directly examine the developmental trajectories of our target phenomena, that is, the actual age changes that our longitudinal studies are so proud to be able to detect, and see whether they are different for participants who inhabit the different biopsychosociocultural niches created by race, ethnicity, class, gender, education, and immigration status. Some of the most interesting work in aging across adulthood shows that the pathways of, for example, intra-individual changes in intellectual performance are not at all the same for people who inhabit these different niches. As you can imagine, the good news niches contain people who start higher, increase their functioning more and longer, maintain a plateau of good functioning at a higher level for a longer period, and start their declines later and lose less at a slower rate toward the end. These are just the kinds of individual differences in intra-individual change that our lifespan forebears promised we might see if only we would go look for them.

Terminal Drop: Don't Forget to Count Backwards from Death

There is one additional kind of selection effect that both cross-sectional and longitudinal studies need to take into account. It was discovered in longitudinal studies (Riegel & Riegel, 1972). When researchers were closely scrutinizing the patterns of intra-individual change they were finding for study participants over the age of 80, they noticed an interesting pattern: They saw relatively steep declines in all kinds of functioning. When they looked at individual pathways, they noticed that a subset of participants was responsible for steep declines across each age period, and that these participants were less likely to participate in retesting at the next time of measurement. And suddenly it occurred to researchers that perhaps these drops could be better understood by noting when their participants died and then organizing their scores, not by age (years since birth) but according to years *before* death*.* And indeed, for participants who died of natural causes, steep declines in all aspects of functioning could be observed starting at 18 moths to two years prior to death. It seemed that death was exerting its gravitational pull, perhaps through reductions in circulation or respiration that exerted a downward pressure across the board on psychological and physical functioning.

As explained by Baltes, Reese, & Nesselroade, “Terminal change is an accelerated rate of change during the last few years before natural death. Persons who differ in longevity enter the period of terminal change at different ages, but the proportion of dying individuals increases with age, leading to spurious changes in developmental curves constructed from group means” (1977, p.119). Many researchers who are interested in estimating trajectories of “normal aging” pull their participants from their samples at about 2 years prior to death so that trajectories of “normal dying” can be estimated separately from trajectories of normal aging.

Do selection effects only plague developmentalists?

No, perhaps surprisingly, they are everywhere. And if researchers forget to consider them, we get ourselves in big trouble. If we are comparing novice and master teachers, or workers who are new on the job with those who have 20 years of seniority, or sixth graders with ninth graders, we are dealing with selection effects. In each case, the masters and senior workers and ninth graders have not only been *shaped* by their long journey but they have also been selected—the only people left to study are the *survivors* of that journey. So, for example, if we compare beginning and experienced teachers, and we know that about 50% of teachers quit teaching in their first five years—then we also know that the experienced teachers are highly selected and any differences between the two groups could be (and likely are, at least partly) based on the preexisting or emerging characteristics of the early teachers that allowed them to survive. These selection effects are what make retrospective studies, in which the survivors provide developmental accounts of their pathways so different from prospective studies, in which we begin with everyone who was there at the starting line and follow their progress, noting when they fell out of the race.

Retrospective and Prospective Study Designs	
Retrospective	Study that starts with a group of people who are at a particular end-state (e.g., adolescents who are showing anti-social behavior or parents who are maltreating their children) and looks backward at their previous lives to see the factors that may have contributed to this endpoint.
Prospective	Study in which people who are at-risk for a particular end-state are all followed forward in their lives to see the factors that may contribute to who will actually land on this end state and who will not.
Differences	Retrospective studies typically overestimate the extent to which the end-state was predetermined by earlier factors. Because prospective studies include in their samples, individuals who had all the same risk factors but did not reach the same end-state, they typically reveal that pathways are probabilistic, with much higher rates of multi-finality.
Example	Most highly aggressive 20-year-olds were also highly aggressive at 12, but most highly aggressive 12-year-olds are not highly aggressive at 20.

So what can researchers do?

The overarching idea is that, as researchers, when we show up to a place and time, we should always have in mind that the participants that we meet in that place and that time are not there by accident (or not *only* by accident). Places (and length of time in places) always shape their occupants. But places also *select* their occupants, by only allowing some people in. And people are active in selecting their places and the length of time they spend in them, as well as shaping their places once they arrive and over time. In the world of peer relationships, this is called "assortativeness" and it refers to the idea that people, their partners, (and in our example, their places and times) are mutually selected.

Peers, homophily, selection, and assortativeness.

So wherever and whenever we conduct our research, we would do well to quiz our settings and times for their assortativeness or selection: Who are these people? How did they get here? What did it take for them to get here? How are they the same and different from others who are not here? from others who got here and then left? And to think through how the answers to any of these questions may differ depending on our participants' location in time: their age or cohort or length of stay. As a rule, where someone is located (e.g., job, peer group, gang, relationship) and how long they have been there tells you something about who they are (selection effects).

Developmental sampling equivalence, selection, and bias: Our motto.
Just as our view of history is impoverished if its stories are told only by the victors, so too is our view of development impoverished if its stories are told only by the survivors.

If other researchers who are interested in other comparisons would do the same, they could see, for example, how gender comparisons in electrical engineering or stay-home parenting are dealing with assortative pressures that are very different for men and women. Or researchers studying prison guards or truckers would think carefully about the assortative pressures that select and keep people in those kinds of workplaces. Researchers know that all our participants are *volunteers*, of course, and it is always worthwhile to think about the factors and characteristics that led our participants to agree to participate in our research, and the differences between the people we are studying and those that we did not reach or who declined to participate. These nonparticipants should become our "silent partners," helping us interpret what we did find with our volunteers. So, too, when one cares deeply about time (as we developmentalists do), we are always studying *survivors* of some sort, and so the non-survivors, who cannot speak directly for themselves, should become our silent partners as well.

Table 20.3. Goals, Problems, and Strategies for Dealing with Developmental Sampling Equivalence.	
Goal	Recruit and create representative samples of people of different ages who are the same on everything but age.
Problem	People of different ages are differentially easy to recruit.
	People of different ages are inherently different on many things besides age.
Strategies	*Cross-sectional*
	Recruitment. Recruit hard-to-get participants to create representative age-graded samples.
	Statistical control. Measure attributes on which age-graded samples are selected and statistically control for them in examining age differences.
	Matching. Create matching samples of older participants and younger versions of themselves.
	Longitudinal
	Recruitment. Recruit hard-to-get participants to creating representative longitudinal samples.
	Retention. Retain the heck out of longitudinal samples to maintain representativeness.
	Replacement. Replace longitudinal drop-outs with similar participants.
✓	*Differential development*. Examine how patterns of developmental change differ for participants from different niches (combinations of gender, race, class, education, ethnicity, and immigration status).

✓	*Assortativeness.* Examine attributes that explain how people select and are selected into their specific contexts and length of stay in these contexts.
✓	*Survivors.* Examine the attributes that separate “survivors” from the non-survivors and consider their effects of differential development. If any of the non-survivors (e.g., workers who quit their jobs or were fired) are still alive, find them and study them.

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Peers

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Chapter 21. Developmental Equivalence:

Measurement and "Developmentally-friendly" Conceptualizations

Each time is true, but the truths are not the same.
— Alan Lightman, *Einstein's Dreams*

What is developmental measurement equivalence?

As developmentalists, whatever our target phenomena may be, we are interested in comparing people of different ages (cross-sectional) or following people across different ages (longitudinal). So, our goal with *developmental measurement equivalence* is to validly measure that target phenomena at different developmental periods/ ages. It sounds simple: As shown in Figure 20.1, we just want to measure a construct in a way that is both: (1) valid at each age and (2) comparable across ages. It seems like the most straightforward solution to maximize comparability is simply to use the same measure at different ages. But the problem is, when you use exactly the same measure, you may actually be measuring *different* constructs at *different* ages.

Insert Figure 20.1 about here

How is that possible?

Let's think of an example. In early cross-sectional studies of intellectual functioning, researchers used standardized tests of intelligences, kind of like the SAT or GRE exams with which most students are familiar. Researchers gave the exact same tests to people of age 20 to age 80. So you would expect the tests, since they were exactly the same, to measure just what is the items on the test were designed to capture, namely, intellectual functioning. But even a few moments' reflection suggests that the 20-year-olds and the 80-year-olds are likely to experience such tests differently. For example, let's consider recent practice effects. When would we guess is the last time that the typical 20-year-old has taken a test like our intelligence test, namely, one that uses a Scantron-type form where the answers are bubbled in? The answer might range from "yesterday" (if they are in college) to "a few years ago" (while they were in high school). But in any case, the format of the test looks familiar. Now, let's think about a typical 80-year-old. The last time they took such a test would likely be "never." Even if they got a Ph.D., the last exam would have been completed 50 years ago.

So how well participants perform on our intelligence test also depends on things like familiarity and other performance factors, which turn out to be very different between age groups. For example, performance includes a variety of "test-taking skills"—older people tend to be more cautious, so if they don't know the answer, they are less likely to guess than younger people, and so miss out on the random correct choices; older people care more about their performance, and so tend to be more worried, which may impair performance. One very big difference with age is just plain speed—speed of processing. So any assessments that are timed put older people at a disadvantage.

Taken all together, this makes us rethink the connection between our target construct (i.e., intellectual functioning) and the measure we are using to map it (namely, participants' answers to the multiple choice questions on our intelligence test). Performance on that test taps intelligence all right, but it turns out that it also taps familiarity-caution-anxiety-and-speed as well, all of which are factors that weigh differentially on people of different ages. And very clever intervention research by Paul Baltes and his team demonstrated just how much (Baltes & Lindenberger, 1988). They showed that (at least for the young-old), it is possible to systematically peel back those performance factors—if researchers allow older people to become familiar with how the tests look and work, give them practice using the Scantrons, add instructions that encourage them to guess on items even if they are not sure, help reduce worry by underplaying the importance of what the tests measure, and allow them to take the tests under "power" (untimed) conditions. And if researchers do this-- lo and behold. Those elderly people get smarter and smarter and smarter. Their performance improves markedly. So exactly the same test measures different constructs (or combinations of constructs) depending on the age of the participants.

Is this a problem for non-developmental researchers, too?

Yes, just like sampling equivalence, measurement equivalence is everywhere. It is an issue for any researcher who wants to make comparisons between groups. It is very common to think about cross-cultural equivalence of measures, or gender equivalence, or racial and ethnic equivalence. The issue of equivalence is at the heart of discussions about tests (and especially tests with consequences—like ones that decide whether students will get into and out of special services or advanced placement courses or college or graduate school) that are "biased"—against people who were not part of the group on which most tests are created (i.e., the dominant group—typically white middle class native-English speaking groups). The definition of a "biased test" is one that does not measure the same thing across groups, and almost always, this means tests that inadvertently privilege the dominant group.

Before we get into the details, could we think about another developmental example?

Yes, let's work through an in-class activity we often use to illustrate the challenges of measurement equivalence. Say we are going to conduct a lifespan study of aggression. And we decide to measure aggression using an observational coding system, so we want to generate behaviors that we think would be good markers of aggression at different ages. We usually divide students into groups of 2 or 3, assign each one an age group, and have students generate three or four key behaviors for their age group and list them on the board. In Table 21.1, you can see how we organize this information in the board as well as some typical examples of the categories of behaviors our students have suggested.

Table 21.1. Examples of categories of behavior that capture aggression at different ages.

Age group	***Approx. Age***	***Examples of behavioral categories that tap aggression***
Infancy	0 - 6 mon.	
Infancy Toddler	6 - 18 mon. 18 - 24 mon.	Hitting people with hand or object, biting people. Grabbing objects away from others.
Childhood		
Young	3-5 yrs.	Hitting or kicking people, throwing objects at people, yelling or name calling, hair pulling.
Middle Late	6-8 yrs. 9-10 yrs.	Threatening, verbal taunts, and name calling. Chasing, bullying.
Adolescence		
Young	11-13 yrs.	Gossiping, shunning, threatening. Fist fights. Cyber-aggression.
Middle Late	14-16 yrs. 17-19 yrs.	Verbal bullying, exclusion. Sexual aggression. Swearing at someone.
Adulthood		
Emerging Young	20-25 yrs. 25-35 yrs.	Road rage. Verbal and emotional mistreatment during marital fights. Pushing underlings around in the job.
Middle Late	35-55 yrs. 55-65 yrs.	Cutting in line. Telling someone off. Blowing up at own kids. Dismissive and demeaning comments.
Old age		
Young-old Old	65-76 yrs. 77-89 yrs.	Refusing to cooperate (e.g., taking out hearing aids). Cheating at cards. Verbal harassment. Name calling.
Old-old Centarians	90-99 yrs. 100+ yrs.	

When we start off this exercise, the group of students assigned to "Infancy" typically begin by complaining about the injustice of being saddled with that age period; they usually spent their group time arguing about whether it is even *possible* to label any newborn behavior as "aggressive." If aggression involves intentionally hurting others, are infants even capable of those kinds of intentions? The toddler and preschool groups are typically smug and rattle off their lists, which we recognize as "prototypical" aggression—hitting, biting, and (when their walking is stabilized) kicking other people. We are sobered by descriptions of bullying and cyber-bullying in late childhood and middle school, and start to chuckle when we think about how we express our own grown-up aggression while driving, at work, or on the sports field, and so on.

What is the point of this in-class exercise?

The most interesting discussions come when we suggest that, to conduct this lifespan study, all we have to do is use the entire set of behavioral categories in our observational catalog and then we will have the coding system we need to observe at any age. One or two students invariably point out that we can't just do that. The behaviors that are prototypical aggression at one age—like biting at age 2--- if we see them in older children or adults are a marker of something completely else. A 12-year-old who bites someone is not only showing aggression, they are showing signs of psychopathology. Do we think that preschoolers gossip? And a 20-year-old who punches someone is not at all the same as a 3-year-old who hits—the law even codifies this—the 20-year-old can be arrested for the same behavior that would get a three-year-old a 10-minute time out. So the point is that the *same* behaviors at *different* ages are likely to be markers of different constructs.

So what are our options?

We usually then consider the alternative: creating behavioral indicators that seem just right (i.e., valid) for our age ranges and then just sticking to those. On the one hand, that seems like an excellent idea, who could be faulted for prioritizing validity? But on the other hand, then how do we trace changes in aggression across age? How do we create estimates of those differential trajectories that developmentalists are always searching for ? Every time we cross a developmental period, we leave our previous behavioral categories behind and fall over a cliff—we lose comparability across time. How can a researcher draw a meaningful line from hitting at age 3 to social exclusion at age 13? It just doesn't make sense.

So that's the developmental measurement equivalence problem, right?

That's it in a nutshell. If we measure things in *exactly* the same way, it can mean that we are measuring something different for people of different ages, so we have a *validity* problem. However, if we measure things in different ways, we never know if we are measuring the *same* thing at different ages, so we have a *comparability* problem**.**

So how do developmentalists typically solve this problem?

Believe it or not, they typically respect the problem of measurement equivalence by staying *within* the age groups circumscribed by their key measures. They define their age group of interest based on the range of ages for which their key measure is valid. That is, they follow their participants up to the gap created by the new and different measure, and they stop and turn around. By respecting the age-delimited validity of measures, researchers have successively cut up age into narrower and narrower bands. The downside of this strategy is also apparent—if each research group only focuses on a small age range (and you would probably be surprised by how small an age range can be sliced—witness researchers who specialize in studying the second half of the first year of life), then we have inadvertently converted all "developmental analyses" to the cross-sectional sort, in which we have to compare findings for participants of different age groups. Of course, Taken together, this creates the equivalent of a cross-sectional study in which we have used different measures for each of our age-graded sub-samples-- so this makes knitting together our developmental story a very dicey proposition.

It is true that, by each of us sticking to our age-valid measures, we are individually safe, but together we have no metric with which to bridge the age groups we have created. And, in fact, we would argue that, partly based on this strategy, so-called developmental research over the last twenty years has devolved into a greater and greater focus on *individual differences* within smaller and smaller windows. As you can imagine, cumulatively such as strategy prevents the accumulation of any truly developmental information—that is about age changes across developmental periods and different pathways across those periods.

Why isn't there a bigger bruhaha about this problem in the developmental literature?

There are probably many reasons, but mostly because researchers have found ways around the problem, without always thinking carefully about the consequences of their solutions. One of the most common strategies, based on the current dominance of cognitivist meta-theories, is, once we enter the age ranges where they easily can be measured via surveys, to re-conceptualize our phenomena up to the level of appraisals. So many researchers who are interested in proximal processes, like social support or parent-child interactions or teacher-student interactions or peer groups, have decided to study them using measures of children's and adolescents' *appraisals* of these proximal processes. These appraisals are everywhere (remember Sameroff's ubiquitous "representations"?) and researchers reasons for relying on them are often based on pragmatic grounds: Surveys are much more easily administered than observations, and it is not what parents or teachers or peers are *actually* doing that shape children's development, but what children and youth *perceive* or take away from those interactions, as captured by their appraisals, for example, of parental warmth ("My Mom let me know she loves me") or teacher autonomy support ("My teacher is always telling me what to do").

Some of the earliest trends in this direction can be traced to the measurement of social support in adults. In research on stress and coping, it was assumed that social support was a good thing (as is apparent from its label) but it turned out that people who actually utilized social support were not better off; they tended to be worse off, in terms of emotional distress and other indicators of functioning. It turns out that greater utilization of social support is a marker for trouble—it crops up when a person is dealing with more severe stressful events, when a person has fewer psychological resources or is more fragile, and so on. It also turned out that not all social support is that supportive—it can be intrusive or controlling or make recipients feel incompetent (Ryan & Solky, 1996). In response to this pile of surprising findings, researchers turned to the construct of *perceptions* of the *availability* of social support. Now *there* was a measure that was well-behaved—it was positively correlated to well-being and high functioning.

What's wrong with studying appraisals instead of actual proximal processes?

The goals are understandable. Researchers have created developmental comparability by measuring appraisals all right, but in order to exclude the messy bits (the proximal processes) that are changing with age, researchers have also unintentionally excluded the part of our phenomena that is doing most of the heavy lifting. The easiest way to see the problem is to do a thought experiment in which we as researchers have completed our excellent program of study showing the crucial nature of children's appraisals of the supportiveness of their interactions with (pick one or more) teachers, parents, or peers in shaping, for example, their academic self-perceptions, motivation, engagement, coping, learning, and school success.

So now we move from the "explanation" to the "optimization" phase of our research program, and we suddenly realize that we have no advice for teachers, parents, or peers because we have learned nothing about the real day-to-day interactions that shape appraisals. In fact, as mentioned in earlier chapters, if we follow our train of research to its logical conclusion, our interventions would consist in working directly with children and youth themselves and trying to influence their *appraisals* (since that was our explanatory mechanism)-- maybe by trying to persuade them that their parents and teachers really do like them, even if they don't think so. It is obvious that such interventions would offend our sensibilities: We want to improve the context itself so that children and students are having interactions with their teachers and parents that naturally result in them feeling loved and supported.

However, once we get out of our participants' heads, and back to where we belong, which is amidst proximal processes, we can see that the pesky problem of measurement equivalence is rampant. The kinds of interactions with a teacher than make a first-grader feel cared about are very different from those that would make a fifth- or ninth-grader feel cared about, as any parent knows who has tried to kiss their fifth-grader good-bye when dropping them off at school. So the take-home message of this long story is that the strategies that researchers use to solve the problem of measurement equivalence can inadvertently throw out the proverbial baby with the bath water.

Are there any good options?

Yes, let's start with two technical solutions. The first is to conduct longitudinal studies, and just use the measure that is most valid for each age group as you go (Measure A for the youngest ages, followed by Measure B, and so on). Then, analyses focus on inter-individual cross-time connections between the two measures—the extent to which participants' position on Measure A at age 1 predicts their position on Measure B at age 2. So these measures are valid but not directly comparable. The good news is that this strategy has allowed us to cross over into new developmental periods—that's why it is a favorite strategy in long-term longitudinal studies.

At the same time, however, its two downsides are (1) when correlations are relatively low or non-significant, it is not possible to determine whether this is due to discontinuity in the phenomena or to lack of comparability in the measures; and (2) it produces no information about intra-individual change in the level of the phenomena (i.e., trajectories) or different pathways.

The second strategy is pictured in Figure 21.2: Build a bridge by creating a series of overlapping age groups and measures. This strategy takes advantage of the fact that most measures are not valid for only a single age point, but typically cover a range of ages. This would allow researchers to use the measure that is valid for the younger ages on children when they are younger, then start the measure that is valid for the next age group while continuing to use the previous measure. As a result, researchers would have information from the age groups that are at the "seam" between the two measures on both of them and it should be valid for both. This allows researchers to directly and empirically examine of the comparability of the two measures, as shown in the ovals in Figure 21.2. Of course, the downside of this strategy is the extra work for researchers, and especially for participants, in using multiple measures of the same construct.

Insert Figure 21.2 about here

What would a relational organismic-contextualist systems-thinking type researcher do to deal with the problem of developmental measurement equivalence ?

You can probably guess the two prongs of the response: (1) don't try to get rid of it by sticking to a narrow age range or focusing on appraisals, instead look it dead in the eye; and (2) and then look it dead in the other eye and the other eye, that is, from many different perspectives. Let's consider three options.

First, it would be possible to take a category of behavior, for example, any one from our catalog in Table 21.1, say “biting,” and follow it along its little lifespan, noting its first appearance as a strategy of aggression, its changing frequency and the proximal processes it gets itself into—what elicits it, what alternative responses the individual has in the same situations, its contingencies, the kinds of responses it prompts from peers and adults, what kinds of situations and states pull it out after it has virtually disappeared, and so on. We could follow the individual arcs of all these aggressive behaviors—their emergence, usage, integration, substitution, demise, and resurrection. We can use individuals’ ages as an index and so see how biting (and other forms of aggression) appear and disappear, as well as the proximal processes (e.g., attacks by older siblings or parental socialization) that prolong their use or support more socially-acceptable alternatives. This kind of a research strategy, pictured in Figure 21.3, is thinking bottom-up, from behavior to proximal processes, and allows us to watch behaviors appear or disappear, and change or remain the same in their functions and meaning with age.

Insert Figure 20.3 about here

What is the second strategy?

A second option, pictured in Figure 21.4, is to think top-down, for example, from appraisals to proximal processes. This kind of program of study allows researchers to stick with their beloved appraisals, but to ask the musical question: “What are the proximal processes that give rise to these appraisals and how do they change with age?” So, for example, researchers working within self-determination theory have shown that students’ experiences of autonomy support in their classrooms and from their teachers create contexts that allow intrinsic motivation, identified self-regulation, enthusiastic engagement, constructive coping, conceptual learning, and other good things, to flourish. So Johnmarshall Reeve set out to discover "what autonomy supportive teachers do" by conducting a series of observational studies in which he examined the kinds of teacher behaviors, curricula, assignments, proximal processes, and so on, that appear in classrooms students appraise as "autonomy supportive" (Reeve, 2006; Reeve, & Jang, 2006; Reeve, Bolt, & Cai, 1999). This is exactly the kind of information that interventionists need to help teachers support students' autonomy, and it would be possible to examine whether there are regular developmental changes in the kinds of teacher behaviors, academic activities, and proximal processes that lead students to feel autonomy support in their classrooms.

Insert Figure 20.4 about here

The development of perceived control: Adding experiences of control.
Another excellent example of how to combine the study of appraisals and proximal processes to create a developmental story can be found in work on perceived control. The beginning of the story doesn't seem very developmental: Researchers point out that perceptions of control are an important marker and predictor of good things (e.g., effort and engagement, constructive coping, positive emotions) across the lifespan—clearly documented from 4-months of age (when babies vigorously kick their legs to operate a mobile whose movement is contingent on their actions and who give up and gaze sadly at the mobile when the contingencies are cut) to oldest age (when interventions in which visitors come contingently have been shown to prolong life expectancy). These kinds of claims sound like the workings of a universal age-independent human need—the need to be effective in one's interactions with the context (White, 1959). Not particularly developmental, eh? In fact, the vast majority of research (and the research on control is seriously vast) looks at *individual differences* in perceptions of control and their differential effects. Almost no developmental literature exists. However, a huge developmental swarm of ideas swoops into this area when researchers add the idea of *proximal processes*, in the form of "experiences of control." Suddenly the question becomes—what kinds of experiences contribute to a

person’s feelings of efficacy, competence or control? And the answers to that question differ mightily by developmental level. We need to think about the representational and cognitive strategies infants, children, and adolescents use to extract causal information out of strings of interactions with the context, the changing means that individuals have to exert control, the varying roles that participation by other people play (for example, when help from others boosts a sense of control at younger ages but then subsequently undermines in), when inferential processes allow causes of effort to be differentiated from causes like task difficulty, luck, and one’s own ability, and when such inferential processes start to create a closed loop, such that beliefs launch actions that create experiences that verify the originating beliefs.

We could go on. But you get the idea. We are not trying to create equivalence, we want to see how the experiences that generate perceptions of control change with age. We use the “constant” (i.e., the power of perceived control) as a compass to guide the study of the changing parts that continually recreate that constant.

What is the third strategy?

The third strategy is to stick with the same construct and then ride it through all the peaks and valleys of its transformations—which require qualitatively different measures at different ages. In this, admittedly challenging strategy, the comparability or glue between these measures are “developmentally-friendly conceptualizations” that create a space to hold the changing manifestations of the construct. A great example can be taken from attachment research which includes the important construct of “proximity-seeking,” a species general biobehavioral strategy that brings infants in contact with their caregivers when the infants are distressed. This construct becomes developmental as soon as we start to wonder how infants can seek proximity at different developmental periods using the capacities that are available to them at those periods. So, for example, the earliest forms of “proximity seeking” are actually carried out by the caregiver in response to newborns cries, diffuse body movements, and other expressions of distress (can you detect the proximal processes happening here?). As newborns apprehend these contingencies, they can start to direct their expressions so that they become communications. We will spare you the blow-by-blow, but just keep asking the same question as new capacities develop—Now how can you seek proximity? And you will see as reaching, calling, and finally locomotion are added, and the balance shifts from the caregiver to the infant in seeking proximity. If you keep going long enough, you will end up with adolescents texting or imagining what Dad would say in this difficult situation.

How did attachment researchers blow up that developmental balloon so successfully?

They identified an "organizational construct" with an important function, and then they followed across development the ways that the actions of infants, young children, older children and adolescents can serve that function with the capacities available to them at different ages. It is a combination of thought experiment ("how do we imagine they could do that?") and empirical question ("how are you doing that?") and it can be applied to any function. We provide another example of this idea in the research on coping during childhood and adolescence over the last decade, which has come to rely on "developmentally-friendly" conceptualizations of coping-- ones that move away from notions of coping as a list of strategies people can call on to solve problems and relieve distress, and toward views that highlight the basic adaptive functions of coping in detecting and appraising threats, mobilizing and tuning action, and learning from stressful encounters (see box).

This shift to conceptualizations that focus on higher-order functions characterizes research across many domains, so-called "functional perspectives" on may interesting phenomena—such as the functions of emotion, attention, and neurological subsystems. It is easy to see how this larger functional view can unite actions that have a very different surface appearance, such as when the study of language has replaced by the study of "communication," which then incorporates pre-language verbal and non-verbal means of expression, or the study of walking is replaced by the study of "locomotion," which then incorporates creeping and crawling as well. Perhaps not as immediately obvious, these functional theories shift the focus of researchers from the structure of individuals' behaviors or actions to their *goals*—the reasons *why* agentic individuals are motivated to pursue these activities, in service of their own intentions, such as to get to Mom, to allow me to get my eyes and hands on that attractive object, to relieve my distress, to let Dad know what I want. An illustration is provided in Figure 21.5 for the development of coping (see box).

Insert Figure 20.5 about here

Developmentally-friendly families of coping
In the research on coping, the building blocks of the area are considered to be "ways of coping," which depict how people actually deal with real stressors right on the ground, and they include ways like problem-solving, escape, seeking support, or distraction. A problem that has bedeviled the area is the identification of core ways of coping. Dozens of sets of coping strategies have been proposed that include hundreds of ways of coping (Skinner, Edge, Altman, & Sherwood, 2003). This massive drift of potential strategies has made it difficult to integrate studies on coping, which utilize a wide variety of partially overlapping coping categories. Recent theoretical and empirical work has resulted in the idea of a small set (maybe a dozen) of higher-order "families" of coping that are defined by their functions in dealing with stress. For example, the family of "problem-solving" coping includes lower-order ways of bringing one's actions in line with current contingencies, like effort, instrumental action, strategizing, and so on. Or the family of "accommodation" coping includes lower order ways that bring one's preferences in line with currently available options, like focus on the positive, cognitive reappraisal, distraction, and so on. Researchers can hypothesize and discover age-graded members of these families by using developmental analyses to identify the ways that individuals can carry out these functions at different ages depending on the capacities available to them. For example, infants can "seek information" through social referencing or they can "escape" using gaze aversion. This line of research promises to create a body of developmental research on coping, that allows us to propose and study important constructs that show qualitative shifts in their manifestation (and hence in their measurement) across age.

All these strategies seem to imply that with development, some things are changing and

some are staying the same. Is that right?

Exactly right, and this is where our relational systems meta-theory can give us eyes to see what is changing and what is staying the same. In the first strategy, in which we follow the same behavior across its lifespan, the part, that is the behavior (e.g., biting), is staying the same, but the role in plays in the whole (i.e., aggression) is changing, for example, first is plays a less important part, then it is replaced by other actions, then it may disappear, and its utilization at older ages reveals that it is part of a different whole (maybe psychopathology). The second strategy, in which we trace the changing proximal processes that lead to certain kinds of appraisals, it is the whole that we are holding constant, that is the appraisals, and the parts (i.e., the proximal processes that give rise to the appraisals) that are rapidly changing, even as the whole (i.e., the appraisals) continue to enable and constrain the parts (i.e., the subsequent proximal processes).

In the third strategy, in which organizational constructs guide our search across different developmental terrain, it is the concept, that is the function, that remains the same (e.g., proximity-seeking or communication) and everything else can be changing—the actions, the means, their structure or interrelations, the appraisals that guide them. These discussions start sounding very systems-y in that we start theorizing about the differentiation of new means to serve old functions, the integration of old means to serve functions in new ways, the substitution of new means, the emergence of new structures to serve functions, new uses for old means, and so on.

Whatever the strategy, the take home message is that the "problem" of developmental equivalence can be turned into an asset when researchers use it as a signpost, telling them that – here is some qualitative development—and urging them not to turn back. The recognition that developmental researchers are all interested in these pesky multilevel systems, that include lower-level actions that serve immediate goals, proximal processes in which they are embedded, appraisals to which these interactions give rise which in turn guide subsequent proximal processes, and the structures of these episodes are all bound up in the larger functions of the system. Lines of sight.

If we can keep our finger on one of these levels (the actions, the appraisals, or the functions) to hold it "constant," we can cope with the frenetic movement at the other levels. For example, if we hold appraisals still, then they become like the duck sailing along smoothly on the surface of the water (seemingly continuous and so available to be captured with "equivalent" measures) whereas the proximal processes are busily churning up action below the surface, guided by the appraisals, but also feeding into them. If we pursue this metaphor long enough, we have to give our duck swimming lessons in that the means used to propel the appraisals change radically over time; maybe we will give our duck swim fins and then oars and then a small outboard motor. Anyway, we will need qualitatively different measures to capture them.

As you know by now, relational researchers realize that none of the parts of this complex and dynamic system are actually constant. Nevertheless, our finger holding a part still, temporarily creates a line of sight that we can use to capture one interesting view of our developing phenomena. And then we can move our finger to create another view and another. We will begin to see how the dynamic parts are creating some of the stability, for example, how children can experience the love and affection of their parents as constants only if the parents continually change the way that they interact with their child as he or she develops. Or how, for children to experience themselves as competent, they must have a series of systematically changing experiences in which they succeed, then they must succeed without help, then they must succeed at hard task without help, and then succeed at hard tasks without help when other's don't, and then succeed at hard tasks without help when other's don't using little effort.

<table>
<tr><td colspan="5">What would mechanistic and organismic researchers say about developmental measurement equivalence?</td></tr>
<tr><td>Mechanistic</td><td colspan="4">What problem? A behavior is a behavior is a behavior. Come on down from “aggression” and look at the specific behaviors, like “hitting” or “verbal theats.” We should be looking at their antecedents and consequences, the contingencies that shape and reinforce them, the discriminative stimuli that elicit them, and how they generalize across situations. If you want, you can compare how these antecedents and consequences differ or change across different ages.</td></tr>
<tr><td></td><td colspan="4"></td></tr>
<tr><td>Organismic</td><td colspan="4">What problem? We are interested in qualitative changes—they are not only the rule, they are the point. Development is inherently “non-equivalent,” so we should be looking for transformation, reorganization, or restructuring. We want to see how something turns into something else—for example, how aggression is transformed from physical to verbal, or transformed to words and negotiation.</td></tr>
<tr><td align="right">Example</td><td colspan="4">Development of emotion regulation (Kopp, 1989, Table 2)</td></tr>
<tr><td></td><td>Phases</td><td>Approx ages</td><td>Features</td><td>Cognitive requisites</td></tr>
<tr><td></td><td>Neurophysiological modulation</td><td>Birth to 2-3 mo.</td><td>Modulation of arousal, activation of organized patterns of behavior</td><td></td></tr>
<tr><td></td><td>Sensorimotor modulation</td><td>3-9 m. +</td><td>Changing behavior is response to events and stimuli in the environment</td><td></td></tr>
<tr><td></td><td>Control</td><td>12-18 m. +</td><td>Awareness of social demands of a situation & initiate, maintain, & cease physical acts, communication, etc. accordingly; compliance, self-initiated monitoring</td><td>Intentionality, goal-directed behavior, conscious awareness of action, memory of existential self</td></tr>
<tr><td></td><td>Self-control</td><td>24 m. +</td><td>As above; delay upon request; behave according to social expectations in the absence of external monitors</td><td>Representational thinking and recall memory, symbolic thinking, continuing sense of identity</td></tr>
<tr><td></td><td>Self-regulation</td><td>36 m. +</td><td>As above, flexibility of control processes that meet changing situation demands</td><td>Strategy production, conscious introspection, etc.</td></tr>
</table>

It doesn't seem like you are solving the problem of developmental measurement equivalence. Are we missing something?

You are right. We don't want to “solve” it. We want to convert the problem into theoretical and empirical growth—the creation of "developmentally-friendly" conceptualizations that make it possible to use qualitatively different measures of constructs (be they actions, appraisals, or proximal processes), and render this information useful for creating differential pathways or trajectories by contextualizing them as parts of larger wholes and functions.

Table 21.2. Goals, Problems, and Strategies for Dealing with Developmental Measurement Equivalence.

Goal	Validly measure the same constructs in people of different ages.
Problem	If you use the same measure, it may tap different constructs at different ages, but
	If you use different measures, how can you be sure that you are tapping the same construct?
Strategies	*Successive measures*. Build a bridge across the age gap between measures and directly examine the comparability of the measures during the age period when both are valid.
✓	*Focus on actions*. Select an important category of behavior and follow it over its lifespan, studying how it changes in it functions as part of different goal directed-episodes, proximal processes, and higher-order constructs.
✓	*Focus on appraisals*. Select an important kind of appraisal and identify developmental changes in the kinds of proximal processes and episodes that give rise to it and which it in turn guides.
✓	*Focus on function*. Select a higher-order organizational construct that captures an important function and identify how the actions, means, and strategies that are coordinated to serve that function change with development.

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SECTION VI. STUDY OF DEVELOPMENT: EXPLANATION

Chapter 22. Experimental Designs: Lab and Field

> The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm.
> — Bertrand Russell, *Selected Papers*

If you have decided to organize and conduct your developmental research program by connecting the dots provided by this textbook, you will, after reading the previous section, have completed the descriptive portion of your work. We congratulate you on many fronts. You have attended zealously to recruiting and maintaining samples that are representative of their age grades, going beyond standard recruiting strategies to find those participants who are typically overlooked. You have mentally interviewed your participants, settings, and times about how they got together, how long they have been involved with each other, and whom they ended up excluding. You have assessed the heck out of your participants on all manner of selection variables (but not all of your participants, so you can check whether your assessment battery has done any permanent damage). You have all manner of devices ready (e.g., Facebook pages, birthday cards, and pizza parties) to keep your participants in the study, and you stand ready to add new participants, if any old ones should slip through your fingers.

You have been through the wringer with your measurement decisions, building a "developmentally-friendly" conceptualization as a frame to help you figure out who is going to be the duck on the surface and who is going to be the changing propulsion devices (and you dedicated a whole meeting of your research team in order to discuss metaphors like ducks and icebergs and what it means to measurement to "put your finger" on something to hold it still for a minute). You have figured out which constructs are parts and which are wholes (for the time being) and you knew that you could not show your face around here without including the measurement of some proximal processes. You have wrestled with the meaning of “function” and “adaptive function” and “functional theories,” and ended up taking a brisk walk around the block to clear your head.

You have made peace with the idea that you and your team are unlikely to conduct a 70-year longitudinal study, and are convinced that there is no shame in starting with a cross-sectional study, especially if your “cohorts” are one year apart. You identified some potential time windows where interesting age/cohort differences seem to be hovering, and noted that these locations happen to coincide with some age ranges that seem to be seismically active (e.g., the 5-to-7 year shift or early adolescence) and some time points that include transitions (e.g., starting school or transitioning to middle school) as well as some (e.g., third grade and age 15) that seem to be out in the middle of nowhere. Following our instructions, you have conducted a series of short-term longitudinal studies across these time windows and have in your possession some of the most beautiful data known to developmentalists—patterns of intra-individual change that differ across your participants. You know where you are—you are at Grand Central Station—your participants have come from somewhere and are going somewhere, you get it, but you were able to track them for a little while and you can see how they are changing. If your measures allow you to, you can see them as trajectories, as growth curves, one for each participant, some of them improving, some declining, some staying the same, kind of jumbled. If your measures permit, you may also see some transformations—differentiations, integrations, or reorganizations.

You have muscled and cogitated your way through “Description” and your reward is more hard work-- now you have been promoted to “Explanation.”

What is the difference between “description” and “explanation” again?

As we mentioned in the first chapters of the book, *description* is the task of depicting, portraying, or representing patterns of development in the target phenomena, including patterns of normative age-graded changes and continuities, as well as the variety of different quantitative and qualitative pathways. (Have another look at Figure 2.1.) In contrast, *explanation* refers to an account of the *causes* that together are necessary and sufficient to produce the patterns of changes and stability that we have described: What sets of factors cause, influence, or produce these different patterns of normative and differential change or stability over time? Explanation focuses on the weighty question of "Why?". Brace yourself. We have reached the thorny problem of "causality" (Pearl, 2009).

What makes causality such a difficult issue?

It continues *ad infinitum*, like everything else that we encounter in relational meta-theory-world. Shadish, Cook, and Campbell (2002) give us words to understand the importance of this issue when they distinguish "causal description" in which researchers identify the causal factors, from "causal explanation" in which researchers specify the mechanisms or mediating processes by which causality operates (see box). Some researchers refer to these as "the active ingredients;" we think of them as "what is on the arrows" between antecedents and outcomes," the critical question of "how does that work?".

Shadish, Cook, & Campbell (2002) on Causal Description vs. Causal Explanation.
The unique strength of experimentation is in describing the consequences attributable to deliberately varying a treatment. We call this causal description. In contrast, experiments do less well in clarifying the mechanisms through which and the conditions under which that causal relationship holds-what we call causal explanation (p. 9).
For full explanation, they would then have to show how the causally efficacious parts of the treatment influence the causally affected parts of the outcome through identified mediating processes (p. 10).
This benefit of causal explanation helps elucidate its priority and prestige in all

sciences and helps explain why, once a novel and important causal relationship is discovered, the bulk of basic scientific effort turns toward explaining why and how it happens. Usually this involves decomposing the cause into its causally effective parts, decomposing the effects into its causally affected parts, and identifying the processes through which the effective causal parts influence the causally affected outcome parts (p. 10).

But the whole causality thing can't really be so hard, right?

Yes, it seems like researchers should be very good at identifying causes. In fact, when we think of humans as a species, it seems like we all are already good at this—at figuring out who is doing what to whom—or how would be have survived so long? Hey, and what about those 4-month-olds we read about in the last chapter, who fell into a deep depression when the dangling mobiles were no longer tied to their little kicking feet? They were detecting causality all right, and acting on it.

So what's the big deal?

The kind of causality that humans are *really* good at detecting is called "generative transmission." It's an "experience of control" in which we directly feel the power of our actions transmitted into the objects or people in our immediate context, and we can see the energy create effects in front our eyes. Prototypical experiences of generative transmission include the baby leaning over the tray of her highchair and dropping the spoon, calling Mom and having her turn around, the hand reaching the apple and pulling it off the branch, the crack of the bat against the baseball and the baseball soaring off in a completely new direction, touching a match to a candle wick, hurling mean words into your little brother's face and watching him crumple into tears. We are designed to detect the effects of our actions (so we can be effective in our interactions with the social and physical context).

But our actions are rarely either necessary or sufficient causes for target outcomes. They are not necessary—in that my little brother will cry when he encounters other provocations (in fact, for just about any reason, if you ask me) and when I light the candle I see only the match as a cause—but it is not sufficient, the flame needs fuel and oxygen, which I am unlikely to perceive as part of my causal experience (which is why no one ever answers the question, "What caused this forest fire?" with "Trees"). People are good at answering the question, "Can I make this happen?" and "How can I make this happen?" and "What is added to this scenario to create a change?" but we are not as equipped to figure out "What are the necessary and sufficient causes to produce this outcome?".

It turns out, perhaps surprisingly, that causality is quite the inferential feat. We need to integrate information from multiple contrasting combinations of experiences before we can come to a conclusion about causes. In the study of the development of causal reasoning, we can see the progressive complexity from "How often does X happen when I do Y?" to "Does X happen more often when I do Y compared to when I do not do Y?" and so on. The cause "ability" is so highly inferential that it has its own developmental course. Initially high ability is inferred from high performance, then high performance without help, then from high effort, then from high performance on hard tasks (in which task difficulty is in turn inferred from other's performance—difficult tasks are ones that few people do well on), then finally from high performance on difficult tasks with low effort. No wonder determining causality, when we do not directly experience the generative transmission of our causes, is quite a challenge.

Is it worse for relational meta-theorists?

Maybe a little. In relational meta-world, causal inference is messy: Things are always multiply determined, rarely is any one cause really *necessary*, there are lots of packages of sufficient causes, who work only under certain conditions and for certain people at certain times. And, worst of all, many of these effective factors turn out to be imposters, but they have already snuck into the empirical party created by the design of our study and so we have to spend our time rooting them out or we have to call the whole party off. In fact, entire branches of psychological science are dedicated to the issue of how to design your studies so that you can rule out all these alternative explanations, so you can validly make causal inferences about whether your hypothesized antecedent is actually producing your target outcome (Campbell Stanley, 1963; Shadish, Cook, & Campbell, 2002), or in the case of developmental science, your target trajectory.

So what do they have to tell us?

Well, read the classics yourself by all means, but one of the things that you will learn in all design classes is that the best design (and some will say the only design) for proving causality is the experiment, in fact, a particular kind of experiment, the randomized control trial (RCT), the so-called “gold standard.” And, in the olden days, it was assumed that experiments happened in the laboratory, so experimental designs and laboratory settings often get merged in students’ minds. So let’s take a minute to consider experiments and labs and relational meta-theories. Let’s let all our descriptive trajectories for all of our cohorts and age groups sort of bump into each other and pile up behind us as we stop to stare into the window behind the one-way mirror into our lab.

EXPERIMENTAL DESIGNS and RESEARCH SETTINGS

Of the many features of research designs, the ones relevant to experiments and laboratories refer to the “where” and “how” of collecting data. In order to answer the causal questions of interest to relational meta-theorists, we want to create designs that allow us to make valid inferences about causes and effects as they unfold in the actual contexts of daily life. As usual, we will discover the tensions in our goals, the balances we can strike among them, and the multiple strategies that can be used to create clear lines of sight.

Didn't we get rid of experiments and labs in 1977 when Bronfenbrenner basically demolished experimental child psychology?

In a way. At the very least it introduced a healthy dose of skepticism about lab settings. Instead of thinking about the lab as a place where the researcher could get more pristine information about his target phenomenon (i.e., the child and his or her behavior), the lab came to be regarded as one context with its own attributes (e.g., novelty) and set of social partners (i.e., the experimenter) that were exerting their own effects on the child. Moreover, contextualists like Bronfenbrenner argued that by removing the child from his or her familiar surroundings and interaction partners, researchers have inadvertently left much of the phenomena of interest behind.

Relational meta-theorists would likely go further. To us, contexts are not just geographic and architectural "settings" in the sense that you can pick people up and "set" them down in new places. Contexts have tentacles that reach out and wind themselves around people, and people have roots that reach down into places. They are connected, interpenetrated even, so that our most likely causal forces, our proximal processes, cannot even be constituted when we look at only one without the other. When researchers split the child from his or her context, it destroys the phenomenon itself, like removing the heart from the body in order to see how it works. You can't. Once you remove it, it doesn't work any more.

So developmentalists don't conduct research in laboratory settings any more?

