DISSERTATION

AWARENESS OF AGE-RELATED CHANGE (AARC): MEASUREMENT, CONCEPTUAL STATUS, AND ROLE FOR PROMOTING SUCCESSFUL AGING

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ABSTRACT

AWARENESS OF AGE-RELATED CHANGE (AARC): MEASUREMENT, CONCEPTUAL STATUS, AND ROLE FOR PROMOTING SUCCESSFUL AGING

Recent renewed interest has arisen regarding the ways in which individuals experience the process of growing older, an area of research known as subjective aging. A growing body of research shows a consistent pattern of results in which subjective aging exerts wide-reaching and consequential influence on both physical functioning as well as psychological well-being in later life. Historically, research has relied on simplistic, unidimensional measures, that while quite predictive of developmental outcomes, are somewhat of a 'black box' in that it is not understood exactly what information people rely on to make them. Therefore, the construct *awareness of age-related change* (AARC) was developed to yield insight into the specific behavioral domains in which aging experiences are noticed. Given the need for such a construct in the literature, the manuscript in Chapter 2 focuses on the development of a reliable and valid assessment tool to measure *awareness of age-related change* (AARC). Not only is such a construct more representative of leading theories in adult development and aging, it is also vital for understanding how people experience aging in different life domains. Therefore, the manuscript in Chapter 3 will explore how AARC is similar to and distinct from existing subjective aging constructs, and also how it is related to important physical and psychological outcome variables. Chapter 4 then extends the current state of research regarding subjective aging, which has largely been observational in nature, and attends to the issues of intervention design: Given the mounting evidence of the importance of attitudinal variables of aging, Chapter 4 explores the

following questions: 1) Can more realistic and positive attitudes toward aging be promoted through intervention? and 2) Does modifying attitudes have tangible effects on health behavior promotion?

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DEDICATION

For my grandparents – Jim & Fay Roby, Bob & Jan Wahlgren – my first and most inspiring examples of healthy aging

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CHAPTER 1.

General Introduction and Review of the Literature

The course of human aging, albeit fundamentally biological in nature, is not solely determined by physiological and genetic processes. Instead, a multitude of biological, psychological, environmental, and social forces interact throughout the entire lifespan to shape the course of adult development and aging. These outcomes include, but are not limited to, a person's physical health, functional status, psychological well-being, and longevity. The way individuals perceive, interpret and experience their aging process and their chronological age is one psychological force that undeniably influences the aging trajectory (Westerhof et al., 2014). Known broadly as *subjective aging*, extensive empirical evidence demonstrates that individuals who hold negative attitudes and expectations about aging are at higher risk for developing a host of negative outcomes in later life. To name a few, negative subjective aging is empirically linked to poorer physical and cognitive functioning (Levy, Slade, & Kasl, 2002; Robertson, King-Kallimanis, & Kenny, 2016; Robertson, Savva, King-Kallimanis, & Kenny, 2015), higher risk of acute medical problems, including cardiovascular events, falls, and hospitalizations (Levy, Slade, Chung, & Gill, 2015; Levy, Zonderman, Slade, & Ferrucci, 2009; Moser, Spagnoli, & Santos-Eggimann, 2011), Alzheimer's-like neuropathology (Levy et al., 2016), and shorter longevity by 7.5 years on average (Levy, Slade, Kunkel, & Kasl, 2002). Taken together, these studies are part of a growing body of evidence that demonstrates an undeniable link between the way in which individuals perceive age and aging, and the developmental trajectories and outcomes they may show throughout adulthood.

The potential role that subjective aging plays in shaping aging trajectories is quite relevant, given the accumulating evidence of the possibilities of developmental plasticity throughout adulthood. Empirical support for the heterogeneity of aging continues to emerge, and the possibility of remaining quite healthy until very advanced ages is more