Not at all. Contextualists are just very wary about the idea of the "setting" and very aware of what is lost by leaving the "scene of the crime," that is, the contexts of daily life.

Well, when *would* relational meta-theorists bring participants to the lab?

One important reason is to measure a construct that you can't capture outside of the lab. There are some phenomena of great interest that are not visible without specialized instrumentation or procedures that can only be administered in the lab setting. All manner of neurophysiological constructs can only be measured in the lab setting using complex equipment, like *f*MRI, as well as the assessment of internal states and capacities, like IQ or executive function or delay of gratification. In fact, precisely because people and their contexts are so intertwined, we sometimes bring our participants into the lab to see what they can do *without* the scaffolds or interference of social partners.

A second important reason is to get more detailed information about proximal processes themselves. In this case, researchers have the task of re-creating the relevant proximal processes under more controlled conditions. They bring *both* the target person *and* their social partners into the lab setting, help a proximal process get started, and then are in a position to collect more information they could access in the field. Many studies of relationships include lab components, in which both partners (for examples, spouses, parents and adolescents, or children and their friends) are brought in to participate jointly in (what are hopefully) interesting activities, such as to discuss marital issues, work jointly on teaching and learning tasks, play competitive games, and so on. These exchanges are often videotaped or observed closely, and in some cases, simultaneous physiological measures are collected, such as heart rate or blood pressure.

A third reason researchers might turn to lab settings is to create conditions where they can trigger and then observe interactions that are relatively rare in field settings. For example, research on learned helplessness often brings children into controlled settings where researchers can watch them work with solvable and then with unsolvable puzzles, mazes, and concept tasks, while monitoring their strategies, efforts, and actions over time. (And, of course they always end with success experiences.) Another example is the Strange Situation in which researchers trigger the attachment system in the living-room-like lab setting, by sending in a stranger and asking the caregiver to leave, and then observe the child's actions.

In all these cases, naturalistic observation may seem preferable, but because of assortativeness and the responsiveness of contexts, social processes can be impossible to tease apart. For example, mastery-oriented kids run into fewer tasks that they cannot solve than helpless-prone kids and so it is harder to catch them in failure situations, and in schools teachers do not assign impossible tasks, and so observers could go for weeks without seeing their phenomena. And, by the way, after about five years of age, kids are busy trying to hide their true reactions to negative events (a phenomenon called "masking"), which makes it harder for observers to actually detect undesired states (like anxiety or boredom).

Table 22.1. Distinguishing between settings and designs.

	Setting	
Design	*Lab*	*Field*
Experimental	Lab experiment	Field experiment
Naturalistic	Observation in lab	Field observation

These sound like access or measurement issues. Where is the causality?

Part of causality *is* a measurement issue—where you can get the best view of your potential causal processes or your potential effects, and when you get there how deeply you can see into the steps of the process you are trying to understand. So the lab, and all its lovely paraphernalia, often offers the best strategies we have for how to measure our target causes and effects.

Cool inventions: Neurophysiological vests?

Are labs good for other parts of detecting causality?

Indeed they are. They are handy locations for experiments. They cannot be beat for settings in which the researcher has more or less complete control over two key features of the design: (1) the random assignment of participants as to whether they will receive the causal treatment or not; and (2) the administration of the hypothesized causal variable.

Do contextualists care about random assignment?

Do we ever. Remember all those selection effects and assortativeness issues we talked about in previous chapters? Those are shorthand for the huge problems created by the fact that in the contexts of daily life people are not randomly assigned to causal conditions—there are particular personal characteristics that go with people who get in the way of particular causal factors, or who participate in them directly. And so, if we are going to distinguish pre-existing conditions that launched someone on a particular developmental trajectory from the causal factors that we are interested in deciphering, we have to create groups that are "the same on everything" before we start our causal show. Randomized assignment is one strategy to accomplish this, as well as its more systematic options, such as block randomization (randomly assigning different categories of people), matching, propensity score matching, and so on.

Aren't there better strategies?

Okay, here's what we would really like to do. We would really like to take our complete sample and expose them to the treatment (the potential causal factor) and see what happens to them, for however long we are interested in detecting effects. Then we would like to load them all into a time machine and take them back to a point in time *before* the treatment occurred and leave them alone, and see how they would have changed without the treatment. That's what we are always trying to approximate, a time machine: Let's see what this groups of people's development would have been like *with* this factor and then compare it to the development of the *same* people *without* that factor. Pesky time, again. So we have to try to create groups of different people who are the same on everything we can imagine (matching) as well as everything we can't (random assignment).

Why are we so excited about exact control of the causal factor?

Well, that's the cool feature of the experimental design. The researcher is like the fairy godmother who waves her magic wand and introduces the potentially new future for the treatment group. So the researcher *knows* that the treatment group got the potential causal factor, and how much of the factor, and so on (like in a drug trial—the doctor administers the drug and its dosage). And then the researcher has approximately a bazgillion control groups, who got shades of everything but the hypothesized active ingredient (and these can be so creative, the control group with nothing, with only attention, with a visit to the lab but no causal factor, with a causal factor that looks like the actual causal factor but really isn't, and so on).

Is it easier to control the administration of the causal factor in the lab?

So much easier. Once researchers get out in the field, and especially if they decide that the treatment (often as an intervention program) will be administered through intermediaries (like teachers or parents or social workers), it can be a giant headache. There is a whole area of research called "implementation research," and a focus on "implementation fidelity"—or how the heck you would know and could measure whether the participants actually made contact with the causal factor that you are studying. It's like doctors who send the treatment pills home with their patients and then hope for the best, but never get to count the pills that are left in the bottle at the end of the trial, and if patients do not improve, they can't really say whether the drug didn't work or whether the patients just didn't take their pills. Very unsatisfactory from a causal inference perspective.

So we are starting to warm up to labs, right?

Yes, we are regarding them at arm's length but with respect and appreciation. They can be our ally in measurement and they can give us a leg-up on our simulated time machine for creating groups who are the same, so we can send the different groups on their separate (and with many control groups—their varieties) of carefully calibrated and dosed causal experiences.

And what about experimental designs-- are we starting to warm up to them, too?

Yes, we respect and appreciate them, too. But both lab and experimental studies have serious limitations when it comes to the kinds of questions that contextualists and developmentalists want to answer.

What are those limitations?

Let's think about three big limitations. First, we already mentioned that labs and fields are not just settings to us. The "field" is an intrinsic and crucial part of the target we are trying to understand, and if we are going to bring our whole phenomenon into the lab, we have to know all the relevant elements of the context and effectively simulate them in the lab. For us, it is an issue of internal validity.

Second, we assume that all our causal factors, that is, our proximal processes, are embedded in contexts and shaped by them. So if we are looking at the functioning of proximal processes in the lab, we can be sure that the lab context is shaping then, which means we *can't* be sure that they will operate the same way in the contexts of daily life. So we always have to admit that any causal links we may have watched operating in the lab have to be couched as "can cause" our target and not as "does cause" our target. We have to wait and see if these same processes are operating in the actual contexts that form the natural microsystems for our participants. This is a problem of external validity.

Third, the time span over which developmentalists assume that causal effects accumulate cannot be easily simulated in the lab. The causal processes of interest to developmentalists unfold over months and years and decades, across multiple contexts, so although we can use the lab to *measure* the long-term effects of causal factors by bringing our participants back to the lab as many times as we want to, if we want to actually *look* at the causal processes having their effects over months or years, it will be difficult to achieve that in the lab setting.

Please say that these problems are not just for developmentalists.

You are right. They apply to everyone. But there is one problem with typical lab research that in general does not apply to developmentalists.

What is that?

Much of the lab research that is conducted by university researchers uses convenience samples. And who could be more convenient to university researchers than college students? So a great deal of research, for example, in social psychology or on cognition or decision making or perception or education relies on samples of college sophomores—psychology majors, no less. If researchers take their populations seriously and worry about selection effects, then this is a big problem. However, most developmentalists dodge this particular bullet—they do not imagine that the average college sophomore could be considered a reasonable facsimile for an 8-year-old or an 80-year-old or a parent with three children or a person who has experienced the Great Depression. So developmentalists who work in the lab typically import participants from their actual target populations to the laboratory setting.

Then what is the fatal flaw with experimental research?

As noted by many methodologists, the seemingly insurmountable problem with experimental designs is that it is not possible to randomly assign or manipulate the causal forces that are of biggest interest to developmentalists. No one can randomly assign their participants to a particular age group ("I have flipped a coin and you will be in the five-year-old group" "Oh no, I wanted to be 10!") or to a particular cohort or developmental history.

In fact, most of the causal factors that are of interest to us can't ethically be manipulated at all—the happy single-parent family or the unhappily married parents, the delinquent or theatre-obsessed friends, school failure or indifference, peer rejection or popularity, high stress reactivity, dangerous neighborhoods, perfect pitch, or height. Before you ask, we will just add that this same issue applies to all areas of psychology. Many applied problems cannot be manipulated—divorce, PTSD, dangerous job conditions, psychopathology, work-family conflict, serious medical diagnosis, intimate partner violence, and so on. So there are limits to how much experimental designs can help applied researchers study the conditions and causes that most interest us.

Rutter, Pickles, Murray, & Eaves (2001) on the interplay of risk and protective factors in designs for testing complex hypotheses about the causal effects of environmental risk:

It is evident from numerous reviews that causal processes usually involve a complex interplay among risk and protective mechanisms, with indirect chain reactions, bidirectional influences, gene-environment interactions, and synergism between chronic and acute risk factors the rule rather than the exception…[T]he interplay concept means that there are certain further design implications, of which we emphasize four as especially important.

First, putative risk variables must we conceptualized and measured in sufficiently broad terms to encompass the risks that may rely on a combination of factors. The extent to which that is the case, plus the delineation of which elements carry the main risk, is better done by subtraction techniques than by the addition of micorelements, each of which on its own might carry no significant risk.

Second, Designs, samples, and analytic techniques must be chosen on the basis that they can test for the possibility of both gene- environment interactions and person-environment interactions based on the effects on the person of prior experiences or of maturational features or gender…

Third, appropriate designs must be used to examine the ways in which different forms of gene-environment interactions and person- environment correlations play a part in the causal processes associated with environmental risk mediation…

Fourth, attention must be paid to the phenomenon of resilience, meaning a degree of resistance to psychosocial adversities, operationally defined as relatively good outcomes despite experiencing major environmental risks… The reality of the phenomenon has been well demonstrated, but the protective factors have been little explored as yet despite their potential implications for prevention and intervention" (Rutter et al, 2001, p. 297-298.

Wait! What about optimization studies?

Yes, indeed. Those are rightly considered *field experiments*, and they can even be conducted as randomized control trials (the gold standard!). And it is correct that we can ethically study any old target we please as long as we are trying to *optimize* development—to remediate unfavorable developmental trajectories, to maintain resilient ones, and in general to prevent adverse and promote healthy development. So we can learn a great deal and do a great deal of good by trying to create and study interventions designed to optimize development.

At the same time, such optimization studies have two important limitations for developmentalists. First, one thing that such studies cannot tell us is what caused these unhealthy pathways of development in the first place, any more than studying aspirin can tell us what causes headaches or how to prevent them. So additional work will always be needed to fill in the causal puzzle of the factors that contribute to and maintain non-optimal development or lead to psychopathology. It seems that such studies would be essential to prevention efforts.

Second, we have a bone to pick with randomized control trials (RCT) as the ideal methodology for studying causal relationships. As you may know, this methodology was borrowed from clinical trials of medical treatments, and it is cool in many ways. It has time in its design, which is always welcome news to developmentalists. RCTs compare (at least) two groups who should be equivalent to each other (based on random assignment), one of which has received the drug and the other probably a placebo, so that researchers can examine the effects of the drug over and above the effects of knowing that one is being treated. Then after a sufficient amount of time for the drug to do its work, changes in the treatment and control group can be compared over however many time points the design includes.

This sounds very time-machine-esque. What is the problem?

The problem is that, at the end of the day, the only thing that this design can tell you is “yes” or “no,” that is, the only information it yields is whether the two groups are different. You can add many features, for example, many indicators of disease or health, you can measure dosage and its effects, over several time periods, and so on. However, developmentalists would say that, after all this work, the only thing we have in our hands is a causal *description* but not the thing that we most want, that is, a causal *explanation*. For the drug companies, everything they want to know about causal explanations is contained in the drug itself; to the extent that they care about *how* the drug works, its mechanisms of effects have already been studied (and of course, we take many drugs that are effective, but whose mechanisms of effects are unknown).

Limitations of Randomized Control Trails for Studying Causal Processes

But as developmentalists, our interventions contain hundreds of potential active ingredients. And so we want to poke our heads in under the hood and look all around, watching the cogs engage and the wheels turn. (Whoops! Wrong metaphor for relational meta-theorists!) We want to watch the tennis game or the dance, and see who is hitting the ball the hardest and how the players adapt to each other’s style over time and who is playing the music. In other words, we are on the trail of causal explanation and so we can’t really be satisfied with “yes” or “no.” We will forever be asking “why?” or “why not?” and especially “how did that work?”. So we will always be supplementing experimental and lab studies, and even RCT studies, with studies using designs that can provide us with more complex process-oriented accounts of the multiple causes of differential developmental trajectories and transformations.

Table 22.1. Advantages and disadvantages of different settings and designs.		
Laboratory Experiment	*Advantages*	*Control and precision* Unambiguous causal inference.
		Precise control of hypothesized causal factor.
		Precise measure of hypothesized effect.
	Disadvantages	*Artificiality*
		May change phenomena.
		Limited to “can cause” versus “does cause” causal conclusions.
		May or may not work in actual contexts.
		Most potential causal factors cannot be manipulated.
Naturalistic Laboratory Study	*Advantages*	*Precision* Measure constructs that are “below the surface” (e.g., neurophysiology, capacities, knowledge).
		Observe proximal processes more closely.
		Observe proximal processes without typical scaffolding or interference of social partners.
		Trigger phenomenon that are rare or masked in the field.
	Disadvantages	*Distortion*
		Splitting of person from context may have destroyed causal factors.
		Hard to locate “active ingredient” of causal packages.
		Artificiality and novelty of context, instrument, or trigger distorts causal phenomena.
Field Experiment	*Advantages*	*Control and Actual context* Potential for causal inference.
		Potential to see how causes operate *in situ.*
		Potential to see effects *in situ.*
	Disadvantages	*Messiness*
		Hard to precisely control the implementation of the potential causal factor.
		Especially if delivery agents are also naturalistic (i.e., parents, teachers, social workers)
		Limited to “can cause” versus “does cause” causal conclusions.
		Most potential causal factors cannot be manipulated.
		Limited account of causal process.
Naturalistic Field Study	*Advantages*	*Authenticity* Whole phenomena is intact.
		Can discover causes that were not expected.

	Disadvantages	*Murkiness*
		Hard to specify “active ingredient” of causal packages.
		Impossible to control all selection effects.
		Limited to “may cause” versus “does cause” causal conclusions.

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Chapter 23. Naturalistic Designs and Causal Inferences

Time is what keeps everything from happening at once.
— Ray Cummings, *The Girl in the Golden Atom*

So we had a good visit with laboratory settings and experimental designs, and although we will meet up with them again at the end of this section (when we arrive at "converging operations"), for now let's just focus on their limitations in providing detailed process-oriented causal accounts involving conditions we can't randomly assign and potential causal factors we can't manipulate. In this chapter, we consider the potential utility of field settings and alternative naturalistic designs. What we appreciate about naturalistic field studies is obvious already from the limitations we encountered with lab and experimental designs: In naturalistic studies we can examine the effects of potential causes that we can't manipulate directly (e.g., maltreatment, ability tracking, peer rejection). Moreover, we can watch these processes operate in their actual multi-level contexts, and we can follow them for months and years.

But after we sow our wild oats, freely roaming this interesting space and documenting some of the fascinating pathways our participants are taking, we will want to turn from description to explanation. And as soon as we do, we will start to feel homesick for our familiar labs and experiments. In the field, the causes we want to analyze come in annoying piled up clumps of conditions, whereas in our experiments, we had the capacity to create treatment and control groups that we exposed to carefully distinguished and calibrated causal strands. And in the field, these causal clumps land on particular people, sometimes in a "rich get richer" or other complex pattern, whereas in our experiments, they were randomly assigned to groups of people who are the same on everything else. So in naturalistic studies, any causal exposure is always confounded with participants' pre-existing differences.

One broad way to characterize the difference between lab experiments and naturalistic studies in the field, is that in lab experiments researchers have front row seats and very clear lines of sight on a phenomenon, but we can never be positive if it is exactly the one that we are interested in observing; whereas in naturalistic field studies, researchers can be certain that the actual phenomenon we want to understand is happening right in front of us, but it is all happening so fast and in so many directions (and maybe we are in the balcony and seated behind a pole) that we can never be sure of exactly what we are seeing. In other words, to get causal information out of naturalistic field studies takes quite a bit of work—conceptual, inferential, and empirical.

Wait a minute. Aren't experiments the only way to show causality?

Yes, experiments can provide important evidence of causal processes. But let's consider the kinds of causal evidence that can be provided by naturalistic studies.

Wait another minute. Are we talking about correlational studies? Because we know for a fact that "correlation does not prove causation."

Right, it is correct that correlation by itself does not *prove* causation. But let's take a minute to understand *why* this is true, and then to see whether there are some things that researchers can do to improve the designs of their studies so that naturalistic studies, using more than correlations, can provide evidence about causes. Because, remember—correlation may not *prove* causation, but causal processes do *generate* correlations- causes create effects and so effects covary with their causes. In fact, this covariation is one of the defining condition of causality (see box). As a result, correlations (or covariation or contingencies, however you want to label them) may be the smoke that leads us to our causal fires. The problem is that many things *besides* causation lead to correlations, and so we have to work hard to decipher the causal evidence among all the other kinds of covariation information we are examining.

> **John Stuart Mill (1843) on causality.**
> To establish causality, three basic conditions must be met:
> 1. The presumed effect(s) must covary with their presumed cause(s);
> 2. The presumed cause(s) must precede their effects in time; and
> 3. All other plausible alternative explanations for the effect must be excluded.

Okay, can you break down the reasons that correlations do not prove causation?

Yes, let's start with a consideration of a typical bivariate concurrent correlation between two variables, and let's pick variables that tap constructs we think could be causally connected, say, teacher involvement and student engagement (see Figure 23.1). Let's say that in this research we get a robust correlation between good measures of both variables. Why can't we conclude that teacher involvement *influences* student engagement? There are two main reasons. First, as also shown in Figure 23.1, the connection between these two variables could be due to a *reciprocal* causal effect, in which student engagement influences teacher involvement. This direction of effects is conceptually plausible, since more engaged students may attract more positive teacher attention and interaction whereas students who are more disaffected may lead teachers to withdraw from interactions or treat students more harshly. Of course, the correlation could be due to *both* feedforward (i.e., teachers' influences on students) *and* feedback (i.e., students' influences on teachers) effects.

Insert Figure 23.1 about here

The second possibility is that there is no causal effect (forward or backward) between these two variables because they are both actually produced by another cause all together (the ominously named “third variable”); because they are both effects from the same cause, they covary, but the covariation is not causal, so it is called *spurious*. In our example, also shown in Figure 23.1, we selected students’ gender as our third variable because gender it is a plausible cause of both variables—girls are more engaged and teachers show more involvement with them whereas boys are less engaged and teachers show less warmth toward them. In this scenario, as in all other scenarios involving concurrent bivariate correlations, there are a very large number of third variables (alternative causes) that could be in play—it could be achievement (engaged students perform better in school and teachers attend more to high performing students) or social class or student sense of relatedness—as well as a large number of third variables that we can’t immediately imagine.

So does this example tell us something about the problems we face in trying to get causal information out of naturalistic studies?

Yes. In trying to extract causal information from a situation in which we just observe what is going on (i.e., a naturalistic design), we have two general problems, as well as a set of special issues that we have created for our own selves by choosing to belong to the relational-meta-theory-club. The two general ones are: (1) causes naturally happen to people who were different *before* the causes ever landed on them, so we have to distinguish the *pre-existing* differences that may have attracted the causes to specific people from the effects of the causal experiences themselves; and (2) our potential causes naturally come in clumps and so we need to peel them apart in order to distinguish the active causal ingredients in these tangles.

What is the specific problem that researchers working within relational meta-theories have created?

We assume that there are many different causal bundles that are sufficient to produce the same developmental pathway, and we assume that all of them are biopsychosociocultural packages. If we lived in a world where we were hunting for a single necessary and sufficient cause (like the *tubercle bacillus* as a cause of tuberculosis), our job would be easier because those kinds of causes create a recognizable signature of covariation (in which the outcome *never* occurs when the cause is absent, and *always* occurs if the cause is present). Before we get to feeling too sorry for ourselves, however, we should note that almost no one in the social sciences, or even in epidemiology or medicine, believes that important outcomes are caused by single necessary and sufficient causes (see box). Even exposure to our *tubercle bacillus* won't cause TB if there is sufficient host resistance.

As pointed out by Rutter (2007), “With very few exceptions, there is no such thing as a single necessary and sufficient cause. It is not just that multifactorial traits or disorders have multiple causal influences, but also that several different causal pathways may all lead to the same endpoint” (p. 378). So we are looking for a “constellation of components acting in concert” (p. 378) or actually several constellations since there are always several different pathways. That means that we will need to sort out the possible causal factors into effective (or sufficient) bundles (what Judea Pearl, 2009, calls “causal beams”), including the identification of factors that can’t be in the bundles or else they will preempt or nullify the impact of the causal beam.

“Necessary and Sufficient” or “Insufficient but Necessary Components of Unnecessary but Sufficient Causes”?

Despite the fact that most people would start out by defining a cause as something that is both *necessary* and *sufficient* to produce its effects, it turns out that the kinds of causes studied by social scientists almost never satisfy those claims (Mackie,1965).

Mackie examines this idea through the illustration of a house fire that investigators conclude was caused by an electrical short-circuit, even though the short-circuit was not enough by itself to start the fire (i.e., it was not sufficient) and the fire could have started in a variety of other ways (i.e., it was not necessary).

“At least part of the answer is that there is a set of conditions (of which some are positive and some are negative), including the presence of inflammable material, the absence of a suitably placed sprinkler, and no doubt quite a number of others, which combined with the short-circuit constituted a complex condition that was sufficient for the house's catching fire-- sufficient, but not necessary, for the fire could have started in other ways. Also, of this complex condition, the short-circuit was an indispensable part: the other parts of this condition, conjoined with one another in the absence of the short-circuit, would not have produced the fire. The short-circuit which is said to have caused the fire is thus an indispensable part of a complex sufficient (but not necessary) condition of the fire. In this case, then, the so-called cause is, and is known to be, an *insufficient* but *necessary* part of a condition which is itself *unnecessary* but *sufficient* for the result. The experts are saying, in effect, that the short-circuit is a condition of this sort, that it occurred, that the other conditions which conjoined with it form a sufficient condition were also present, and that no other sufficient condition of the house's catching fire was present on this occasion. I suggest that when we speak of the cause of some particular event, it is often a condition of this sort that we have in mind. In view of the importance of conditions of this sort in our knowledge of and talk about causation, it will be convenient to have a short name for them: let us call such a condition (from the initial letters of the words italicized above), an INUS condition" (Mackie, 1965, p. 245).

We should also keep in mind that, as explained by Rutter, "almost all causal pathways involve several different phases. For example, the pathway to the psychological or psychopathological end point does not begin with a causal risk factor, it must be preceded by the pathway leading to exposure to the risk factor" (2007, p. 378). As a result, the causes that lead to one step may not be the same ones that lead to another. Moreover, the causes that lead to even the same step may also be different if they happen during different developmental periods. For example, the most common way for a 17-year-old girl to get access to beer may be through association with older boys, but the most common way for a 10-year-old girl to get access to beer may be through stealing the beer from her parents.

And finally, remember that lovely metaphor of the "conversation" or "dance," which we liked so well as relational meta-theorists? Well, that metaphor implies that most of the causal effects we find are likely to be reciprocal-- meaning for example, in our illustration in Figure 23.1, that we should expect that, not only does teacher involvement influence student engagement, but student engagement is also likely to reciprocally influence teacher involvement. That does not mean, of course, that we are supposed to manufacture reciprocal causation, but it does mean that when we look for it, we have to look for it in a way that can distinguish between these two directions of effects.

Causality and Causal Beams

In his fascinating book on causality, Judea Pearl (2009) distinguishes several shades of causality which are important to consider:

1. ***Production***: capacity of a cause to bring about the effect in situations where both are absent. Requires us to step outside the world momentarily and imagine a new world where the particular cause and effect are absent. We apply the cause and see if the effect sets in.
2. ***Dependence***: an aspect of causation that appeals to the necessity of a cause in maintaining certain effects of in the face of certain conditions that would otherwise negate these effects.
3. ***Sustenance***: enriches the notion of dependence with features of production while remaining in a world where both cause and effect are true. The cause alone would be sufficient for maintaining the effect no matter what the other circumstances. The cause takes responsibility for sustaining the effect under such adverse conditions.
4. ***Causal beam:*** Set of sustaining parent variables that are effective under each set of conditions.
5. ***Natural beam:*** Sustaining set of parent variables that are effective when we freeze all the variables outside the sustaining set at their actual values.
6. ***Actual cause:*** Exists as a natural beam.
7. ***Contributing cause:*** Causal beam but no natural beam. (p. 316-319)

So how do we deal with these issues?

Let's take them one at a time, starting with the issue of "pre-existing conditions" or the issue that people may have been different even before they encountered the potential causal factor. Let's just take an obvious example. We discover that people who go to hospitals are much more likely to die than people who stay home, and so we wonder whether spending time in hospitals can be fatal. Before we get carried away, of course, someone will immediately point out that the reason that people *go* to hospitals is that they are very sick or injured, so hospitalized people are very different from non-hospitalized people before they ever even *arrive* at the hospital, and it is this pre-existing condition that is more likely to cause death than the hospital stay—both the hospital visit *and* death are likely to be the effects of pre-existing illness or accident.

In fact, that is one of the mains reason we are grateful to experimental methods-- because random assignment helps us with this problem. As we mentioned previously, the ideal test of causality requires a time machine, or a "reality bifurcation device" in which we could split reality in two and send the exact same participants on two different trains simultaneously, one in which they encounter the potential causal factor and one in which they do not. As explained by Rutter (2007), "All causal reasoning requires an implicit comparison of what actually happened when an individual experienced the supposed causal influence with what would have happened if simultaneously they had not had that experience. Even in a controlled experiment, that observation can never be made" (p. 378). And, because we can't do this, we are always stuck with the fact that we have to send *different* groups of participants on those two trains, and that's why we appreciate random assignment, because it means that our groups are as similar as we can possibly make them before they go, and we can even estimate (and, if needed, adjust for) that similarity by comparing treatment and control groups on their pretest measures before they board their trains (i.e., before they are exposed to the potential causal factor).

But in naturalistic designs, we only get to *watch* our participants take their different trips, and since we know that different people prefer different vacations, we are forever fretting about whether they were *already* different to begin with before they even encountered the cause (or did not encounter the cause). Because if they *were* different (and we have every reason to believe that they would be), it could be that it is those *pre-existing* differences that are creating the differences we detect between the two groups that took the different trains and not the effects of the different trains (the cause) at all.

Any third variable could represent a selection effect, that is, the reason that the person took that particular train, and so provide an alternative possible explanation for the observed covariation between the potential cause and the outcome (besides a causal connection between the potential cause and outcome). For example, if we are interested in determining whether American students who spend their junior year abroad in England versus in Zimbabwe come back with a broader worldview, we can look at differences in their worldviews when they return. Say that we find one: the students who stayed in Zimbabwe have broader worldviews than the students who spent time in England. It is plausible that their different experiences may have produced the differences in their worldviews. But it is just as likely that students with a broader worldview would be more likely to *choose* Zimbabwe over England, and it could be those pre-existing differences selected them into the different experiences. So the students were already different in their worldviews before they even embarked on their different experiences, and it is these pre-existing differences that we detect upon their return, and not any causal effects of their different experiences while they were away.

Well, why not just look at them before and after they went, and see how they *changed*?

Yes! You have stumbled across one of our secret weapons in the fight to document causal processes, and that is *time*. If we include time in the design of our naturalistic studies, we have several advantages.

ADDING TIME TO THE DESIGN OF NATURALISTIC STUDIES

What do you mean by "adding time" to a design?

Remember the data cube proposed by Cattell (pictured in Figure 17.3)? When we say we are "adding time" to a design, we mean that we are adding "occasions" or "times of measurement" or "repeated measures" to a design.

Like in a longitudinal study?

Yes, that is one excellent way to add time, but we are referring to all kinds of studies that add a second, third, or fourth measurement wave, whether or not those waves are far enough apart to satisfy the conventional understanding of "longitudinal" (which typically implies that enough time has passed for some kind of development to have occurred). Maybe the most general description is "time series" because the design includes a series of different times of measurement.

What are the advantages of adding time?

Let's say that we add just one more time of measurement, so we have two waves in our study. The first advantage is that now we have a way to check the first condition of causality, namely, that causes precede their effects. So we can check out a time-ordered correlation. Continuing with our example from Figure 23.1, with time in the design, we can look at whether the potential cause at Time 1 predicts the potential outcome at Time 2. This is depicted in Figure 23.2. So we are excited to be able to use the word "predict" correctly to describe our correlation. However, this is still just a zero-order bivariate correlation, so it does not allow a causal inference—it still has all the problems with so-called "third variables," the term we use to stand in for all the alternative causal explanations that could underlie the connections between our predictor and its possible consequence.

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Insert Figure 23.2 about here

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But we can use our two time points to start looking for how people change from Time 1 to Time 2 in our consequence and to see whether those changes can be predicted from where each person was on the potential cause at Time 1. This is also pictured in Figure 23.2, and has been referred to as a "launch" model because it tries to examine whether an individuals' initial levels on an antecedent can predict the individuals' (mini)-trajectory on the target consequence (see Figure 23.3, from Skinner, Zimmer-Gembeck, & Connell, 1998). The term "launch" is used because such a model assumes that the initial levels of the potential causal variable may act like a slingshot or catapult or rocket launcher to create the direction and angle of change in the object that is hurled, that is, the target outcome (in our analogies, the stone, or ball, or rocket).

Insert Figure 23.3 about here

So what do we like about this kind of "launch" design?

Well, this design is bringing us a little closer to our time machine. We get to look at developmental trajectories as our outcomes (and if we add more time points, they will look more like trajectories), we are looking directly at individual differences in trajectories, and we are looking at predictors of individual differences in those trajectories. So, in our example, we can ask, "Does teacher involvement at the beginning of the school year predict changes in students' engagement from the beginning to the end of the school year?". And if the empirical answer is "yes" (i.e., the antecedent is a significant predictor of change from Time 1 to Time 2), we can say things like "Students whose teachers were warmer and more involved with them at the beginning of the school year, also showed increases in their engagement over the school year; whereas students whose teachers were less involved with them at the beginning of the school year, showed corresponding declines in their engagement as the year progressed." This is a descriptive statement, but is is consistent with a causal hypothesis.

Any other advantages?

Yes. We can also, using the same design, look at the "reciprocal" predictions, in that we can take our antecedent variable and examine how *it* changes from Time 1 to Time 2, and see whether the variable we had been thinking of as a consequence (which we now consider as a possible antecedent) predicts these changes. This sounds more confusing than it is—see Figure 23.3. In our example, we would be asking "Does students' engagement at the beginning of the year predict changes in how involved their teachers are with them over the year?" And, if the empirical answer is "yes," we can say things like "Students who were more engaged in fall experienced increasing involvement from their teachers as the year progressed, whereas students who started the school year lower in engagement experienced declines in their teachers' involvement from fall to spring." Again, descriptive, but causally interesting.

One of the most important things about a design with two points of measurement (remember, we just added *one* more point) is that it allows researchers to begin to pull apart the different directions of effects. A concurrent correlation contains information about both direction of effects, which cannot logically be untangled, but these two analyses that we just ran—the first looks at the feedforward prediction of teacher involvement on change sin subsequent student engagement, whereas the second looks at the feedback prediction of student engagement on changes in subsequent teacher involvement. So the answers to the questions posed by these two sets of analyses could be different—we could get two "yeses" or two "noes" of one of each. And if we get two yesses, we have the possibility of a feedback loop, which feels like we are getting some hints about potential dynamics in the system.

What about all those pesky third variables, those alternative explanations?

Well, we have good news and bad news about them.

What is the good news?

The good news is that we have reduced them some. If you start thinking about the third variables in the concurrent correlation in our illustration, that is, all the factors that are positively correlated with both teacher involvement and student engagement, an enormous number come to mind (e.g., achievement, SES, supportive parents, IQ, a sense of relatedness, and so on), and here is the kicker, these are only the ones we can imagine, there are also *unknown* confounders. However, when we include in our design and analyses intra-individual change over time, we are using people as their own controls. This means that *out* of our potential consequence at Time 2, we are taking the consequence at Time 1, which has in it by definition everything (known and unknown) that led up to the consequence at Time 1 (e.g., achievement, SES, supportive parents, IQ, a sense of relatedness, and so on) as well as all the *unknowns* that created or predicted the consequence at Time 1.

So, for example, if we think that achievement is a possible alternative causal explanation for the zero-order correlation between teacher involvement at Time 1 and student engagement at Time 2 (meaning that high performing students are more engaged and teachers pay more attention to them), when we control for student engagement Time 1, we take out all of the achievement that was responsible for engagement up to that point, so we have controlled for that as a potential confounder. By controlling for the same outcome at an earlier point in time, we have scraped off all the known *and unknown* predictors of engagement up until Time 1 that could be a potential confounder, or a plausible pre-existing difference, or an alternative causal chain. (We still have all the measurement problems as before—about practice, reactivity, and developmental equivalence, of course, but the list of possible third variables is considerably shorter.)

So then what is the bad news?

The bad news is that the nortorious third variables are not completely eliminated. Since we are still kind of looking at a correlation—the correlation between teacher involvement at Time 1 and *changes* in student engagement from Time 1 to Time 2, we are still on the hunt for possible alternative causes of both. Remember, before we were looking for things that were correlated with both teacher involvement and student engagement, but now, with this design, we can narrow down our candidates for third variables to those that are correlated with both teacher involvement and *changes* in student engagement (see Figure 23.4). An excellent example of the incorporation of such variables in research designs that examine change over time can be found in the study of effects of children's peer groups on their engagement (see box).

Insert Figure 23.4 about here

Peer groups and individual development: Selection or group influences?

The study of the effects of children's peer groups on their development presents researchers with a series of knotty problems. This area starts with a very well-known state of affairs, called *homophily*, which means that "birds of a feather flock together." In other words, kids hang out with other kids who are like them in lots of ways. So we see a high correlation between a child's characteristics and those of the peers in his or her group. But what does this mean? Do kids *select* other kids who are like themselves to hang out with? Or do kids *become* more similar to each other over time?

If kids are socializing each other, then we have an intervention lever. For example, if kids are smoking and hanging out with other kids who are smoking, we just have to pry them away from these "bad influences" and then they will quit smoking. However--if these are primarily selection effects, then we can pry them away from their smoking friends, but as soon as our backs are turned, they will go out and find new friends who smoke. Because parents and teachers often have the impression that "good" kids go "bad" when they hang out with "bad" peers, the research area was mired in the idea that homophiliy was evidence for peer influences for a long time.

By now, however, you can see that homophiliy could be due to *either* selection *or* socialization or *both*. One strategy for teasing these effects apart is the one we have been discussing (for other strategies that also use within-individual change, see Rutter, 2007). Once we have good measures of children on some important characteristic (and let's take student engagement again) and of their peer groups on the same characteristic, we can start with our concurrent bivariate correlation—and land on homophily again, in that engaged students tend to hand out with other engaged students and disaffected students with other disaffected students. If we stop here, we are stuck, but if we add measures of both individual and peers at a second time, we can look at the extent to which peer group engagement at Time 1 predicts changes in individual engagement form Time 1 to Time 2. If we keep the correlation between individuals and their groups at Time 1 in our model, we are essentially controlling for initial similarity or for selection effects.

Now we need to think through the third variables that might be correlated with both peer groups at Time 1 and with individual *change* in engagement. What about achievement again? Smart kids may hang out with more engaged peers (who are also presumably smart) and they may also become increasingly engaged over time. What about teacher support? Teachers may provide more support to students who hand out with more engaged peers and so promote the student's individual engagement; or teachers may be unsupportive to students who hang out with disaffected peers and so undermine their own engagement. We can check whether these variables are correlated with both peer group engagement at Time 1 and changes in individual engagement. If they are, we can add them to our models as control variables.

What should be thinking about in adding time to our study design?

So many things. But let's start with some basic questions that we almost never know the answer to—What are the right windows and the right time gaps between measurement points to capture the action the causal process and its possible cyclicity (both feedforward and feedback)? If we are thinking about teacher involvement and student engagement, it seems like the beginning of a new school year would be a good moment for them to be calibrating to each other, but how long would that take—a week, a month, six weeks? Who knows? One rule of thumb is to use more measurement points than you think you will need, so you can look over different time gaps for your possible process.

USE OF TIME SERIES DESIGNS FOR CAUSAL INFERENCE

What do you mean more? Weren't we excited to be adding just one more time of measurement?

Well, two is qualitatively different from one, so that's good. But more really is merrier. Additional times of measurement allow researchers to look at these predictors of change across additional time gaps (from a predictor at Time 2 to changes form Time 2 to Time 3), to use growth curves to look at trajectories of mean level change (from a predictor at Time 1 to a trajectory from Time 1 to Time n),

Can we even use these designs to look at how changes in our antecedents predict changes in our outcomes?

Yes, these have been called "Change-to-change" models (Skinner et al., 1998), but you should stop using the word "predict" to describe these connections. They are actually like correlations between growth curves, and then we land back in our concurrent correlations puddle. So it would probably be better to look at the connections between *time-lagged* growth curves, for example, the connection between a growth curve from Time 1 to Time n to predict an outcome from Time 2 to Time n+1 (see Figure 23.5). Then you could also look at reciprocal change-to-change effects by switching around your antecedents and consequences. Just like with the designs that incorporate only two measurement points, these two analyses can provide different estimates of the connections between the different portions of the growth curves.

Insert Figure 23.5 about here

What is happening with all our third variables in these analyses?

We can control for them, but it may be more interesting to look directly at their effects, by organizing our data into a "niche" study, where we look at the connections we are interested in for subgroups of children—for boys or girls separately or for students high or low in achievement. If the connection between teacher involvement and student engagement is due to gender, it will disappear when we look at boys and girls separately. Looking directly at the developmental patterns of different groups is more consistent with a relational meta-theory which holds that development is differentially shaped by the characteristics of the people and their contexts (see box).

Perceived control, teacher support, engagement, and achievement.

An example of a "niche" design using growth curves can be seen in a study that examined the connections between teacher context (involvement and structure), students' perceived control, their engagement, and achievement from the beginning of grade 3 to the end of grade 7 (Skinner et al., 1998). As you would expect, these variables were positively intercorrelated with each other at each time point and also predicted changes in each other over time.

To get a feeling for how the processes were working over time, some "niches" were created by pulling apart the variables that usually go together. This was accomplished by selecting groups of students that were high versus low in perceived control at the beginning of third grade and who were in the top versus bottom quartiles of their slopes of teacher context. Then their growth curves in perceived control are plotted over time (see Figure 23.7).

As you can see, at the beginning of third grade, the students whose teachers were supportive differed very little from students whose teachers were unsupportive. However, as students moved from grade to grade, the cumulative effect of teacher support becomes visible. Two trajectories told the typical story of positive correlations between teacher support and perceived control: Students who started high on perceived control and continuously received high levels of teacher support (which is the typical case with a positive correlation between these two variables) maintained high and steady levels of perceived control. In a similar fashion, the students who started off low in perceived control and received little teacher support over the years showed deteriorating levels of perceived control over the years. However, in these typical pathways, because student perceived control and teacher support go together, we can't really see the effects of one versus the other.

That's where the beauty of the unusual case or the off-diagonals comes in. We can also describe the trajectories of perceived control for combinations of conditions that are not very common: Students with high control who do not receive teacher support and students with low control who do. In the figure, we can see the "main effects" of perceived control in that students who started low tended to stay low and students who started high tended to stay high, at least until the end of fourth grade. But starting in fifth grade, the trajectories took a different direction, with students who experienced their teachers as unsupportive are losing ground in their perceived control whereas students who experienced their teachers as supportive started gaining ground, until by the end of seventh grade the trajectories had crossed over each other.

Do we ever get to causal inferences in these time series designs?

It is understandable that you might think that we can never get from here to there, but there is one kind of time series design that gets us within shouting distance. It is called the "interrupted time series" or "regression discontinuity" design. You can almost guess what it looks like form the name. Researchers have many repeated measures of the potential consequence, enough that we begin to be confident about being able to predict the level and directionality of the phenomenon. Then this series is "interrupted" by the occurrence of the potential causal variable. We have our time machine, in that we think, from the past history of the consequence, that we can estimate where the consequence was headed *without* the interruption. And then we see whether the consequence shows an abrupt and unexpected shift after the interruption. In a regression discontinuity design, researchers test whether the slope of the consequence was changed at the point of the interruption, so that the slope before the interruption is significantly different from that after. We included a few examples of these kinds of designs in Figure 23.8 and 23.9.

Insert Figures 23.8 and 23.9 about here

Such a design is considered to allow causal inference in intervention studies, where the intervention is the interruption. It is not used as often in naturalistic studies because it is harder to locate naturally-occurring "interruptions" that are both sufficiently perturbing and regular enough to allow researchers to collect their time series measures *before* the interruption takes place. One area in which naturally-occurring "interruptions" have been well-studied are school transitions, for example, the transition to middle school and the transition to high school. Students' academic, motivational, and social functioning show sharp declines across these transitions, although it has taken several decades to figure out what it is about these transitions that cause declines in functioning (see box). Researchers have long been on the hunt for "natural experiments" in which unselected populations are subject to abrupt shifts in environmental factors (Campbell, 1969; Rutter, 2007).

Transition to Middle School: Stage-Environment Fit

What is responsible for the dramatic losses observed in students' motivation, engagement, academic performance, and self-confidence across the transition to middle school?

Researchers were interested in the factors that could explain these regular and significant declines in functioning. One group of researchers begin by examining the characteristics of schools that shifted from the organization of elementary schools to middle schools, things like larger schools, a variety of subject-specific teachers for shorter periods of time. Because school transitions take place across specific age ranges, a competing explanation was neurophysiological development—the idea that declines were the result of the tolls of puberty and adolescence, which would have taken place with or without a school transition.

Very clever researchers used designs that allowed studies to separate the age changes of adolescence from the environmental transition across middle school. Researchers compared students from school districts that were organized in three different ways: (1) K-8 schools in which buildings included kindergarten through eighth grade; (2) elementary and middle schools in which districts reshuffled students from all elementary schools (K-5) into larger middle schools (6-8); and (3) elementary and junior high schools in which districts reshuffled students from all elementary schools (K-6) into larger junior high schools (7-8).

The results of these kinds of studies were definitive (Eccles & Midgley, 1989). Adolescence was not the primary risk factor for declines in functioning—precipitous drops were apparent at whatever age the school transition took place (6^{th} grade for districts with middle schools or 7^{th} grade for those with junior high schools) and, most important, such drops were not seen (or were greatly reduced) across the same ages in districts that did not require school transitions (K-8 schools).

The best account of these issues seems to be provided by stage-environment fit (Eccles et al., 1993) in which the typical changes over the transition to middle or junior high school include features (e.g., more distant and less caring teacher-student relationships, more competitive and performance-oriented learning goals, more impersonal discipline, fewer choices about academic work) that are a very bad match for the changing needs of adolescents (for stronger adult relationships outside the family, more intrinsic motivation, and greater autonomy in learning).

Is there an elegant way to get information about *both* dynamics *and* development into one model?

Good question. That is exactly what methods that model latent change scores (LCS) are designed to do (Ferrar & McArdle, 2010; McArdle, 2009; McArdle & Grim, 2012). These methods allow researchers to look at several things of great concern to developmentalists at the same time. Imagine a standard developmental data set that has measures of possible antecedents and outcomes at many time points. If you didn't know any better, you would look at different parts of your causal questions using all different kinds of analyses. For example, you would ask whether antecedents at one time point could predict changes in a possible outcome from that time point to the next, and then whether it could predict changes in a growth curve (i.e., launch model). Then you would go back and see if *changes* in the antecedent could predict changes in the outcome (change to change model) and you might lag the growth curves. Then, to examine reciprocal effects, you would go back and start at the beginning again, with your antecedents and consequences reversed. Whew!

It was as if you could only “spend” the time that was in your design in one way at a time: It could *either* be used as a marker of interindividual differences in the analysis of predictive dynamics from one time to the next, *or* it could be used as a marker of developmental time to create a slope or growth curve. With LCS, both of these questions can be examined in the same model. For example, in our trying to answer our question about the potentially reciprocal effects of teacher involvement and student engagement, let's imagine that we have measures of both of these variables at the beginning and the end of fifth, sixth, and seventh grades. With LCS, we can examine: (1) whether teacher involvement in fall of fifth grade predicts changes in students' engagement across the school year; (2) whether it also does so across sixth and across seventh grades; and (3) whether those predictive effects differ. At the same time, it can examine (1) whether *changes* in teacher involvement predict *changes* in student engagement across each of those time gaps, as well as (2) whether the reciprocal pattern, that is, from student engagement to subsequent teacher involvement, also holds or is different. Of greatest interest to developmentalists, researchers can use LCS to model whether changes in teacher involvement or in engagement seem to act as leading or lagging indicators, so that one could examine whether, for example, teachers' involvement drops as students start middle school, followed by declines in students' engagement; or whether students' engagement declines over the transition to middle school after which teachers begin to withdraw their support.

Does this mean that LCS models can be used to answer all the questions that we have considered so far?

Yes. They can be used with classic developmental designs to provide descriptive information about normative and differential trajectories, and then they can go on to chew their way through time-lagged predictions of growth curves, looking at whether they are the same or different over different developmental swaths of time. LCS models can be further enhanced through the addition of "interruptions" and hypothesized discontinuities.

At what point are we done with "alternative plausible causal explanations"?

In naturalistic designs? Never. The process of digging for potential causes is a never ending story. As explained by Shadish et al.

> In quasi-experiments, the researcher has to enumerate alternative explanations one by one, decide which are plausible, and then use logic, design, and measurement to assess whether each one is operating in a way that might explain any observed effect. The difficulties are that these alternative explanations are never completely enumerable in advance, that some of them are particular to the context being studied, and that the methods needed to eliminate them from contention will vary from alternative to alternative and from study to study. (2002, p. 14)

That is why there is no substitute for knowledge and careful thinking about the target phenomenon, and why multiple research teams working on the same target can jostle and spur each other to examine a variety of possibilities. Some of the most useful writings on design are ones in which researchers try to outline the likely alternative explanations or threats to validity (e.g., Shadish ate al., 2002); for developmentalists, these are slightly different (e.g., Rutter, 2007; Rutter et al., 2001; Foster, 2010; Jaffee, Strait, & Odgers, 2012).

Plausible alternative explanations for the effect.

Given that one of Mill's criteria for causal inference was the exclusion of other plausible alternative explanations, it is very helpful to borrow lists of such plausible alternatives, such as that provided by Michael Rutter (2007), who offers five key alternative explanatory hypotheses that should be ruled out before concluding that environmental risk factors contribute to the development of psychopathology.

1. ***Genetic mediation.*** Risk stemming from an environmental factor is caused by genetics.
    a. *Passive*. Risky environments are created by adults who also pass on genetic risk.
    b. *Active*. People at genetic risk tend to select and create risky environments.
2. ***Social selection or allocation bias.*** The outcome (e.g., psychopathology) is not the effect but the *cause* of the potential risk factor (e.g., low SES).
3. ***Reverse causation.*** The outcome (e.g., child defiance) elicits the potential risk factor (e.g., harsh parenting).
4. ***Risk feature misidentified.*** The risk factor is an umbrella for many components but only some of them actually cause the outcome.
5. ***Confounding variables.*** Additional variable that both distinguishes groups to be compared and is associated with the outcome.
    a. Use of hypothesis-driven analyses to identify and test alternative pathways.
    b. Use of propensity score matching.
    c. Use of sensitivity analysis to quantify how strong a confounder must be to overturn causal inference.
    d. Use of diverse strategies and samples with different sets of potential confounders.
    e. Consider regression discontinuity to account for unmeasured confounders

(despite limited applicability).

GETTING RID OF DEVELOPMENTAL DIFFERENCES AND CHANGES

At the same time, in developmental designs, there are two interesting kinds of study designs that may seem counter-intuitive, but can be useful in compiling a causal case: one in which the researcher tries to get rid of age effects and one in which the researcher tries to separate age and the potential causal variable.

Why would a researcher want of get rid of age effects?

We know it sounds paradoxical, but getting rid of age differences or changes in your data may be an effective strategy for identifying a sufficient causal bundle. Let's think of an example with which we are already familiar—we see age differences in our cross-sectional study of cognitive performance and wonder whether these could be cohort effects. We know that there are cohort differences in education and health care, and so we can do use two strategies to see whether these cohort effects may underlie our age differences: (1) control for education and health status and see if our age differences disappear; or more interesting for relational developmentalists, (2) look for age differences *within* groups of our sample stratified by these conditions. We used the same strategy in our longitudinal study, remember? We looked within the conditions we thought might be contributing to our different pathways and found (to a contextualist, not surprisingly) that these groups showed different pathways.

This strategy can be used in any kind of study that includes a pattern of age differences or age changes, to look more closely at the factors that researchers think may contribute to these patterns. A simple example can be found in a study of cross-year changes in children's use of help-seeking and concealment as ways of coping in the academic domain (Marchand & Skinner, 2007). Across the transition to middle school, students in sixth grade showed higher use of concealment and lower use of help-seeking compared to fifth graders. One possibility was that losses in motivational resources across this transition could be contributing to these age differences in coping, so two analyses were run: (1) one in which the same grade differences were examined, but with level of motivational resources held constant; and (2) groups who were high and low in motivational resources were created and grade differences *within* each group were examined. For both analyses, grade differences disappeared. The separate analysis of each of the motivational resources individually revealed that only a subset of them were effective in getting rid of the grade differences, suggesting that they might be more central in explaining the losses in coping capacity over the transition.

How else can a researcher get rid of age differences or changes?

We saw lifespan researchers trying to get rid of age differences that may have been based on performance factors that disadvantaged older individuals, through massive practice, untimed tests, and so on. Unfortunately, there is no list of strategies for trying to get rid of age differences or changes. Researchers must use their knowledge of the phenomenon and alternative possible explanations to systematically test which ones might be effective in wiping out age differences or changes. And, of course, only a subset of factors can be remediated in the present moment.

What are the strategies for separating age from causal processes?

Despite the fact that developmentalists are always looking for age-graded changes, none of us actually think that age *per se* causes anything. Age is an index for time at a particular biopsychosocicultural window, and so we think of it as a marker for some causal process that is taking place during that window. One of the most interesting causal designs is an attempt to separate age and the potential causal variable. A great example if provided by Baltes et al. (1977) in their introduction to lifespan research methods: As people age, their hearing normatively declines, but how much of this decline is inevitable and how much due to a history of exposure to noise? In typical samples, as participants get older, they have more of both: more age and more noise exposure. However, researchers can search for and select samples for whom those two factors are not confounded: young people who have very noisy jobs or who spend their time in noisy rock concerts, and older people who have very quiet jobs and live in very quiet areas. This allows researchers to "simulate" those age-graded factors that they think may be involved and see if they end up with no age differences-- or (more likely) different patterns of hearing loss for participants with different histories of noise exposure at different ages.

A second way of separating age and developmental factors is to zoom in on a particular narrow age range and to use a careful assessment of a specific developmental accomplishment that is scheduled for that age range. This assessment can then be used to distinguish people of the same age who have "crossed over" the developmental accomplishment from those who have not. Researchers can then see whether age or the developmental change is more important to the potential outcome of interest. One accomplishment that has been used this way is the differentiation between effort and ability, which typically takes place between 10 and 12 years of age (see box).

Separating Age and the Effort-ability differentiation.

Children's views of their ability make a big difference to their participation and success in school. An important developmental change underlying these perceptions is the cognitive shift in inferential reasoning that allows children to differentiate the cause of effort from that of ability. This development accompanies the shift to formal operational reasoning, which typically takes place between 10 and 12 years of age (Nicholls, 1984).

Before this point, children see effort and ability as mutually diagnostic, in that greater effort implies more ability and vice versa; after they are differentiated, children come to believe that they have an inverse compensatory relationship in that more effort implies less ability, and greater ability entails less effort. So researchers could look at age-graded changes from ages 10 to 12, such as changes in ways of coping or the correlates of perceived control, and see whether these changes follow age or the developmental shift (Band & Weisz, 1990).

Two such studies showed that age differences between these age groups disappeared after controlling for performance on tasks of effort-ability differentiation. More interesting, direct examination of differences according to levels of effort-ability differentiation revealed that differences in functioning walked right along those developmental steps. For example, before children differentiated effort from ability, their cognitive performances were correlated with their beliefs about their capacity to exert effort, but as effort was successively differentiated from ability, the primary correlate of performance shifted to beliefs about ability (Chapman & Skinner, 1989).

Can natural experiments be helpful here?

Absolutely. As mentioned previously, researchers are always on the look out for situations in which society or its institutions send people on different journeys in ways that simulate our time machine. Again, no list of these situations can be found in a textbook, but we can give a few examples to alert students to their potential in answering important questions.

What are the effects of school retention?

One of the situations in which educators and parents really long for a time machine is when they are making decisions about whether to retain students who are struggling academically. Should these students be required to repeat a grade (in order to ensure mastery of the academic material before they continue) or should they be socially promoted (in order to keep them with their age-mates and to avoid undermining their perceived competence)? If only researchers could compare the outcomes of those two decisions.

Researchers have been working out how to use to clever designs to simulate these comparisons. The initial selection of students uses a matching design, in which struggling students who were retained are matched with students in the same grades who showed the same pattern of performance (e.g., academic grades, disciplinary referrals, and demographics connected with performance, such as gender, race, class, and SES) but were promoted; in addition, a sample of students randomly selected from the same grades can provide another comparison for both selected groups (e.g., Pierson & Connell, 1992).

Using a variety of measures of potential academic, peer, and self-perception outcomes of retention, researchers can see what happens to the students who were retained compared to those who were promoted, and those who were typical for their cohort. Of course, interesting additional factors can be included, such as the grades at which students were retained (with the notion that earlier retention can set a more positive academic trajectory) and parents' attitudes toward the retention (e.g., whether they saw it as evidence of their child's academic "failure" or as a welcome corrective opportunity).

One of the best known designs of this kind takes advantage of the essentially arbitrary cut off dates for starting Kindergarten or first grade. If researchers want to find out whether the intellectual gains apparent across childhood and adolescence are due to learning that takes place in formal schooling, they are stuck because age is hopelessly confounded with years in school—as children get older, they have also spent more years in school. But clever researchers (e.g., Cahan & Cohen, 1989) separated age and years in school by focusing on children who were closely clustered around the age cut-offs for starting school—these children were within months of each other in age. However, based on their exact birthdate, they were essentially randomly assigned to start school and or to wait a year (sort of like our time machine). Comparisons of students who were the same ages but in different grades provided good estimates of the contributions of formal schooling to intellectual performance.

Challenges to Extracting Causal Information from Naturalistic Studies

In the natural contexts of daily life, certain events and experiences that might promote or undermine development are not dispensed randomly —they happen to people with particular characteristics and developmental histories. The causes also do not occur in isolation, they are parts of other organized forces that act together.

1. ***Pre-existing differences.*** We need designs that help us distinguish the ways people were different *before* they encountered the cause from the effects of the causal experiences themselves.
2. ***Causal clumps.*** We need designs that help us "unpack" causal clumps so we can distinguish the effects of particular aspects of target experiences, some of which may be "active ingredients" and some of which may be trivial.
3. ***Causal beams.*** Causal packages can be thought of as "bundles" or "constellations of components" that are effective in producing the outcome under specified conditions. We need methods for identifying these effective bundles and the conditions under which they operate or are preempted.
4. ***Multiple pathways.*** There are always many sets of causes that can lead to the same outcome so we need designs that can help us distinguish multiple causal pathways.
5. ***Multiple steps.*** Every developmental pathway toward an outcome has multiple steps and the causes may be different for each step, so we need designs that can examine causes for each segment of the pathway.
6. ***Developmental level.*** The causes for a step may be different for people at different points in development, so we need designs that allow us to examine

	causal beams, pathways, and steps within different developmental phases.
7.	***Reciprocal effects***. In these causal pathways, feedforward as well as feedback loops are likely to be the rule. So we need designs that can help us distinguish the directions of effects.

Can we stop with design ideas for a while?

Yes, but keep in mind the challenges of extracting causal information from naturalistic studies (see box above). And keep your eyes open for cool designs that are being used in areas other than your own and within other disciplines that are using other methods to track down causes, like epidemiology, sociology, and economics (e.g., Gangl, 2010; Heckman, 2008). Finally, despite the fact that we did not discuss them here, an important set of tools for causal inferences involve the careful application of sound statistical methods (see box below).

What is Causal Inference?	
As explained by E. Michael Foster, an economist and demographer, who was a long-time associate editor of *Developmental Psychology*, "Causal inference is a set of tools for distinguishing associations from cause-and-effect relationships, or rather, inferring the latter from the former. Researchers across a range of fields have made considerable progress in developing methodology for causal inference. To some extent, improvements in causal inferences involve better statistical tools.. To a large degree, these improvements also reflect and require better causal thinking—for example, conceptualization of the nature of causal inference…These improvements reflect the two-pronged nature of causal inference. To move from association to causal relationships involves both careful thinking and sound statistical methods" (2012, p. 18).	
In this text, we focus more heavily on issues of conceptualization and design in conducting research that has causal description and explanation as its goals. At the same time, we want students to be aware of the fast-growing development of sound statistical methods for analyzing data collected through these designs. Perhaps it goes without saying—but such methods are essential in making causal inferences.	
1.	***Directional acyclic graphs (DAG):*** Chart depicting the researcher's understanding of the directed causal relationships among all the measured and unmeasured components of the target treatment or process. Used to clarify the causal conceptualization, make predictions about covariance matrices, and make decisions about how to treat potential confounders (Foster, 2010).
2.	***Potential outcomes:*** Methods to estimate the set of outcomes needed to make a causal inference (i.e., everyone's scores had they been exposed to the potential cause and the same people's scores had they *not* been exposed) given that only

	one potential outcome can ever actually be observed for each individual. Involves the estimation of counterfactuals (e.g., what an untreated individual's score would have been had he or she been treated) in order to calculate the average causal effect (Rubin, 2005; Schafer & Kang, 2008).
3.	***Propensity scores***: Estimate of each individual's likelihood of receiving a particular dosage of a treatment (or causal factor) based on their values on a set of pretreatment characteristics. Used to take into account pre-existing characteristics that may have contributed to an individual's exposure to treatment (or causal factor). "In particular, the propensity score is a balancing score: conditional on the propensity score, the distribution of observed baseline covariates will be similar between treated and untreated subjects" (Austin, 2011).
4.	***Instrumental variables***: The identification of variables that lead to the potential causal risk factor but do not directly influence the target outcome. Used to examine whether the risk factor *per se,* however arrived at, is connected to the outcome.

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Chapter 24. Proximal Processes and Sequential Observations

I guess you had to be there.
-- *Urban Dictionary*, phrase used when the recounting of a hilarious personal experience fails to evoke the same response in the listener.

It is possible that, over the previous few chapters, we have been thinking so hard about counterfactuals and time machines, and are so jealous of clever researchers who managed to discover revealing contrasts in the every day organization of people's lives, that we have forgotten exactly what it is that we are trying to accomplish as developmental researchers. Let's get re-oriented: We are on the second goal of developmental science, and that involves causal *explanation*, and not just any old causes, but the causes of normative and differential pathways of stability and change. We are looking for multiple constellations of causal components, some good news and some bad news.

In our discussions of experimental and naturalistic causal designs, it could be easy to lose track of our meta-theoretical assumptions. Yet, thinking back, there is one in particular idea that seems like it could be very useful to our explanatory endeavors—the big idea that is centrally focused on causality, that is all about the "engine of development." Ring any bells? Yes, we are thinking about *proximal processes*. So one strategy for conducting useful research about causes and explanations is-- just look right at them. That's it, just *look* exceedingly closely at proximal processes, as they unfold over episodic time, and change over developmental time. And if we can frame them or contrast them in some way, they may help us construct those detailed process-oriented causal accounts that we chase for their own sweet sakes, but that we also must eventually catch if we are going to create effective optimizing interventions.

Are there specific methods that are particularly useful for capturing proximal processes?

Yes, but let's remind ourselves of the idea of proximal processes and then move to the methods.

What are the important conceptual points about proximal processes?

Not complicated. These are the verbs. They involve our target developing person and his or her social partners, both animate and inanimate (physical objects, tasks, symbols). We are particularly interested in the actions of the individual and the affordances of the context, and how they interact with each other—the dance--what they do "to, with, for, or against" one another. We start with our target developmental outcomes (remember your treasured MacGuffin and anti-MacGuffin?) and our list of proximal processes that are likely to promote and undermine them in their relevant microsystems.

And then?

Well, then it is time for a moment of clarity about the different ways we can pursue them.

What do you mean?

There is an easy way to measure proximal processes and a hard way.

We might as well start with the easy way. What is it?

The easy way to measure proximal processes is to ask people about them. There is a cottage industry that supplies researchers with psychometrically sound survey measures of a variety of verbs (i.e., proximal processes) that might be of interest. These are questionnaire measures of parenting, teaching, engaging, coping, supporting, caring, comforting, responding, arguing, learning, supervising, and so on. Don't get us wrong. It is very hard and very worthwhile to create valid measures of people's experiences of proximal processes, and doubly hard to create measures that validly capture the perspectives of *both* interaction partners—husband *and* wife, teacher *and* student, parent *and* child.

It sounds like there is a "but" coming?

Yes. We have to admit that, technically speaking, these are not measures of proximal processes, are they? They are measures of people's *appraisals* of proximal processes, their perceptions or representations.

Yes, but these representations also play a role in causal processes, right? Didn't we see little thought bubbles representing appraisals in all our graphics of proximal processes?

Yes, appraisals are crucial, but they are the individual's interpretations or reconstructions, of proximal processes, and not the dance of actions and affordances themselves. So measures of the *actual* interactions would be closer to our phenomenon. These we can capture with observations.

So naturalistic observations are the preferred methods for looking right at proximal processes?

Yes, they are one important set of methods that are useful for explanatory studies. There are others, which we discuss later.

Are these the "hard ways" that you were talking about before?

Yes, they seem harder because we are not used to them, and we have to learn some new things about design, data collection, and data analysis, but to provide some inspiration for the extra effort, we point out that in return, researchers win the opportunity to peer directly down into their target phenomenon. This allows researchers to create close encounters with their phenomena and discover what is "really going on" in exciting new ways. We provide two of our favorite stories of discovery from direct observation—one in which a researcher cleverly invented a method of looking at chick embryos *inside* fertilized eggs as they were developing, and one in which a cancer surgeon, by looking directly at *living* cancer inside the bodies of his patients during surgery, discovered a new method for battling the disease (see boxes).

The Study of 3000 Eggs (as told by Greenberg, 2014, p. 1-2)

Greenberg (2014) explains how painstaking *in vivo* observation revealed the process by which newly hatched chicks come to be able to peck at and eat their food. He describes the research of “the important Chinese comparative psychologist, Zing Yang Kuo (1967), showing how the pecking behavior of a newly hatched chicken was not the result of some inborn gene-based instinct, but of experiences the developing bird would inevitably have, a function not of its genes, but of the fact that it was a bird that developed on top of the yolk of its egg. Immediately after hatching and drying off (about a 4-hour process), little baby chicks peck at and eat food.

Without knowing any more, one could easily assume that this was not the product of learning or of experiences, but of some genetic program. After all, the animal has just been hatched—what experiences could it possibly have had that could result in its performing a complex sequence of behaviors involved in pecking and eating? This includes orienting to a grain of food, head raising and lowering, beak opening and closing, and swallowing—all in coordination. In the 1920s and 1930s Kuo, living in China, and without a fancy laboratory, devised a way of looking into an egg during the 21 days it takes for a chicken embryo to develop into a chicken and hatch. He carefully peeled away a portion of the egg shell, leaving the membranes intact, thereby creating a window into the egg. By painting the translucent membranes with melted petroleum jelly, the membranes became clear enough to see inside the egg—much as steam and water clear a translucent shower curtain. This enabled Kuo to observe what was happening to the embryo on a daily basis as it developed from a spot on the yolk to a fully formed chick. Kuo was the first to peer inside an egg since Aristotle did so (Kiessling & Anderson, 2003). And what did Kuo see?

… Between Days 4 and 7 into its 21-day development, Kuo could see that this was to be a chicken. It had developed a little baby chicken beak, and its little baby chicken heart had begun to beat. As the heart beat and pulsed, it forced the chick embryo’s head, resting directly over the heart, up and down. Mind you—this was not something the chick was doing, but rather, something that was happening to it that caused its head to move this way. Because of the musculature of the head, as it rose and fell, the beak would open and close accordingly, and fluids inside the egg would rush into the buccal cavity. As the mouth closed, some fluids would be forced out, but some would not and the reflexive action of peristalsis would cause the embryo to swallow. So, 14 days before the very survival of this to-be chicken depended on its being able to raise and lower its head, open and close its beak around a grain of food, and swallow this grain, in a coordinated manner, this to-be chick was doing all of that! Kuo’s work had shown that experiences that happen to a chick well before it is hatched have a profound effect on its subsequent behavior after it is hatched. So here we have a behavior, pecking for food by newly hatched chicks, that has all the characteristics of an instinctive behavior: it is characteristic of all newly hatched chicks, it is stereotyped in form, it appears in animals isolated from others of their kind, and it (seemingly) appears without practice. We have since learned that a behavior can show these characteristics and be accounted for by experiential rather than by genetic factors (Lehrman, 1953)” (p. 1-2).

Observations of Living Cancer

"What surrounds a tumor can determine whether a cancer lives or dies." So begins an article by Laura Bell (2009) on promising cancer treatments that focus, not on the cancerous tumors themselves, but on the "micro-environments" surrounding them. As early as 1889, cancer surgeon Stephen Paget noted that the patterns with which cancers spread are not random, they seem to fare better in certain locations. However, it took almost a century before scientists returned to this observation. Over the past decade or so, the examination of cancers as they are actually living and functioning in the body (the equivalent of *in vivo* observations) reveals that their immediate environments (i.e., their neighbors) contain several distinct features which make it easier for the cancers to grow and thrive. For example, cancer prefers and then creates locations that contain blood vessels that can provide oxygen and nutrients for tumor growth. The pattern of new blood vessels tumors create are so distinctive (characterized by leaky tangles) that they can be used to locate tumors. Moreover, promising new therapies, called angiogenic treatments, target (and interfere with) blood vessel growth. Unlike many chemotherapies, which can have toxic systemic side-effects, these new therapies, which often are formulated so that they can seek out specific tumor sites using micro-environmental markers, are designed to target only the tumors and their local neighborhoods.

Our point? Naturalistic observations of living cancer as it functions in the body were essential to the discovery of completely new ways to treat cancer. Researchers had to stop looking at only the cancer, and begin thinking about the many ways cancers interact with the affordances in their environments, in order to shift the old paradigm and usher in exciting new possibilities for intervention.

Bell, L. (2009). Bad neighbors. *Cure*, *Winter*, 41-45.

How are naturalistic observations connected to our meta-theories?

During the heyday of the behaviorist meta-theories, the only way that researchers were allowed to access their phenomena was through behavioral observations. As you can imagine, if researchers were assuming that the unit of analysis was "the behavior" and the target processes involved discriminative stimuli and reinforcements (think back to Gewirtz), then careful observation of behaviors combined with experimental manipulation of contingencies was the norm. However, starting in the 1960s, when "the mind" was brought "back into the human sciences after a long cold winter of objectivism" (Bruner, 1990, p.1), researchers shifted over to the use of open-ended interviews and self-reports, and a focus on the kinds of appraisals we mentioned previously. So much so that the old-timey behaviorists among us used to complain that psychology has disappeared “up into the head” of our participants. (It is important to note, however, that observational methods have always been the stock-and-trade of researchers who study people at both ends of the lifespan—both those who study infants and young children who can not yet provide reliable self-reports, and those who study people in oldest age, when people can no longer provide reliable self-reports. The majority of these observations take place under laboratory conditions, but we’ll talk about that later.)

Without ignoring the meaning that participants’ are making of their interactions or the importance of assessing our participants under controlled conditions, we would argue that researchers should also be curious about what is happening every day on the plane of action. You know by now why we are such enthusiastic proponents of naturalistic observations— because these methods give researchers the opportunity to stare right at their target phenomena, that is, proximal processes in their contexts. At the same time, however, as our students discover in their observational projects, staring right at one’s target phenomena can be confusing. So let’s walk slowly up to the kinds of observational methods that are most useful for capturing proximal processes.

Aren’t observations just a method of measurement?

They can be. “Observations” are a variety of methods in which researchers (acting as or working through observers) look at openly visible behavior and try to extract information about it. There are lots of kinds of observational methods, depending on where you look, how you extract information, and what you do with it once it is extracted (see box).

Observational methods: A variety of strategies.	
1.	***Narrative observations***: Extended viewing inside a setting with running notes of events and exchanges. Can produce stories of proximal processes.

2.	***Participant observations***: Set of techniques by which a researcher studies the life of a group by sharing in its activities over an extended period of time.
3.	***Local experts:*** Participants in a setting who have observed the social interactions of interest to researchers.
4.	***Checklists:*** Compilations of focal behaviors that are rated for their presence/absence or frequency by observers or local experts. Often used to assess a selection of child or adolescent behaviors of clinical importance (e.g., Child Behavior Check List or Achenbach).
5.	***Ratings***: List of dimensions on which observable actions can be arrayed. Typically used to rate focal behaviors after a fixed interval of observation (e.g., 5 or 15 minutes).
6.	***Behavior categories***: Mutually exclusive and exhaustive sets actions that are coded by trained observers.
7.	***Sampling methods:*** Ways in which unit of analysis (and focus of coding) are determined.
	Time sampling: coding initiated when timer goes off at pre-specified (or random) intervals.
	Event sampling: coding triggered by the occurrence of specific target incident.
	Continuous real-time coding: coding, once it commences, codes all target behaviors and all partner responses as they occur in their natural sequence.
8.	***In vivo coding:*** Observations that are coded "live" in the naturalistic settings in which interactions usually occur.
9.	***Sequential interactions:*** Behavior codes recorded in their naturally-occurring order that are then analyzed to determine whether certain behaviors are more likely to occur following other behaviors than would be expected given their base rate.

What are the most common types of observational methods?

The most common use of observations is as a method for validly assessing a single construct. So many observational coding schemes have been developed that have as their goal to measure a specific target behavior or set of behaviors (like on-task, off-task, or helping behaviors). These can have quite extensive systems of categories, say up to a dozen, and a common visual image of researchers using these strategies would be the unobtrusive observer slouching in a corner of the playground or in the back of the classroom with their clipboard (or nowadays data tablet) and making little ticks in columns as the behaviors scroll by. Such systems also include well thought-out ways to aggregate the codes over time, such frequency counts or rates per minute.

These kinds of observations can be useful, but in the end, no matter how complex and careful the system, they are just descriptive, and they tend to be telescoped back into single measures of inter-individual differences. Their biggest drawback, from the perspective of researchers interested in proximal processes, is that we are only listening to one side of the conversation—a very important side, of course, because it tells us about our target phenomenon—but just one side nevertheless. These coding systems seem to assume that everything we want to know about an individual's behavior can be gleaned by looking only at the individual.

Se we prefer observations that include both interaction partners?

Yes, but at the risk of sounding too picky here, we also want to mention the limitations of a second common usage of observational assessments: the behavioral rating. These are systems in which researchers identify dimensions of the quality of the behaviors of interest (like warmth or engagement) and rating sheets are created with behavioral or intensity anchors for each of the points on the rating scales. Here the visual image is one in which observers (also unobtrusively located) watch for a fixed period of time (say 5 or 15 minutes) and then rate the behaviors or interactions they have witnessed on one or more dimensions. Compared to frequency counts, these kinds of systems are typically used to capture more molar behavior and they have become required parts of studies in some areas. For example, in research and interventions focused on quality of teaching, observational ratings have become part of the "gold standard" for documenting outcomes, as a welcome replacement for teacher self-reports or student-reports of teachers' classroom behavior.

At the same time, relational meta-theorists note that there are some drawbacks to these kinds of ratings. First, although ratings typically incorporate the behaviors of interaction partners, they are often labeled as if they were a measure of only one of the partners. For example, observational ratings of "teaching style" typically include the assessment of student attention, engagement, and on-task behavior. These ratings are even sometimes used in the evaluation of the quality of a particular teacher's classroom practices, mistakenly regarding them as a quality of the teacher instead of the teacher-student interaction. Second, these kinds of ratings of the interactions between partners fuse the behaviors of the two partners into one rating. For example, "engaging teaching" includes something about the way the teacher is teaching (e.g., enthusiastic or clear presentation) with something about how the student is responding (e.g., with attention, interest, and on-task behavior). If other combinations occur, for example, enthusiastic teaching accompanied by student off-task behavior, these will not be recorded by the rating system.

Third, ratings do not allow researchers to recover the temporal sequence of the actions of the interaction partners, although different temporal orders might imply different processes. For example, if a teacher's coercive behavior (e.g., a teacher imperative) is followed by student oppositional behavior (e.g., student noncompliance), this tells a different story than if it is student oppositional behavior that is followed by teacher coercion. So, although we applaud all kinds of observations, we would see ratings as similar to a "thermometer," in that they are most helpful for "taking the temperature" in a current setting—Are things going well or is there a "fever"? And if they are labeled correctly (as tapping interactions instead of the attributes of one partner), then these can be considered global indictors of proximal processes. At the same time, if more detailed process-oriented accounts of proximal processes are desired, alternative observational strategies may be more useful.

SEQUENTIAL OBSERVATIONS

Okay, so what kinds of observations are you herding us toward?

Observations that look at both (or multiple) interaction partners' actions separately but in ways that allow them to be temporally knit back together. One set of methods for accomplishing this includes continuous real-time coding of behavioral interactions in their natural sequence, combined with sequential probability analyses for extracting information about call and response in those interactions (Bakeman & Quera, 2011; Gottman & Bakeman, 1997). These kinds of observational strategies do not collapse time (as is the case with frequencies or ratings), but instead directly examine the time-ordered information that is contained in streams of antecedents and consequences.

Can you provide some examples of the kinds of things we could learn from sequential observations?

There are many cool examples of sequential observations, but perhaps the most well-known were conducted by Gerald Patterson and his research team, when they were trying to understand the kinds of day-to-day parenting practices that were connected with antisocial or oppositional behavior in children and youth (e.g., Patterson & Reid, 1984; Snyder & Patterson, 1995). By conducting naturalistic observations in the home, they were able to reconstruct recurring patterns of parent-child interactions that they labeled as a "reinforcement trap." In these interactions, parents requested their child's behavioral compliance on some task (such as turning off the television or finishing up on homework) to which children replied with noncompliance; then when parents insisted, children escalated their opposition until finally parents gave up.

Thus, through this cycle, parents were inadvertently reinforcing children's oppositional behavior as an effective means for getting parents to back down. This discovery played a key role in intervention programs designed to improve the difficult task of effectively parenting oppositional children.

Another example of how sequential observations can reveal interesting information about proximal processes can be found in the research of Margret Baltes, who was interested in trying to understand the sources of increasing dependency during old age (Baltes, 1988, 1996). She hypothesized that increases in dependency in the elderly were not just the inevitable result of losses in competencies as people age, but were also shaped by the contingencies in their environments. To examine this possibility, She and her team conducted *in vivo* observations in nursing homes for the elderly in which they coded residents' dependent and independent behavior, and staff's independent and dependent supportive behavior. These studies showed that staff (inadvertently) reward residents for passive and dependent behavior—staff were more supportive when elderly residents cooperated by passively allowing staff to (more quickly) take care of the residents' activities of daily living rather than encouraging residents to carry out these activities independently themselves. These patterns of contingencies have important implications—they contradict for our views of aging and decline as primarily biologically-based, and they suggest that interventions that train staff to support independent behavior are likely to promote residents' independence (Baltes, Neumann, & Zank, 1994).

Oaky, how does one go about collecting these kinds of behavioral data?

It's actually a very cool and educational process that allows researchers to spend time with their proximal processes and then to successively add more and more structure to what they are seeing. Conceptually, it involves differentiating the kinds and attributes of social interactions that you think might matter to your target phenomena. Methodologically, it involves the construction of a coding system. We outline some steps in Table 24.1.

Why can't we just use an existing coding system?

You can—if someone has already constructed the right one. However, even to be able to pick out the right scheme, it is helpful to check out the proximal processes on the ground.

Okay, what is the first step?

The observational project for our class would be a good first step. Sometimes these kinds of observations are called "thematic observations," because the observer goes in with a general idea of what he or she is looking for, but uses the experience in the context to make decisions about what should ultimately be incorporated. These kinds of observations, as describe din the observation project, requires researchers to think through their MacGuffin and anti-MacGuffin, and the widest list they can possibly create of the kinds of interactions that could promote and undermine these target developmental processes. The key to this phase of the project is "openness" and "clarity." The openness part is needed because, during one's time in the setting, the thematic observer is trying to cast a wide net—who are the relevant interaction partners? Are they people? objects? tasks? rules? In our own work on engagement, for example, we knew right away that an important interaction partner is the teacher (because the student can be paying attention or daydreaming when the teacher is teaching), but it took us a while to realize that a primary partner with which students interact when they are engaged or disaffected is the academic tasks themselves or the academic work that they are asked to undertake. Missing this partner removes an important intervention lever for encourage student engagement.

Constructing a coding system.	
1.	***Decide on thematic observations***. Identify the target constructs and a wide variety of candidate proximal processes that may be involved.

2.	***Behavior mapping.*** Spend time in the setting in order to get to know its geographic and social properties: where, when, and with whom the target behaviors are visible.
3.	***Catalog proximal processes.*** Take careful notes of behaviors and social interactions that seem to be relevant to the target processes and outcomes.
4.	***Specify the unit of analysis for coding.*** Decide whether coding focuses on specific events, or follows a series of target people after specified units of time.
5.	***Select organizing categories for each interaction partner.*** Condense and structure reality in a specific way through the lens of your theory.
6.	***Classify behaviors.*** Place all the relevant behaviors into one of the categories.
7.	***Pilot coding system.*** Take the observational system back into the setting and see whether what you are seeing is captured by the categories and behaviors you used.
8.	***Revise and resubmit.***

Why do you need to spend so much time in the setting?

This second step can be called the "getting to know you" period, during which the observer is a curious spy about everything in the setting—who does what to whom where and when. The observer is trying to figure out when and where the interactions of interest are located and concentrated. For example, if a researcher is trying to observe peer interactions in a preschool setting, "group time" and "nap time" are not good settings, because peer interactions are actively discouraged or even forbidden during those times.

The observer may even learn that what they assumed would be their target social interactions (e.g., teachers helping students cope) are rare events, or that the events are seasonal—for example, preschool teachers may spend more time with individual children at the beginning of the year when they are getting to know each other--and to see the target, the observer may decide to come back during the season. We are so used to survey measures, which can be administered anywhere and anywhen because they rely on respondents to pull from their memories the relevant interactions. However, our proximal processes really are shaped by time and place, and so that is one of the important lessons to learn during thematic observations.

What is meant by "cataloging proximal processes"?

The next step is to write furiously, taking careful notes about the social interactions and proximal processes you are witnessing. During this phase, you are trying to be as descriptive as possible, making notes for the selected and edited video that you are making in your mind. The more days and times you and other members of your team can come back, the better you catalog of behaviors will be. If it is not too disruptive, it is also a good time to be a little bit participant-y in your observations and check in with the people who actually belong there about what you are seeing. If you are invited to read a book to one of your preschoolers or to have dinner with your elderly participants, by all means graciously accept and see what you can learn from them—your resident experts. These narratives and conversations are the treasures that you bring back from your visits and they are the substantive grist for next steps.

Are there any special features required for a coding system that is destined to participate in sequential analysis?

Oh, yes. From the beginning, researchers need to be thinking about the coding system as capturing a "conversation," or many "conversations," between the target person and their (perhaps multiple) social partners using continuous real-time coding. It needs to be anchored in the target person's behaviors and then to include, exhaustively and sequentially, all the possible relevant "answers" from their social partners; and then starting with these answers, consider again the next conversational response options, until the important features of turn-taking in the interaction process have been covered. This kind of system is very different form one that focuses only on the target person and then only on the social partners, and then tries to zip them together afterwards. Such systems are more likely to create sequences of "parallel play" then they are to recover meaningful interaction processes.

How do you identify organizing categories?

It is tempting to describe this step as “miracle occurs and categories pop out,” but this process is really more like one in which the research team (all of whom have hopefully spent lots of time in the setting) basically thrash around for a while, zigging and zagging from idea to idea, part of the time worrying that the overarching categories are too general (a typical question signaling this problem would be “Aren’t these category names just synonyms for ‘good’ and ‘bad’?”), and part of the time worrying that there are so many overarching categories that it will be impossible for anyone to code them live (a typical comment signaling this problem would be, “Well then I assume that you are the one who is going to do the observer training, right?”). In other words, the first draft of the category system emerges from the proximal processes among the research team members, in concert with their theoretical framework (which is never specific enough about what is happening on the ground to be definitive) and their narratives (which are never general enough to map unambiguously onto our constructs).

So, a great deal of discussion will center on what is the same (and so should go into the same category) and what is different (and so requires two categories). For example, let’s say that we decide to map engagement in the classroom. We will probably all agree that it makes sense to start with the standard overarching categories of “on-task” and “off-task” behavior, but we will have lots of arguments about whether we need to distinguish “active” on-task from “passive” on-task behavior, and whether it is possible to distinguish “paying attention” from “not paying attention”—whether these are actually visible behaviors. As a result, many of these decisions will come down to what the researchers see as actions that are so qualitatively different from each other that we will get mixed up if we try to fit them into the same category. This is the artistry of creating or adapting a category system. (To keep students from getting discouraged about constructing coding systems, we often note that these are exactly the same qualitative judgments that researchers make when they are in the throes of constructing survey measures and need to determine how many dimensions should be initially included in a construct—for example, should we include both warmth and involvement in our assessment of teacher support?)

What does it mean to "classify behaviors into categories"?

Once the overarching categories have been identified, then they have to be populated with specific behaviors. So, for example, once we decided to use active and passive on-task and off-task as our categories, we have to decided where the behaviors we actually saw should belong—so is whispering to one's neighbor actively off-task or does a student have to talk back to the teacher? And so on. These are not trivial decisions. How one classifies behaviors determines how the overarching categories will behave. If we put giving students instructions into "controlling" teacher behavior when it really belongs in teacher "structure," the category system will not behave. It is as if we have the wrong items to tap our major dimensions.

How long does this process go on?

It goes on until your team feels ready to pilot the system. In this trial run, the observer tries to keep on two hats at once. The first hat is as the participant-observer, who is getting a global or molar feeling for what is happening in the setting, whether meaningful exchanges are taking place between social partners, whether they seem to be good news or bad news, and so on. The second hat is the observer-recorder, who is tasked with using the coding system as it was developed, carefully slicing and dicing interactions according to the instruction booklet provided by the categories, and placing each slice into one and only one category. At the end of the day, the two hats will need to confer with each other, to see if the category system was adequate to capture the important features that the participant-observer noted. The category system will never get it “all,” so the question is whether it got the meaningful gist of events, “meaningful” and “gist” being defined in terms of the target developmental outcomes and its potentially causal proximal processes.

How do you know if you have a “good” observational system?

There are several indicators, in addition to the global sense gained during the piloting and subsequent reworking of the coding system. The reliability of a coding system is assessed through the calculation of inter-observer agreement, which reflects the replicability of the observation or the extent to which two observers who are coding exactly the same interactions agree on how they should be classified. It’s Often these indices of agreement are adjusted for the number of categories, with the idea that, in a system with only a few categories, observers have a greater likelihood of agreeing just by chance. Typically over the course of a study, inter-rater reliability is repeatedly assessed, to make sure to detect and correct any “observer drift.”

What determines a “good” category system?	
1.	***Reliability.*** Is there good inter-observer agreement?
2.	***Validity.*** Does the system actually capture the key constructs according to your “theme”?
3.	***Quality of categories themselves.*** All behaviors fit in one and only one category.
	Mutually exclusive: All behaviors fit in only one category.
	Exhaustive: All behaviors can be categorized, without over-use of the “other” category.
4.	

When do these become sequential observations?

If the observational system has been created in a way that turn-taking behaviors between the target individual and their social partners are coded in their natural sequence, then these kinds of data can be analyzed to see whether there are sequential dependencies in these antecedent-consequence chains of participants' behaviors. These kinds of analyses (see box) start with the "base rate" of each behavior category for each participant. The researcher selects one partner's behavior as the antecedent and calculates the likelihood that the other partner's behavior appears as a consequence directly following that antecedent (its conditional probability), and then compares that with the likelihood of the consequence in general (base rate or unconditional probability). If the probability of the consequence given the antecedent is significantly greater that the probability of the consequence in general, then there is a sequential dependence between the two.

What are sequential probability analyses?	
1.	***Base rates.*** Calculate the base rate for each behavior, as the unconditional probability of that behavior occurring during an observation.
2.	***Conditional probability.*** Test each hypothesized antecedent-consequence chain for significance, by examining whether the probability that a consequence occurs given that it is preceded by a potential antecedent is greater than the probability of that consequence appearing in general (its base rate or unconditional probability).
3.	***Significance testing.*** Chi-square values are used to determine significance.
4.	***Multiple and reciprocal chains.*** These sequential probabilities can be examined for all combinations of behavioral codes and for both target person-to-partner sequences and for reciprocal partner-to-target person sequences.
5.	***Multi-step sequences.*** Sequences greater than two behaviors can also be examined. Pairs of behaviors are combined into a joint code, and then the sequence of calculations in repeated: The likelihood of a consequence following a given pair is compared to the unconditional probability of the consequence.
	See Bakeman & Gottman, 1997.

Note that the dependencies are always sequential—in that each analysis checks for whether a specific consequence follows a specific antecedent, so that even if a sequential dependency is found in one direction, it is a completely different question (with a completely independent answer) if the dependency runs the other way. So, for example, let's say that we had coded in their natural sequence, children's engaged and disengaged behaviors in the classroom along with teacher's positive involvement and negative withdrawn behaviors. We could calculate the conditional probability that student engaged behavior occurred given the occurrence of teacher involvement, and find out that this sequential dependency is significantly higher than the base rate for engaged behavior; and then look at its reciprocal, namely, the conditional probability that teacher involvement occurred given the occurrence of student engaged behavior, and discover that this sequential dependency is not greater than the base rate of teacher's involved behavior. So, for this behavior pair, we see dependency from teacher-to student but not from student-to-teacher. Of course, there may be student-to-teacher sequential dependencies for other behavior pairs. For example, teachers may be more likely to show negative behaviors following student disengaged behavior.

Why are we so enthusiastic about these kinds of sequential probabilities?

Ye gads, man! Here we are in the midst of our target causal force—proximal processes. We are at the dance! We can see the actions and affordances of the target person and their social partners in their conversational turn-taking glory, and see whether the each partner's behaviors make it more likely that the other partner will respond in a certain way. We are staring directly at our potentially causal mechanisms. Taken in combination with certain other design features, this kind of information can be very powerful evidence of social influence (see box for an example).

The reactions of the members of children's peer groups to their on- and off-task behavior in the classroom.

As part of his work on the influence of children's peer groups on the development of the academic motivation, Kindermann and colleagues decided to look directly at the kinds of contingencies that students receive for their on- and off-task (engaged) behaviors in the classroom (Sage & Kindermann, 1999). Their earlier work had shown that students tend to affiliate with peers who are similar to them their levels of engagement, so they knew that children who are more engaged have peers who are also more engaged, whereas children who are more disaffected also have peers that are more disaffected. So they wondered whether those peers were providing different kinds of contingent reactions to students' on- and off-task behaviors in the regular classroom.

To examine this hypothesis, they conducted an observational study in which target students' on- and off-task behaviors were coded, and then the reactions of classmates (both members and non-members of students' peer groups) and the teacher were coded in their natural sequence as either supportive or non-supportive. Using sequential probability analyses, they were able to determine that engaged and disaffected students were receiving different kinds of contingencies from their peer group members for their on- and off-task behaviors. As could be expected, teachers were consistent in their reactions: although they occasionally laughed at a student's humorous off-task behavior, in general they were supportive of on-task and un-supportive of off-task behavior, no matter the student's level of engagement.

However, peer group members were more discriminating. The peer group members of engaged students provided contingencies that were similar to the teacher: They were supportive following students' (frequent) on-task behaviors and un-supportive following their (infrequent) off-task behavior. However, disaffected students' peers provided quite a different set of contingencies: They were supportive following both active and passive off-task behaviors.

This study provided initial evidence that supportive contingencies for students' off-task behavior may be one pathway through which disengaged peer groups may shape off-task behavior in their members.

DESIGN DECISIONS WITH SEQUENTIAL OBSERVATIONS

What are the other design features?

In general, researchers need a frame to help them make sense of the kinds of proximal processes they are looking at. Remember the contrasts we had students use in their observational projects? They are very useful in designs that include observational analyses. They can be contrasts built around attributes of one of the partners—for example, in Patterson's studies, they were interested in contrasting contingencies in dyads involving troubled versus untroubled children and youth (which led to the discovery that troubled youth also have parents who have trouble parenting), or in Kindermann's studies, they contrasted engaged versus disaffected students. Such comparisons allow researchers to hold up the atypical proximal processes and examine them in the light of more typical interactions.

Any aspect of the system provides a potential comparator—proximal processes in classrooms in rich versus poor schools, proximal processes in high versus low quality romantic relationships, between friends and non-friends. Even events within the coding chanins can be sued for contrasts. In continuous real-time sampling, an observer typically follows a pre-specified list of target people and observes each of them for a specific amount of time (e.g., 3 or 10 minutes), coding all that persons behaviors and their partner's responses during that period. This pre-specified list can include everyone in the setting or it can focus on specific categories of people identified through other means (children who are high and low in impulsivity, teachers with different years of experience). When events trigger continuous real-time coding, the observer scans the setting for a pre-specified target event (e.g., aggression) that triggers the beginning of an episode during which the observer continuously codes all subsequent interactions. If events are used to trigger observations, however, it is important to select the right point of entry. For example, if researchers want to capture the events that elicit aggression, it is essential to locate the triggering event far enough back in the chain of an episode, so, for example, instead of starting coding when "aggression" has already occurred, it would be preferable to start coding when a "disagreement" is detected—this would allow coding of a variety of ways that a disagreement can be resolved, only one of which might involve aggression.

And of course, our favorite kind of contrast design involves (did you guess?)—time.

How could time enter into an observational study's design?

By examining how proximal processes *change*-- using designs that compare them for the same people at two points in time. For example, a study could determine whether proximal processes change from before to after an interruption, like an intervention. Alternatively, it could examine whether and how proximal processes naturally change as children get older or as parents and teachers become more experienced in their roles. An important part of these kinds of designs involves figuring out what kind of developments (in the individuals, their relationships, their contexts, or other factors) would precipitate systematic changes in interaction patterns. An example of a developmental frame that may organize such changes can be found in the concept of "developmental tasks" (Havinghurst, 1948). These were used in a study of how mother-child contingencies change as children proceed over the phases of early developmental tasks (see box).

Changes in mother-child contingencies as children learn to eat, walk, and dress.
In a study of the contingencies in mother-child interactions involving very young children, Kindermann (1993) decided to examine whether those interaction patterns changed as children proceeded through the developmental tasks of learning to eat, walk, and dress. To mark these developmental changes, he used mother's reports of children's competencies in these three areas, and looked at how contingencies changed across three time periods: before children were working on the task (when they were not competent to eat dress, or walk by themselves), while they were learning, and after they were competent. Because these tasks are themselves sequential, in that children learn to feed themselves first, then to walk, and then to dress themselves, it was possible to not only examine changes *within* tasks, but to compare contingencies at the *same time* in tasks that are at different points in their progression.
As explained by Kindermann, "Changes in behavior frequencies and interaction patterns were consistent with hypotheses that mothers adjust their socializing interactions to children's growing competencies in developmental tasks. Before task were begin, interactions could be characterized a nurturant (contingent maternal support for child dependent behavior only); when children were actively learning in a task, interactions evolved into complementary patterns (contingent maternal support for both dependent and independent behavior; and when competence was firmly established, mothers rarely showed contingent support for dependent or independent task-related behaviours" (p. 513-514).

Any developmental milestones could be used to create a "before-during-and-after" set of comparisons for proximal processes involving the relevant social partners, such as parent-child disciplinary contingencies and the development of self-regulation, or changes in sibling contingencies when the younger sibling can locomote (and thus swoop in to interfere with the older sibling's activities more unpredictably). Other markers that might signal "interruptions" or developmental changes include school transitions, before and after children move out of the house, or before and after a divorce or other significant life event.

Why is timing important?

The design in observational studies instructs the research on where and when proximal processes of interest should be visible and important. Just as there are certain activities and settings in which target proximal processes are more likely to appear, so too are there specific time windows—developmental times, points in a relationship, points in the family cycle, and so on—where episodes of proximal processes are more likely to coalesce, to be more open to perturbations and change, and hence to reveal more about causal processes and explanations.

Does it matter where the observations take place?

Observations can take place in lab settings and they can be assessed in response to experimental manipulations, as we mentioned in the chapter on lab settings and experimental methods. Because all proximal processes involve multiple interactants and are shaped by the contexts in which they unfold, we are especially interested in observations in the context of daily life, or in observations that take place in the lab but have imported or simulated all relevant interaction partners and contextual attributes. The most will be learned about development by observing proximal processes in situations that are highly typical of children's natural environments.

Does it matter whether behaviors are coded "live" or from recordings?

Observations can be coded "*in vivo*" or they can be coded from digital or other recordings. The advantage of coding from videos is that more complex systems can be used that require coders to pause the tape, rewind it, or make multiple passes through the material. The image that comes to mind for this kind of coding is a coder in a darkened room huddling in front of the monitor with a clipboard or its equivalent on their computer, synchronizing their coding with a time stamp and watching and rewinding over and over, zooming in on faces and hands to see what is happening; and making way for the next wave of coders who will be coding other complex sets of behaviors.

The contrasting image, connected with an researcher who is coding live in the actual context, is a highly alert observer, with their eyes moving systematically and their fingers continuously tapping on their tablet (or speaking softly into a recording device), and then collapsing from exhaustion after an hour or so. One advantage to live coping is that the data are "in the can" as soon as the observer leaves the setting, as opposed to coding from tapes in which 5-10 hours of work may be needed to code each hour of video. But the more important advantage to coding *in vivo* is that observers have access to much more information about what is happening in the surround, in areas that are "off-stage" from the central focus of a video. This allows observers to have a much more complete picture of what they are coding. In general, if observers can capture the target behaviors by coding only once and at rapid speeds, *in vivo* methods would be preferred.

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Chapter 25. Individual Time Series: Trajectories and Episodes

Your mind is the knife that cuts the continuum of space and time into
neat slices of linear experience.
--Deepak Chopra, *The Way of the Wizard: Twenty Spiritual Lessons for Creating the Life You Want*

The goal of explanatory studies is to provide careful process-oriented accounts of proximal processes and developmental changes. In the chapter on sequential observations, you started to get a feeling for the kinds of demands that researchers put on their methods in order to answer these questions. As you can see, if we want information about sequence and time-ordered organization of action to come *out* of our studies, we need methods that are designed to deal with data that contain such information. And where would that information be found? In dense time-ordered data, like in the continuous real-time behavioral interactions brought to us by our observations. But a funny thing happened on the way to these kinds of designs and data. The developmental area lost track of the side of Cattell's cube that our bread was buttered on—the surface that includes time.

It is easy for developmentalists, like other psychologists, to become enamored of the number of variables and the number of participants we have in our studies, as markers of the amount of information we are bringing to the table. Studies that have few participants but many data points are sometimes looked down upon (van Geert, 2011). For example, one of us tried to publish a study with six participants, and was told that he would likely need more participants before anything could be learned from his data. But, our intrepid researcher prevailed when he pointed out that his data could hold its own compared to most other studies, since he had collected some 10,000 data points on each participant. Without too much finger pointing, we encourage our students to become friends with methods for collecting and analyzing dense time-ordered data-- not because it is easy or popular, but because that is where the treasures that all developmentalists seek are likely to be found.

What are some strategies for collecting and analyzing our bread-and-butter, that is, dense time-ordered data?

One important set of strategies live under the umbrella of "time series" methods. There are many good articles, chapters, and books on time series methods (see box). Because our goal is to make clear how central these methods are to mapping relational meta-theory-world, we will try to explain enough about these methods that students will be motivated to try them out—or to work with methodologists who love them, because such methodologists are always hungry for more collaborators, more time series questions and data, and more opportunities to play with (ahem, "analyze") such hard won data. We focus especially on the design of such studies, offering a few ideas that may help the data they yield to be more useful for developmentalists, especially in charting individual trajectories, developmental transitions, and proximal processes.

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What are intra-individual time series studies?

You have probably heard of them, since they have become increasingly visible since the late 1970s (Wheeler & Reis, 1991). Time series studies are ones in which data are collected over a great many time points, sometimes 25 to 50 (or more) per participant; the densest studies include continuous recording or participant assessments up to 20 times per day. Such studies often involve daily measurements and participants' self-reports, so they are sometimes called "daily diary" studies (e.g., Bolger, Davis, & Rafaeli, 2003), but they are also called "self-recording," "self-monitoring," "ecological momentary assessments," or "experience sampling" methods (see box). As a set of methods, they can use data from any source—self-reports, reports from others, institutional data, or data collected automatically by, for example, physiological monitors or other devices that can record or transmit information.

Where did times series methods come from?	
Time series methods have arisen from a variety of disciplines and have been used for a variety of research purposes, starting in the late 1800s. Here are several of the best known strands (for more details, see Shiffman, Stone, & Hufford, 2008; and especially Wheeler & Reis, 1991).	
1.	***Baby diaries***. Developmentalists observe, take careful notes on, and document their own children's development over years, such as Wilhelm Preyer (1882), Jean Piaget (1936), Stern and Stern (1907), and Stern (1914).
2.	***Work sampling.*** Self-reported activity sampling in the workplace, such as communication patterns. Built on the tradition of "efficiency experts" who conducted naturalistic observations of workers' movements and activities to optimize time usage. Started in 1910s.
3.	***Time budget studies.*** Large scale cross-national studies in which participants record details of their daily activities (sometimes concurrently and sometimes for the previous day): what they did at what time, for how long, how often, in what order, where, and with whom. Started in 1910s.
4.	***Ecological research***: Continuous observation of behavior throughout the day in its natural environment, for example, Kansas School of Ecological Research. Started in 1950s.
5.	***Self-monitoring.*** Recording of frequencies of specific behaviors, often as a form of self-modification to increase the probability of desirable or decrease the probability of undesirable behaviors (e.g., cigarette smoking). Started in 1960s.
6.	***Behavioral diary.*** Self-recording of target behaviors, feelings, or changes in thoughts as well as circumstances surrounding events; also used to detect the effectiveness of clinical interventions. Started in 1970s.

7.	***Experience sampling.*** Self-reporting of specific activities, mood, thoughts, or subjective in response to random signals, initially transmitted via beepers. Started in 1960s.
8.	***Ambulatory monitoring:*** Participants wear or carry technological devices that automatically record information continuously or at fixed intervals, such as physiological data or words spoken to a child. Initially used with wearable cardiac monitors.
9.	***Interaction or communication records.*** Participants complete fixed format diaries following each target event, such as social interactions or conversations. Initially completed on decks of cards carried by participants.

Time series studies sound like a lot of work. What do researchers get out of them?

Many very cool things, things you have been secretly longing to see. Proponents emphasize their advantages in terms of accuracy of recording ongoing states and events (and evidence that retrospective cumulative self-reports are biased in many systematic ways). Proponents also emphasize the “ecological” validity of these reports, which are nestled down into the contexts of respondants daily (and even hourly) lives as they are lived and then reported. Developmentalists, as you can imagine, are enthusiastic about validity and context, but we are rubbing our hands together when we imagine these kinds of data for one additional reason—time! They contain time-ordered information. And with this kind of intra-individual time—time series, above all, will turn your head inside out—in a good way!

How do they turn researchers’ heads inside out?

Up until now, you may not have noticed that the vast majority of research in developmental (and all areas of psychology) spends most of its empirical energy mapping out “inter-individual questions,” that is, questions about differences between different people.

What are “inter-individual questions"?

They focus on data from the front face of Cattell’s cube (see Figure 25.1) about people (cases) and their attributes (variables) at one time of measurement. For example, if we are interested in the role of students’ effort in their academic performance, we could collect data on those two variables (and perhaps some others, like intelligence or level of difficulty of the classwork) from many different students, maybe even across several grades, like grade 4 and 6. Let's think about the questions we would typically ask with these data. We might start with descriptive information: "What are students' effort and academic performance on average?" and "How much variation do we see in students' effort and academic performance?" You know that the standard way of answering these questions is to calculate a mean and a standard deviation for each variable.

Insert Figure 25.1 about here

What you might not have thought through so carefully (because these are our statistical conventions) is how you arrived at that information. A mean reflects the value of a variable averaged *across many people* and a standard deviation represents the variability of that variable *across many people.* To get these statistics, you combined information that came from many different people (all the participants in your sample, to be exact).

So what?

Before we answer that, let's take our reflections one step further. Let's say that we also ask, "What is the connection between students' effort exertion and their academic performance?". You recognize this as a question that can be answered with a correlation or a regression—which looks at the connection among variables. These correlations are describing differences between people: Each person has a value on their effort and on their performance, and if we rank order people on one of these variables and then rank order them on the other, and then draw lines from each person's score on effort to their score on performance, we can get a general visual on this correlation: If there are no crossing lines, the correlation would be positive

1.0, and if the lines cross completely, the correlation would be negative 1.0 (see Figure 25.2).

Insert Figure 25.2 about here

Again—so what?

By using these statistics, which are based on inter-individual differences, you have inadvertently taken on the assumptions that are baked in them—that the answers you seek are to be found in comparing variables across different individuals at one point in time.

What is the alternative?

The conviction that the answers you seek are to be found in comparing variables across different time points for one individual.

Why would anyone prefer this assumption?

Because, believe it or not, this assumption is consistent with the relational meta-theories that we found so compelling—right up until we realized that they would require us to learn so many new methods and turn our heads inside out.

In what way do relational meta-theories converge on that assumption?

Take a minute and think about relational meta-theories, actually-- think about *all* developmental meta-theories. What is clearly the target of all such perspectives? Development, right? Which is what? How individuals change over time, right? So if you had never been trained in statistics and you didn't know any better, what would you *think* you would do to study development? Close your eyes and imagine yourself. What would you be doing? Here's one scenario: You would find someone and you would follow them around, a lot, all day, every day, for maybe years. And you would be taking detailed notes about what they were doing and how they were changing.

Like a baby diary?

Exactly. If you hadn't passed your classes on quantitative methods and read all those journal articles, you would think that developmentalists would focus on exploring how one individual is changing over time. And so, like we said before, you would want methods for comparing variables across different time points for one individual.

These are the time series methods?

Right, these methods are sometimes called "intra-individual" to contrast them with the standard "inter-individual" methods.

How are the two different?

Well, one way to think about it conceptually is using Catell's cube. Say we collected our first data point: a bunch of information (variables) from or about a specific person. Case #1. Now we need to collect our second data point. Here is where the perspectives part ways. An *inter*-individual framework sits on your right shoulder and says, "Get the same information about another person." And an *intra*-individual framework sits on your left shoulder and says, "Get the same information at another point in time." The two frameworks only have that one data point in common, then they diverge (see box).

What is the difference between an inter-individual and an intra-individual approach?
"The standard approach in psychology is analysis of interindividual variation. Its defining features are the following: (a) a random sample of subjects is drawn from a given population; (b) it is assumed that the population of subjects is homogeneous (i.e., subjects are exchangeable, and all obey the same statistical model); (c) investigators estimate statistics of interest by pooling across the sampled subjects; and (d) the results of statistical analysis are generalized to the population of subjects from which the random sample was drawn. This definition of analysis of interindividual variation can be straightforwardly refined for mixture analysis. In contrast, the defining features of analysis of intraindividual variation are the following: (a) a given subject is repeatedly measured during an interval of time, where this interval of time is considered to be a block of time points randomly drawn from the entire time axis; (b) investigators estimate statistics of interest by pooling across time points; and (c) the

results of statistical analysis are generalized along the entire time axis (retrodiction, interpolation, and prediction)" (Boker, Molenaar, & Nesselroade, 2009, p. 861).

What are the consequences of this difference?

Well, using an intra-individual time series data set, researchers can ask questions about means, standard deviations, and correlations, but they are completely different questions and can produce completely different answers than standard inter-individual difference analyses.

How is that possible?

Let's start with questions about the means and standard deviations, as in our example about students' effort and academic performance. When, in inter-individual-speak, you ask about the average level of effort, you have a bunch of implied meanings embedded—you are really asking about mean level of effort, *averaged across people (at one time point)*. Whereas, in intra-individual-speak, when you ask about the average level of effort, you are really asking about mean level of effort, *averaged across time points for one person*. And when you are asking about standard deviations-- in inter-individual-speak, you are asking about the variability in effort *across people at one time*, whereas in in intra-individual-speak, you are really asking about variability of effort, *across time points for one person*.

So when you get an inter-individual average across people it could be right in the middle of your scale, but an average for one person across time could be high or low, or even in the middle. Since they only have that one data point in common (that one person on their first occasion of measurement), they are statistically independent from each other. Just like the standard deviation – the group's standard deviation could be very high, whereas a particular individual might not show much variation in effort over time. And remember, it could also be the other way around—the group might be very similar in the effort that each of them is exerting (low inter-individual standard deviation), maybe no one is trying very hard because it's an easy academic task; but the individual's efforts across time could be very variable (high intra-individual standard deviation) —because he or she is encountering a series of tasks of all different difficulty levels after that first easy one. Again group and individual—they are completely independent statistically, so could be any combination.

Do correlations also differ depending on whether they are inter-individual and intra-individual?

Indeed. There are the inter-individual correlations we are used to, which tell us about the covariation between variables across different people; where if we get a positive one, we can say "People who try harder also tend to perform better academically." But what about the *intra-individual* correlations? These tell us about the covariation between effort and performance *within one person*. If we get a positive one of these, we can say "When a person tries harder, he or she tends to do better on subsequent performances." Can you also hear the implied rest of these sentences? For inter-individual correlations, we are actually saying, "People who try harder also tend to perform better academically, *compared to people who don't try as hard, who do worse*"; whereas, for intra-individual correlations, we are actually saying "When a person tries harder, he or she tends to do better on subsequent performances, *compared to times when the person doesn't try as hard, when he or she does worse.*"

Don't these sound very similar?

If they do, it may be because we have formulated our theories around intra-individual relationships, but we have been using inter-individual analyses, so we have been back-translating our theories to match up with our methods. Let's consider a situation where the inter-individual and intra-individual correlations are in the opposite direction. For example, researchers find that inter-individually, students who try hard tend to do well, but then the same researcher also finds that intra-individually, when a student tries hard, he or she tends to do more poorly.

Why would that be?

Well, maybe students only try really hard on extremely hard academic tasks, but because the tasks are so hard, they also tend not to do as well on them. Or maybe they only try really hard on important academic assignments, but then they also get anxious about important assignments and so don't perform as well.

The pattern could just as easily be the other way around: Intra-individually, we could find that high effort leads to better subsequent performance, but inter-individually, we could find a negative correlation—students who try harder do worse. Maybe because really smart students do well but without exerting much effort whereas the less prepared students put in a lot of effort but don't have much to show for it in terms of performance outcomes. The point is that inter-individual and intra-individual relationships are statistically independent (because they have only the one data point in common; see Figure 25.3), so the findings could be completely different from each other.

Insert Figure 25.3 about here

But what about studies that try to cover Cattell's whole data cube-- like longitudinal studies that include lots of people and lots of variables *and* lots of time points?

Yes, we love those, don't we? Those can be arrived at from two directions—(1) typical inter-individual studies that we repeat for additional slices, and (2) typical individual time series studies that we repeat for additional people.

Well then why make such a big deal about the differences?

There is one big design difference and one big analytic difference. The big *design* difference is that in standard longitudinal studies, researchers typically are thinking about developmental time scales and so collect information over relatively long intervals (say every 1, 5, or 10 years), which results in relatively fewer time points; whereas in time series studies, researchers typically are thinking about real time or episodic time scales and so collect information over relatively short intervals (weekly, daily, hourly, or continuously) and so have data over many more time points. In fact, for most intra-individual analyses, it is good to have at least 25 points of measurement on each participant, although more is better. So, in general, the time scales of time series studies are nested within the larger time scales of longitudinal studies. The big *analytic* difference, following up on previous discussions, is that we can look at the information contained in longitudinal and time series data sets two different ways. The inter-individual differences way or the intra-individual change way.

Wouldn't all the variation around a single person's score over time be considered error, that is just noise?

Some of it could be, just like in our inter-individual measures. But take a minute and look at the assumption that you are working from here—the assumption that an individual should be exactly the same over time and that any deviation from that single "true" score is error. This assumes complete stability over time—and it is not consistent with our meta-theory (or any other developmental meta-theory). There are lots of systematic reasons why effort might vary over time—the tasks are harder or easier, the person is getting tired (effort is decreasing) or getting better on the task (and so needs less effort), or is more motivated or distracted by social partners, and so on, you get the idea.

So variation (ready for it?) *within* people should not automatically be assumed to reflect error—intra-individual variation over time is not only to be expected and investigated, but also to be recognized as the primary target of developmental study (Nesselroade & Molenaar, 2010; see box). In fact, Ram and Gerstof (2009) argue that researchers should think about both (1) the amount of fluctuation or variability each individual shows (what they call "net interindividual variability") as a marker of a dynamic characteristic that may describe that individual's flexibility, lability, or capacity for change (which may increase or decrease as people age); and (2) the time-ordered dynamic processes (what they call "time-structured intraindividual variability") which capture "the transformations individuals undergo in response to endogenous and exogenous influences (e.g., adaptation)" (p. 778). They provide a useful graphic that depicts these two kinds of information as part of time series information, that are themselves embedded in longer-term longitudinal designs depicting intra-individual development (see Figure 25.4).

Insert Figure 25.4 about here

Why are developmental methodologists interested in the study of "intra-individual variability"?
Well, what can you expect? They are methodologists and technically they are correct, the parts of a longitudinal or time series study that they are targeting are the parts that "inter-individual" methodologists ignore—that is, how single individuals vary over time. But the thing that is easy to miss in that descriptive label is that one of the ways that individuals vary is time-structured. So developmentalists may not recognize that their precious treasure, namely, *individual change over time*, is buried within the study of "intra-individual variability."
As explained by Nesselroade and Ram, "Basic precepts of the study of intraindividual variability are that an individual, at any given moment, is a complex configuration of characteristics and that some of these characteristics are changing from moment to moment, day to day, week to week, whereas others are relatively stable. Thus, instead of being well characterized as a static set of relatively fixed values, individuals exist as complex dynamic systems, many of the characteristics of which are constantly changing. The study of intraindividual variability is focused on how, when, and why the individual changes over time (see, e.g., Baltes, Reese, & Nesselroade, 1977; Nesselroade, 2002)" (2004, p. 10).
Ram et al. (2009) continue, "In recent decades, a growing number of researchers have begun using methods focused on *intraindividual variability* (for overviews, see e.g., Hultsch &

MacDonald, 2004; Lindenberger & von Oertzen, 2006; MacDonald, Nyberg, & Bä̈ckman, 2006; Martin & Hofer, 2004; Moskowitz & Hershberger, 2001; Nesselroade & Ram, 2004; Walls & Schafer, 2006). The general idea, whether applied to the stream of images obtained via functional magnetic resonance imaging (fMRI) or narrative histories obtained via life-reconstruction methods, is that the dynamics (progression) of behavioral processes manifest themselves within persons as *systematic patterns* over time. Those engaged in research on intraindividual variability seek to locate, extract, and understand those patterns" (p. 775).
So, in order to awaken students to the excitement of these methods, we tend to use labels like "intra-individual time series" that highlight their inherent interest to developmentalists, and emphasize the importance of "microtime" to the study of "microgenesis." Methodologists will have the last word, of course, but we are excited to see the study of "intraindividual variability" find its developmental home as part of the larger issue that has come to be depicted as the study of development (from micro- to macro-) as it unfolds along multiple nested time scales.

Okay, my head is starting to turn inside out. How far are we going with this?

Let's just ask time series studies to help us in two ways: to capture individual trajectories over developmental transitions and to capture proximal processes. They can do so much more, but these are two of the most fundamental developmental questions and so would be a great place to start.

STRATEGIES FOR CHARTING INDIVIDUAL TRAJECTORIES OVER DEVELOPMENTAL TRANSITIONS

Dense time-ordered data are essential if we want to chart individual trajectories as they travel over developmental transitions. As argued by Adolph, Robinson, Young, and Gill-Alvarez (2008), "Decades of reliance on cross-sectional designs, demonstration proofs, and broad-sweeping longitudinal approaches have left researchers with a gallery of before and after snapshots, studio portraits of newborns, and fossilized milestones but little understanding of the process of development itself. What we need are accurate, fine-grained depictions of developmental trajectories" (p. 527). Time series data are the key to looking directly at the shapes and the processes of developmental change (Nesselroade & McCollam, 2000). In some ways, we are so used to thinking about development as increases or decreases, perhaps largely because our methods are mostly geared to detecting linear change, that we have lost touch with other possibilities. We include in Figure 25.5 a variety of potential shapes listed by Adolph et al. (2008) along with a beautiful description they provide about the shapes of developmental processes researchers have discovered so far (see box).

Insert Figure 25.5 about here

What is the shape of developmental change?
The staggering variety of developmental trajectories has also contributed to the lack of progress in understanding change processes. The shape of developmental change might assume any number of patterns… For instance, a trajectory might show smooth and monotonic improvements with age, proceeding at a steady pace, as in children's use of retrieval strategies in addition (Siegler, 1996), or with accelerating or decelerating rates of change, as in infants' acquisition of new words (McMurray, 2007) and improvements in toddlers' walking skill (Adolph, Vereijken, & Shrout, 2003), respectively. The path of change may show discontinuities such as abrupt, stage-like shifts in performance between periods of relative stability, as in children's stage-like success on many Piagetian tasks (Shultz, 1998), their abrupt shift from ignoring to marking the past tense of verbs (Marcus et al., 1992), and the sudden transition to grasping while reaching (Wimmers, Savelsbergh, Beek, & Hopkins, 1998). Variability may increase during the period of acquisition, with a series of reversals vacillating between less and more mature expressions of the skill, as in children's conservation of volume (van der Maas & Molenaar, 1992). Or a variable acquisition period may entail use of multiple, unsystematic use of strategies between incorrect and correct endpoints, as in children's gesture–speech mismatches (Church & Goldin-Meadow, 1986) and their acquisition of a theory of mind (Flynn, 2006). Discontinuities can take on other shapes, such as episodic changes, where development advances like climbing a staircase, with sudden improvements in children's conceptual understanding separated by long periods in a single stage (Case & Okamoto, 1996) or small fits and starts of physical growth separated by periods of stasis (Lampl, Veldhuis, & Johnson, 1992). Discontinuities can involve reversible patterns of change, as in the U-shaped course of children's success on math equivalence problems (McNeil, 2007), infants' alternating stepping movements (Thelen, 1984), the classic description of overregularizations in past-tense verb forms (Marcus et al., 1992), the inverted-U-shaped trajectory of cognition over the life span (Craik & Bialystok, 2006), and infants' zigzag-shaped error rate in detecting threats to balance as they learn to sit, crawl, cruise, and walk (Adolph, 2005). (Adolph, Robinson, Young, Gill-Alvarez, 2008, p. 527-528)

Do we dare to ask why they are so important?

Of course--- they are the beginning of developmental science's goals—descriptions of normative development. But this is not just any development, that is, not just any intra-individual change between two or more arbitrary points. This is the real McCoy-- development across transitions from one qualitatively different state to another. And then time series can take researchers one step further and help us look at *each individual's* developmental trajectory, maybe a different shape even, so we are looking at individual differences in developmental trajectories. And we can group people by the shape of their trajectories or their timing, and then we can even see whether certain factors can predict the nature of these trajectories or membership in the groups, so we are creeping into explanatory territory.

Haven't we already seen the movie starring individual trajectories—using longitudinal methods and growth curves and latent change scores?

Absolutely. But this is where awareness of nested time scales helps us to see what else time series methods may bring to this movie. Instead of 3 or 4 or 5 time points used to estimate a growth curve over multiple years, researchers would have 50 or 100 or more densely spaced points. If longitudinal studies provide a movie (as opposed to the snapshots of cross sectional studies), then time series investigations are akin to frame-by-frame slow motion views. One way to think about it is that time series studies provide greater "resolution."

What can researchers do with all these data points?

Many dense time points are required if we are going to be able to distinguish among different potential shapes of these curves and to identify alternative pathways that different children may take. Dense time points are also needed to pinpoint the timing of change—the age of onset of a particular skill or competence, compared to other skills, whose leading and lagging timing may settle questions about which developmental changes scaffold subsequent changes. These may also allow researchers to examine the effects of prior experiences (especially proximal processes) leading up to the onset of a developmental transition. In short, dense time points allow researchers to examine processes of development over a transition—the timing of the onset, the duration of the acquisition period, and stabilization of the target developmental process. These are the change processes that developmental theories are designed to explain, so they are foundational for developmental research.

It seems like these time series designs are good for short intense measurement bursts, right?

Yes, that is general how they are used.

But, if they are tuned to real or episodic time, how can they manage to be lucky enough to capture development as it is actually happening in real time?

This is the million dollar design question for researchers who want to use time series designs to actually look at developmental transitions. For many researchers who conduct time series studies, these methods are the best strategy for seizing a slice of "real life"--- a segment of ecologically-valid experience shorn of the problems with retrospective recall. From this perspective, any time researchers throw their time-series bucket into the well of everyday life, they will bring up good water (i.e., informative data). For developmentalists, however, the proposition is more complicated. Most developmentalists do not think that developmental transitions are homogeneously distributed across any of the time scales we consider—across real time, episodic time, or chronological time. So, for us, it is more like throwing your time series bucket in the river and trying to come up with a fish—researchers can't just toss them in anywhere or at any time.

How do developmentalists decide where to fish?

Very carefully. Remember how we decided to use cross-sectional studies (with all their flaws) to give us a very rough idea about where we might want locate our more effort-intensive longitudinal studies? Well, we can use our longitudinal studies (with their big time gaps) to give us a rough idea about where we might wish to cast our finer time series nets.

How will we know the location when we see it?

As everyone agrees, "decisions about design and scheduling of assessments need to be driven by the natural history of the target behavior" (Shiffman et al., 2008, p.16). Hence, there are several possible strategies. First, depending on the target developmental trajectory, researchers can tie the design to some objective markers of a transition—including transitions that have a large physical component, like puberty or locomotion; or ones that are largely social, like the birth of a new sibling or starting school. Sometimes observers or participants themselves can signal researchers about when a transition is starting, as when parents report that young child is beginning to understand language or is wanting to dress independently. Researchers can think of these as providing cues for their entry. The action or performance itself may signal the beginnings of a transition, indicated by increasing variability or fluctuations that suggest perturbations in the underlying system.

Mostly there is no substitute for the empirical discovery of the window. An excellent set of guidelines are offered by Adolph et al. (2008), who describe them as a set of recommendations for determining sampling intervals, but we see them as also including strategies for locating the developmental window of interest (see box). In pilot studies, the best strategy is to "sample as small as you can," with the notion that researchers can always use their data to see what happens empirically when they skip over some of the intervals, but they can never use their data to see what would happen if they used shorter intervals.

Finding the window: Sampling in time series analyses.
When researchers step off the comfortable plane of conventional studies, such as ones that take place on only one occasion of measurement or that are organized by the standard yearly or bi-yearly calendar of longitudinal designs, they are left with few guideposts to indicate how

frequently they should be sampling their target phenomenon. Because the appropriate time gaps depend on the phenomenon under study, Adolph et al., 2008, provide the following strategies for empirically locating the best intervals for sampling:	
1.	***Determine the base rate.*** In most cases, skills of interest to developmental psychologists eventually reach a level of stable, consistent performance. Estimating the typical rate at which the skill is expressed is important in planning how to sample the acquisition period and/or the more mature, stable period. (p. 540).
2.	***Find the acquisition period.*** For most kinds of skills, researchers are likely to initiate a study with some knowledge of the timeframe encompassing significant development. Some aspects of children's behavior emerge over a span of weeks; other aspects may require years. A preliminary investigation with economical sampling (at monthly intervals or longer) may be useful to identify the approximate age range for the acquisition period and thereby narrow the span of time requiring more detailed examination (p. 540).
3.	***Sample as small as you can.*** If the objective is to accurately portray the shape of a developmental process, it is crucial to sample data at the minimum, practicable interval, especially over the ages spanning the acquisition period. Researchers should consider the default rate for most kinds of child behavior to be daily sampling... One reason to consider daily sampling a privileged sampling interval is that it reflects the nearly ubiquitous influence of 24-h circadian rhythms on human psychological functions. Skills expressed each day are interrupted by sleep each night, during which the day's activities and experiences may be absent, suppressed, forgotten, or consolidated (p. 540).
4.	***Look before the onset**.* To satisfy the objective of describing the entire trajectory, especially the shape of the acquisition period, researchers need to focus attention on the ages when the skill is first expressed. A preliminary investigation using coarse sampling should be useful for obtaining an initial estimate of an onset age, but… estimates of onset ages based on infrequent sampling are likely to produce large delay errors, and such errors increase with larger sampling intervals... Therefore, the earliest expression of the skill is likely to occur before the earliest onset age identified by relatively infrequent sampling. As a consequence, more dense sampling efforts should include ages prior to the crude estimate of onset (p. 540).
5.	***Look for changes in variability**.* For skills indexed by binary data, trajectories may be step-like or variable. The latter will show fluctuations prior to attaining a stable level of performance. If the base rate of occurrence is high but <1 during the period of stable performance (>.8), then a variable acquisition period will likely consist of an increased number of transitions. In contrast, if the base rate is low (<.5), then a variable acquisition period should show a lower number of transitions relative to the later period of stability… Thus, smoothing techniques can be useful in demarcating changes in the level of variability of performance, which can help researchers verify that they have distinguished the acquisition and stable periods (p. 540-541).

So researchers should be looking for developmental windows?

Yes, you can think about time series studies as bursts of measurements that you can eventually lower over longitudinal time gaps that show promise of containing developmental transitions (see Figure 25.6). Such methods allow researchers to "zoom in" during a particular time frame (or part of the developmental film) that researchers believe is of significance because it contains a transition or other developmental target.

Insert Figure 25.6 about here

Do time series designs have the same problems as other kinds of longitudinal studies?

Yes, chief among them selection, drop-out, compliance, and reactivity. You can imagine the recruitment challenges when explaining to potential participants—all you have to do is fill out an entry for every social interaction you have all day every day, or complete this checklist covering 50 kinds of child behaviors every night before bed. So participants are likely to be selected. It is also a challenge to retain them until the end of the study. As would be expected, compliance can also be a problem, as is missing data. A major problem in the integrity of data seems to be created by participants who complete some portion of their assessments all at one time right before the deadline, back-dating them to look like they were collected on time and in sequence. Use of electronic devices with time stamps can help solve this problem, without seeming to lead to lower levels of completion. Reactivity is also a natural concern-- completing a diary every day (about anything) naturally promotes greater awareness and self-consciousness about those behaviors, and so may change them (Bolger et al., 2003). That's why daily self-monitoring studies were considered by behaviorists in the day to be intervention studies. Research has tried to directly examine these concerns-- which, with the exception of falsification of paper diaries, have turned out to be less problematic than feared (e.g., Shiffman et al., 2008). Books, chapters, and papers are chock full of ideas about how to minimize or directly examine these issues.

This sounds like a lot of work.

Yes, and that doesn't even include the thought and care that goes in to reconstructing these developmental trajectories from the hundreds of time series data points per participant (see box).

But, really, just think about it—historical improvements in recording technology and quantitative methodology have conspired to make the present moment a wonderful era for collecting and making sense of time series data. The rewards, as with sequential observations, are that you get to *look* right at your phenomenon. Perhaps the vivid descriptions of infant motor development gleaned from fine-grained time series studies can provide inspiration for researchers who are studying other phenomena. The candid depictions of infants pulling up on couches and then abruptly sitting back down on their diapered bottoms, and pulling up again on trembling legs, taking tentative steps while holding on, eventually cruising around coffee tables, all the while using the cross-pattern crawl to cover long distances across living room deserts devoid of supports, to arrive at the goal, and pull up so that at least one arm is available for the target smash and grab. Do we sound jealous? We should be. These are just the kinds of detailed process-oriented accounts we developmentalists have been longing to construct. Researchers who dedicate themselves to time series studies may also have the honor of being the first person to publish this kind of information about their own phenomenon. A rare treat.

The challenges of recovering meaningful trajectories from time series data.
There is no getting around it: the kinds of data that come from time series studies are very "busy." When a researcher looks at fifty or a hundred (or more) data points for a single measure for a single person arrayed across time, the most striking feature is their volatility—their variation. If that same researcher imagines that there are many more variables and many more individuals to meet and greet, it becomes clear that he or she will need some tools to extract the "developmental signal" from the rest of the signal (likely tied up in contextual variation, social partners, and so forth) as well as the noise. To accomplish this, it is useful to think about quantitative strategies as "filters" that allow the researcher to preserve and highlight selected portions of the time-ordered information.

Smoothing functions?

STRATEGIES FOR CHARTING INDIVIDUAL PROXIMAL PROCESSES

Let's think about a second important use that developmentalists have for time series methodology, namely, capturing proximal processes. If such studies are designed well, inside those dense time-ordered streams of data is delicious information about sequences of events and interaction processes. Remember our sequential observations? Well, if you think about it long enough, you will realize that continuous real time coding of behavior produces time series of categorical data. So it makes sense that we can also use other kinds of time series data to learn about the *order* of our processes. For example, thinking back to our long-running illustration of student effort and academic performance, we decided that time series data allow us to ask the intra-individual question, "When a student tries harder, is he or she is more likely to perform better on an academic task (compared to times when he or she does not try as hard)?" At the same time, we can also ask the intra-individual question about the *reciprocal* process, namely, "When a student performs better on an academic task, is he or she is more likely to try harder the next time (compared to times he or she does not perform as well)?".

Hey wait a second. Aren't these just intra-individual *correlations* and so aren't we under arrest if we try to infer any directionality?

It's good to be skeptical, but in this case, the data actually are time-ordered, so we are not *inferring* directionality. As long as the design allows it, we are able to empirically examine the *actual* sequence. So we can look at sequences in which effort came before subsequent performance, as well as sequences in which effort followed previous performance.

Why do you keep saying "if the design allows it"?

Because there are many ways to collect time series data. Some of them are better than others for producing the kinds of sequential information we want about our proximal processes.

What are the design features we should be thinking about?

The key issues for time series designs, not surprisingly, are about *timing*: what initiates a measurement or report and how often they take place. Proponents of time series studies typically distinguish three kinds of designs, depending on whether reports are provided: (1) in response to researchers' signals (typically random within blocks of time), (2) at regular time intervals (e.g., every night), or (3) in response to pre-specified events whenever they occur in their natural timing (see box). These three kinds of designs can also be combined in many different ways. The second issue is time sampling, which refers to how frequently participants respond. This can range from continuous or nearly continuous data (typically provided by technological devices) to multiple times per day to daily, weekly, or monthly.

Three kinds of time series designs.	
Designs are usually differentiated based on how the recording of information is triggered and organized:	
1.	***Signal-contingent:*** Participants or observers report whenever they are signaled by the researcher, at fixed, random, or some combination of intervals within fixed blocks of time, usually on current events or states.
2.	***Interval contingent:*** Participants or observers report at some regular predetermined Interval, based on theoretical or logically meaningful units of time (e.g., once or twice daily), usually on events or states that have happened since the previous report.
3.	***Event-contingent***: Participants or observers report whenever a pre-specified class of event occurs (e.g., social interaction, hassle, use of alcohol).

How do we figure out the design of a time series study?

It depends on the target developmental trajectory and their generative proximal processes. So this would be a good time to go dig out the list of proximal processes that you hypothesized might promote and undermine your MacGuffin (and anti-MacGuffin). This is what you are after.

How do we capture them?

This is the key nut to crack. You are on the hunt for episodes or episodic processes, so this narrows down your design choices. Since we do not expect proximal processes to be distributed homogeneously across the day, it seems like random sampling would only rarely be of use. Just as we had to think carefully about timing and location to figure out when and where we would be likely to find the "fish" of developmental transitions, so too do we have to think carefully about the timing and location for finding the "fish" of proximal processes. One reason why time series studies often produce findings that seem ephemeral ("Boy, mood sure does vary!") or anchored only by the calendar ("Monday is the most stress-filled day") instead of by important psychological and social processes is because they are often missing a design frame—one that could be provided by episodes or target experiences.

Then what are the options?

There are at least two good design options. Participants can report on events as they unfold, or they can recall recent events at the end of the day. The key in both cases is to try to get the reports timed and anchored to concrete events, so that they bring sequence and order to the data.

How do we do that?

Researchers have to really get inside the timing of the processes they are trying to understand. Let's think of two very different examples of time series designs that accomplished this. In time series studies of alcohol use, researchers used daily diary methods to examine the connection between stressful daily events and the amount of alcohol consumed. However, when these two things were monitored every day, it became clear that there was a chicken-and-egg problem: Was it that more stressful daily events resulted in more drinking (called the "drinking to cope" hypothesis), or (equally plausibly) did more drinking result in more stressful events? The typically daily diary design did not allow them to distinguish between these two possibilities.

In response to this seemingly intractable problem, researchers used their knowledge about the cyclicity and timing of alcohol use to rework their time series designs. They asked participants to fill out brief diaries *twice* a day: (1) Once when they got home from work (in the late afternoon or early evening) but *before* they started drinking, when they would report on the day's stressful events, and (2) once the *next* morning before the regular day started, when they would report about their drinking the *previous* evening and any stressful events they experienced that night (Mohr, Armeli, Tennen, & Todd, 2010). This design built into the data the order and sequence needed to distinguish stressful events that happened *before* drinking, from those that happened *during* drinking, from those that happened the day *after* drinking. So clever.

Can you provide another example of an episodic time series design?

Another example can be found in a time series study of students' effort, perceived control, and academic performance (Schmitz & Skinner, 1993). Rather than use a fixed interval design, in which students report on all these constructs each day or week, researchers thought carefully about the structure of students' daily experiences at school and decided to organize the design around *episodes* of academic work, operationalized as all the graded assignments (homeworks and tests) that students completed in their normal sequence and frequency (see Figure 25.7). These events became the *anchors* that created strategic entry points for structuring the timing of assessments. Students provided information at two key moments: (1) *After* the assignment was completed but *before* it was graded, children provided information about their objective effort (time spent completing the homework or studying for the test), the subjective effort they had expended, the difficulty of the assignment, and their mood and anxiety; and (2) *after* the grades were returned but *before* a new assignment was begun, children reported their actual performance (number of correct and errors on the graded assignment), their subjective evaluation of their performance, their beliefs about the likely causes of their mistakes and correct answers, and their expected control over the next assignment.

Insert Figure 25.7 about here

How does this design help researchers?

That's the beauty of thinking carefully about time series designs. Because of the timing of the reports—before and after graded assignments, researchers can distinguish (1) the effects of effort on subsequent performance, (2) the effects of performance on subsequent attributions, (3) the effect of attributions on subsequent expectations of control; and (4) the effects of control expectations on subsequent effort exertion. Voila! These are the beliefs, effort, and performance cycles or episodes that researchers had been hypothesizing about, but had not been able to really *see* before, even in their longitudinal studies using 5 or 6 measurements. Such a time series study uses 20 to 40 episodes to create estimates of average intra-individual correlations.

What kinds of new things could researchers learn?

Cool things—let's just give two examples that contrast inter-individual and intra-individual findings. First, the link that was assumed to be most solid, namely, between effort and subsequent performance, was more complex than expected (see box). Although the inter-individual analyses, average effort exertion was positively related to average performance, the results from the multivariate time series analysis of individual children showed that some children experience that connection (i.e., that higher effort leads to subsequently higher performance) and some do *not;* the experience of this kind of ineffective effort may be a key to helplessness.

What is the connection between effort and performance?	
In time series studies, the seemingly simple prediction that effort improves performance can be tested in at least three different ways. In this study (Schmitz & Skinner, 1993), it turned out that the three kinds of methods created different "lines of sight" about effort (operationalized as time spent and exertion)—and that, even though the answers differed, together they created a richer picture of the role of effort in performance.	
1.	***Inter-individually***, the question "Do children who try harder on their graded assignments (i.e., homeworks and tests) perform better?" can be answered by examining the correlation between children's effort scores (averaged across all graded performances) and their performances. As expected, effort exertion was *positively* connected to performance, but surprisingly, time spent was *negatively* connected. This negative correlation only made sense in analyses that took children's IQ and task difficulty into account: Children with higher IQ scores put in less time but performed better than children with low IQ scores, and all children put more time into tasks that were more difficult, but did not perform as well on them. In sum, children performed better who exerted themselves more, who needed less time for assignments, who were smarter, and who rated tasks as easier.
2.	***Intra-individually***, the question "When children try harder, do they perform better, compared to times when they do not try as hard?" can be answered by examining the correlation between effort on specific assignments and subsequent performance on those assignments. Contrary to inter-individual findings, effort exertion was not intra-individually connected to performance. Similar to inter-individual findings, time spent was negatively connected to performance—more difficult assignments resulted in both more time spent and worse performance.
3.	***Multivariate time series*** could be used to answer the question, "What is the connection between this child's effort and their subsequent performance?". For some children effort exertion on specific assignments was positively connected to subsequent performance on those assignments, but for some children it was not. Their effort was not effective in improving performance.

Second, inter- and intra-individual findings differed for a very interesting kind of attribution—attributing failure to "unknown" causes. Inter-individual findings (not just in this study but in general) suggest that these are toxic- children who attribute failure to unknown causes are at risk for disengagement, giving up, helplessness, and poor performance. However, in the intra-individual findings (which are the first of this kind to be published), when children viewed themselves as successful, they were more likely to attribute their errors to unknown causes, but this did not have any subsequent negative impact on perceived control. Even though a general pattern of reliance on unknown attributions was maladaptive (inter-individually), the intra-individual use of unknown attributions for the occasional failure seemed to do no harm, perhaps they even brushed these experiences off, minimizing their negative impact.

What parts of the designs make time series studies so revealing?

Designs that get inside the time structure of your proximal processes, both the anchors of the episodes and the time gap over which they operate or cycle. This allows the sequence in time series data to reveal something about the time-ordered steps in the researchers' target processes.

Where is the "development" in these kinds of time series designs?

It is in the potential of these kinds of proximal processes to generate and shape the directionality of development. You can imagine that (and eventually explore whether) the two intra-individual systems captured in the multivariate time series analyses for individual children—one organized around effective and one around ineffective effort—will cumulatively generate very different experiences and appraisals of control and so guide their children down very different paths of academic development. You can also see that the implications for the kinds of interventions needed to optimize development would depend completely on a diagnosis of the functioning of such individual systems. The typical intervention to improve performance, in which children are encouraged to believe in the power of effort, may boomerang on children whose effort is ineffective—greater effort may lead to more frustration and increased helplessness. Such children may benefit more from interventions that help them generate and deploy more effective strategies.

Can even more development be packed into time series designs?

Yes, it can. Remember that kind of "top-down" causality we were thinking about as part of the circular causality of relational meta-theories? This kind of causality organizes and shapes the functioning of the lower-order processes it contains, and so should influence the way that proximal processes function. We can use time series designs to examine whether intra-individual connections constituting our processes differ or change across developmental transitions.

Can you give an example?

In our time series study of control, effort, and performance, we might wonder what happens to children between grades four and six, before and after they cross over that differentiation of ability from effort. Does that change the strongest intra-individual predictors of effort, so that before the differentiation, children's beliefs about effort are the strongest predictors of their subsequent exertion, whereas after, they rely more and more on their beliefs about ability? Time series analyses can answer these questions (p.s. the answer is "yes).

Designs that frame the time series as occurring before, during, or after a developmental transition have the potential to tell us how these higher-order organizations are shaping our lower-order processes (which are themselves generating higher-order changes—you know the drill). In principle any transition can serve as a frame, as long as it provides windows of before-during-and after, whether such frames be psychological (like our example of the effort-ability differentiation in causal reasoning), social (e.g., entering a new social system or the onset of romantic relationships) or contextual (e.g., starting school or parental divorce). Because time series studies are so effort-intensive (for participants as well as researchers), the guidelines offered by Adolph et al, (2008) in identifying developmental transitions can be useful to creating such customized designs.

Are there any other times series methods that we should be on the look out for?

There are many (e.g., see the special section on intra-individual variability and aging, Ram, Lindenberger, & Blanchard-Fields, 2009). We will just mention three—dyadic time series, idiographic filters for measurement, and state space grids. *Dyadic time series* designs, as you can guess from its moniker, involve integrating time series data streams from two people (or other sources of information)—these are complex and challenging designs and analyses (see box) but you can imagine that they would bring us closer to proximal processes, which involve at least two interaction partners and their sequential turn-taking, aka, the dance (Nesselroade & Ram, 2004). Again, if we have eyes to see, here we are looking directly at the process of interest.

To infinity and beyond: Dyadic time series studies
As explained by Nesselroade and Ram (2004) in their discussion of methods for modeling intra-individual variability, a "key concept of this modeling approach is the *coupling* of systems and/or subsystems... Subsystems that influence one another are said to be coupled. Such interrelations can be modeled explicitly and are described by *coupling* parameters... These parameters explicitly model how the dynamics or changes in one system influence the dynamics in another system" (p. 19).
"Extending the notions of intraindividual variability to spatial context, the environment in which an individual exists is itself constantly changing (e.g., Ford & Lerner, 1992). This intracontextual variability can also be modeled... [T]he inclusion of coupling parameters in the models allows for the identification of patterns in how the dynamics, or changes, in the contextual variables influence changes in the individual variables. Although modeling the interacting dynamics of multiple variables in the space can become rather complicated, it promises a closer understanding of how people interact with other parts of themselves and their environments" (p. 22-23).
"It is possible… to model the interactions between persons or processes. For example… Ferrer and Nesselroade [2003] used dynamic factor analysis to investigate the interrelations in mood between a husband and wife. By modeling mood ratings over time, they found that, within the dyad defined by the married couple, the husband's current mood affected the wife's future mood, but not vice versa: The wife's current mood did not affect the husband's future mood. The model captures each partner's mood process within the context of their relationship" (p. 24).
See also: Steele, J. S., Ferrer, E., & Nesselroade, J. R. (2013). An idiographic approach to estimating models of dyadic interactions with differential equations. *Psychometrika*, 1-26.

What are idiographic filters?

The notion of *idiographic filters* represent a potentially revolutionary application of intra-individual methodology to measurement (see box). Built on the analogy of a "syndrome," which "presumes a common core of meaning across individuals but allows different but overlapping subsets of indicators of that core from one individual to another," these methods allow "individually tailored measurement schemes for the same underlying higher order constructs, hence the term *idiographic filter*. Use of the idiographic filter is tantamount to an assertion that the underlying mechanisms are the same (nomothetic relations) but the observable manifestations of those mechanisms reflect individuality (idiographic relations)" (Boker et al., 2009, p. 861).

Individual measurement: Idiographic filters and higher-order equivalence
If the appropriate unit of analysis is the individual, what does this imply for measurement? For starters, it encourages researchers to question one of the basic assumptions in inter-individual measurement work, namely that good survey measures are ones that show invariance in the factor loadings of items on their designated construct dimensions. *Idiographic filters* provide an alternative that allow the connections between specific markers and the higher-order dimensions to differ from individual to individual, as long as the higher-order dimensions of the construct show invariant relationships to each other. This allows idiographic measurement at the level, say, of item loading on dimensions, combined with nomothetic measurement at the level of the connections among the dimensions themselves. As explained by Boker, Ram, & Nesselroade (2009),
"Termed the *idiographic filter*, the proposal explicitly recognizes that individuals and subgroups differ in important ways in how they construe items and in their learning and conditioning histories and frankly accepts the possibility that a rigidly standardized measurement framework at the observable level may not be the most appropriate way to proceed with the assessment of abstract constructs. Rather, the idiographic filter rests on individual- or subgroup-level factor analyses in which, to the extent possible, theory-guided conceptions are used; these conceptions do not impose strictly invariant factor loadings across comparisons but, instead, allow for necessary individuality in the manifest expression of underlying constructs (the factor loadings). Researchers impose rigor by defining invariance on the relations among the constructs (the factor intercorrelations). Thus, the pattern of relations between constructs and observable indicators (the factor loadings) can exhibit idiosyncrasies, but the interrelations of the constructs—the factor intercorrelations—are invariant across individuals (or subgroups, if that is the basis of the analyses). The singularly important feature of this resolution is that if one now factor analyzes the intercorrelations of the factors (i.e., conducts a second-order factor analysis; Loehlin, 1998), those factor loadings will be metrically invariant across analyses, thus reinstituting the classical notion of factorial invariance but at a more abstract level. Moreover, transformations can be performed to obtain the loadings of the manifest variables directly on the second or higher order factors" (p. 861).

What are state space grids?

The use of *state space grids* to analyze time series data comes from researchers interested in nonlinear dynamic systems, who were looking for ways to represent time-ordered changes in the states that dynamic systems visit and dwell in over time (Lewis, Lamey, & Douglas, 1999; see box). Some of the most interesting plots can be constructed from dyadic interactions between social partners, say between mother and child. To capture the directionality of exchanges, these grids have the flexibility to allow researchers to plot different sequences separately--distinguishing combinations in which the dyadic exchange was in the order "mother-then-child" from one in the order "child-then-mother." Such plots would then have the potential to capture both the order *within* interactions that makes sequential observations so informative as well as the movement of these sequences over.

Ho do researchers use state space grids?
As explained by Hollenstein (2007), "[t]he SSG method is a graphical approach that utilizes ordinal data and quantifies these data according to two dimensions that define the state space for the system. As an example, consider a parent–child dyad as a system. With this method, the dyad's behavioral trajectory (i.e., the sequence of behavioral states observed during an interaction) is plotted as it proceeds in real time on a grid representing all possible behavioral combinations. Each cell of the grid represents the simultaneous intersection of each dyad member's behavior. The parent's coded behavior is plotted on the *x*-axis and the child's behavior is plotted on the *y*-axis. Any time there is a change in either person's behavior a new point is plotted in the cell representing that joint behavior and a line is drawn connecting the new point and the previous point. Thus, the grid represents a sequence of dyadic events…"
"GridWare 1.1 (Lamey, Hollenstein, Lewis, & Granic, 2004) [is] a free program that can be downloaded from the web (www.statespacegrids. org). Any time series with two or more synchronized streams of categorical data can be used as input. The format required of the data files is a tab-delimited text file for each trajectory that has at least three columns: Time of Onset (or Event Number for event-based data lacking duration information), and one column of sequential data for each axis (i.e., mother behavior and child behavior)... Thus, any researcher interested in the dynamics among two synchronized variables can easily use this technique. In fact, even though the method was developed with [dynamic systems] research in mind, it is not necessary to adopt this approach in order to find it valuable. In general, there are three ways that SSGs are useful: (1) as a visual tool to depict the temporal patterns among two (or more) variables that are synchronized in time, (2) as an exploratory tool for developing hypotheses about processes that unfold in time, and (3) as a source of measures not available with existing methods. Each SSG and the measures derived from it can represent a single trajectory (e.g., a sequence of states for one parent–child dyad), a selected group of trajectories (e.g., a control group), and/or the entire sample" (p. 386).

State space grids can be combined with the kinds of developmental frames just mentioned to allow researchers to compare patterns of changes in the system before, during, and after a developmental transition. An example from Hollenstein (2007) is presented in Figure 25.7, which shows the system on two time scales. The boxes along the bottom of the 8are state space grids, showing that (1) prior to the transition, the system is stable in the upper right-hand portion of the state space, then (2) during the transition, the system shows increased variability in its trajectory, until (3) after the transition, it settles in a new stable state in the lower right hand corner of the state space.

Insert Figure 25.8 about here

Is there a take-home message from time series designs?

Maybe the most important lesson is a very simple one: That the unit of interest to developmentalists is the individual (and his or her interactions with his or her individual partners and contexts) across time. Just let that idea sink in.

Methodologically, this idea insists that the way to start any developmental project, after we have collected our hundreds of time series data points, is with *one* individual's data—a *single* participant. Using multivariate time series analyses, we examine the shape and progression of that one person's individual trajectory on our target phenomenon (description), and then we model the time-ordered connections of that one person's scores on that target with all the information that we have been smart enough to gather on the many personal, social, and contextual factors that may be shaping how it changes (explanation). Then we take a coffee break. And then we go get a second participant's data—*one* more person. And we analyze them the same way, and then we see whether the two sets of patterns are comparable or not. In this way, we build our findings, stacking the individuals into groups based on their similarities and differences in patterns of intra-individual change and intra-individual connections (see box).

Replicated time series designs: Building from the individual to the group(s).
"Modern statistical tools for multivariate time-series analysis can be applied not only to the data of a single subject but also to data obtained with multiple subjects in a replicated time-series design. If time series of multiple subjects are available, then in the first step, a subject-specific dynamic systems model is fitted to the data of each subject. In the next step, parameters of these subject-specific dynamic systems models are tested to determine whether they are invariant across subjects. This opens up the possibility that detailed conclusions can be drawn, on the basis of dedicated statistical tests, about the respects in which subjects differ from each other and other respects in which they are homogeneous. Such a finding—namely, that the dynamic systems models fitted to the time series of different subjects have parameters that are invariant across subjects— constitutes an important step along the path to the derivation of nomothetic laws for the structures of intraindividual variation" (Boker, Ram, & Nesselroade, 2009, p. 861).

In this way, researchers are rescued from creating inter-individually average pictures of change and connection that may not characterize a single participant in their entire study. We are rescued from assuming that all individuals (and their trajectories of development and the causal forces that shape them) are exchangeable replicas of each other. Of course, no developmentalist would ever seriously argue for that notion—it's just that we have accidently been converted into champions of that view, not because we believe it, but because we have been hijacked by our use of conventional methods. But we can still get off the plane at its next stop, and take the bus back to our original destination (although the ride may be bumpy and long and the maps are not complete and the roads are just being built). But, on the bright side-- the other people on the bus are fascinating company and you will be learning a great deal about the things that really matter along the way.

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Chapter 26. Person-centered Analysis: Configurations, Lifespaces, and Life-paths

Not I, nor anyone else can travel that road for you.
You must travel it by yourself.
It is not far. It is within reach.
Perhaps you have been on it since you were born, and did not know.
— Walt Whitman, *Leaves of Grass*

Developmental systems perspectives remind researchers that each individual functions and develops as a conscious, active, and intentional part of an integrated, complex, dynamic, and adaptive person-environment system (see box). As explained by David Magnusson (2001), "for empirical research on individual development, the purpose of any study on a specific problem is to contribute to the synthesis and integration of knowledge about how and why individuals function and develop as integrated organisms in real life" (p. 153). As a result, "[t]he important information about an individual is to be found in the organization of working mental, biological and behavioral factors in terms of configurations or patterns at different levels of the whole organism. This feature has important methodological implications" (2001, p. 158).

Holistic people and processes: Leave Humpty-dumpty back together again.	
1.	The manner in which an individual functions in a real situation represents an integrated, complex, dynamic, and adaptive process. It has the main properties of holistic processes (Magnusson, 2001, p. 154)
2.	An individual develops as an active participant in an integrated person-environment system of higher order (Bergman et al., 2003, p. 7).
3.	In this integrated process a broad range of elements in the individual and in the environment are involved and integrated: the brain, perception and cognition (including automatic processing), emotions and values, the physiological system, and behavior, on the part of the individual, and the physical and social aspects of the proximal situation, particularly as it is interpreted by the individual and because it offers possibilities and constraints for adaptive responses (Magnusson, 2001, p. 154).
4.	The current organization within the individual, within the context, and in the inter-relationships between them all influence the concurrent functioning of the individual and shape his or her future organization and development.
5.	This means that over time, the individual developmental process is driven by a nested system of mental, biological, and behavioral factors in the individual and social, cultural, and physical factors in the environment (Bergman et al., 2003, p. 10).

What are some of the implications of this approach for methods?

Because the individuals we are so keen to understand are integrated coherent wholes, their parts cannot be clipped off and studied in isolation.

Is this the idea that you keep illustrating by offering to rip out people's hearts and plop them on the table, and then pointing out that by looking at this isolated little heart, we can no longer understand anything about how it really beats and works?

Well, yes. But we want to go beyond that dramatic illustration to think more generally about what this "holism" means for methods of studying human development.

Okay, like what?

First, there is the idea of the biopsychosociocultural individual, who always is comprised of multileveled attributes. If you remember, we brought this idea to conceptualizations by encouraging students to continually push themselves to "embody" and "contextualize" their psychological and social phenomena. And to examine how all these attributes work together at the same time and then over time.

So how does that affect our methods?

Well, we hate to keep bringing things like this up, but most psychological researchers, including developmental scientists, are focused on "variable-centered" analytic strategies.

How can that be true, when most researchers have never heard of "variable-centered" analyses?

The other name for them is "that's just the way we do things around here." Conventional analyses are so ubiquitous that they don't have to go by their real names. Remember "correlations"? They did not have to identify themselves as "inter-individual correlations" until "intra-individual correlations" showed up on the scene to challenge them for the title.

Okay—so what are "variable-centered" analyses?

As their name suggests, they are analyses that are focused on variables: the means of variables, their standard deviations, and how the variables "perform," how they are relate dto each other. Thus, when we say that we study "engagement" or "self-regulation" or "identity," that statement is more literal than we may realize: We are studying the variables.

Instead of?

Instead of "persons," "whole persons"—who are made up of a variety of attributes, and so would be studied as combinations of variables.

How could researchers ever study *whole* people? Aren't people made up on an infinite number of attributes?

Of course. However, as Bergman et al. explain, "the holistic integrated model for individual functioning and individual development does not imply that the entire system of an individual must be studied in every research endeavor. The application of a common model of nature for research in the natural sciences never implied that the whole universe should be investigated in every study" (2003, p. 11).

The key idea is that, even after researchers have selected the subset of attributes and variables that they will focus on, it is not the individual variables that are of interest, it is their combinations, as a way to characterize individual people or subgroups of people. So, as opposed to "variable-centered" approaches, these are called "person-centered" or "pattern-centered" approaches. As Bergman et al. explain further, "[t]he idea is to treat a whole pattern of information as the indivisible unit of analysis instead of the variable, which is the usual unit of analysis. In other words, the information *Gestalt* is the focus, not the separate parts" (2003, p. 1).

Why does this keep happening to developmentalists?

As you know, in the Cartesian-meta-world of science, a focus on splits and parts is very common. Once you know what to look for, you will see it in many professions. You may have noticed that doctors are often reminded that they are not treating “liver disease” or “cancer;” they are treating “patients.” And teachers do not teach “math” or “social studies,” they teach students.

Can you give an example of a variable-centered approach?

Okay, lets’ start with a single construct, like engagement, which (like almost all psychological constructs worth their salt) is multi-dimensional. It includes both good news (engagement) and bad news (disaffection) as well as behavioral and emotional components of each. And let’s suppose that we focus on engagement as a variable. If we rank order all of our participants in terms of their engagement scores (in imaginary preparation for, say, calculating a correlation or regression), we just made some assumptions about how our participants are organized in terms of their engagement.

What assumption?

Well, at the top of our rankings are participants whose profile of scores for the sub-dimensions of engagement looks like this: high behavioral engagement and high emotional engagement, combined with low behavioral disaffection and low emotional disaffection.

How can you be so sure?

Because that’s the only way to get the highest scores on engagement—you have to be high on each good news component and low on all the bad news components that are going to be reverse-coded when they are combined. Using this same logic, we also know exactly what the profile looks like for students who are at the bottom of our rankings: They are the mirror image, that is, high behavioral disaffection and high emotional disaffection, combined with low behavioral engagement and low emotional engagement. That’s the way to get the lowest scores.

What's the problem?

Think of all the students in the middle of our rankings: children who are trying hard but are very anxious (high behavioral engagement and high emotional disaffection), students who are passive but satisfied (low behavioral engagement and high emotional engagement), ones who are active but bored, or interested but off-task, and so on. All these students, by virtue of their combinations of scores-- not high on everything but not low on everything-- are mooshed up in the middle. By focusing on the *variable* of engagement, which linearly combines all the subcomponents, we cannot distinguish these different kinds of students-- because they all have similar mid-range scores.

But don't those sub-groups differ in important ways?

It seems as if they would. Each might require a different kind of support from teachers or parents, or they might differ in how likely they will be to drop out. At its most general, we could say that it is possible that these groups differ qualitatively from each other-- perhaps in terms of their antecedent attributes or experiences, their concurrent life spaces, or their future life paths.

Pattern-centered approaches to variables.
Holistic-interactionist perspectives on *people* regard individuals as organized functional systems. At the same time, this perspective implies a particular view of *variables* as well. As explained by Bergman et al. (2003), "[t]he role of a single variable and its significance for the functioning and development of the individual is dependent on its context of other simultaneously operating factors; that is, its contribution to the understanding of the developmental processes of individuals cannot be finally investigated and understood in isolation from its context" (p. 17). Hence, both individuals and their subsystems (as captured by variables) are contextualized in their functioning.

How could we figure that out?

That's exactly what person-centered and pattern-centered analyses are designed to do (see box): They allow researchers to discover whether there are "sub-groups" of participants in their data, and when they have been identified, researchers can then directly examine whether those groups differ in important ways.

But what happens to the participants who were ranked high and low on our variable, engagement?

They will likely show up as two of the sub-groups-- but they may not be the only sub-groups. And even more interesting than just using one multi-dimensional variable to look for subgroups, researchers can combine *multiple variables* to create sub-groups—ones who differ on profiles or combinations of multiple variables.

A spectrum of analytic approaches to the study of individuals and groups.		
Every person is in certain respects:		
1.	Like all other people	***Nomothetic***: Study of the general laws governing all people. From the Greek "nomos," meaning "law."
	Examples of methods:	***Variable-centered analyses.*** The aim of variable-centered analyses, like correlations or regressions, is the examination of relations between variables across all persons (Magnusson & Bergmann, 1988). This assumes homogeneity of sample or population; an assumption akin to the search for nomothetic knowledge at sample level. Findings apply to everyone in general, but to no-one in particular.
2.	Like no other people	***Idiographic***: Study of the ways that individuals are unique. From the Greek "idios," meaning "own" or "private."
	Examples of methods:	***Case analyses***. The aim of case study is an examination of the idiosyncratic details of a single life (Runyan, 1982).Findings apply to this person in particular, no-one in general.
3.	Like some other people	***Idiothetic***: Study of classes or types of persons. From the Greek "idios" meaning "own" or "private," and "thetic" meaning to "put or place."
	Examples of methods:	***Person-centered analyses.*** The aim of person-centered approaches, like cluster analysis, is an examination of the patterning among variables within persons (Magnusson & Bergmann, 1988). This assumes heterogeneity of sample or population; an assumption akin to the search for "idiographic" knowledge at subgroup level. Findings apply to particular subgroups.
	From Murray, Kluckhorn, & Schneider (1953).	

When should we look for subgroups?

Let's start by considering the alternative assumptions—what are we assuming if we use a *nomothetic* approach. When researchers treat all of their participants as a single group and look for findings or laws that apply to everyone, we have to assume that each participant is a "replicant" of each other participant, sometimes called the "exchangability" assumption, because researchers assume that each person could substitute for each other person with no loss or change of information.

When would that assumption be justified?

Like so many things, it's probably not a good idea to start off with this as an *assumption*. It's better to treat it as an empirical question. It is certainly possible that for a given sample and a given set of variables, there is no evidence for meaningful subgroups. But that would be an *empirical conclusion* that researchers could make only *after* they have looked for subgroups, right?

What would be signs that we have subgroups in our data?

Let's consider a case in which we are interested in educational attainment, and we have decided to consider two constructs, each of which forecasts school success, but that are rarely looked at in combination—school motivation and mental health status. Rather than focus on each of these singly or in a linear combination as predictors of achievement or retention, we start by turning our back on the outcomes and staring at the predictors—and ask them how are they are connected to each other.

Why do we do that?

Hold on just a second, and look at a scatterplot of those variables in Figure 26.1. In a variable-centered mindset, we would notice that the two variables covary—their correlation is .5. That's a large enough correlation that it might give us trouble if we want to use both of these variables in a multiple regression to predict school outcomes, so what would we typically do?

Insert Figure 26.1 about here

Couldn't we just combine them together in one score?

Yes, we could—typical strategies in this situation would include: aggregate them both, select one, or look at them separately. Notice how, as variable-centered researchers, we are focused on that regression line. Deviations from that line are a problem for us. For example, look at that pesky case in the lower right hand corner. Way off our line.

That's an "outlier," right?

Yes, when we focus on the slope, we think of every case that is off this diagonal as "error." A nomothetic mindset is annoyed by every case that does not agree to be a replicant of the other cases.

How else could these off-diagonal cases be seen?

From a completely idiographic perspective (which assumes that every single person is unique), these off-diagonal cases are like little beacons—signaling "Come over here, this way something interesting waits!" In this approach, researchers intentionally look for individuals who occupy the whole combinatorial space. They are interested in cases at all different points along the regression line, but when they are done scrutinizing those-- they happily launch into the off-diagonals—see Figure 26.2, in which individuals who are far off the regression line are not considered "error" or "outliers." Instead they are viewed as "cases"— to be exact, case # 13, the "sad scholar," whose mental health is poor but loves school, and case #29, the "happy slacker," whose mental health is robust but does not really care about school.

Insert Figure 26.2 about here

But what if the two variables are uncorrelated? Aren't we home free?

If you keep thinking about this from a variable-centered perspective—researchers can either be happy (no multicollinearity between our potential predictors) or they can be unhappy (viewing a non-significant correlation as a problem).

Is there another way to view this situation?

Yes, it could be viewed as a message from your phenomenon (see Figure 26.3). Lack of correlation between your two favorite predictors tells you that there is heterogeneity in your sample—some of your participants have high scores on both, some have low scores on both, and some are high on one and not on the other. It is those participants who are high on one but not the other that are the "problem" for variable-centered approaches, but for researchers who are thinking in terms of person-centered analyses, these "odd-ball" participants (cases of high-low, low-high, or off-diagonal combinations) are not "odd" at all. They are interesting individuals who could be looked at in single case studies. Or, there might be groups of participants who share these profiles. So researchers with a person-centered mindset will rub their hands together and say—"It looks like we have a *variety* of *combinations* or *patterns* among our predictors—I wonder what those subgroups are like?".

Insert Figure 26.3 about here

Sounds like these researchers are headed for person-centered analyses?

Exactly right. They are not annoyed by participants who are off-diagonal, non-exchangeable, or non-replicants, because they never subscribed to these assumptions.

Are person-centered methodologists operating from a set of larger principles?

Indeed they are. They start with a set of meta-theoretical assumptions about the nature of their phenomena (i.e., individual functioning and development). They argue that, for empirical research to be useful, there must exist "a strong link between the methodology applied for elucidation of the problem, on the one hand, and the character of the structures and processes involved on the other" (Magnusson, 1998, p. 42). Then they analyze current conventional methods for their assumptions, and conclude that they are not a good match for the organized and holistic processes under consideration. Magnusson (1998) explains that, "[t]here is nothing wrong with any statistical model. The specific properties and assumptions of a statistical model are clear and cannot be disputed. The problem arises when it is applied for the study of phenomena that do not meet the assumptions" (Magnusson, 1998, p. 50).

What do they object to in conventional methods?

Standard processes of measurement and data analysis. In terms of measurement, they object to the assumption that the primary goal of measurement is to measure variables, so that researchers can locate individuals on a dimension relative to other people's locations. They do not agree with the assumption that individuals can be compared on a nomothetic, continuous dimension in a meaningful way; or that individuals differ only quantitatively, not qualitatively, along the dimension of a certain variable (Magnusson, 1998, p. 46). As Magnusson explains, "In a *variable* approach, each single datum derives it psychological meaning from its position relative to the positions for other individuals on the same dimension. In a *person* approach, each single datum derives its psychological meaning from its place in a pattern of data for the same individual representing his or her positions on the latent dimensions under study" (1998, p. 32).

What do they object to in methods of analysis?

They do not agree with the whole set of standard linear assumptions: that relationships among variables and their ways of functioning are the same for all individuals; that sets of variables meet the assumption of a multivariate normal distribution (instead of individuals forming clusters in the multivariate space); or that interrelations among variables studied in a nomothetic analysis can be used to make inferences about how the variables function within individuals. They object to the idea that generalizations of empirical results refer to variables and not to persons (Magnusson, 1998, p. 46).

Most of all, because they assume wholism, they object to "summing"—a person is not a summation of variables, instead each one comprises an organization or configuration of attributes. And they object to summing across studies of individual variables. As Magnusson points out, "a total, dynamic, complex process cannot be understood by summing the results of studies on single aspects, taken out and studied in isolation from other, simultaneously operating factors. The totality has properties that cannot be derived from the investigation of one variable after the other" (1998, p. 36). Hence, they conclude that, for their assumptions, they need person-centered approaches to measurement, design, and analysis. Person-centered researchers want methods that can help them to identify subgroups that can accommodate all these different combinations, configurations, or organizations-- and then get to know each group.

Are there any other reasons to focus on person-centered analyses?

Developmentalists working in applied settings, like schools or workplaces, will find that person-centered approaches resonate with practitioners. Teachers, social workers, and human resource professionals do not typically think about people as "variables" but instead regard them as whole persons—how do I help *this* student, *this* youth, *this* family, *this* patient, *this* employee—in other words this "case." For example, teachers may be able to identify children or youth who are "unmotivated," but they recognize and respond differently to unmotivated students who are sad compared to those who are bored or disruptive. So discussions of "kinds of students" or "kinds of families" make sense to practitioners. Many applied disciplines (such as law or behavioral medicine) actually prefer case-based methods.

Person-centered analyses are particularly important for intervention studies. As you can imagine in medical studies, it would make no sense to provide the same treatment for all our patients—we would want to group them by their common characteristics and treat them accordingly. As a result, optimization efforts use a range of person-centered intervention techniques (see Figure 26.4). Only one—universal prevention efforts—assumes that everyone should receive the same treatment, other prevention efforts are "selective" for participants who are at-risk for a poor outcome, whereas others are "indicated" meaning that participants have already shown signs that foretell the poor outcome (see box, for the example of substance abuse).

Insert Figure 26.4 about here

Universal, Selective, and Indicated Prevention Efforts: The Example of Drug Abuse	
1.	**Universal** prevention strategies are designed to reach the entire population, without regard to individual risk factors and are intended to reach a very large audience. The program is provided to everyone in the population, such as a school or community. An example would be universal preventive interventions for substance abuse, which include substance abuse education using school-based curricula for all children within a school district.
2.	**Selective** prevention strategies target subgroups of the general population that are determined to be at risk for substance abuse. Recipients of selective prevention strategies are known to have specific risks for substance abuse and are recruited to participate in the prevention effort because of that group's profile. Examples of selective prevention programs for substance abuse include special groups for children of substance abusing parents or families who live in high crime or impoverished neighborhoods and mentoring programs

	aimed at children with school performance or behavioral problems.
3.	**Indicated** prevention interventions identify individuals who are experiencing early signs of substance abuse and other related problem behaviors associated with substance abuse and target them with special programs. The individuals identified at this stage, though experimenting, have not reached the point where clinical diagnosis of substance abuse can be made. Indicated prevention approaches are used for individuals who may or may not be abusing substances but who exhibit risk factors such as school failure, interpersonal social problems, delinquency, and other antisocial behaviors, and psychological problems such as depression and suicidal behavior, which increases their chances of developing a drug abuse problem. In the field of substance abuse, an example of an indicated prevention intervention would be a substance abuse program for high school students who are experiencing a number of problem behaviors, including truancy, failing academic grades, suicidal ideation, and early signs of substance abuse.
	Retrieved from Texas Department of State Health services June 22, 2014: http://www.dshs.state.tx.us/sa/prevention/classifications.shtm

PERSON- AND PATTERN-CENTERED METHODS: CLUSTER ANALYSES

Person-centered approaches are built on four principles: (1) people are organized wholes so they can best be represented by a configuration of attributes or (in systems terms) operating factors; (2) people differ in how they are organized or configured, so researchers should be examining individually specific constellations of operating factors; (3) the variety of constellations is restricted, so the search is for a set of actual clusters or "natural classes"; and (4) these differential organizations are the foundations upon which future development (and different developmental pathways) is built. So "[t]he task for empirical research on individual functioning and development in terms of patterns is, in each specific case, twofold: (a) to identify the possible operating factors in the system under consideration (factors that have to be considered in the particular pattern) and (b) to identify the ways these factors are organized (the actual working patterns)" (Magnusson, 1998, p. 42).

How do we find the "natural classes" or sub-groups in our data?

Wouldn't it be lovely if we could just get all our participants together in the school cafeteria and say, "Okay, all of you who belong to sub-group #1, please head over to that first table and take a seat. Okay, is sub-group #2 ready?" Instead, we have to rely on conceptual and empirical clues that we can piece together about whether we have meaningful sub-groups, and if so, how many sub-groups we have and what they are like. One set of tools that are useful in this regard are methods of cluster analysis (see box). Those "clusters"? Those are group of participants who are similar on a set of variables. Those are our potential "natural classes" or sub-groups.

What is cluster analysis?
Cluster analysis describes a set of methods for using multiple variables to classify people (cases) into discrete groups. As explained by DiStefano (2012), "classification refers to the process of dividing a large heterogeneous group into smaller homogeneous groups in which members are similar to each other and different from cases in other groups (Gordon, 1981). The objective is to identify groups underlying a larger set of data, with the number of groups unknown at the outset. Once created, groups can be thought of as possessing like patterns of characteristics, and cases within the same group may be treated similarly" (p. 645-646).

Could you provide an example?

Okay, let's talk about the issues involved in using person-centered analyses by walking through the steps using an empirical example (Roeser & Peck, 2003). These researchers were interested in educational achievement, but they wanted to go beyond typical variable-centered approaches that identify the early risk factors (i.e., variables) that predict whether students will eventually drop-out before they complete high school. They were interested in resilience and success, so they were interested in trying to understand the early factors that contributed to graduation and college readiness, and they were also interested in using a holistic and developmental approach to answer this question (see box).

As a result, Roeser and Peck (2003) used "pattern-centered analyses and longitudinal data to explore how configurations of personal and contextual factors forecast the educational achievement and attainments of different youth across adolescence" (p. 29). Their goal was to "identify subgroups of adolescents who were defined by configurations of factors in early adolescence that probabilistically forecast their subsequent decisions to enroll in college or not five years later" (p. 30).

Principles of holistic and developmental study of achievement.	
Pattern-centered analytic approaches provide a good methodological fit with a view of educational achievement that is holistic and developmental in nature (Roeser and Galloway, 2002). The basic tenets of such a perspective are threefold.	
1.	***Whole person.*** First, such a perspective is concerned with how multiple dimensions of individuals (demographic characteristics, multiple identities, motivation, mental health, and cognitive abilities) are associated with educational achievement and participation over time. Different adolescents are characterized by different profiles of such "person variables," and such profiles provide insights into individual differences in educational outcomes (Snow, Corno, and Jackson, 1996).
2.	***Lifespace.*** Second, such a perspective is concerned with how the manifold social environments that youth experience and co-create cultivate or thwart school-related motivation, regulatory capacity, and behavior. Understanding the differential social affordances and constraints in the family, the school, and the peer group in relation to educational outcomes among different subgroups of youth is a second important consideration in understanding individual differences in educational outcomes (Eccles, Wigfield, and Schiefele, 1998).
3.	***Lifespan.*** Finally, a holistic and developmental perspective on adolescents' educational functioning focuses on how outcomes in one developmental period are associated with those in the preceding and succeeding periods.
	(Roeser & Peck, 2003, p. 40)

How do we get started?

The first step (see box) is to select a set of variables that you want to use to characterize and distinguish your subgroups.

Steps in pattern-centered analyses: An illustration focusing on educational attainment.	
Roser and Peck (2003) used longitudinal data on about 1500 students who were in 7th grade at the outset of the study, and were assessed again in 8th grade and post-high school. Students were largely African-American (60%) and white, from a variety of socioeconomic backgrounds, predominantly middle class.	
1.	***Selection of variables via theory and empirical information*** • Education • Motivation • Development
2.	***Identification of clusters*** • Persons • Situations
3.	***Condensation of clusters into configurations***
	• Self types: clusters of individuals based on psychological variables
	• Social worlds: clusters of individuals identified based on their perceptions of their

	families, schools, and peer groups.
	• Lifespaces: configurations of individuals identified by their "self type" crossed with their "social type"
	• Persons by contexts: types that add more information about social context from other informants.
4.	***Validation of clusters and configurations*** • Behaviors • Cognitive abilities • Noncluster variables • Multiple raters • Multiple time points
5.	***Demography of clusters and configurations*** • Social class • Race • Sex
6.	***Longitudinal probabilistic associations*** • Point to point • Pathways • Lifespace analyses • Prodigal analyses

How do researchers decide which variables to include?

This is the single most crucial issue in person-centered analysis, because these decisions will completely determine the kinds of subgroups you can recover and the kinds of questions that you can subsequently ask about them.

So what should researchers consider in making these decisions?

Most important are theoretical considerations, of course, but let's start with a few pragmatic concerns. One set of important decisions involves identifying the variables *not* to include in creating subgroups. Although this may seem self-evident, the way to think about this issue is that any variables that you put *into* your cluster analysis, you cannot then include in answering your later theoretical questions—to see whether subgroups *differ* on these characteristics or outcomes.

Can you give an example?

The most obvious would be that researchers interested in the subgroups that follow different pathways toward higher education should not include student college enrollment in their clustering, because they are interested in later *predicting* that outcome.

Then how do researchers decide what to include?

Person-centered analyses are based on the idea of individuals as organized wholes. As you may remember from our previous discussion of systems, these organized holistic persons can be considered adaptive systems that are organized in service of some specific function. So it is as if people are like entire warehouses full of musicians and musical instruments, but only pull together certain combinations of musicians and instruments based on the desired *function* -- individuals form string quartets or orchestras or all-girl rock bands or dulcimer soloists, depending on the venue, kind of occasion, audience, and musical performance that is required. An adaptive structure or organization is not just any old collection of parts, it is composed of *components* that are assembled and required for a particular set of functions.

So, when selecting a set of variables for person-centered analysis, researchers definitely should not just be throwing into their analysis whatever bits (individual variables) come to hand. They are searching for the essential components, what Magnusson calls the "operating factors," of a functional system.

What system?

The system that produces the developmental outcome of interest. So, to identify these components, we can send students back to their most comprehensive MacGuffin drawing. The conceptual status of the constructs and variables in these drawings will give them advice about their selection of variables. We distinguished the attributes of the developing person from the context and from the short- and long-term developmental outcomes. So it is likely that the components of the relevant system include the *target attributes* of the developing person. The variables that mark these components will help us identify subgroups with different combinations or profiles of these attributes—which, in systems terms, would represent different functional organizations of the components of these systems. These are the variables to include in an initial search for sub-groups.

In our illustration, we can see that Roeser and Peck (2003) relied on a model of self and identity in school learning and achievement (see Figure 26.5) that posits two important pathways to students' autonomous choice during early adolescence to learn and perform well in school, one that involves a commitment to school supported by self-knowledge, motivation, and positive emotion; and one that involves performance capacities supported by content knowledge, procedural skills, and learning strategies (Roeser, Peck, & Nasir, 2006). As a result, this became the theoretical space within which these researchers were looking for "whole persons" or in this case "whole students."

Insert Figure 26.5

Then what do you exclude?

We suggest that you exclude constructs that are markers of your short- and long-term outcomes (like high school graduation and college enrollment in our illustration) because you are interested in those constructs as potential destinations for your subgroups. We would also suggest that you exclude demographics and markers of contextual constructs.

Why would researchers exclude demographics and context?

Because a *second* question, after the psychological composition of the groups has been established (as captured in different profiles of biopsychsocial attributes), that researchers want to answer involves membership—as in “Who falls into these groups?”. If researchers use demographic information to create the groups, they cannot ask that empirical question.

And why exclude context?

Because a *third* question is “What kinds of contexts do these subgroups encounter and create?”. So, again, if we want to ask this question, we can’t put contextual variables *into* our cluster analyses of person attributes.

But aren't researchers supposed to think about contexts like they do about participants-- as just as organized and holistic?

Absolutely fabulous-- yes, hold that thought. We will eventually get to the organization of the context, but for now, we are focusing on creating subgroups based on individual attributes. So, in our illustration, Roeser and Peck (2003) did not include any demographic or contextual variables in their initial clustering (but they did circle back around after they were finished with individual attributes and look for contextual clusters).

Any pragmatic advice on which individual attributes to include or exclude?

Well, frankly, most large longitudinal data sets (the ideal kinds of data sets for these questions) were not collected with cluster analysis in mind, so to some extent researchers need to go shopping among the existing variables.

What should we look for when we consider candidate individual attributes?

You are trying to select a manageable number of somewhat different attributes, like a fanned out hand of cards in poker. Five or six attributes (its hard to make sense of more) that have a common core (that's where the fan converges) but that are not exactly the same (like if your hand contained two aces of hearts, you would be in trouble). So a first step would be to look at the inter-connections among your candidate attributes, using correlations, factor analysis, or principal components analysis. Some pairs may essentially be indistinguishable (e.g., all those measures of sense of control, perceived competence, and self-efficacy) and you can aggregate them or select one. The surviving constructs or variables become your list of candidates.

When are we going to do that thing that methodologists always recommend when they run out of advice—where they say "depending on your particular theoretical perspective and research question"?

This is our moment—the wonderful process where theories about systems and the functional organization of their components are tested and created. Here is where the research team chews and juggles, and multiple competing pictures of systems and their components are drawn, and constructs are moved on and off the table (or white board) and, if teams are wise, they include practitioners who talk about how these constructs are packaged as combinations in the students, clients, or offspring they have known and loved. This is the art—we mean theory—of person-centered analysis. Researchers have to call on or devise theories of organized, integrated, whole persons in their variety of natural configurations.

In our illustration, Roeser and Peck (2003) relied on theory to point them toward key motivational constructs, like perceived competence and valuing of school, but they also opened out, reaching toward individual factors that have been much less well-studied in work on achievement, namely, student mental health or emotional distress. They could check their ideas using variable-centered analyses, which showed that each of these individual attributes was a good predictor of student achievement and problem behavior in school, over the age ranges of concern to them (early adolescence or 7th and 8th grades). So these were the three variables that they used for clustering: perceived competence, value, and emotional distress.

So once we have selected the variables to include, then are we done?

No, this is where the fun begins. By deciding on the set of variables to include in cluster analyses, it is as if we have decided on the question we want to ask our data—“Do you contain sub-groups that differ in their combinations of these variables—and if so, how many subgroups are in here, and how are they different from each other?” But the data have their own their own opinions and messages from the phenomena, and so cluster analyses are full of exchanges and negotiations with the data in order to wrest from them “interpretable” or meaningful natural clusters.

How do researchers conduct these negotiations?

There are a variety of important statistical decisions to make and how you make each one can have an effect on the cluster solution that emerges (see box). Different methods create clusters of different density, variance, shape, and separation.

Modeling decisions to make during cluster analyses.		
1.		***Standardization***. Refers to whether variables to be clustered are standardized before they are subjected to cluster analysis. Considered important decision because analyses are scale dependent, in that variables with large mean differences and/or large standard deviations may suppress the influence of other variables.
		Advantages. Converts all variables to same metric level. Removes undue influence of metric or variability.
		Disadvantages. May mask differences on variables that best differentiate groups. Can reduce differences between groups.
2.		***Cluster analysis:*** collection of scores for each case creates a multivariate profile, which is used to identify similar cases. Variables are observed and assumed to be independent and uncorrelated; cases independent. May produce a greater number of groups with finer detail.
		Clustering algorithms: *methods used to join cases.*
	•	***Hierarchical agglomerative****.* Method of joining cases that starts with a single case and sequentially merges (agglomerates) cases by similarity case-by-case. Produces discrete groups that do not overlap (hierarchical). Most commonly used: Ward’s method that minimizes within-cluster heterogeneity.
		Caveats. Only passes through data once, so cases cannot be reassigned even if better fit with later group. Sensitive to a poor start. No stopping rules. May not produce

		stable groupings. Not robust to missing data.
	•	**Iterative partitioning**. Groups are created by initially dividing (partitioning) sample into a set of groups specified by the researcher. Individual cases are reassigned to the group with the nearest mean. Then group means are recalculated and individuals are reassigned if a different group has a closer mean. Repeated (iterated) until no cases change cluster assignment.
		Caveats. Scale dependent so may produce different solutions with raw vs. standardized variables. Sensitive to initial cut. Only valid if correct number of clusters was specified by researcher.
	•	***Combination***. May use hierarchical agglomerative methods (e.g., Ward's method) to create starting cut for subsequent iterative partitioning.
3.	***Latent class cluster analysis***. Methods for modeling group membership as a categorical latent variable from data that are assumed to comprise a mix of homogeneous sub-populations with different probability distributions. Uses estimated parameters to calculate probability of any one observation belonging to a cluster. Models number of discrete and mutually exclusive groups with normal distributions, given certain restrictions. May produce fewer more broadly defined groups.	
	•	Subsumes latent class analysis and latent profile analysis.
	•	Can accommodate variables measured on different scales without standardizing.
	•	Allows flexible testing of different models (e.g., with different restrictions or different numbers of groups).
	•	Uses iterative techniques to estimate and re-estimate model parameters until reaches stopping rule (e.g., prespecified maximum number of iterations or until improvements over interations are trivial). Can indicate if no clusters are detected.
	•	Variety of criteria for evaluating solutions (e.g., fit indices) using heuristic conventions. Can test if model converges on same groups using different start values.
	Adapted from DiStefano, 2012, see especially Table 36.1.	

This sounds very messy.

No, just a little bit messy. The researchers' goal is to use everything that they know for sure about the phenomena to help them locate their groups, but at the same time, not to influence the process unduly, that is, to be sure to give the data an opportunity to speak for themselves.

So a key part of the negotiation is recognizing when you are facing a decision that will take you down two different paths, and getting straight on whether you have such a preponderance of theory and evidence that it is clear which fork is correct, or whether you are taking your best guess or the conventional path. If you are not clear, then an important part of negotiations would be, after you have played out one alternative and had a look at the resulting clusters—to go back to the fork in the path and try the other road, and see what clusters this procedure produces. Perhaps they are very similar (easy negotiation), but perhaps they are different. If they are radically different, it probably makes sense to retrace your steps and see where things diverged. Eventually, researchers will feel most confident about cluster solutions that were consistently reached using many different procedures.

Where are our significance tests?

We are in statistical-modeling-land now (Rodgers, 2010), where there is no null hypothesis significant testing and no $p < .05$s to say "turn here" and "stop, you have arrived." Methodologists are constantly working on additional criteria that can advise researchers on the number of groups to recover and the heuristics for recognizing a "good fit."

Then how do researchers ever come to a conclusion about how many clusters they have?

Researchers rely on a range of considerations (see box). There are statistical clues—in cluster analysis, researchers can examine plots of successive numbers of groups, and look for breaks or gaps in the plot—suggesting the number of sub-groups. Or in latent class cluster analysis, researchers can compare a range of plausible alternative models and consult a variety of criteria. Researchers are looking for a "reasonable" number of groups, say between 4 and 6, each of which is a "reasonable" size. If there are only 3 groups and 85% of the sample is in one of them, this may indicate that there are not really multiple distinctive subgroups.

The art and science of identifying clusters
Researchers use a wide variety of factors in making decisions about how many and which groups to recover from their data set. These include:
• ***Face validity***: Clusters are theoretically and practically meaningful.
• ***Distinctive profiles***: Clusters can be distinguished by more than differences in elevation.
• ***Parsimony***: Smallest number of meaningful clusters. Can be improved by aggregating

	similar clusters, and eliminating any cluster that is not interpretable or is very small.
•	***Concurrent and predictive validity***: Clusters differ on mean levels of clustering variables, and on demographic or other concurrent attributes, and differentially predict future outcomes.
•	***Replicability***: Cross-methods, cross-time, and cross-sample cluster analyses consistently recover the same groups.

Researchers are also looking for subgroups that are distinctive from each other, that is, who differ in their *profiles* across the clustering variables. Cluster methods can distinguish groups based on differing "elevations," that is, mean levels. But if clustering suggests three groups with identical profiles but different elevations—so that we have a group that is high-high-high on our clustering variables, and one that is medium-medium-medium, and one that is low-low-low, this suggests that linear combinations of these variables would be satisfactory markers, and so we do not really have strong evidence that we can use these variables to distinguish qualitatively different sub-groups.

Where does theory figure in?

Yes, the research team is back in the art department—hopefully with the aid of methodologists and practitioners. So together they will start interrogating the cluster solutions with the best combinations of statistical indicators, about whether the groups that they suggest are theoretically and practically distinctive and meaningful. Then researchers should continue--by interrogating the solutions above and below those cut off points. The team is looking for "natural classes," trying to "carev nature at the joints." So researchers should be looking for the "joints," asking themselves, using theory and practice, "Who are these kids? Do we recognize them? Do they seem to differ from one another in important ways?" One useful strategy for cross-validating any subgroups researchers recover from their data is to check in with applied professionals. When practitioners are supplied with detailed descriptions of the possible sub-groups, researchers should listen carefully to see whether professionals recognize and corroborate the groups—sometimes they can even provide common-sense labels for the subgroups or recall actual students or clients who fit each profile.

In the illustration we are following, Roeser and Peck (2003) decided to extract six groups (see Figure 26.6). You can see that they have two groups at the ends who basically have a high-high-high profile (Cluster I, whom they named "Multiple Assets") and a low-low-low profile (Cluster VI, "Multiple Problems"), as would be expected since the clustering variables can covary. But even taken together, these two groups comprise less than a third of the sample. That is evidence that additional subgroups are warranted: Most interesting are the four clusters in the middle (Clusters II-V), consisting of two competent and two problematic patterns--these are the sub-groups that would have been lost in variable-centered analyses. Note their distinctive profiles—this is a good indication of multiple sub-groups. For example, the most populous group, Cluster II, includes students with average perceived competence and high valuing of school, whereas Cluster III includes students with average perceived competence but low school value. In terms of the other two problematic profiles, students in Cluster IV are distinguished by low motivation, whereas students in Cluster V by high levels of emotional distress. Each of these clusters represents a profile that theoreticians and teachers recognize and can corroborate.

Insert Figure 26.6

Do these clusters represent "types" in a "typology"?
There is a long history in psychology in trying to come up with classification systems for identifying people of different "types." Because person-centered methods have often been used to create typologies and classify people, it is natural that students might assume that the person-centered approach we describe here is also on the hunt for "types." However, these kinds of traditional types are not our types at all. We agree with Bergman et al. (2003), who take an unequivocal stance when they state, "[w]e strongly object to a revival of typology thinking in which persons are seen a belonging to unalterable permanent classes" (p. 195).

Consistent with a holistic-interactionist approach, we see these patterns or configurations as temporary organizations or attractor states. It is of great empirical interest to examine *why* these patterns cohere and what forces are holding them in place or acting in their transformation. For example, as we mentioned in the section on states and state variables, it is possible that recursive proximal processes maintain specific patterns of characteristics over time.

Aren't there an infinite number of combinations or configurations?

In principle, but not in practice. Systems are constrained—they cannot be organized in an infinite number of ways. Some of the constraints are bottom-up—there are only certain ways that the parts can fit or work together. Some of them are functional—only a limited variety of organizations can be adapted to serve certain functions. And some of them are top-down—the higher-order organizations only allow the subsystems to work together in a limited number of different ways.

Correlated constraints and configurations.
Remember those systems ideas about self-organization? The idea that higher-order organization emerges from the recursive interactions of lower-order components? And then the wholistic organization, in turn, comes to shape the interactions among the components? These bottom-up and top-down forces constrain systems to a limited number of configurations. As explained by Cairns and Rodkin (1998),
"More broadly, conservation is social behavior may be supported by the correlations between events that occur within and outside of individuals (e.g., Cairns, 1995; Magnussin & Cairns, 1996). Biological states of the individual tend to be brought into line with environmental context and social actions and vice versa. These normal conditions of development yield what we have termed elsewhere *correlated constraints* (Cairns, McGuire, & Gariépy, 1993). The result is that behavior organization tends to be continuous and conservative over time despite the fluidity and change. In ontogeny, correlated constraints establish conditions such that (a) variables occur in packages, not as independent elements; (b) similarities evolve among individuals in that only a limited number of configurations of characteristics are possible, and (c) commonalities in developmental pathways will occur, given the parallel constraints that become active over time… The correlated constraints in development place limits on the pathways possible and provide direction for future development" (p.262).

What do researchers do about configurations that are rare?

Study them! In person-centered approaches, the configurations or organizations that rarely or never appear are called "anti-types" or "white spots" because in a configural plot, no dots or cases appear in certain spaces or coordinates, so they remain blank or white (see box).

Such approaches encourage the study of exceptional cases and careful analysis of the reasons why certain combinations are so infrequent or never visited. (In dynamic systems, these states are called “repellers,” and in developmental typography, they are often are represented by hills that are so steep they are difficult for the marbles of development to climb).

The study of “white spaces” and roads not taken.
Inherent in the idea of systems organization is that the constraints in a developmental system produce, not only “typical configurations” and “typical developmental paths,” but also configurations that rarely or never coalesce and paths that are rarely or never taken. As pointed out by Bergman et al., “within the limitations of what is theoretically possible, the patterns that occur often and those that occur seldom or not at all together map out the empirical terrain being studied. A search for the boundaries of areas containing nonoccurring developmental patterns in rarely undertaken…In our opinion, the serious study of constraints in the form of boundaries and white spots is a rare instance of a promising approach to understanding the empirical world that has been left almost unattended” (p.195).

Can researchers really trust the outcomes of these kinds of analyses?

Yes. As argued by Bergman et al. (2003), “pattern-oriented methods produce trustworthy results if applied with good judgement on sound data” (p. 196).

Are there any ways to empirically check out the team’s decisions?

Yes, once researchers are confident about the clusters they have identified, they can start the process of validation—basically examining how the groups differ from each other on relevant variables that were not used for the initial clustering. For the first step the validation of their six clusters, Roeser and Peck first used a set of related variables, including concurrent self-esteem, achievement tests, and educational expectations as well as GPA for the current year (7th grade) and the following year (8th grade). As can be seen in Figure 26.6, the clusters differed significantly in sensible ways.

Insert Figure 26.6

Clusters can also be compared based on their demographic composition— from what kinds of social addresses (e.g., gender, race, class) do children in the different clusters hail? For example, in our illustration, Roeser and Peck discovered that white females were equally represented in all six clusters, whereas black females were over-represented in Cluster V (high emotional distress), back males were overrepresented in Cluster VI (multiple problems), and white males in Cluster III (low school value). Moreover, students in these clusters also differed in their socioeconomic status: for example, Cluster I (multiple assets) youth came from families that represented the full spectrum of educational attainments. Most importantly, sizable numbers of youth from every demographic status were present in every cluster group.

Are there ways to create configurations besides cluster analysis?

Yes, there are many different ways to find and create configurations (see box). Remember, the goal is to think carefully about "whole persons" as integrated systems of attributes that work together to create qualitatively different wholes. So researchers can use a variety of "bottom-up" strategies to locate people with different combinations of attributes, or they can use a variety of "top-down" strategies to identify people who are similar to these qualitatively different wholes.

Ways to identify subgroups and create configurations.	
Top-down Strategies	
1.	***Theoretical apriori identification***. Theory prescribes the "kinds" or "states" of people, such as children who are high on both ego-control and ego-resiliency.
2.	***Expert selection.*** Asking experts in the setting to identify participants belonging to specific categories that inherently combine a variety of attributes or are unusual or exceptional in some way. For example, asking workers to identify supervisors who are both highly supportive and highly productive, or teachers to identify students who are "bucking the odds."
3.	***Participant selection.*** Asking participants to nominate people belonging to specific categories that inherently combine a variety of attributes or are unusual or exceptional in some way. For example, nominating people who are "wise" or "master teachers," or identifying other kids who are "smart but not full of themselves" or "cool nerds."

4.	***Crossing multiple variables.*** Dividing the sample (e.g., using median splits or cut-offs a standard deviation above and below the mean) on multiple variables and then creating different combinations by crossing the levels of the variables. If variables are discrete and take on only a few values, it is possible to examine all possible value patterns.
Bottom-up Strategies	
5.	***Cluster analysis.*** Statistical procedures for classifying participants into subgroups where members are maximally similar to each other, and groups are maximally different from each other.
6.	***Selecting exceptional cases.*** Identifying participants who are exceptional compared to the rest of the sample (e.g., gang members who left gang life) and focusing on those individuals, often following them from “beginnings” to “endings.”
7.	***Classifying profile extremes***. Grouping participants with similar value profiles, based on the highest and lowest value in each profile (maximum-minimum combinations).
8.	***Classifying profile serration.*** Grouping participants who are similar in the evenness or unevenness across the profile of their values.
9.	***Q-sort technique.*** An ipsative assessment technique in which the task is to sort a group of statements, traditionally presented on index cards, in perceived rank order ranging from "most descriptive" to "least descriptive" of the target person (sometimes the self). Each person is represented by an individual profile on those attributes.
10	***Configural frequency analysis, multivariate p-technique factor analysis, correspondence analysis, and network analysis.*** Alternative statistical procedures for disaggregating samples into homogeneous subgroups.

PATTERN- and PERSON-CENTERED APPROACHES TO DEVELOPMENT

When do pattern-centered approaches get developmental?

Right now. Because person-centered approaches are used to detect individual patterns of functioning at one point in time, it is easy to wonder how they will ever be helpful to us in examining changes in these individuals over time. There are many strategies (see, for example, Bergman et al., 2003; Cairns & Rodkin, 1998; DiStefano, 2012).

Let’s start out with the most straightforward—persons with these different configurations of characteristics may be on different developmental paths. These can be considered “point-to-point” analyses, and can be examined by investigating whether clusters differ in terms of a future outcome. In our empirical example, this can be illustrated by Roeser and Peck’s interest in whether their students from their six clusters differed in their chances of enrolling in college. As can be seen in Figure 26.6, they did: Youth in Clusters I (multiple assets) and II (positive valuing of school) were significantly more likely than predicted by chance to attend college after graduating from high school. In contrast, youth in Clusters IV (poor academic motivation) and VII (multiple problems) were significantly less likely to do so.

Insert Figure 26.6

Multi-finality and equi-finality in point-to-point person-centered analyses.
Pattern-centered analyses afford interesting opportunities for cross-cluster comparisons in which one assesses how individuals with different starting points end up at the same developmental outcome (equifinality) and how those with similar starting points end up at different outcomes (multifinality), as illustrated in Figure 26.7. These kinds of analyses regard developmental transitions as versions of "Grand Central Station" where individuals may change trains (or depart the train all together) depending on how well the new contextual affordances are attuned to their needs. Roeser and Peck explain how they use these concepts to help them make sense of their findings:
"Equifinality is exemplified by comparing youth in Clusters II and III; both groups show rates of college enrollment of around 75 percent, but this is an unexpectedly high rate for Cluster II. Youth in Cluster II overrepresent families in which the head of household has a high school diploma or less. In comparison, youth in Cluster III are more likely to be white males from the wealthiest families, with parents who are well educated (for example, they hold an advanced degree). What accounts for the fact that black and white males and females from households where parents had a high school diploma or less enrolled in college at rates similar to those who were predominantly white, male, and from relatively advantaged backgrounds? How did Cluster II youth develop such positive educational values, expectations, and eventual attainments?
Multifinality is exemplified by comparing youth in Clusters II and IV; both subgroups are characterized by an overrepresentation of parents who have high school diplomas or less, a factor usually associated with lower college attendance rates (National Center for Educational Statistics, 1999). This general pattern is confirmed by Cluster IV members, who are less likely to enroll in college after the completion of high school, but disconfirmed by their Cluster II peers from a similar background who actually are more likely to enroll in college than predicted. Clusters II and IV youth did not differ in terms of their verbal and math abilities, but they did differ in their academic motivation, long-term educational plans, achievement, and self-esteem in middle school. It appears that motivation, mental health, and school achievement factors (but not social status or cognitive abilities) differentiate these groups in middle school and thus perhaps account for their educational choices over the longer term. But what is the source of this academic motivation, well-being, and achievement in middle school?
PCAs can also reveal ***resilient*** as well as ***optimal*** patterns of functioning. For instance, the fact that attendance rates for Cluster V youth are no less than expected by chance is substantively interesting in that, based on previous research, youth with poor mental health in early

adolescence might have been expected to be less likely to enroll in college after high school (Kessler, Foster, Saunders, and Stang, 1995). One wonders about the source of this educational resilience. In terms of optimal functioning, Cluster I youth accomplished higher-than-expected college enrollment rates (almost 80 percent went on to college). These youth all had positive motivation, esteem, and achievement in middle school and were not under or over-representative of any particular sex, race, or parental educational level. Given the social status and ethnic diversity of this subgroup, one wonders how features of their social worlds might have played a role in their attainments."
From Roeser and Peck, 2003, p. 49-50.

Insert Figure 26.7

What about detecting individual pathways of development or transformation?

One way to explore this question with person-centered analyses is to investigate whether individuals show *change* in their configurations over time, that is, whether individuals shift from membership in one cluster to membership in another cluster along their pathways of development. This might indicate changes in individual organizations or systems of functioning.

Roeser and Peck investigated this possibility by expanding on the clusters they had recovered when their participants were in 7^{th} grade, and repeating this analysis for the same students when they were in 8^{th} grade. The interesting developmental question was whether students *changed* in their cluster membership across the two adjacent measurement points. Did some students who showed competent patterns shift to problematic patterns as they transitioned from 7^{th} to 8^{th} grades? And did some students show the reverse progression—from problematic patterns to competent patterns over the same transition? As shown in Figure 26.8, they found both stability and systematic shifts: About two-thirds of the sample remained in their 7^{th} grade configurations through 8^{th} grade (whether competent or problematic), but about one-third shifted from 7^{th} to 8^{th} grades.

Insert Figure 26.8

And these shifts seemed to matter in terms of future educational engagement. Roeser and Peck classified students according to the number of "good" and "bad" years that they experienced in 7th and 8th grade (i.e., two good, one of each, or two bad) and examined whether students in these higher-order configurations differed in their likelihood of enrolling in college. (They did, enrolling at rates of 77%, 66%, 55%, respectively, even controlling for achievement and SES). The researchers also "unfolded" the higher-order configurations back into the six clusters and followed their exact pathways to college enrollment (Figure 26.9)

Insert Figure 26.9

The origami of pattern-centered analyses.
Roeser and Peck demonstrate the ways that configurations can be looked at as narrowband cluster memberships and broadband cluster memberships. They note that, even in the broadband clustering, "the more narrowband cluster membership information is not lost in this aggregation, but only backgrounded temporarily. Strategically aggregating and disaggregating, folding in and unfolding the data in this way, can allow for the pursuit of complex developmental questions in a parsimonious fashion" (2003, p. 50).

LIFESPACE ANALYSIS

"Lifespace" analyses join the configurations created by the organization of an individual's attributes with those created by the organization of the social worlds within which each individual develops. The fit or mismatch between persons and their social contexts can be described by concepts such as "alignment" or "synchronization." Every time a social transition takes place, or the individual develops, or the context changes, a realignment or re-organization of person-context connections is required. Important features of these organizations can be captured using pattern-centered methods. Perhaps surprisingly, pattern-centered analysis can be applied to contexts, as well as to persons, in order to examine how the multiple contexts with which individuals interact are organized and integrated. In contrast, typical variable-centered analyses of contexts would examine a single aspect of the context (e.g., autonomy support vs. coercion) or a single context (e.g., parents), or if multiple aspects were considered, would aggregate them by forming linear combinations.

Contexts from a holistic-interactionistic perspective.
The principles of a holistic-interactionistic perspective apply to the individual, to the context, to their interaction, and to developmental processes themselves.
As explained by Bergman et al., "Applied to psychological research, the models also emphasize the holistic-interactionistic, integrated nature of developmental processes. The holistic principle holds for all systems of interest in research on human ontogeny, regardless of the level at which the system is operating. It holds at the level of the mental, behavioral, and biological processes of individuals as well as for the individual sa active partner in his or her integrated person-environment system. It holds for the environment and its subsystems, such as the peer system among youngsters or the family system" (2003, p. 8).

But variable-centered selection and aggregation creates problems, right?

Right. Two big problems. First, variable-centered approaches assume that the effects of one aspect of the context (like autonomy support) are not influenced by the other aspects of the context (like warmth vs. hostility)-- even though researchers may wonder whether warm autonomy support is more likely to be experienced as supportive whereas cold autonomy support may be more likely to be appraised as rejecting or hostile. Second, they assume that the effects of one *kind* of context, such as the parenting context, is not influenced by other contexts (like teachers or peers)—even though researchers may wonder whether positive friendship relationships could compensate for the effects of harsh parenting, and so mitigate its negative effects (maybe by providing a more supportive "home-away-from-home" with the friend's family).

Are we back to clustering again?

Yes—it is just as useful to cluster children's contexts and their contexts' attributes as it is to cluster individuals and their attributes. These are person-centered analyses, but they capture the configuration of contexts in each person's life.

And we select the contexts or contextual attributes to cluster using the same principles?

Absolutely. Researchers select the relevant components of the contextual subsystems that are shaping their target developmental phenomenon. Following our empirical illustration, Roeser and Peck utilized adolescents' perceptions their home, school, and peer contexts at the end of 8th grade, and created two higher-order scales that combined multiple constructive and destructive features of each. These clustered into five distinct kinds of "social worlds": (1) "positive worlds," which contained the 46% of the sample with high scores on constructive elements for every context; (2) stressed family, positive friends (11%); (3) family risks (19%); (4) family and school risks (11%); and (5) multiple risks (12%).

To create lifespace configurations, researchers crossed the two broadband aptitude patterns (competent versus problematic) with the five social world clusters. As shown in Figure 26.10, competent students were much more likely to be found in positive social worlds, and students with problematic patterns were much more likely to be found in risky contexts, as shown by analysis of both the types (high probability configurations) and anti-types (low probability configurations). These resulted in four combinations of students and social worlds: (1) competent students in positive social worlds, referred to as a positive lifespace configuration (PLC); (2) problematic students in negative social worlds, or negative lifespace configuration (NLC); and two less common configurations (3) problematic students in positive social worlds, referred to as "vulnerable" lifespace configurations; and (4) competent students despite negative social worlds, or “resilient” lifespace configurations. Compare to youth with a NLC, youth with a PLC were less likely to drop out of high school and more likely to enroll in college.

Insert Figure 26.10

Niche analysis of social worlds.
One way of thinking about social worlds is to examine the configurations or layers of contexts that characterize certain social addresses or niches, for example, those created by crossing race, class, gender, ethnicity, and immigration status. These would include the combinations and developmental supportiveness of families, parenting, kin networks, neighborhoods, teachers, schools, medical care, friends, peers, and so on. The quality of each child’s actual niche may help explain the nature of that child’s individual pathway, and the prototypicality of the individual niche may help explain the similarity and deviation of that child’s pathway from their expected trajectory.

LIFESPAN ANALYSIS

Pattern-centered lifespan analyses are explicitly developmental, examining the connections between past, current, and future individual and contextual organizations. An interesting kind of lifespan person-centered analysis involves the examination of “prodigal cases”—exceptional individuals who “buck the odds,” in the sense that they do not follow the long-term developmental path that is typical for members of their initial subgroup classification (Cairns & Rodkin, 1998). Prodigal cases are considered “resilient” if the developmental deflection is a positive one, or “vulnerable” if the long-term outcome is worse that would be expected given their starting configurations.

In our illustration, Roeser and Peck used prodigal analyses to examine the 8th graders in their sample in the Negative Lifespace Configuration, who seemed to have everything going against them, but nevertheless graduated form high school and enrolled in college despite the improbability of this outcome. In addition to coming from slightly wealthier families, an important factor that changes the odds in their favor was participation in prosocial extracurricular activities during high school (see Figure 26.11).

Insert Figure 26.11

Principles of prodigal analysis.
As explained by Cairns and Rodkin (1998), prodigal analysis "involves the use of subgroup information to highlight the pathways of the limited number of persons who constitute exceptions to the rule. Depending on the normative pathway of the original subgroup configuration, *prodigal cases* (individuals whose developmental pathways depart significantly form that of their configuration subgroup) may be viewed as either resilient or vulnerable...
A *prodigal analysis* reverses the typical figure-ground relationship between subgroups and individuals. Rather than being buried in the error term "exceptional" pathways of individuals are projected into the foreground. They become candidates for intense analysis of when and how developmental deflections occur and what their consequences are" (p. 255).
Once it has been determined that these exceptional cases did not differ from the other members of their subgroups on initial levels of the variables used for classification, the intensive study of these individuals provides an opportunity to test hypotheses about the factors arising during development that contribute to these deflections and turning points, as well as the conditions needed to maintain a particular developmental trajectory. Results from such investigations may also provide suggestions about how to prevent otherwise well-adjusted participants from "going off the rails" or to intervene with participants who otherwise seem to be headed for trouble.

Are there other developmental applications of person-centered analyses?

Indeed there are (see box). Once we researchers open our minds to the possibilities, they are endless.

Developmental applications of person- and pattern-centered analyses.		
1.	***Prospective configurations***. Using earlier (or initial) configurations to follow developmental pathways prospectively.	
	a.	***Point-to-point prediction.*** Using current configurations (i.e., membership in particular subgroups) to predict later outcomes.
	b.	***Equifinality.*** Examining how participants with different initial configurations all end up at the same long-term outcome.
	c.	***Multifinality.*** Examining how participants with the same initial configuration nevertheless end up at different long-term outcomes.
	d.	***Prodigal analysis.*** Examination of individuals who follow pathways that are very

		different from those that members of their initial configurations typically follow—either for better (resilient) or for worse (vulnerable).
2.	***Configurations of outcomes.*** Using configurations of outcomes at a later point (or the end) to trace retrospectively the pathways that led to the different configurations.	
		Can use in analyses that are (a) ***Point-to-point***; in pathways that are (b) ***Equifinal***, or (c) ***Multifinal***; and (d) in analyses of ***Prodigal cases*** with unusual pathways to those configurations.
3.	***Stability and changes in configurations.*** Examines whether sets of natural configurations change with age or time. Then uses current configurations (i.e., membership in particular subgroups) to predict whether participants subsequently switch or maintain configurations (i.e., membership in same or different subgroups).	
	a.	***Latent transition analyses***. Examines probability of changing from each subgroup to each other subgroup over time, for example, from a more to a less risky group or vice versa.
	b.	***Pathway analysis.*** Using a series of configurations (i.e., membership in successive subgroups) to predict later outcomes.
	c.	***Developmental streams.*** Identification of sequences of configurations that are more likely than chance (“types) or less likely (“anti-types”) along with individual and contextual factors that distinguish the different streams. Also called i-state (sequence analysis.
4.	***Higher-order clustering.*** Combining clusters and crossing clusters. For example, combining individual clusters and social world clusters to create “lifespaces.”	
5.	***Classification based on patterns of change.*** Participants are grouped, not based on multiple variables at one point in time, but instead based on similarities in their patterns of change over time, for example, using their growth curves or other intra-individual patterns.	
	a.	***Trajectory classification.*** Groups are created that have similar patterns of change over time.
	b.	***Longitudinal classification.*** Groups are created based on the direct clustering of complete longitudinal patterns over multiple time points.
	c.	***Beginnings, middles, and ends.*** Groups are created based on age of onset, rates of change, time to completion, or age at achievement of specific milestones.
	See Bergman, Magnusson, & El-Khouri, 2003; Cairns, Bergman, & Kagan, 1998; Collins & Lanza (2010); Roeser & Peck, 2003.	

Are there other methods compatible with a holistic-interactionistic perspective besides cluster analysis?

Believe it or not, holism-interactionism is only the *first* principle of this developmental systems perspective (see box). We encourage students to continue following this conceptual train of thought (and its sister trains) and, especially, to attend very carefully to the empirical strategies and methods developed and promulgated by longitudinal methodologists from these traditions. As argued by Magnusson, "[w]e have to develop our own tools in a way that matches the characteristic properties of the phenomena that are the object of our concerns" (1998, p. 63).

Principles of a holistic-interactionistic developmental paradigm.	
1.	***Holistic-interactionism.*** Focus on *patterning of variables* within each level of analysis (e.g., psychological, biological, behavioral, social-contextual) requires use of person-centered analyses.
2.	***Adaptation and stasis.*** As open-systems, humans show both *adaptation and resistance to change,* both growth tendencies and homeostatic tendencies, each of which should be considered in research.
3.	***Transformation***. Development involves *non-linear, qualitative changes characterized by speed and degree of plasticity (openness of the organism to) of change*. Both degree and speed of developmental change during different periods in the lifespan should influence the research design and measurement strategy.
4.	***Synchronization***. Development involves the spatial-temporal coordination of phenomena within the organism (e.g., synchronous firing of neurons; coordination of home+work role identities) and between the organism and the environment (e.g., developmental attunement or mismatch of person and others). The *quality of synchronization of organismic processes at the level of the body, the mind, and person-by-environment relations should be foci of research*.
	From Magnusson, 2001.

Are researchers allowed to use both variable- and person-centered analyses?

Absolutely. As you know by now, we encourage students to examine as many lines of sight on a phenomenon as possible (see box). However, in integrating the information seen from these different angles, it is essential to keep track of what one is actually looking at and what is obscured by these different perspectives. For example, our conventional group-based inter-individual analyses can *never* provide information about individual pathways of qualitatively different kinds of persons.

Can researchers combine variable- AND person-centered approaches?
Proponents of person-oriented approaches are tentatively optimistic about the utility of combining approaches. In their book on the methodology of person-oriented approaches, Bergman et al. (2003) suggest that it is "often in highly productive to mix the two types of approaches, or rather alternate between them. To obtain a preliminary understanding of a new area, it is frequently useful to apply variable-centered methods (e.g., by computing correlations,

performing factor analysis, comparing means) in order to obtain a provisory understanding of which factors are involved in individual processes. Based on this and good theory it might be possible to construct reliable and valid scales measuring central concepts and to form relevant profiles mirroring the system under study. A person-centered methodology can then be used to find/test for typical (developmental) configurations. Sometimes, after such an approach has been carried out, it might be possible to formulate a nonlinear SEM model in which interactions that have been previously identified are incorporated. This might lead to new theoretical formulations that can be empirically tested, most frequently by a person-oriented methodology; and so on. Having said this we must also point out that, in our experience, the variable and the person perspectives are not easy to reconcile. Finding ways to integrate these two perspectives is a challenge we should continue to work toward" (p. 197).

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PART VII:

OPTIMIZATION OF DEVELOPMENT

Chapter 27. Development of Contexts

> No man ever steps in the same river twice, for it's not the same river and he's not the same man. — Heraclitus

In meta-theories, like developmental systems meta-theories, that assume that all the elements that create development, from biology to culture, are themselves changing and developing, it is still easy to implicitly deal with the highest and lowest levels--- namely, context and neurophysiology, respectively, as if they were stable. Explanatory accounts of children's and adolescent's development often treat their parents and teachers as social contexts whose parenting styles and teaching styles continue to broadcast to offspring and students a steady beam of parenting and teaching quality, instead of considering parents and teachers as developing adults. Similarly, explanatory accounts of how individual differences in particular brain systems underlie behavior and performance often treat these systems as if they were a permanent part of the individual's neurophysiology, rather than a temporary installation that may have just arrived on the scene. Hence, these last chapters provide a set of frameworks for explicitly conceptualizing and studying both contexts and brains as potentially malleable and developing systems.

Don't we already have the idea of "changing contexts" incorporated into our meta-models?

Yes, we do. We have been thinking a great deal about contexts. We have our individuals embedded in multiple layers of them, individuals are reciprocally interacting with them and thereby creating the "engines" of development in proximal processes, and we are certain that contexts are continuously changing over time—real time, episodic time, and historical time.

And don't changing contexts figure prominently in our interventions?

Indeed they do. A primary goal of interventions is to change contexts. We assume that changing the contexts within which people live, learn, and work can be an effective strategy for altering the proximal processes that shape their development. So we think that, rather than airlifting people out of their natural contexts, and "fixing" them, and then putting them right back into the contexts that "broke" them, we should work to change the contexts themselves as well as the way people select and interact with them, of course.

So isn't our work here done?

Not completely. Compared to the cornucopia of theories and studies describing how *people* develop, there is a paucity of perspectives that conceptualize how *contexts* change or develop. The discipline can't help it; psychology is the study of *people*, and so it is easy to leave contexts trailing in the dust—and to forget that the people who often comprise the active ingredients in "contextual influences" (like parents, teachers, coaches, and bosses) are themselves developing. In fact, it makes sense that the researcher among us who hops up and down the most about developing contexts is the one who studies the effects of children's peer groups on their own development. In work on peers, the contexts are made up of exactly the same people as the target developing persons. In work on parenting or teaching, the relationship is asymmetrical—the slow-moving contextual adults are shaping the fast-developing offspring and students. With peers, the same people are on both sides of the equation, so it is hard to argue that one is more steady and it's the other one who is doing all of the developing.

But don't "contextual" models tell us everything we need to know about contexts?

They have told us a lot. We now think about contexts as more than "environmental soup full of causes" (Thorngate, 1995, p. 43) or "amorphous, haphazard, and unpredictable circumstances" (Dannefer, 1992, p. 14; see box). We know that they are organized and structured, both sociologically and psychologically, full of intentional agents and culturally-shaped affordances, and that people are busily reciprocally influencing them through a variety of interesting processes, such as selection, avoidance, provocation, and creative interpretation.

A sociologist's view on conceptions of contexts in developmental discourse.

The sociologist Dale Dannefer (1995) has criticized developmental psychology for its lack of theoretical grounding in describing the contexts that shape development. He suggested four models that developmentalists could use to conceptualize the role of contexts:

1. ***Irrelevant***. Models that assume contexts are not important in explaining developmental pathways or outcomes.
2. ***Important but random***. Models that assume contexts play an important role, but their effects are essentially accidents (e.g., being born into certain castes or social strata).
3. ***Important but static***. Models that assume contexts lead to developmental effects on individuals, but do not themselves change.
4. ***Active systems of social relations***. Models that assume full reciprocal effects between changing people and their changing contexts.

Didn't we also get instructions about how to identify and measure contexts?

Yes. We got some good advice from our explanatory theories: The contexts and attributes that matter always depend on the MacGuffin (and the anti-MacGuffin) and the proximal process that promote and undermine them. We also have to consider "developmental windows," since we don't expect processes of contextual influence to be global, regular, frequent, homogeneous, and stable. And we were reminded how little we know about individual *or* contextual sensitivity or susceptibility (or immunity) to influence—when and why windows are open, what strength of "dose" or length of time individuals must be exposed, and the quality or quantity of proximal processes that are involved in "moving the dial" on or sustaining developmental change.

So isn't that enough to stew about? What else are researchers supposed to consider?

How to conceptualize and study contexts as processes that are *changing*.

Can you give an example?

Okay. Let's think of the kinds of contexts that support the development of individual competence. Let's imagine that, when individuals have no clues what they are doing, contexts must be heavily involved, scaffolding actions so they can be effective. So far so good. Now, as individual competence starts emerging, what should the context be doing? Right—it should be slowly backing off. Keeping its hand on the back of the bicycle seat so to speak, but letting go where the individual's practice and skill can start steering and correcting and pedaling all at once.

Meaning that—to continue being supportive, the context needs to *change*?

Yes. Attunement requires tuning. And once you think about it, the notion is everywhere. Remember "developmental measurement equivalence," which turned out to be "developmentally-friendly conceptualizations" in disguise? All of the constructs that are depicted as contextual good news, like warmth or limit-setting or provision of help, need to be radically reconsidered in how they are expressed at different ages in order to continue to be appraised as those good things as children and youth become older. Parents and teachers complain about their jobs—their charges represent moving targets, and just as you have figured out how to provide for their needs, they change-- and those "old" provisions are outdated and no longer welcome or sufficient.

So good contexts are always *changing*.

Not always. Sometimes contexts can be supportive by remaining stable and steady—through contextual transitions (like moving house, divorce, or serious medical illness) or even as individuals undergo radical changes (like the "terrible twos" or early adolescence). Sometimes even in the face of children's or youth's demands for change—calm steadfast predictable parenting, teaching, or supervising can provide a foundation for development that is reassuring and helpful, and maybe even appreciated by the developing person (although often not until much later).

So what? Does this mean that contexts are changing or are staying the same?

Yes. Contexts can do both, sometimes in tandem with developing people and sometimes not.

Well, then what are researchers supposed to do?

That's the methodological challenge—how to conceptualize and study changing contexts.

MODELS OF CONTEXTS THAT ARE INDIFFERENT TO CHANGE

Where do we start?

It can be useful to look at current conventions for examining the effects of contexts, and to gently critique them for their assumptions about contexts and how they change.

What are our current methods?

Well, let's skip over the most prevalent strategy—the examination of correlations between attributes of the context and attributes of the developing person at one point in time. Correlations at single time points may be useful for sending up flares ("Look over here!"), but they have major limitations for studying potential contextual influences: They are plagued by all those marauding "third variables," and they do not contain information about causal direction, or even about whether the contextual attribute is correlated with changes in our developing person.

So, instead, let's start with "launch models." As we discovered in the chapter on causal inference, they use information about inter-individual differences in the context at one point in time to predict inter-individual differences in the subsequent trajectories of individuals, as depicted in Figure 27.1.

Insert Figure 27.1 about here

Why are they called "launch" models again ?

Because they assume that the context at Time-point 1 hurls or catapults the developing person along their trajectory from $Time_1$ to $Time_n$. It is a time-lagged effect--the initial force of the context is assumed to be a major determinant of the arc of the outcome. These are models that look at, for example, the effects of attachment styles on the development of infants, the effects of parenting styles on children's development, of teaching styles on changes in students, of management styles on changes in workers, and so on.

These sound wildly developmental. What's the problem?

Because they look at context at only a single point ($Time_1$), they implicitly assume that the context is not changing, or if it is, that such changes do not matter for development. As you can see in Figure 27.1, the context itself can be increasing or decreasing over time and it would not register in studies that use a launch model.

As long as contexts predict changes in individuals, aren't we satisfied?

Not if the "effects" of context at $Time_1$, are actually being re-generated at each time point by the next concurrent context.

Can you give an example?

The most well-known example can be found in work on attachment, in which researchers challenged the then prevailing interpretations of studies showing that early maternal sensitive responsiveness was linked to attachment classifications which then predicted a host of positive long-term developmental outcomes across childhood. Critics argued that the conclusion that maternal sensitive responsiveness and secure dyadic attachments "launch" these salutary developments did not account for the potential impact of *subsequent* maternal behaviors (Lamb, Thompson, Gardner, & Charnov, 1985). Maybe there is no “launch” at all—maybe it is the quality of *later* caregiving that is the dominant influence on later child functioning (as pictured in Figure 27.2). The idea that early maternal sensitive responsiveness might be a marker for *continued* responsiveness, and it is this “continuity of care” that shepherds adaptive development, led to empirical examination of constellations of caregiving (including patterns of continuous sensitive, continuous insensitive, initial sensitive followed by insensitive, and initial insensitive followed by sensitive caregiving) which produced different kinds of developmental trajectories for the children experiencing them (Belsky & Fearon, 2002). Looking at the stabilities and changes in maternal caregiving is essential to understanding the effects of this aspect of context on development.

Insert Figure 27.2 about here

So “launch models” would completely miss the effects of changes in contexts?

Exactly. Launch models, which assume that changes in contexts are not relevant, should only be used to test models that include the idea of a “window of influence” or “sensitive period” followed by a developmental process which is sealed off from environmental effects.

Do any developmental phenomena fit that bill?

Maybe. Like “learned helplessness” in which early experience with noncontingency leads to expectations of non-contingency, so that children come to live inside the bubble of their own appraisals. They withdraw their engagement at the first sign of trouble, and so are no longer open to actual contextual contingencies. Or, more happily, think of mastery-oriented children, who through early development of competence and effective coping are “inoculated” against subsequent failure experiences.

So sometimes researchers are justified in using launch models?

Not really. Phenomena can end up being well-described by launch models, but researchers should not start off testing context effects as launch models. In fact, in research on helplessness, because it was discovered during a historical period when behaviorism still dominated, researchers had to subject the phenomenon to grueling empirical tests to conclusively demonstrate that behavior was subsequently “sealed off” from later contingencies. It took researchers *years* to get from models in which environmental contingencies were changing (from non-contingent to contingent) before researchers could safely conclude (not *assume* but conclude) that prolonged exposure to non-contingency *launches* helpless reactions (i.e., passivity and giving-up) at the first sign of resistance or failure, even when subsequent contingencies are restored.

What are alternatives to the launch model?

A second common model looks at the effects of *contextual transitions*. Sometimes these studies are described as the examination of “changing contexts,” but researchers really mean “*ex*-changing contexts,” because individuals are transitioning across multiple distinct contexts, which may be different from each other. As pictured in Figure 27.3, the contexts are actually stationary, it is the individual who is changing location. These models are ones that follow individuals as if they are on a train—the individual experiences the view out the window as changing, even though the landscape is holding still. Individuals arrive in new destinations and need to deal with new and potentially different demands, even though the places and contexts themselves are not changing. These transitions can come in all shapes and sizes: They can be culturally assigned (e.g., transition to kindergarten), assigned by others (e.g., family moves), assigned by biology (e.g., transition to hospital), or even self-selected (e.g., choosing new friends or dropping out).

Insert Figure 27.3 about here

Do we hate these models, too?

We don't hate any models. To quote Magnusson (1998), "Everything is exactly what it is—no more, no less" (p. 50). There is nothing wrong with any model. The problem is when it used to as a skeleton to mold a phenomenon that does not conform to its contours. All models, as simplifications of a complex reality, contain assumptions that may be hidden from us. If we apply these models thoughtlessly to our target phenomena, they can deform or obscure our view of the actual functioning and complexity of our target.

This sounds familiar.

Well, it is the theme of the class and this whole book.

So we are skeptical about the transition model?

We love the transition model—it is very useful to study movement across different contexts: Children starting school, workers starting new jobs, families moving to new neighborhoods, immigrants settling in new countries, and so on. Transitions across contexts can be considered potential "perturbations" or "disruptions," and can have powerful effects on the portion of development that is localized around the site of the transition. Moreover, many transitions (like high rates of mobility or many new step-parents) in an individual's life can cumulatively deflect their long-term pathways. Even transitions that result from success can have a potentially negative impact, as our graduate students discovered when they left high school (where they were typically among the smartest of students) to college (where they were usually among the top 25%) to graduate school (where they discovered that they were just “average”) (see box). Transitions can even be turning points. And all developmentalists love a good turning point.

From talent to chance: Transitions across competitive contexts.

Thorngate (1995) provides an instructive example of how transitions across contexts can influence individual development:

“The proud parents of 10-year-old Mary note that she seems to have a natural gift for swimming and enroll her in a local swimming program. Soon her coach discovers her talent and encourages her to compete in a local swim meet. She does and wins with little effort. After a few more wins in local competitions, she becomes a big fish in a small pond. Thus rewarded for her talent, she decides to enter regional meets. Here she discovers that many competitors are talented, and after a few losses realizes that she can only win by training more.

More training produces more wins. But at the Provincial meets Mary discovers that every competitor is talented and every competitor trains hard. Thinking even more training will give her a winning edge, she reduces her school load, moves to another city to work with a professional trainer, and spends almost all her waking hours in the pool. She is now 12 years old.

A few losses at the Provincials are devastating. Now training almost all her waking hours, Mary tries other strategies. She lifts weights. She convinces her parents to hire a sports psychologist. Knowing nothing else, she devotes herself totally to her only source of reward. Her parents continue to invest thousands of dollars in her performance. And it works, At age 14 Mary wins at the Provincials and now trains for the Nationals.

But at the National swim meet Mary notices that every competitor is talented, every competitor trains hard, every competitor lifts weight and consults a sports psychologist. Except for drugs, there is nothing more she can do. The race will be won or lost by no more that 3 or 4 hundredths of a second, a blink of an eye. And it will be determined not by talent, not by training, not by motivation but by chance. Mary will have devoted much of her development to enter a situation where her fate will be determined at random. In doing so she will experience the mathematics of situational change that explain why the best person rarely wins (Thorngate & Carroll, 1987, 1991)” (pp. 50-51).

Is there a “but” on the way?

An “at the same time.” At the same time, contextual transition models should not be mistaken for models of *changes* in the contexts themselves. Having one’s workplace become more globalized during one’s tenure there, or experiencing one’s school start to fall apart or one’s father become less depressed—these are *changes* within the same contexts, and can require as much accommodation and adjustment (and risk as many developmental disruptions) as transitions *between* contexts—without the regularity, predictability, and external supports that often accompany socially sanctioned movements from one context to another.

So what are the alternatives?

You guessed it—models that consider, and therefore can examine, whether contexts *change*.

MODELS OF CONTEXT DEVELOPMENT

Let's look at three models of contextual development, just to get a feeling for what it means to think about contexts as continuously and actively changing (see box; Kindermann & Skinner, 1992). These three models do not claim to be comprehensive; there are as many ways for contexts to change as there are for individuals to change. And, unfortunately for researchers, there is no encyclopedia of contextual development. To plump up our toolkit of conceptual models and design, measurement, and analytic strategies, we encourage students to monitor and collect ideas from disciplines, like sociology, anthropology, urban planning, ecology, or history, that make it their business to track trends in how the contexts of greatest interest to developmentalists are changing.

What is the first model of context development?

The first one is called the "weather model" because it suggests that contexts are continuously and systematically changing, and these changes have an essential impact on individuals and their development-- but the changes are not influenced by or based on the actions of the individuals (see Figure 27.4). Instead they are based on the dynamics of the weather system itself. From this perspective, contextual "development" can be seen as a series of gradual changes or dynamic shifts that are not calibrated to the target individual and over which the individual has no control. The weather does not care if we have planned a wedding or planted tomatoes—it is up to us to cope with the changes that the weather brings—whether that be erecting a tent, lugging a watering can, or opening an umbrella.

Insert Figure 27.4 about here

Conceptualizations of context development.

1. ***The weather model of co-development*.** Contexts are changing in a systematic fashion that has an impact on developmental trajectories, but these contextual changes are not initiated, steered, calibrated, or otherwise shaped by target individuals.
2. ***The developmental co-adaptation model.*** Contexts change along with individuals over time--person and context reciprocally influence and mutually adjust to each other repeatedly over a series of time points.
3. ***The developmental attunement model.*** Contexts are changing based on a developmental agenda that the context holds for the developing person and synchronized with the individual's development.

From Kindermann & Skinner (1992).

What are some examples of contextual changes that are like the weather?

Many life events and decisions of parents seem, from the child's point of view, to resemble the weather. Fallout from parents' stressful life events, such as job loss, divorce, illness, or addiction, can all "rain down" on children unexpectedly, whether they are ready or not. Even positive events, like birth and growth of a sibling, a parent starting a new job, or an older sibling going off to college can bring contextual changes to which children have to adjust. By the same token, some of the key decisions by schools and teachers, or neighborhood and local politics, or the health care or legal systems, can all be seen as potentially operating like the weather—decisions are made to increase class sizes or reduce subsidized housing or cover mental health services based on the dynamics of the higher-order system, whether the outcomes are good for individuals in these systems or not. Considering these contextual changes within weather models allows researchers to focus on "events" as a series of overlapping shifts in the environment, over which the child or youth has no control, but which may nevertheless have important consequences for their development in a variety of ways.

It is also important to point out that children and youth can create "weather events" for the adults in their lives: if a child takes up with a "bad crowd," starts drinking, has a religious conversion, becomes pregnant, decides to drop out of school, or to become a rock star, these can generate waves of critical life events for their parents, teachers, siblings, and friends. Systems researchers point out that, because individuals are all parts of interconnected networks, any changes in the life of one family or network member, whether positive or negative for that specific individual, can send ripples (or shock waves) throughout the whole system and require adjustments from all its members.

How should researchers study contextual "weather" changes?

Investigations based on weather models would first identify the location of global changes or "weather fronts." For example, if the focus is on parents, then the occurrence of a stressful event in the parent's life can be used as a marker to locate the advent of a contextual shift. Then researchers can zoom in with appropriate measures on the particular local contextual dimensions that are being affected (e.g., being "caught in a thunderstorm" versus "subjected to a drought"), including the pattern of individual differences in these changes. A key design issue for these models is mapping, using the meteorology and geography of these events, exactly who will actually directly experience the specific weather or micro-climate.

Especially important, when analyzing weather events, is a consideration of the differential consequences for people of different ages in dealing, for example, with "heavy snow" or "partly-cloudy" days. Individuals will differ in their ability to forecast events, evacuate the area, "batten down the hatches," and all the other rough weather metaphors we have been saving for this moment. To test a weather model, the trajectories of the contextual factors would be assessed and then examined for their effectiveness in accounting for corresponding trajectories of individual change. As concluded by Kindermann and Skinner, "The weather model attempts to highlight the dynamic nature of 'events'… which often produce multiple environmental changes in the lives of those who experience them as well as their social partners. The analysis of those changes, their dimensions, and variations in their individual trajectories, may contribute to our understanding of their effects on individuals' development" (1992, p. 175). Together, these elements should be helpful in explaining how changes in the contextual weather, although neither calibrated to individuals nor under their control, can have an impact on their subsequent development.

What is the second model of contextual development?

A second way that contexts can change is depicted in the "developmental co-adaptation model," in which, as its name suggests, the individual and environment adapt to each other across time. In this model, individual and environmental changes are reciprocal and characterized by a continuous sequence of mutual person-context adjustments or re-synchronizations (see Figure 27.5). Unlike in the weather model, in the co-adaptation model environmental changes are influenced by the target individual's characteristics, actions, and changes. However, although these contextual changes include reactions to the individual, they are not calibrated to the target individual's development, nor produced by a developmental agenda of the context.

Insert Figure 27.5 about here

What would be some examples of this kind of contextual change?

Because these models require that the context harbor no developmental agenda for the target person, one of the first contexts that comes to mind as involving "co-adaptation" would be the peer context. A child's or youth's peers are as busy developing and changing as the targets themselves, but they rarely have the kinds of developmental goals for the target that can be devised by adult socialization contexts. Children and their peers are required to mutually adjust to each other as both develop—through processes that include individuals accommodating to changes in their friends and vice versa, or processes of reciprocal reinforcement, or the mutual (re)construction of group norms that guide both partners' behaviors. These changes can influence the development of individual characteristics as well as changes in relationships, such as their closeness, intimacy, liking, and influence, which of course, may in turn require processes of co-adaptation.

It is important to point out that the contexts created by adults, even ones who have responsibility for the development of children, youth, or the elderly, are often best characterized by the co-adaptation model, in that adults can easily react to changes in their charges with no particular consideration given to the individual's current developmental level or an agenda for his or her future. For example, teachers may respond to a student's disengagement by withdrawing their involvement, even if this reaction has the unintended consequence of reducing the student's motivation even further (see box).

One source of contextual changes: The effects of children on their adults.

An important source of contextual changes and development is often overlooked, namely, the bottom-up effects of individuals on the contexts in which they are embedded. Despite the decades long insistence on the "active individual," studies that investigate the top-down effects of contexts on individuals far outweigh the relatively few studies that examine bottom-up effects. For example, fifty years ago, Richard Q. Bell bemoaned the lack of attention to the effects of children on their parents, noting that:

"Since 1961 eight different investigators have commented on the oddity that the child's contribution to parent-child interaction is overlooked (Bell, 1968; Gewirtz, 1961; Kessen, 1963; Korner, 1965; Rheingold, 1969; Stott, 1966; Wenar & Wenar, 1963). Child behavior is seldom an independent variable, parent behavior a dependent variable, even if the child is acknowledged by a formal place in theories. Until very recently we have had no hypotheses concerning the child's stimulating effects on the parent. Accordingly data are not gathered so that the effects of the child can be identified, and most of the relevant findings are accidents generated by research directed to other purposes. Parent and child are clearly a social system and in such systems we expect each participant's responses to be stimuli for the other. Why, then, is the child's own contribution to an interaction overlooked by social scientists, and what can be done about the problem?" Bell, 1971, p. 63).

This same state of affairs holds for the dearth of research exploring the influence of students on their teachers, workers on their supervisors, patients on their doctors, the elderly on their caregivers, and so on. Even after conceding that the power differential between higher-order social players and their lower-order interaction partners typically also leads to asymmetries in influence, nevertheless, a puzzle remains. In a thought experiment, if we imagine interviewing parents, and ask them who has influenced their development as parents the most, or teachers about who has taught them the most about teaching, or doctors about healing, surely the majority would answer "my children," "my students," and "my patients."

Does the co-adaptation model apply only when contexts are composed of *people*?

No. Of course, processes of co-adaptation are easiest to imagine when contexts are composed of social partners, like peers or adults, but it should also be applicable to the study of the nonsocial microecology. For example, developmental co-adaptation models might provide an organizing frame for the study of coping processes (see box) where the interaction partner consists of stressful life events. Stress, almost by definition, either brings or threatens a host of contextual and person changes and losses. These challenges, threats, or losses trigger changes in the individual (such as reappraisals, constructive coping, and discouragement)—which can be thought of as "adjustments" or "adaptations." These changes in people in turn trigger changes in the stressful events, sometimes making them better, sometimes worse, and sometimes both. In that sense, some facets of the stressful events "adjust" or "adapt" to the changes in the individual. At the same time, stressful life events are not calibrated to the developmental level of the individual and typically do not entail a developmental agenda for the target person. Hence, coping with stressful life events can be viewed as successive person-context co-adaptations.

Coping with stressful life events as a process of developmental co-adaptation.

"Researchers argue that coping processes (as well as the stressful events that invoke coping) consist not merely of an episode but are comprised of a series of events that take place over time (Lazarus & Folkman, 1984). Individuals cope with environmental changes through processes of appraisal, reframing, and active attempts to compensate for or restore loss. For example, the loss of a job encompasses many changes, including perhaps the loss of a social network a source of self-esteem, respect of others, financial support, and so on, down to loss of a reason to get up in the morning. Over time, the effects of the loss on the individual's developmental trajectory will depend, among other things, on the extent to which the losses are compensated for by changes in the individual and other social partners. Hence, the pattern of changes in these contextual elements will influence the individual and the individual will in turn, through his or her coping responses influence the rate and nature of contextual changes (including the probability of getting a new job). Together these reciprocal changes will predict the developmental effects of the loss" (Kindermann & Skinner, 1992, p. 177-178).

How should researchers study co-adaptation processes?

As can be seen by the double-headed arrow in Figure 17.5, researchers must conceptualize, measure, and analyze two explanatory links: (1) how the antecedent contextual changes influence subsequent individual development; and (2) how the antecedent individual changes produce changes in the relevant aspect of the context. Surprisingly enough, those two processes may include completely different attributes of individual and context—because the same parts of the individual that are malleable (and so register an effect from the context) may not be the same parts that are influential (and so generate a change in the context). An important design feature of such models would also be zooming out a level on these joint processes to see what these feedback loops are creating together over time.

What is so interesting about feedback loops?

As systems scientists point out, reciprocal loops are one variant of the recursive processes that give systems their higher-order structure and directionality. For example, if in feedback loops both directions of effects (from context to individual as well as from individual to context) are operating in the same direction, together they create *amplifying* loops. Depending on the nature of the changes, these can be described as "virtuous" or "vicious" cycles (or circles) that magnify initial individual differences—so that the “rich” get richer and the “poor” get poorer. A simple example of a vicious cycle can be found in an argument, in which each new exchange escalates negative feelings and boosts the hostility of both participants.

Alternatively, if the directions of effects are running in different directions (i.e., one positive and one negative), then the feedback loops are *compensatory*. For example, in such processes, the escalation of one partner is followed by the de-escalation of the other partner; or the distancing of one partner is followed by the approach of the other partner. Compensatory loops are often used by systems to keep their functioning and development within tolerable ranges, because such loops successively redirect interaction partners back to a middle ground, and so smoothen out the shapes of their joint trajectories. Compensatory processes are visible, for example, in well-functioning parent-child dyads, in which disciplinary interactions are kept within a range of appropriate behaviors by the use of emotion regulation strategies, humor, or mutual time outs when exchanges become heated. One interesting control systems idea is that social contexts (including schools, families, peer groups, and workplaces) have their own norms that create a wider or narrower “zone” of acceptable behavior. If individuals remain within this zone, contexts basically leave them alone, but if individuals stray outside these boundaries, contexts use compensatory processes to bat them down if they exceed the upper limit or boost them up if they fall below the lower limit (e.g., Bell, 1971; Bell & Chapman, 1986).

Do models of developmental co-adaptation themselves ever change?

Good point. Yes, the nature and quality of person-context co-adaptations may stabilize, improve, or deteriorate over time. At some points, they may even convert over to “weather models”—if the contexts become “sealed off” for some reason and stop adapting to or being responsive to the individual—say when stressful life events become non-contingent or uncontrollable or when the social context stops “listening to” or being responsive to the attributes, actions, or changes of the individual.

What is the third model of contextual change?

The third model is called the “developmental attunement model,” because the development of the individual is an *agenda* item for the context. In this model, contexts have plans for the individual’s development, so environmental changes are adjusted according to the developmental progress of the target individual in relation to this set of goals. Models of developmental attunement are characterized by a pattern of environmental change that is calibrated according to the target individual’s development and is guided by the context’s goals to shape that individual’s trajectory (see Figure 27.6). This is a familiar model to developmentalists because we are always advising the applied contexts with whom we are working (and ourselves) to strive for this kind of relationship with our developing charges.

Insert Figure 27.6 about here

Who has a developmental agenda?

This model would be a contender for accounts of any context that has specific motives and goals for the developing person. This would include contexts that are routinely entrusted by the culture with nurturance or (re-)socialization activities, such as parents, schools, orphanages, self-help groups, managers, hospitals, prisons, or institutions for the elderly (even though many of these contexts might not show such attunement to their charges). This model might also characterize relations in which the context elects to assume these duties; examples include relationships with mentors, coaches, siblings, or grandparents (Kindermann & Skinner, 1992, p. 179).

How would researchers study developmental attunement?

The good news is that this is already a very popular topic in developmental research, even though more studies focus on the effects of contextual or relationship attunement on individual development, and relatively fewer focus on investigating the effects of individual development on changes in the context's attunement. Of interest is a step-by-step understanding of this process from the context's perspective (see box).

Process-oriented study of developmental attunement.

Theories, designs, measures, and analytics are needed that allow researchers to examine each step in the process, including explanations of:

1. the agenda and timetables of the context, including what their specific contents and origins;
2. how well the context's agenda and timetables are coordinated with the individual's own agenda and tuned to their zone of proximal development;
3. the impact of the agenda on what the context actually does, including the nature of the affordances and scaffolding provided;
4. how the resulting socializing interaction patterns shape the development of the target individual;
5. how developmental change of the individual feeds back onto changes in the agenda and behavior of the context; and
6. the nature of the supports provided to the context in carrying out or modifying the agenda.

Is contextual attunement always a good thing?

In general, individuals function and develop better when contexts are attuned to their needs. In this regard, the context's *agenda* is of crucial importance. If the context is oriented toward the optimal development of the individual, and is in harmony with the individual's own agenda and coordinated to their zone of proximal development, then attunement is a beautiful thing (and is often considered to qualify as attunement only if it meets these criteria). If, however, the context's agenda, as can often happen, is not focused on the well-being of the individual but instead on some larger system goal (like maximizing productivity or test scores, or minimizing the work of the context), then the context's agenda may not be so good for the developing person, no matter how thoughtfully it is implemented.

Flexibility and attunement in contextual agenda and timetables.

In early work on child maltreatment, researchers working with parents who were at risk for maltreating their children discovered that such parents often held unrealistic views of the kinds of behaviors they could expect from their children. They sometimes created expectations and agendas for their infants and young children that far exceeded their capacities for mature behavior (e.g., responding to requests for quiet or other forms of compliance). Researchers wondered whether parent education about child development and its normal milestones might help parents develop a more reasonable agenda for their child's functioning and development.

Then something very interesting happened. Some clever researchers thought to examine the developmental norms and agendas held by more typical parents who did *not* maltreat their children, and they discovered interesting similarities and differences between the two groups of parents. Counter to expectations, researchers found that non-maltreating parents were no more realistic in their expectations and knowledge about developmental milestones or in their developmental agendas.

However, they were very different in a crucial regard. When maltreating parents encountered the actual capacities and developmental progress of their own infants and young children, they tended to stick rigidly to their misaligned expectations and standards, thus creating high demands and friction when children could not fulfill them. In contrast, parents who were more developmentally attuned, upon interacting with their own offspring immediately realized that their expectations were unrealistic and abandoned them, substituting almost week-to-week a more developmentally appropriate agenda, guided by the child's own capacities and progress.

What is the role of the individual in all this context attunement?

The ease with which contexts can reach their goals for individuals' development depends heavily on the cooperation of the target individuals themselves, as captured by terms like "readiness to be socialized." This notion suggests that individuals must either already be ready and willing or must *become* ready and willing to participate in the context's agenda for their development. If we wish to out-meta ourselves, we can even note that a central goal of most contexts and cultures is that their individuals eventually take ownership for this agenda and continue socializing their own development long after the contexts have faded from view. For that reason, developmental attunement may be especially important during "new beginning" or entry into new contexts, such as school transitions, employee "onboarding," initial apprenticeship, as preservice teachers take on their own class for the first time, and so on.

If we admit that contexts are developing, will we have to learn a whole bunch of new strategies for measurement, design, and data analysis?

Not so much, actually. Perhaps surprisingly, the entire range of strategies we have been discussing for studying individual development contain within them almost everything we will need to get started on scrutinizing the development of contexts (see box). If we play our cards right, all we need to get started is the *idea* that not only people but also their social partners and higher-order contexts develop over time, so we can use these methods to turn around and look at changes in the contexts. It would be good to keep an eye on new statistical tools that allow researchers to deal with quantitative data that contain the kinds of dependencies created by reciprocal person-context influences (e.g., Ojanen & Little, 2010). Developmentalists can even get to the point of becoming seriously curious about how contexts coalesce into configurations, undergo intra-individual changes, and show qualitative shifts and reorganizations. Good times for researchers dedicated to understanding "changing people in changing contexts."

Methods for studying contextual development and change.

1. ***Longitudinal studies*** that include repeated assessment of the important contexts of children's lives, both locally (e.g., family, school, peers) and more globally (e.g., neighborhood), and link changes in these contextual elements to changes in individuals.
2. ***Studies of causal influence*** that focus not only on the ways that contexts can shape individual development, but also on the many factors that *produce changes in contexts* themselves, including:
    a. Examinations of the *bottom-up ways* in which people can (intentionally or unintentionally) reciprocally shape their contexts.
    b. Explanations of how the people who comprise social contexts *themselves develop* and change (both intentionally and unintentionally).
    c. Examinations of how *changes in higher-order contexts* (such as economic or societal changes) can produce changes in the more local contexts that directly influence the development of children and youth.
3. ***Continuous real-time observations*** that document the sequential probabilities in social interactions-- not only from contexts to individuals, but also from individuals to their contexts.
4. ***Time series studies*** that scrutinize intra-contextual changes in multiple dimensions of the environment during key windows, and that include changing contexts as a focus in intra-individual analysis of person-context interactions and episodes.
5. ***Pattern-centered analyses*** that focus on the differential organization of multiple contexts and contextual dimensions, and how changes in (or streams of) these configurations can

be linked to changes in the patterns and pathways of individuals over time.

6. ***Analysis techniques that model person-context dependencies*** include the social relational model for the analysis of dyadic data and social network modeling to capture more complex group structures (e.g., peer groups).

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Chapter 28. Developing Brains: Experience and Neuroplasticity

The past is never dead. It's not even past.
— William Faulkner, *Requiem for a Nun*

A key assumption of systems perspectives is that all psychological and social phenomena are "contextualized" and "embodied." By "embodied," we mean that all developmental phenomena involve, not only the mind and behavior, but fundamentally, essentially, and indivisibly, the body. And since the brain is part of the body, we can also insist that all developmental phenomena are inherently "em-brained." Even a moment's reflection makes clear that the brain busily accomplishes a host of vital functions for us continuously--for me as I write this paragraph (e.g., breathing, heartbeat, sitting, collecting visual information from the keyboard and screen, bringing me snippets of yesterday's class on this topic, working to formulate my thoughts, helping me select words to express them) and for you, as you read it. The brain is involved in all our behaviors, waking and sleeping, making over 2 million synaptic connections a second. A huge amount of this activity takes place outside of our conscious awareness, but of course, the brain is also deeply involved in that mysterious and emergent state-- consciousness. Thank you, brain.

The idea that neurophysiological systems underlie all our developmental targets is both obvious and, in the years following the "decade of the brain" perhaps the fastest growing area of research in psychological science. With the invention of new tools for measuring brain activity, we have witnessed an explosion of information about the brain systems that seem to be involved in a wide variety of social and psychological experiences and behaviors, and our view of the brain is updated and revised almost daily.

Are we going to have to memorize a lot of Latin names for brain parts that sound fancy but actually mean things like "top front outer layer"?

Not today. We want to think together about the role of the brain in the study of development and the role of development in the study of the brain.

Okay, but haven't we already incorporated the brain as the "bio" in our "bio-psycho-socio-cultural" people?

Indeed. However, there is a standard way in which the brain is typically read into our developmental theories. In the majority of this work, neurophysiological systems are considered as *antecedents* or underlying *substrates* of our target psychological and social phenomena. The directionality of the relationships between brain and behavior is assumed to flow *from* brain *to* behavior.

Can you give an example?

Let's consider the research on school readiness. One way that researchers have thought about readiness is to analyze the brain systems that underlie the cognitive and behavioral skills children need to succeed in kindergarten. For example, Figure 28.1 pictures three brain systems that are implicated in children's learning, memory, language, and self-regulation skills, all of which are important preparation for behaving appropriately and performing well in kindergarten. Individual differences in the functioning of these brain systems are one explanation researchers are considering for the gaps in school readiness found for young children from different socio-economic backgrounds.

Insert Figure 28.1 about here

What is wrong with this perspective? It seems like a good example of an "em-brained" phenomena, right?

Yes, it is definitively good news.

But?

No "buts," just a "Yes and." Yes and yet this picture is not complete. The actions that are sponsored by these brain systems become part of proximal processes in the preschool setting, what we can collectively call "experience." Because brain systems are malleable, such experiences, along with other proximal processes in other settings, have the potential to fundamentally change the brain, as pictured in Figure 28.2. These changes are referred to as "neuroplasticity."

Insert Figure 28.2 about here

Haven't we heard about "plasticity" before?

Yes, we got to know the concept in the lifespan approach as one of its key propositions—the idea that underneath our current levels of functioning and performance, people contain great reserves of potential to be something other than their current selves—a great range of intra-individual possibilities. The key idea is that our current developmental trajectory is just one option—we have the capacity to follow an almost infinite variety of alternative pathways.

What does "plasticity" mean when applied to the brain?

Its core meaning is that, perhaps across the lifespan, the brain remains malleable, modifiable, and open to influences from within and without. In other words, plasticity is inherent in the nature of the brain: It continually changes and develops as a result of experience. As Minsky (1986) points out, "The principal activities of brains are making changes in themselves."

What does this mean for our research?

It means that we have the opportunity to incorporate additional directions of effects in our studies. If the brain is so plastic and malleable, then it can move over to the right side of our conceptualizations (see Figure 28.3) and its development can become one of our target outcomes (part of our MacGuffin or anti-MacGuffin). And we can start to think of the proximal processes in our target contexts (like high stress in families of low socio-economic status) that may be having an effect on the experiences of our target people and thereby be influencing the development of our target brain systems. We have open to us the study of the "myriad ways that the structure of experience weaves it way into the structure of the developing brain" (Fox et al., 2010, p. 28).

Insert Figure 28.3 about here

Is this a new idea?

Absolutely not. It is obvious to anyone who looks at a baby's head and an adult head that the brain develops. As is often the case, however, when a biological system is in the foreground, it seems to exert an irresistible pull on maturational meta-theories, so the functioning and development of the brain can easily seem to be all about the genetics and inter-workings of the brain itself. What developmental systems perspectives try to highlight is that, just as every aspect of the functioning and development of the individual relies on the brain and body, so too does every cotton pickin' thing about the brain, from architecture to neurogenesis, depend on proximal processes, including interactions among brain and psychological subsystems, but most often overlooked—proximal processes involving actions, environments, and experience. Like everything else, the neurophysiological system is itself a complex multi-level dynamic system, as well as a sub-system embedded in complex multi-level dynamic systems of whole persons and their structured contexts (e.g., Lewis & Todd, 2007).

Is experience so crucial?

Yes, so very crucial. If you think about it, every experience, based on patterns of associations among sensory information that is contiguous in time and space, leaves a memory trace. And, of course, for experience to influence brain development, the brain must be built in a way that it is open to the influence of experience (Fox, Levitt & Nelson, 2010).

Is that really such a good idea of the brain? Isn't it risky to be so open?

Yes, but mostly it pays off in flexibility of adaptation. The central idea is that the incomplete architecture of the brain allows it to grow the capacities needed to function well in whatever world it actually encounters. For adaptive purposes, the brain is the organ that is designed to change the most in response to experience.

So everything brain-y is up for grabs?

Everything in the neurophysiological system is developing with the participation and close cooperation of experience, action, and the environment. At the same time, subsystems of the brain differ in how much they are influenced by innate mechanisms, how easily they can be modified, what kinds of experiences are needed, and the developmental windows during which experiences have their greatest (or least) impact.

Although news about brain science is updated every few minutes, some working models have emerged that are useful in explaining a few key overarching principles of neuroplasticity. Let's just consider three ideas: the development of early brain architecture, development that is experience expectant, and development that is experience dependent (see box; Nelson, 2000). The goal is to enrich our understanding of the "em-brained" individual by taking seriously the notion that the brain itself is "embodied" and "contextualized," and therefore changing and developing.

Three principles of neuroplasticity.	
1.	***Development of neural architecture***. Environmental conditions and experiences that contribute to the pre- and post-natal construction, organization, and growth of the fundamental anatomical structures of the brain.
2.	***Experience expectant development***. Species-wide process in which brain systems require particular experiences during specified periods in order for growth and elaboration to proceed on a normal track. "[S]ome neural systems remain open only so long to environmental input, and if such input fails to occur, or if the input is abnormal, the 'window' of opportunity' closes and development goes awry" (Nelson, 2000, p.117). Also called "sensitive periods" (Knudsen, 2004).
3.	***Experience dependent development***. Individual-specific processes in which particular neurophysiological developments are contingent on particular sets of experiences that allow adaptation to local conditions. Wide variation in these experiences still allow healthy brain development.

NEURAL ARCHITECTURE

The development of brain "architecture," which refers to brain anatomy, like the layers of the brain, axes, neural plate, and so on (Nelson, 2000), is most concentrated from conception to about three months. As you would expect, these deeper architectural and anatomical structures, especially as they are being laid down *in utero*, are highly conserved, meaning that their development and organization proceeds within a narrow range that is similar across many species.

So brain architecture is *not* part of neuroplasticity?

Actually-- it is. This is just this kind of development that easily leads to nostalgia for genetic determinism and innate mechanisms. Developmental patterns that are uniform across people (and even across species) seem to cry out—"Preformist at work here—can't you see the predetermined plan being carried out by the little gene army?".

But no such luck?

No. All brain structures are constructed in a "continuous series of dynamic interactions between genetic influences and environmental conditions and experiences" (Fox et al., 2010, p. 28; see box). Our current best guess is that this process is orchestrated through complex processes of self-organization, likely based on redundant systems that work together with many checks and balances, that together constrain and channel development along a rather narrow mammalian pathway.

Experience and the development of neural architecture.
Fox et al. (2010) explain how the timing and quality of early experiences influence the development of brain architecture. They point out that,
"Although our genetic code provides an important foundation for early development, it must be understood as a framework upon which many environmental factors influence future structure and function" (p. 31).
"There is increasing evidence that environmental factors play a crucial role in coordinating the timing and pattern of gene expression, which in turn determines initial brain architecture" (p. 28).
"[P]ostnatal experiences drive a protracted process of maturation at the structural and functional level, but the very ability of such developmental processes to occur successfully is dependent in large part on the prenatal establishment of the fundamental brain architecture that provides the basis for receiving, interpreting, and acting on information from the world around us (Hammock & Levitt, 2006). While the term blueprint has been utilized in the past to describe a fixed set of genes with inflexible interactions, the term is used here as an analogy to a rough draft, or design—the framework from which a more defined structure will evolve" (p. 29).

What would be an example of how contexts might influence the development of brain architecture?

Think of the kinds of environmental effects that we commonly hear about during the prenatal period—for example, the noxious effects of exposure to environmental toxins, such as alcohol or drugs, or (because the mother is also a context) stress hormones. Or, on the positive side, obstetricians' recommendations that pregnant women take folic acid in order to prevent neural tube defects. These kinds of environmental effects are constantly in play, down to the finest level of DNA methylation (see box). So the development of the neurophysiological architecture is shaped, not only by local environment within the brain, but also, in concentric circles, by the environment surrounding the fetus, including the mother and the mother's context.

Environment, Experience, and Epigenetics
Just because genes play an important role in the development of brain architecture, it is tempting to conclude that researchers don't really need to worry about the effects of environment or experience. However, in their special section on "the effects of early experience on development," Nathan Fox and Michael Rutter focus on advances in neuroscience and molecular genetics that have revolutionized the way that developmentalists understand the degree to which environmental conditions and experiences penetrate to the genetic and neurophysiological levels of functioning and development. For example, about the role of experience in the action of genes and molecular genetics, they point out that,
"Research in [epigenetics]… argues that experience influences the cellular machinery of the gene, changing in some instances, the expression of the gene and the genome itself. It is the essence of the gene by environment interaction. Experience modifies the gene and its actions creating changes in behavior and in some instances, the expression of the gene and the genome itself" (2010, p. 24).
Gottlieb somehow seems like he might pop up here—THOMAS?

What is the take-home message about brain architecture?

Just this: Even at the deepest level of highly conserved development of neural anatomy and in the seemingly most secluded location (the womb), the development of the brain is intimately connected with environmental conditions.

EXPERIENCE EXPECTANT DEVELOPMENT

In describing the successive ways in which experience "sculpts" brain systems, Fox et al. point out that, "In all mammalian species, this early period of specified patterning to generate a unique architecture is followed by an extended period of synapse formation, adjustment and pruning that typically extends from the last quarter of gestation through puberty" (2010, p. 31). During these years, a second principle of brain development becomes very interesting to researchers and interventionists-- that of "experience expectant development" (Greenough, Black, & Wallace, 1987) and the successive waves of "sensitive periods" created by these kind of processes.

What does "experience expectant" mean?

The idea is that some brain systems develop in a way that they require environmental experiences to allow them to progress normally. These systems proceed to a certain point of readiness, at which time they "expect" particular kinds of experiences, and so they "pause," full of plastic possibilities, for experiential instructions about the next steps in normal development. If the experiences do not arrive at the right time or if they are not the right kinds of experiences, then the brain system looks at its watch, stops waiting, and goes off on its own—meaning that the developmental window closes and abnormal or aberrant development occurs.

Why in the world would the brain count on such experiences showing up at the right place and the right time?

Evolution is a good guide. The kinds of experiences brain systems are waiting for are ones that are ubiquitous in the environment and common to all species members (Greenough et al., 1987), such as the basic elements of pattern perception or language input or responsive interactions with a sensitive caregiver. These experiences are integral parts of an "average expectable environment." In fact, brain systems have co-evolved with environments that include regular sensory information and affordances (visual, auditory, olfactory, tactile, kinesthetic, social, and so on)—so the brain is perfectly justified in counting on them to be homogeneously and continuously available whenever neurophysiological systems are ready for their participation. As Nelson points out, experience expectant processes have the advantage of "saving the genome from the trouble of orchestrating and regulating all aspects of development" (2000, p. 117).

How do experience expectant processes work?

We don't know all the mechanisms, but some of the ideas in play may surprise you.

When we think of experience promoting development, we usually think that experiences have the job of helping to *create* something novel that wasn't there before. But experience expectant development seems to operate more via the "use it or lose it" principle. As Nelson explains,

> In general, Greenough has proposed that the structural substrate of 'expectation' is the unpatterned, temporary overproduction of synapses distributed within a relatively wide area during a sensitive period, followed by subsequent retraction of synapses that have not formed connections at all or that have formed abnormal connections. The expected experience produces patterns of neural activity, targeting those synapses that will be selected for preservation. The assumption is that synaptic contacts are initially transient and require some types of confirmation for their continued survival. If such confirmation is not obtained, synapses will be retracted according to a developmental schedule or due to competition from confirmed synapses. (2000, p. 117)

Can you provide an example?

There are a few examples that are often sited. The normal development of stereoscopic vision requires that regions of the visual cortex receive separate inputs from each eye. The capacity to discriminate and recognize specific language sounds depends on exposure to those sounds during the first year of life: At birth, newborns are able to discriminate all the sounds in all natural human languages (e.g., the difference between "pa" and "ba" or the musical intonations of some tonal languages). After the first year, those discriminations that are not used (and hence confirmed) are "pruned," and these differences can no longer be recognized, resulting in loss of "native speaker" proficiency in languages that require those discriminations. The same appears to be operating in visual discriminations of faces of within species. For example, newborns can discriminate the faces of different lemurs, but unless they continue to be exposed to a variety of lemur faces, that capacity is pruned during the first year, and only the capacity to discriminate human faces remains.

So these processes only apply to brain development in sensory areas?

No, experience expectant development also seems to be operating for other brain systems. For example, the cortico-limbic system of the brain and the hypothalamic-pituitary-adrenal (HPA) axis seem to expect sensitive and responsive caregiving in order to develop normally. It is as if these systems are waiting to see how stressful and dangerous the world is before they set their “alarm” levels. Normatively, within the first three months those levels are set to a social world that is protected from stress and sensitively responsive to infant distress, typically resulting in a “hyporeactive” HPA axis that is relatively calm and recovers easily from stressful encounters. Without these experiences (as seen, for example, in children reared in orphanages or by maltreating parents), the development of these neurobiological systems is abnormal.

What does experience actually *do* for the development of the brain?
Experience seems to trigger changes in the brain at the molecular and genetic levels, as explained by Fox et al. (2010),
“While synapses can form under experimental conditions in the absence of physiological activity, experience is essential for the normally occurring regulation of the molecular basis for synapse formation. In this complex process, activity controls the expression of transcription factors that direct the downstream expression of structural proteins, receptors, and signaling molecules that are needed for synapses to function properly (Flavell et al., 2006; Majdan & Shatz, 2006; Paradis et al., 2007; Sugiyama et al., 2008). Moreover, activity regulates the distribution of key proteins within the synapse, making them available for the important task of information processing during sensitive and critical periods of development (Shepherd & Huganir, 2007)” (p. 31).
Moreover, experiences may have a permanent effect on the genetic substrate of neurological development. For example, Roth and Sweatt, in their review of epigenetic mechanisms and environmental shaping of the brain during sensitive periods, point out that “Experiments in rodents continue to show that experiences during sensitive periods of development influence DNA methylation patterns of several genes. These experience-induced DNA methylation patterns represent stable epigenetic modifications that alter gene transcription throughout the lifespan and promote specific behavioral outcomes” (p. 398).

What is the take-home message about experience expectant development?

The crucial nature of experience is illustrated by these processes—in which the brain co-evolved a pattern of development that requires interactions with the “average expectable environment.” The nature and timing of these proximal processes are so important to development that they constitute a “sensitive period”—a window during which experiences common to our species co-create normal development and then closes. If the opportunity is missed, neurobiological structures and functions develop that are abnormal. If these defects are irreversible, these are called "critical periods" (see box). Because each sensory and cognitive system entails a unique sensitive period, identical environmental conditions will result in very different cognitive and emotional deficits or developments for a child, depending upon his or her age (Fox et al., 2010).

Sensitive and Critical Periods
One of the most fascinating illustrations of the role of experience in brain development can be found in the notion of "sensitive" or "critical" periods in development. Sensitive periods are times during which specific brain subsystems are particularly responsive to patterns of sensory input or activity. If brain systems are deprived of these expected experiences, abnormal development (neurological, psychological, or social) will occur. If these developments are irreversible, they are called "critical periods."
Knudsen (2004) provides a lovely analysis of this process at the level of the neural circuit, arguing that "[t]he central nervous system requires instruction from experience during sensitive periods in order to develop properly. Sensitive periods in the development of complex behaviors (such as social behavior and language) reflect sensitive periods in the development of the neural circuits that underlie these behaviors. The effects of experience operate within the constraints imposed by genetics on a circuit. These effects include the capacity to guide changes in brain architecture and biochemistry and, in some circuits, to trigger and/or end sensitive period plasticity" (p. 1422).
"During a sensitive period, particular kinds of experience shape the connectivity of a circuit in fundamental ways, causing certain patterns of connectivity to become energetically preferred or mechanistically specified. Although plasticity persists after the end of a sensitive period, this residual plasticity alters a circuit's connectivity within the constraints that were established as a result of experience during the sensitive period" (p. 1422).
Knudsen argues that "experience during a sensitive period customizes a developing neural circuit to the needs of the individual" (p. 1414) because "[e]xperience provides precise information about the individual or about the environment that often cannot be predicted and, therefore, cannot be genetically encoded" (p. 1415).
Especially thought-provoking is Knudsen's analysis of the unique advantages of initial experience: "Experience that occurs initially during a sensitive period has a unique advantage in shaping the connectivity of a circuit. Accumulating evidence about the development of synapses and circuits indicates that before a circuit has ever been activated strongly, it is in a state that favors change: excitatory synapses tend to be weak, synapses are occupied by subclasses of neurotransmitter receptors with relatively slow kinetics that favor plasticity, and inhibitory influences are weak and/or unpatterned. Intense and repeated activation of a circuit, as can result from experience, alters these conditions dramatically. Synapses that participate in driving postsynaptic neurons become strong and less susceptible to further change due to the insertion of stabilizing proteins and different subclasses of neurotransmitter receptors... Synapses that do not participate in

driving postsynaptic neurons are depressed and, possibly, eliminated... Inhibitory networks become powerful and organized so that they suppress alternative patterns of excitation... Self-organizing forces, acting according to the Hebbian rule, tend to reinforce already strengthened patterns of connections” (p. 1416-1417).
Important implications for the reversibility of abnormal developments during sensitive periods can be found in Knudsen’s discussion of the complex mechanisms that close sensitive period plasticity and the idea that more plasticity can be expected from circuits that allow multiple stable patterns of connectivity than from those that allow only a single highly preferred pattern. These mechanisms also have implications for the degree of constraint and openness remaining in mature circuits. “The plasticity that remains enables mature circuits to modify their patterns of connectivity within the enduring constraints established as a result of experience during a sensitive period” (p. 1421).

EXPERIENCE DEPENDENT DEVELOPMENT

A second kind of broadly applicable mechanism of brain development is called “experience dependent.” These processes apply to brain systems (or circuits) that maintain a high degree of plasticity and can adopt a broad range of potential stable patterns of connectivity throughout life. As described by Nelson, “This is a process that optimizes the individual’s adaptation to specific and possibly unique features of the environment, e.g., learning. Thus, for any given individual, diverse information will be obtained and stored for use at a later time” (2000, p. 117).

How does that work?

Greenough et al. (1987) explain that, “The neural basis of experience-dependent processes appears to involve active formation of new synaptic connections in response to the events providing the information to be stored” (p. 539). Compared to experience *expectant* development, in which synapses naturally “bloomed” and then “were pruned,” in experience *dependent* development, no new synapses are created unless stimulated by activity and experience. So this process is one in which the brain develops or is modified through “synaptogenesis”—new or faster connections are created through use, practice, and experience (see Figure 28.4)

Insert Figure 28.4 about here

Why would the brain be interested in these kinds of developments?

These processes allow the brain to remain open to new experiences across the lifespan, and so allow neurophysiological systems to benefit from continuous updating. Whereas experience *expectant* processes promote species wide adaptation to common environmental inputs and interactions, experience *dependent* processes promote *individual* adaptation to *local*, even unique, environmental inputs and interactions. Together they foster the development of brain systems that are organized in ways that allow individuals to successfully regulate interactions with both global and local environmental demands.

What are some examples of this kind of development?

These processes are often illustrated with brain systems that subserve motor, cognitive, and memory functions (Nelson, 2000). For example, the neurophysiological motor systems seem to be capable of modification well into maturity. Perhaps because the neuro-motor systems enjoy the capacity for spontaneous movement as well as movement in response to stimulation, which allows them to be continuously exercised and challenged, these systems seem to be open to new experiences and to allow the acquisition of new skills over the entire lifespan. Evidence of the plasticity of these systems can be found in the profound impact on motor performance of accelerated practice (e.g., in sports or playing a music instrument), and the relative success in remediating the functioning of these systems following damage to the corresponding brain areas. (Sometimes researchers do distinguish between "motor learning" of particular sports or physical activities that seem to be established by middle adolescence, and "motor skills" which seem more open to continuous improvement throughout the lifespan.)

Anything besides motor systems that seem to be dependent on experience?

Much of subsequent neurophysiological development is experience dependent—like cognitive and memory development. These brain systems arrive ready and willing to learn and remember. Like motor systems, they also seek out novelty, enjoy exercise, and respond to environmental inputs. Evidence about their openness to experience comes from research on the deleterious effects of stress-- as seen in the sensitivity of the hippocampus and the limbic structures subserving explicit memory thought to underlie subsequent difficulties in learning and memory. More salutary effects of experience have been documented in research on the protective effects of complex environments, and the regenerative effects of practice and use of cognitive and memory systems.

Individual Agency and Activity as Core Features of Experience
Emphasis on the importance of environments and “experience” in shaping brain development are intended to steer researchers and interventionists *away* from maturational assumptions that the development of neurophysiological systems is primarily a genetically-determined process. However, it is important to point out that the “experiences” that promote brain development are not best characterized as processes of passive exposure. Individuals are intentional and active agents in the co-creation of their experiences. Even research on the development of the visual system suggests that the role of specific visual experiences, say, exposure to patterns and contour, are enhanced when organisms *engage* and *interact* with the visual world.
The notion of “experience” is one of those relational concepts that inherently involves the actions and appraisals of the individual along with the affordances and structures of the social and physical environments. In many studies on brain development, researchers are in charge of deciding the kinds of environmental exposures and experiences their animal subjects will encounter. However, in naturalistic settings, individuals play a crucial role in seeking out, initiating, steering, and terminating the social and physical interactions that comprise their experiences.

DEVELOPMENT, NEUROPLASTICITY, AND INTERVENTIONS

What happens when these brain developments go awry? Are they reversible?

This is a great question and one that has been perplexing (and delighting) researchers for decades. In early work, researchers were quick to label certain developments as entailing "critical periods," with the idea that, if children did not receive particular experiences or inputs during specific ages, the "window" would shut and the opportunity for attainment would be irrevocably lost. Most of these developments have now been re-labeled as involving "sensitive" periods—during which the brain is particularly responsive to input.

Why are effects so hard to reverse?

In cases of "experience expectant development," the lack of developmentally-scheduled activity seems to result in abnormal development, which either replaces or interferes with normal patterns of brain functioning. For example, in the development of stereoscopic vision, when visual input is provided to one instead of both eyes, the active eye conscripts the part of the visual cortex typically dedicated to processing information from the unused eye. This hostile take-over prevents the unused eye from recapturing its normal territory, even after visual input has been restored (which is one reason why occlusion of *both* eyes does not seem to produce irreversible damage). It is as if, when it is time to work on stereoscopic vision, the brain says, "Well, we do not have all our players here, so let's just give all of our resources to the player that did show up." Then even if the other player (visual input from the other eye) appears later, the resources have already been occupied by the original players.

Even in experience dependent development, earlier developments place constraints on later developments, a process known as "entrenchment." If high stress reactivity interferes with brain systems subserving memory and learning, such reactivity may continue to "set off" high-strung neurophysiological reactions when the environment itself is subsequently calm and stable, thus wiping memory and learning or significantly interfering with its successful progress.

So—is it possible to reverse these abnormal neurobiological developments?

There seem to be at least three answers to that question. On the one hand, it may be possible to reverse some of the neurophysiological effects of early deleterious experience by creating dramatic and pervasive changes in the environment. This suggests that, although such abnormal developments would almost never be spontaneously reversed, they may still be open to change through the provision of enriched, complex, challenging, and attuned experiences. It is important to point out that abnormal neurobiological organizations put up “resistance” to change (perhaps even at the level of the neural circuit)—so that the therapeutic experiences required to accomplish a later re-organization may require massive amounts of highly structured experiences provided by highly-trained professionals. Research is hot on the heels of mechanisms that would allow critical period windows of neurophysiological plasticity to be reopened—to benefit children who have been deprived of normal experiences (see box) as well as older adults whose neuroplasticity is normatively declining.

Deprivation studies.
Some of the most heart-breaking evidence for the crucial importance of experience comes from studies of infants and young children who, because of neglect, abuse, or institutionalization, have been deprived of the experiences typically provided by the “average expectable environment.” Although neurobiological and behavioral effects are pervasive, the severity and multi-faceted nature of experiences of maltreatment make it difficult scientifically to conclude anything more specific than “the more prolonged the experience, the worse the effects,” and to note that, even after children have been restored to the caring and enriched environments they deserve, many of the developmental sequelae persist.

What is on the other hand?

Since the brain is a complex dynamic system, it has also been well-documented that, when one system is compromised or does not develop normally, the brain has the capacity to spontaneously reorganize its functioning to allow the use of alternative means or pathways to accomplish the same goals. As explained by Fox et al, “early development … may be likened to the laying of a foundation and scaffolding for a building. If the scaffolding pattern is changed, the building may not be constructed in its original form, though a functional alternative may be reached. Thus, irreversible changes at the synaptic level do not necessarily translate into irreversible changes in a complex behavior" (2010, p. 32).

And the third hand?

Since the brain functions at multiple levels, it is also possible that later developments in higher-order brain systems can compensate for damage or deviation at lower levels. As explained by Fox et al, "It must be remembered, however, that information is processed in a series of networks, each reflecting the effects of environment at varying time points. Higher level processing may mask modifications in lower level networks... Thus, behavioral outcomes may be shaped by later experience, even though circuits at the lowest levels in a pathway remain irreversibly altered" (2010, p. 35).

Is there a time-limited offer as to when efforts at reversibility can be effective?

Rules of thumb, as you can imagine, suggest that sooner and younger is better, because the shorter the duration of harmful experiences and the less entrenched the brain is in these abnormal patterns, the easier they are to modify.

So no rehabilitation for adults and the elderly?

Not correct. The brain is malleable and plastic all across the lifespan. However, like development in every other aspect of biopsychosociocultural individuals, subsequent neurophysiological development is enabled and constrained by previous developments and by current levels of plasticity, so intervention research designed to identify the sets of experiences needed to help adults, especially older adults, recover from deleterious early experiences or more recent damage to brain systems, presents a special challenge to efforts to "retrain the brain" (see box).

Retraining the brain.
A great deal can be learned about neuroplasticity through intervention studies that test the effectiveness of structured lab or naturalistic experiences devised to improve or remediate brain development.
Optional quote: "When considering the intended beneficial effects of these approaches for high-risk children, one must also examine the implicit assumptions made by each methodology. Laboratory-based approaches are generally aimed at improving functioning within one cognitive domain. Such research findings suggest that improvements in a given domain can mediate real-world improvements in classroom behavior and achievement or reduce psychopathology symptoms. The implicit assumptions are that strengthening a specific cognitive process via laboratory training allows for more efficient use of this pathway when it is called upon in ecological settings and that the given neural pathway has been strengthened. The problem with these assumptions is that few of the laboratory-based training studies have tested the potential positive effects of training outside of the laboratory, although some exceptions exist" (Bryk & Fisher, 2012, p. 97).
Optional references: Bryck, R. L., & Fisher, P. A. (2012). Training the brain: Practical applications of neural plasticity from the intersection of cognitive neuroscience, developmental psychology, and prevention science. *American Psychologist*, *67*(2), 87-100. Davidson, R. J., & McEwen, B. S. (2012). Social influences on neuroplasticity: Stress and interventions to promote well-being. *Nature Neuroscience*, *15*(5), 689-695. Rabipour, S., & Raz, A. (2012). Training the brain: Fact and fad in cognitive and behavioral remediation. *Brain and Cognition*, *79*(2), 159-179. Ramey, C., T., & Ramey, S. L. (2004). Early learning and school readiness: Can early intervention make a difference? *Merrill-Palmer Quarterly, 50*, 471-491. Thomas, C., & Baker, C. I. (2013). Teaching an adult brain new tricks: A critical review of evidence for training-dependent structural plasticity in humans. *Neuroimage*, *73*, 225-236.

Are there individual differences in how open people are to the effects of experience?

Could be. Researchers are arguing over whether some individuals are (ready for this?) biologically predisposed to be more influenced by the environments and experience they encounter. And these biologically-based individual differences may be triggered (ready again?) by differential early experience (see box).

Differential Sensitivity to the Effects of Context
Research has long documented the detrimental long-term risks posed to children's development by prolonged exposure to stress and adversity, such as through maltreatment, poverty, and institutional care. In early work, researchers discovered a subset of children who seemed to be more strongly negatively affected by these experiences. Closer investigation of the mechanisms of this differential susceptibility revealed that the neurophysiological systems of these infants and children were more reactive to stressful experiences, and so they were

described as high in "stress reactivity."
Then a funny thing happened. Researchers who were conducting intervention programs aimed at remediating the harmful effects of early stress exposure decided to include measures of individual differences in stress reactivity, in order to see whether their interventions could help the children most harmed by experiences of early adversity. Much to their surprise, they noted a very interesting pattern of effects: Children who were high in "stress reactivity" were the ones who benefited the *most* and improved the *most* from intervention efforts.
As a result, researchers began to questions the way that they had interpreted earlier findings on these children, and began to re-conceptualize the notion of individual differences in "stress reactivity" as perhaps actually capturing something more like individual differences in "biological susceptibility or sensitivity to the effects of contexts." This differential "openness" of neurophysiological systems would indeed be a problem if the environment was toxic, but it might confer an advantage if infants and children were interacting with positive social and physical contexts, as in the intervention studies.
Subsequent conceptual work has attempted to review research on contextual sensitivity form many levels, including evidence of behavioral sensitivity (as seen in temperaments), physiological sensitivity (as seen in the HPA axis), and even genetic sensitivity (as). Research has attempted to test these ideas by carefully examining the effects on development of different combinations of biological and environmental conditions. The idea of "contextual sensitivity" would predict an interaction: (1) relative to children who are low in biological sensitivity to context, children who are high should fare worse in adverse environments; however (2) in enhanced environments, children with these same biological endowments should show *enhanced* development compared to children who are low in context sensitivity, because they can take greater advantage of the opportunities offered in the more positive environments.
Bringing these concepts full circle, some recent empirical work suggests that early experiences of stress may re-program the development of such differential susceptibility or openness to later contextual influences.
(See Obradović & Boyce, 2009, for an overview.)

Does all this neuroplasticity mean that we have to become brain researchers?

In a way. Sometimes it seems like researchers only have two alternatives. Either we have to drop everything and dedicate our lives to the study of that fascinating brain, or we have to run as fast as we can in the other direction—to protect our work from that obsession with neuroscience that is eating our field. So it's either "the brain is everything" or "the brain is a distraction." One middle way would come from the idea that an understanding of the brain (and all its neurophysiological systems) *enriches* applied research, since the brain enables and constrains all development. And researchers' efforts, both empirical and interventionist, are also enriched when we keep in mind that the brain itself (along with all its neurophysiological systems) is developing as well.

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Chapter 29. Developing Individuals: Transformation and Branching Cascades

> "The past," he thought, "is linked with the present by an unbroken chain of events flowing one out of another." And it seemed to him that he had just seen both ends of that chain; that when he touched one end, the other quivered.
> — Anton Chekhov, *The Witch and Other Stories*

Just as optimization efforts too often treat contexts and neurophysiologies as if they were fixed entities that are not open to change, so too do interventionists often mistake the malleability of the individual, but in the opposite direction. Because individuals contain great reserves of plasticity, it is easy to imagine that these reserves can be easily tapped. Moreover, researchers naturally spend a great deal of empirical energy focused on their target developing people (i.e., offspring, students, youth) and in discovering the kinds of proximal processes and other contextual conditions and supports they require to optimize their development. As a result, by the time interventions are designed, it is easy to run out of steam and just *inform* the relevant contextual agents about what they should be doing to meet the needs of their developing charges, perhaps accompanied by a compelling rationale and empirical evidence for the superiority of these new behaviors. Some parent and teacher psychoeducational programs use this strategy—for example, explaining the concept of "autonomy support" and reviewing the evidence of its effectiveness in promoting children's cooperation and motivation.

Such interventions are effective in transmitting information but surprisingly ineffective in changing behavior. Or perhaps not so surprisingly, when one considers the assumptions about development—in this case the development of contextual agents-- that underlie them. These strategies assume that the major reason participants are not behaving better is that they are missing some information—the problem is caused by lack of knowledge. If only participants *knew* what we researchers knew, *then* they would change their behavior. Of course, even a cursory examination of our own behavior, reveals that these are dubious assumptions. Everyone *knows* all about healthy diet, exercise, sleep, and drinking 8 glasses of water daily, but few of us *act* on that knowledge. Greater bombardment with these messages may lead to some changes, but the greatest impact is likely to register in feelings—of guilt and self-recrimination—and not on behavior change.

What are our other options?

The most important ingredient is a mindset shift in the interventionist-- the realization (or reminder) that all of the multi-leveled integrative complexity held in place by the organization of bottom-up recursive processes and top-down developmental structures—all the facets of development that our meta-theories bestow upon our developing target participants, well, those are all active in the development of our contextual agents as well.

So what are we looking for?

In the long run, we are looking for full theories and research programs about the development of the context—parents, teachers, supervisors, and so on. But let's just start with two goals: we want better timing and better change processes. In terms of timing, we want to identify those aspects of individual functioning that can most effectively (re)direct pathways, and then we want to locate the developmental windows during which those aspects of functioning are most open to change. In terms of change processes, we want to identify "intervention levers," the social interactions (i.e., proximal processes) that will promote and sustain constructive individual action (and eventually underlying functioning), and then design interventions that help to create and stabilize those kinds of proximal processes in their naturally occurring contexts.

So, we want to explore two ideas, one micro-developmental and one macro-developmental, that may help researchers a bit with issues of creating changes processes and then figuring out when to apply those changes to channel development most effectively.

What is the micro-developmental idea?

An understanding of what is "on the arrows" between proximal processes and intra-individual development.

Which is?

A long story. We don't have time for all of it (and no one actually knows all of it at this point), but it involves the role of agency in the process of individual transformation.

AGENCY AND INDIVIDUAL TRANSFORMATION

How does the story start?

With a question, a simple and magical question, namely, "How does stuff get from the outside to the inside?"

Who cares about this question?

Anyone who is trying to promote development, like interventionists, parents, teachers, supervisors, spouses, coaches, mentors, and so on.

Why is that question so hard to answer?

Technically speaking, it's a question about "internalization" and mechanisms of intra-individual change. Some theories dodge this issue, by starting their work with the individual, without really noticing that they have skipped the step by which the "stuff" in the individual's head and body got there in the first place. For theories that do tackle this issue, the ready-made answer, to which we can easily default, is that internalization is a process of social or cultural *transmission,* in which social agents hand out nuggets of information, like gummy bears, to social targets, and then the targets pop the nuggets into their mouths and swallow them whole (see box). Transmission assumptions seem to implicitly underlie the "teaching is telling" and "learning is listening" interventions we considered previously.

Alternative models of internalization.

1. ***Internalization***: "process by which material that is held out for the individual by social others is imported into the individual's intra-psychological domain of thinking and affective processes, where social others may be persons, social institutions, or socially constructed external mediating devices" (Lawrence & Valsiner, 1993, p. 151).
2. ***Transmission:*** a unidirectional process in which "the 'knower' (parent, teacher, expert) provides the 'not-yet-knower' (child, student, novice) samples of completed knowledge, and the recipients of such pre-packaged messages are expected to accept these as given, in passive (or at least not reconstructive) ways. The transmission process does not entail reorganizations of whatever is transmitted, and any changes in the transmitted material are explained as 'error' in the transmission process" (p. 152)
3. ***Transformation:*** bidirectional process by which "the external-become-internal is transformed by the internal conceptual system that imports it. The transformed input, in turn, is used in the service of coordinating and recombining previously existing knowledge structures… The reciprocal process, externalization, refers to activities by which what has become part of the conceptual system is injected back into the environment" (p. 152).

From Lawrence & Valsiner, 1993.

Transmission seems a bit mechanistic, right?

Right. The photo-copy model of transmission does seem to imply that the individual is a passive recipient of this externally-generated broadcast and that any changes in the social message are mistakes in transcription or copying.

So we need an *active* individual?

Yes. Agency is the key here. We need an active agentic role for the individual-- in selecting and interpreting the socio-cultural messages, and in reconstructing their meaning, building on what is already there, coordinating the new with the old, and restructuring both. A process of *transformation*.

Before we get too deeply into transforming individuals—can you explain why we are targeting *individuals* at all? Aren't we really supposed to be targeting *contexts* and *proximal processes*?

Absolutely. But if you think about it--the social partners in proximal processes are often other individuals (e.g., in parenting, teaching, or peer interactions) and the contexts that we are trying to change sometimes are composed of individuals (e.g., principals and superintendents) and sometimes created by individuals (e.g., school culture).

What about when immediate social partners are *not* people—but objects and symbols, like books or academic tasks?

Yes, these are important interaction partners. At the same time, if we want to change them, we have to change the people who select and assign them.

Same thing when we think about the higher-order contexts like policies, resources, and cultural prescriptions?

Yes, in every case, these are *social* systems, so we have to change the actions of the gatekeepers who have the power to prioritize and reallocate them. So processes of transformation, although they are discussed most often in developmental conceptualizations as a process that characterizes developing infants, children, and adolescents, should also be able to help us think about issues of change in any individual or group, all across the lifespan.

So transformation and the active individual. This is starting to sound reminiscent of Vygotsky and Piaget, yes?

Among many other traditions. Lawrence and Valsiner (1993) provide a review that traces the concept of internalization over the last 100 years, and they identify two lines of theorizing, one through Freud and social learning accounts of socialization and one through the sociogenic theories of Janet, Baldwin, to Vygotsky (see box). In each of these conceptualizations they find notions of "transformation" as the (more or less explicit) central development process. They conclude that,

> Material that is in a form suitable for either discourse or perception is transformed into a form suitable for inner dialogue and manipulation of ideas… [T]o become part of a working conceptual system, lower functions need to be 'gathered' (synthesized) into larger units to which personal sense is assigned… [T]he

individual mind is readily seen as the initiating agent of constructive and reconstructive change. Internal thought is the site of the volitional and effortful operations that Baldwin saw as driving development of new ways of knowing. Environmental models by themselves (Baldwin's 'copies') by themselves cannot provide the goals and efforts that lead to creative persistence and novel constructions… The active and constructive role of the developing person is necessary for psychological development to take place. (p. 165).

Conceptual roots of internalization over the last 100 years.

In their review of the conceptual foundations of internalization, Lawrence and Valsiner (1993) trace two early lines of thinking, one through Freud and social-learning accounts, and one through the sociogenic accounts of Janet, Baldwin, and Vygotsky:

1. ***Identification as the core of internalization***:

   Freud (1896) explained the principle of a self-observing internal agent, through which 'the external restraint is internalized and the super-ego takes the place of the parental agency and observes, directs, and threatens the ego in exactly the same way as the earlier parents did with the child… The basis of the process is what is called 'identification'—that is to say, the assimilation of one ego to another one, as a result of which the first ego behaves like the second in certain respects, imitates it and in a sense takes it up into itself" (quoted in Lawrence & Valsiner, 1993, p. 153). Through volitional activities of the child, experiences with the parent are transformed into the emergence of a controlling conscience as the active agent of socialization.

   Bandura and Walters (1959) adopted the idea of identification into a social learning account which "presumes that he child would: (a) discriminate between actions that parents approve or disapprove; (b) accept parental standards as the child's own; (c) internally anticipate parental reward or punishment; (d) feel fear or guilt as the response of the conscience to such anticipation; and (e) consequently either desist from acts likely to violate parental standards, or do them and then experience guilt" (p. 155). As explained by Bandura in 1991, "It should be noted that people do not passively absorb ready-made standards from whatever social influences happen to impinge on them. Rather, they construct for themselves their own standards through reflective processing of multiple sources of direct and vicarious influence" (quoted in Lawrence & Valsiner, 1993, p. 157).

2. ***Sociogenic approaches to internalization:***

   Janet (1925) argued that, through activities, changes are made to both the incoming material and the individual's mental functions: "in the case of every action there must occur a series of psychological operations which, first of all, transform the action so as to harmonise it with the tendencies and interests of the doer, and secondly, transform the individuality of the doer in so far as the memory of the action becomes part of the individual's archives, and in so far as the personality of the doer is augmented and transformed by the addition of this new element" (quoted, p. 158). Valsiner & Lawrence show that Janet further "formulated the inward journey of the word away from the physical action through to the emergence of an idea and its transformation in internal speech to thought as deliberation" (1993, p. 159).

   Baldwin (1911) adds the notion of "persistent imitation" to explain individuals' active and intentional attempts to produce high quality actions-- initially based on external models, which are soon transformed, as "the actual thing passes into the instrumental image, becoming a mere 'schema' of the further intent read in and through it, to be again 'tried-on' in the actual struggle with the world" (quoted in Lawrence & Valsiner, 1993, p. 160). These "instrumental images" motivate individuals to exert effort in continuing to adapt their actions, using feedback from each attempt to improve the quality of the actions, in successive self-perpetuating cycles of goals, effort, actions, dissatisfaction, and improvement.

Vygotsky (1934) focuses on bidirectional person-society transformations of "meaning," as a relatively stable socially shared entity. The child reconstructs these external cultural tools of socialization, such as speech, as psychological functions, which "originate as forms of coordinated activity and are only later transferred by the child into his own psychological activity. Speech for oneself originates through differentiation from speech for others which is originally social in its nature. It is not gradual socialization that is injected into the child from outside, but gradual individualization that comes into being on the basis of the inherently soical nature of the child, that serves as the main tract of child development" (quoted by Lawrence & Valsiner, 1993, p. 164).

From Lawrence & Valsiner, 1993.

How does the idea of "internalization" aid interventionists in their quest to help individuals transform?

It orients us to what we are trying to do and it orients us to what we are trying to help socialization agents do. If parents and teachers want to promote healthy development, the long-term target they are aiming for is not captured by the concept of "obedience" or even "compliance," but instead by ideas of *agency*.

What do you mean by agency?

Active and willing cooperation and ownership of the developmental change process, that is, *transformation*. If we are trying to help people "transform," we can't expect that all we have to do is hand them some information. Even if they politely take it, they will soon put it down and go on without it.

"Individual transformation" sounds like such a solitary internal activity. What is the role of social others in this process?

As in all developmental processes—the social partners and contexts are wildly active. For example, Lawrence and Valsiner explain, "[s]ocial contributions to the mental construction work revolve around how significant people structure the environment, make available the individual pieces that are suitable for incorporation in the construction, and provide the frames.. within which the individual pieces can be built into the individual's unique structure" (1993, p. 152).

Are there guides about how to promote agency and so accomplish these kinds of transformations?

Yes, a bevy of ideas and strategies are provided by theories of engagement, internalization, and the development of conscience. Especially informative are concepts and research from self-determination theory, which focus on the very agentic notions of *autonomy* and *autonomous self-regulation* (Deci & Ryan, 1985).

Is there going to be a lecture on these topics?

No. Just some hand waving in their general direction and an overview of the commonalities in their approaches.

What is the most important idea?

The central idea is that, if people are active agents in their own development and we think of interventions as the (temporary) provision of a context that creates a set of proximal processes that will foster that development, we can only accomplish our mission with the willing cooperation of our participants—whether they are babies, children, adolescents, adults, or the elderly; that is, whether they are our developing MacGuffins or the contextual agents who shape our MacGuffins. It's the same all the way up and down the line—with brain circuits, learning, organizations, and long-term development—the target must be *engaged* and actively *participating* in the potentially promotive experiences for development to occur.

How do we recruit their cooperation?

We have to create what is accurately but pretty opaquely called a "person-centered" context.

What the heck is a "person-centered" context?

It is a context that is organized around the goal of optimizing the development of all the people in it. You have probably heard of the idea— "student-centered" teaching, "patient-centered" medicine, "child-centered" parenting, "client-centered" counseling, "family-centered" social work, even "citizen-centered" government.

Sounds like it is organized around the individual?

Yes it does, doesn't it? So it is important to expand on the overall idea, in order to make clear that the systems we are optimizing are prioritized around the development of *all* the people they touch. So, for example, we want schools to be not only "student-centered" but also "teacher-, principal-, and parent-centered."

Designing "person-centered" interventions to promote "person-centered" contexts.

Examples of principles for creating interventions and contexts that are designed to promote the agency and development of the people who comprise them:

1. ***Ensure physiological and safety needs are met.***
   Reduce stress and increase joy and fun.
   Acknowledge, appreciate, and build on strengths.
2. ***Love, respect, and expect great things.***
   Help people act with compassion, for themselves and others.
   Consider the well-being and development of all who are in the system (and in the world).
3. ***Help people articulate their own goals.***
   Create or restore a sense of purpose, remember why what we are doing matters.
   Act authentically and in everyone's (and their own) best interests.
4. ***Help people see clearly.***
   Analyze kindly and realistically what is working and what is not working.
   Find, discover, and adapt strategies that work.
5. ***Create a culture of resilience and learning from "failure."***
   Growth mindset. Strategies of constructive coping.
   Mutual openness and support.

(Deci & Ryan, 1985; Hoffman, 1975; Kabat-Zinn, 1994; Kochanska)

What does this mean for our interventions?

They need to be consistent with our developmental systems assumptions—we have to create for our intervention participants the same kinds of contexts that we want them to create for their charges. Interventions will be more beneficial if there is coherence between the intervention process and our developmental target outcomes. For example, if we want teachers to support students' autonomy (Reeve, 2009), then when it comes to our interventions for teachers, we have to support teacher's autonomy as well. So no "teacher-proof" curricula or pull-out programs for us.

Is there a most important role of interventions?

Yes, it is to zoom all the way out and figure out how to set the stage for and facilitate genuine proximal processes—through authentic tasks, activities, conversations, projects—basically working together to accomplish something real and worthwhile.

How does this create changes in the context?

These intervention activities provide a platform for contextual agents to temporarily create new appraisals and actions. Then interventionists guide, support, and coach the contextual agents as they re-enter their existing contexts (which include our focal developing people) and bring these new ideas and behaviors with them. These new appraisal processes and actions, if the intervention model is on target, should shift the proximal processes in that setting. Then with support, contextual agents are guided in generating constructive interpretations, selecting coping strategies, and responding thoughtfully to these shifts. Gears will grind, resistance and friction will be felt, contextual agents outside of their comfort zones will indeed feel uncomfortable. And so the system is perturbed and destabilized. With enough top-down and bottom-up support and responsiveness, new patterns and reorganizations are formed.

As explained by Cairns and Rodkin, "the general proposition that social behaviors constitute the leading edge for contextual adaptations and biological change (Bateson, 1991; Cairns, 1986). Once interactions prove effective, they create the scaffolding for further changes in neurobiology and social contexts. Interchanges affect the internal conditions of both organisms and their environments and provide directions for future development" (1998, p. 262).

Anything else we should be considering as we foster the development of our focal contextual agents?

We also need to be sure that the intervention has targeted their higher-order contexts, that is, the contexts of the contextual agents. For example, for interventions focusing on teachers, we should be considering principals, superintendents, colleagues, parents, and unions (and maybe even students). The contextual agents' top-down and bottom-up contexts have to be cooperating for agents' efforts to reorganize their actions and appraisals to get traction and then for the reorganizations to become sustainable.

Can you give an example of this kind of an intervention?

All interventions that are effective in making and sustaining change are likely following these same principles. So we can provide one example that is close to home, in our efforts to help create "mindful schools."

What is mindfulness?

One contemporary approach to helping teachers address the demands of teaching more effectively is the introduction of mindfulness training as a unique form of professional development (Roeser et al., 2012). Mindfulness, as defined by Kabat-Zinn (1994), is a form of awareness characterized by "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally (p. 4). As such, mindfulness involves three interrelated skills and dispositions: (1) focused attention that is intentionally directed to what is occurring moment by moment (rather than attending to the past or future), (2) conscious and clear awareness of situations and actions (rather than non-conscious perception and action); and (3) an attitude of openness and acceptance to each moment just as it is, without biasing emotional reactions or mental judgments. Mindfulness is also sometimes described as an attitude of warm-hearted curiosity and compassion towards the present moment and all it includes (Cullen, 2011), including oneself. Such an attitude has been termed "self-compassion" (Neff, 2003) and involves (a) mindful self-awareness; (b) suspension of self-judgment and criticism in favor of self-kindness and acceptance; and (c) appreciation of the universal nature of challenge, setbacks, and difficulty."

A considerable body of evidence indicates that mindfulness and self-compassion training can help adults facing significant life difficulties to reduce stress, regulate emotion, and improve their health and well-being (Carmody & Baer, 2008; Grossman et al., 2004). Several mechanisms underlying such effects have been theorized, and research is on-going, but what is clear is that mindfulness helps adults to down-regulate chronic stress reactivity and thereby helps to curtail the cascade of negative biological, psychological, and social consequences that arise from unmitigated and unregulated “stress responses” (Davidson & McEwen, 2012). At the same time, after reducing the deleterious consequences of chronic stress, mindfulness training appears to help individuals to cultivate positive emotion such as loving-kindness and positive qualities such as empathy (Lutz & Davidson, 2002).

The overarching theoretical framework for this proposed research is a stress and coping, broaden-and-build model of teacher professional development (see Figure 29.1). On this view, in order to be resilient and effective in the classroom with early adolescent students, we believe teachers need to be supported in developing sustainable self-regulatory resources that do two things: (a) reduce stress, emotional reactivity, and distressing appraisals of self and others, including students (the conservation and recouping of personal resources); and (2) broaden teachers’ skills and dispositions related to effective classroom teaching and healthy relationships with students and colleagues (the cultivation of personal resources). The goal of mindfulness training (MT) as a novel form of professional development, we propose, is to assist secondary school teachers in conserving and cultivating self-regulatory resources that are then available for investment in classroom relationships, classroom management, and classroom instruction.

From Roeser, Mashburn, & Skinner, 2012.

Inset Figure 29.1 about here

These kinds of interventions sound like they would be very hard to standardize into “experimental treatments” that we can insert into randomized control trials.

Yes, recruiting the agency and engagement of one’s target contextual agents by crafting an intervention according to their joint goals and the current system’s organization, does not produce uniform treatment modules that can be assigned to focal units, and implemented identically with fidelity. Instead, the “fidelity” is in the integrity of the intervention with its developmental principles and core understandings of how to foster change: agency, engagement, actions, appraisals, proximal processes, top-down and bottom-up supports, reorganization.

How could researchers track their effectiveness?

You secretly know the answer to this one. Measure all those elusive but crucial elements.

And then follow individual pathways over the course of the intervention. Think case studies, person-centered analyses, interrupted time series. Everything we have been discussing about describing and explaining different pathways of individual change.

What is the take home message for the ideas of agency and individual transformation?

Well, we just have to keep dragging all our meta-theoretical complexity along with us, not only in our theories and our descriptive and explanatory research, but also in our optimizing interventions. Idea like these: Interventions are always working with and building on the existing organization, relationships, ways of thinking, and habits of mind and action. Transformation involves the whole system, both its functioning and its identity, and can only be accomplished by agentic individuals and groups through sustained interactions that are active, intentional, goal-directed, concentrated, and engaged. Interventionists are a temporary part of the system, and one sign that our work is done is that we are no longer needed to sustain these re-organized and re-purposed systems.

DEVELOPMENTAL CASCADES

What is the macro-developmental idea that will help us figure out when and where to create changes?

The notion of "developmental cascades."

What are developmental cascades?

Developmental cascades are just what they sound like: a set of waterfalls, coursing down multiple channels, picking up volume, speed, and force as they progress.

Is there a conceptual definition?

Yes. Developmental cascades refer to "the cumulative consequences for development of the many interactions and transactions occurring in developing systems that result in spreading effects across levels, among domains at the same level, and across different systems or generations. Theoretically these effects may be direct and unidirectional, direct and bidirectional, or indirect through various pathways, but the consequences are not transient: developmental cascades alter the course of development. Such effects have gone by different names in the literature, including chain reactions, and snowball, amplification, spillover or progressive effects" (Masten & Cicchetti, 2010, p. 491).

How is this definition connected to the waterfall analogy? What are we talking about exactly?

A developmental cascade starts off with the idea of pathways through qualitatively different developmental tasks and contexts. Any textbook on human development will give you the way stations—like temperament and attachment during infancy; parenting, self-regulation, and school readiness during early childhood; peer relationships and school success during middle childhood; identity, autonomy, and progress toward graduation during adolescence; and, during emerging adulthood, intimacy, purpose, and ownership for finding a place in the world. These are the perennial milestones of normative development, so struggles or difficulty with any of these key developmental tasks are markers of potential trouble.

Intervention research is already clustered around these hot spots—insecure or disorganized attachments, "difficult" or highly reactive temperaments, self-regulatory problems in preschool, underachievement or failing school, peer rejection, bullying, and so on up to the rebalancing act which is early adolescence—and its Technicolor overflow of options for trouble, including truancy, delinquency, substance use, violence, depression, and risky sexual activity. These are the "usual suspects" in all pathways into and out of the normative problems, psychopathologies, and resilience that we care about.

What does the notion of developmental cascades have to offer our old friend, the "pathway"?

Dynamics, interconnection, and structure underlying qualitative shifts.

How does it do that?

It helps us get over our assumptions of continuity and silos (or single tracks) of development. Typically, if we detect a problem during early adolescence, say depression, violence, or drop-out, our continuity assumptions tell us to go rooting around during middle childhood (or earlier) for signs of sadness, anti-social behavior, or academic problems. We look in one silo and try to find early paler versions of the thing we see in adolescence.

What's wrong with that strategy?

Maybe we are on the wrong track or in the wrong silo. Maybe it is not early sadness that puts adolescents at risk for depression, but lack of friends; maybe it is not antisocial tendencies, but early school failure that puts adolescents at risk for later violence; and maybe it is problems with self-regulation, and not cognitive issues, that lead to drop out. Or maybe it is all of the above in each case, or maybe there are multiple pathways in and out. It is as if our typical strategies send us to examine individual threads instead of the fabric of development. We forget to look at whole people and their sequences of developmental tasks.

How do developmental cascades add to the idea of dynamics?

It suggests that we consider causal influences from one silo or track to another. Maybe the troubles in one domain are pushing around and precipitating difficulties in another domain. So maybe inept parenting leads children to do poorly in school which leads to peer rejection, which then puts kids in the company of other deviant peers; or acting out in school leads to sanctions that kick kids out of school so they end up with no adult supervision. And so on. These events along different strands are connected—causally—making next steps or branches in the pathways more or less likely. And after a while, the branches of cascades are more or less difficult to get out of—the sides get steeper as a child burns through parents, teachers, and peers as supports and drops out and makes their first contact with the juvenile justice system.

These sound complex. How do researchers start to identify developmental cascades?

Well, because cascades operate across domains and studies tend to be domain specific, we typically start with meta-analyses of the "factors" that are connected with our ultimate developmental state, say disruptive behavior or excellence in academics despite coming from a high risk background. We are hungry to collect all the clues about the correlates (and if any information is available, the causal influences) of our MacGuffin. We can visit descriptive, explanatory, or intervention studies.

Anything we should be paying especially attention to?

Age.

Why age?

We really mean timing. The bedrock used to anchor developmental cascades (just like in pathways) are found in the *timing* of the events: what is the age of onset, what are the developmental windows during which behaviors are normative, and when do behaviors normatively stabilize or ease off. Of crucial importance is the *sequence* or *order* in which things are happening—who comes first, second, third, and so on.

Is that information typically available?

It may not be an explicit focus of each study. But most studies have a restricted age range in the sample, so you can sometimes piece it together.

How do we parse all this information?

On way to start is by putting the findings in three piles. One pile includes information about the MacGuffin: all of its dimensions and facets. The second pile contains all the aspects of individual functioning (not in the MacGuffin itself) that are correlates of the MacGuffin, and the third pile contains information about the social and contextual risk factors that make the occurrence of the MacGuffin more likely.

What do we do with these three piles?

Let's consider them one at a time. Let's start with the first pile—all the dimensions and aspects of your MacGuffin. Using the information you have gleaned about *timing*, think of yourself as making a family photo album of how your MacGuffin looks at different ages.

Sort of like the exercises we were working on with developmental measurement equivalence?

Exactly. The first step in constructing a developmental cascade is being able to trace the water back to where it bubbles up out of the ground. Or maybe not that far back, but as far back as you can. We are going to try to see whether this pile of photos can be organized into a developmental pathway or two or three.

How do we do that?

Let's take an example, and look at the work of Rolf Loeber and colleagues on disruptive behavior in boys (e.g., Loeber, DeLamatre, Keenan, & Zhang, 1998). They wondered whether there were orderly developmental sequences through which boys progressed in the severity of these behaviors, toward delinquency or anti-social behavior. They wanted to see whether they could identify "different developmental progressions for different youth. After the onset of minor disruptive behaviors, some children may escalate over time to serious acts. Others may experience an onset but level off at moderately serious disruptive behaviors" (p. 187).

What did they find?

They distinguished three pathways, each organized in three stages (see box and Figure 29.2). Each pathway corresponds to a developmental task: (1) the authority conflict path reflects the developmental task of respect and cooperation with authority figures; (2) the covert path, honesty and respect for property (vs. lying, vandalism, and theft); and (3) the overt path, positive social problem-solving (vs. aggression). As they explain, “The pathways represent developmentally formulated stages that are sensitive both to age-appropriate manifestations of problem behavior and to increases in severity, with each stage of a pathway serving as a stepping stone toward more serious behaviors” (p. 190).

Three pathways to boys’ problem behavior and delinquency.			
Pathway	***Authority Conflict Pathway***	***Covert Pathway***	***Overt Pathway***
Stage 1	*Stubborn* behavior.	*Minor covert behavior*. Lying, shop lifting.	*Aggression*. Annoying others, bulling.
Stage 2	*Defiance and disobedience*. Doing things own way, refusing to do things.	*Property damage*. Setting fires, vandalism.	*Physical fighting*. Fighting, gang fighting.
Stage 3	*Authority avoidance*. Staying out late, truancy, running away.	*Moderate to serious delinquency*. Joyriding, picking pockets, stealing from cars, fencing illegal checks or credit cards, stealing car, selling drugs, breaking and entering.	*Violence*. Attacking someone, strong-arming, rape.
From Loeber, DeLamatre, Keenan, & Zhang, 1998.			

Inset Figure 29.2 about here

How did Loeber et al. (1998) figure this out?

Step by step (see box). They combined information from several meta-analyses about the dimensions of disruptive behavior with knowledge about its manifestations at early and later ages to posit the pathways and then tested them with longitudinal data. They further classified some of the boys as "experimenters," who tried out some disruptive behaviors at stage 1 or 2 of any of the paths, then experienced the negative consequences and stopped, whereas others were "persisters," who maintained the disruptive behaviors over time and were more likely to start at the beginning of a path and progress down the sequence. "Multi-problem" boys who proceeded down multiple paths were most likely to end up showing the most serious delinquent behaviors by early and middle adolescence.

Developmental pathways: Creating a dynamic classification scheme.

1. ***Collect markers***. Use theory and meta-analyses to identify a broad range of indicators of the target behavior. Be sure markers come from multiple sources and reporters.
2. ***Identify "stepping stones."*** Use theory and structural analyses to organize the markers into multiple important underlying dimensions of the behavior.
3. ***Formulate pathways.*** Using knowledge about the age-graded manifestations of target behaviors, organize the stepping stones from each major dimension into stages of behavior that seem likely to unfold over time in a predictable order.
4. ***Cumulative age of onset curves***. Using longitudinal data, determine whether the age of onset of each of the behavioral markers within each pathway corresponds to its hypothesized stage or order in the sequence.
5. ***Individual-centered pathway analyses***. Using longitudinal data, determine how many participants are "fitters," that is, who show expected normative sequences without skipping stages (i.e., starting at stage 1 and stopping, or then proceeding to 2 and stopping, or then proceeding to stage 3); or non-normative sequences.
6. ***Point of entry.*** Using longitudinal data, determine whether stage 1 is most likely to be the stage at which the first sign of the behavior occurred.
7. ***Identify "experimenters" and "persisters."*** Distinguish participants who only show the behaviors at one time compared with those who show them over multiple time points.
8. ***Single and multiple pathways.*** Combine information about pathways so that participants can be distinguished who follow none of the pathways, or who persist in one, two, or all three of the pathways.
9. ***Characterize members of pathways.*** Use information about other attributes of participants (e.g., ADHD) or outcomes (e.g., serious offenses or contact with the juvenile justice system) to see whether they differ according to pathway membership(s), persistence on pathways, or severity of progression along pathways.

From Loeber, DeLamatre, Keenan, & Zhang, 1998.

So cool. What do we do with the second pile of findings from the meta-analyses on our own MacGuffins?

In the second pile are all the individual attributes (not in the MacGuffin itself) that are correlated with the MacGuffin. Technically speaking, these are cross-domain correlates of our stepping stones in each pathway. We want to know about "spread"-- where additional fires are breaking out along the way. We can use our list of "usual suspects" to comb the area—to see if our MacGuffin is associated with problems with parents, in school performance, with peers, and so on.

And the timing?

Yes! We are taking notes about the ages at which these correlates are detected, to see when the cross-domain connections emerge (or become noticeable to the people who are reporting them).

What are we trying to do here?

We want to walk with the participants along their pathways and see what else they are running into along the way. These are the potential cross-domain or cross-system links that the notion of developmental cascades has warned us about. They could be spreading *effects* of the stepping stones in our original pathway (e.g., if you lie you will have trouble making friends) or they could be *causes* of the stepping stones (e.g., if you are doing badly in school, you may start lying about it to your parents) or they could both be caused by something else (e.g., inept parenting, overcrowded schools, or underlying temperamental vulnerabilities).

Could you give an example?

Yes-- Masten and colleagues have been interested in examining cascades that link academic and social competence with internalizing and externalizing symptoms across a 20-year span from childhood to adulthood (e.g., Obradović, Burt, & Masten, 2009). These researchers wanted to go beyond the two kinds of well-known effects typically found in longitudinal studies: interconnections *across* domains at a *single* time point (sometimes called coherence or comorbidity); and (2) interindividual connections *within* each domain *over* time (sometimes called continuity or stability). They were interested in whether, over and above these common effects, they would see behaviors in one domain predict changes in behavior in another domain across time (e.g., whether internalizing at time 1 would predict changes in academic competence from time 1 to time 2). These would be considered cross-domain cascades.

To examine these questions, they examined a series of nested models pictured in Figure 29.3, which also shows the primary findings from one study (Obradović et al., 2009). These patterns suggest cross-domain developmental cascades: Social competence in childhood had a cascading effect on internalizing symptoms in adolescence, whereas social and academic competence in emerging adulthood had dual cascading effects on internalizing in young adulthood. At the same time, externalizing symptoms in childhood uniquely contributed to lower academic achievement in adolescence, which in turn influenced social competence in emerging adulthood and internalizing symptoms in young adulthood.

Inset Figure 29.3 about here

What is in the third pile of findings from the meta-analyses on our MacGuffins?

Risk factors. This pile contains all the social and contextual qualities and events that make our MacGuffin (or any of its dimensions) more likely.

And the timing?

Goes without saying.

These would all be potential antecedents, right?

Yes, indeed. For example, in the study by Obradović et al. (2009), it turned out that early family adversity set up the whole cascade in that it predicted initial starting levels of childrne's externalizing, internalizing, and social competence. However—risk factors could also be consequences, couldn't they? It could be that when children lie or are aggressive or disobedient, they inadvertently pull down the wrath of their parents, teachers, or peers, and so create for themselves a contextual risk factor for their further development.

This is starting to sound like an avalanche or snowball, isn't it?

Right. A cascade.

Can you give an example?

The cascade that has been most comprehensively studied is the one for anti-social behavior and serious violence in adolescence. For example, Dodge, Greenberg, Malone, and the CPPR (2008) tested a developmental model of conduct disorder (see Figure 29.4) that identifies six major classes of predictor domains and posits that "these domains catalyze early conduct problems into new, more serious, chronically violent behaviors in adolescence" (p. 1907). According to Dodge et al., "The proposed dynamic cascade model posits that a domain operates on antisocial outcomes by directly influencing the next domain in the hypothesized temporal sequence. This next domain both mediates the impact of the prior domain and catalyzes further antisocial development in an incremental manner" (2008, p. 1912).

Inset Figure 29.4 about here

Dodge et al. (2008) tested this model (see box) and findings supported a developmental cascade in which early social contexts of disadvantage predicts harsh–inconsistent parenting, which predicts social and cognitive deficits, which predicts conduct problem behavior in school, which predicts elementary school social and academic failure, which predicts parental withdrawal from supervision and monitoring, which predicts deviant peer associations, which ultimately predicts adolescent violence. Dodge et al. conclude that "The model is one in which a high-risk child traverses a deepening stream across development toward a violent outcome, with each stage of development being predicted partially from previous events and providing growing inevitability toward the violent outcome, but also offering a new opportunity to begin a different tributary toward a nonviolent outcome" (2008, p. 1911).

Some steps in testing dynamic cascade models.

1. ***Identify predictors.*** Identify risk factors or predictors of the target developmental outcome in multiple domains, including contextual, family, school, and peer areas.
2. ***Hypothesize pathways***. Order the predictor domains in sequential steps along the hypothesized developmental cascade.
3. ***Link domains***. Conceptualize the causal pathways connecting each step.
4. ***Longitudinal study***. Collect longitudinal data, including multiple aggregate markers of each domain.
5. ***Predictors to long-term outcome***. Examine whether the predictors from each domain actually predict the target outcome.
6. ***Predictors to predictors***. Examine whether the predictor from a given domain predicts the subsequent predictor domain.
7. ***Sequential mediation of predictor domains***. Examine whether each predictor domain at least partially mediates the effects of the prior predictor domain on the outcome.
8. ***Cumulative effects of predictor domains.*** Examine whether each predictor domain adds to the prediction of the outcome, over and above the effects of the prior predictor domain.
9. ***Branching cascades***. Examine whether these links differ for participants who vary in their initial levels of the target outcome, or any other variable that might influence the pathway.

From Dodge, Greenberg, Malone, & the Conduct Problems Prevention Research Group, 2008.

Does the idea of cascades imply that there is only one pathway to a long-term outcome?

Not at all—there can be branching cascades that take different routes at certain developmental turning points, for example, if the child or youth should run into an especially good teacher or after-school program, or their mother should remarry a wonderful stepfather.

Do cascades only pertain to the development of psychopathology or deviant behavior?

It seems like most of the empirical studies of cascades include psychopathology, but cascades could be used for any kind of behavioral outcome—including the development of competence or resilience.

How do we use information from developmental cascades in our interventions?

So many uses. Most importantly, we can use information about pathways and cascades to locate *strategic targets* and *timing* for our interventions.

They can also help us in our judgments about the severity of children's behaviors, and its prognosis, so we can figure out the kinds of behaviors that should set off alarm bells (or interventions) and the kinds that are likely to disappear on their own. For example, they can help us recognize that the children that teachers notice are having regulatory difficulties early on are likely to be the same children who will turn up later in our interventions for peer rejection.

Do we have to start all our interventions at the *beginning* of the cascade?

No, but we can see that if we start late in the game (e.g., intervening based on peer rejection in fifth grade), we will have to make up for all the previous potentially damaging effects across domains (e.g., poor school performance, years of rejection), which makes everyone's lives harder. So interventions are often calibrated to the timing of a developmental task—for example, making sure that peer problems are remediated before third grade when peer relationships become central to children's lives and development.

What is our intervention goal?

We want to interrupt or divert the flow of negative cascades, and we want to induce or contribute to the flow of positive cascades.

Optimization sounds like a lot of work.

It is. For researchers, the role of intervention studies is not only to improve the lives of our developing people and all their contexts, but we also desire to improve ourselves, to learn how to become better at facilitating change. So we as interventionists and teachers are working on ourselves, our own development—so if our intervention work can teach us how to do better interventions, then we are moving in the right directions.

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Chapter 30. Converging Operations and Multiple Lines of Sight

> We shall not cease from exploration, and the end of all our exploring will be to arrive where we started and know the place for the first time. ---T. S. Eliot

For researchers, it tempting to think of optimization as the end of the road-- something that one does as soon as one has everything figured out. In fact, in our list of the goals of developmental science, didn't we set it in third place—describe, explain, and (then) *optimize* intraindividual development in all its perplexing variation? A common pathway for researchers is to start off interested in the development and well-being of a target population (infants, children, youth, students, the elderly, patients, employees) and spend many years studying them, followed by a shift to the study of the societal, contextual and social factors that are constraining and promoting their development, and then to interventions to try and improve those societal conditions, social policies, or settings on behalf of the target population's welfare.

Of course, it is also possible to start a career as an applied researcher from the other direction, as a fierce critic of the status quo, and a staunch advocate for a specific set of reforms to straighten out the forces that interfering with optimal pathways.

the teacher-proof curriculum.

stuff we learned about interventions: same principles—changing proximal processes, AGENCY

Jaffee, S. R., Strait, L. B., & Odgers, C. L. (2012). From correlates to causes: can quasi-experimental studies and statistical innovations bring us closer to identifying the causes of antisocial behavior?. *Psychological Bulletin*, *138*(2), 272-295.

Risk and protective factors

Without preemptive or nullifying factors

Resilience designs- have all risk factors but doesn't get disease- must have protective factor

Anti-social behavior

e. Following exact pathways

1) Longitudinal studies of individuals/ classes: e.g., anti-social behavior
2) Early predictors, qualitative transformations

3. CONVERGING OPERATIONS

Programs of study that Combine experimental and naturalistic research

Naturalistic: "Does X seem to cause Y ?"
Lab/experimental: "Can X cause Y?"

a. Program of lab and field research: gold standard

1) Lab to field: Learned helplessness

2) Field to lab: Rumination

b. Natural experiments: historical changes, accidents, non-normative events

TV
Earthquakes
Recessions: child maltreatment
Welfare to work, cut social programs

c. Intervention studies

1) Randomized control trials

Different pathways form source (headaches caused by lack of aspirin)
Random assignment to intervention: aptitude by treatment interactions

Dose-response
Unintended side-effects
Compare to business as usual

2) Interrupted time series

d. Prevention studies

Timing, multiple pathways

HISTORICAL SHIFT: e.g., in education research/ in department

CAUTION: when will we be ready

More harm than good

Waste $ on ineffective

Only try to change what we can

Sustainable changes (system shifts)

Causal beams

Epidemiology: Association or Causation? (Hill, 1965)		
In his presidential address to the Section of Occupational Medicine, Sir Austin Bradford Hill (1965) listed these desiderata for distinguishing causality from correlation in the society's work in determining whether conditions of work cause sickness and injury.		
1.	***Strength***	Greater strength of association (although weak associations do not rule out causality).
2.	***Consistency***	Association is observed repeatedly by a variety of different people, in different places, circumstances, and times.
3.	***Specificity***	Association is found among particular people, sites, disease symptoms, and work, and *not* among others.
4.	***Temporality***	The potential cause must occur before the effect.
5.	***Biological gradient***	Dose-response curve in which higher levels of the cause co-occur with higher levels of the effect.
6.	***Plausibility***	Helpful if the suspected causal process is biologically plausible, based on current knowledge (but not necessary since knowledge is limited).
7.	***Coherence***	Should not seriously conflict with generally known facts abut the phenomena, especially if consistent with known mechanisms of effects (but lack of evidence cannot nullify observations).
8.	***Experiment***	Particular weight given to any evidence in which preventative action was taken to reduce cause and effect is reduced.
9.	***Analogy***	Causal process seems to parallel the effects of other similar already proven causal agents.

Patterns of outcomes form multiple studies

	Designs for Examining the Validity of Causal Hypotheses
1.	**Laboratory Experimental Designs**
2.	**Naturalistic Designs**
	a. Standard correlational designs
	1) Add one additional time point:
	a) Predictors of change over time
	b) Reciprocal effects
	c) Think about time gap and cyclicity of process
	2) Add multiple time points:
	a) Repeated predicting of change over time
	b) Time series: intra-individual prediction
	c) Growth curves: predicting different pathways
	d) Time-lagged growth curves
	b. Looking directly at the operation of the hypothesized proximal process over time
	1) Observation of cause and effect: sequential contingencies
	2) Intraindividual time series
	c. Holding constant "all" other variables
	1) Statistical control
	2) Niche studies
	d. Age simulations: Age as a marker for causal variable
	1) Separating age and the possible causal variable
	2) Getting rid of age differences
	e. Following exact pathways
	1) Longitudinal studies of individuals
	2) Early predictors, qualitative transformations

	3. Converging operations
	a. Program of lab and field research
	1) Lab to field: Learned helplessness
	2) Field to lab: Rumination
	b. Natural experiments
	c. Intervention studies
	1) Randomized control trials
	2) Interrupted time series
	d. Prevention studies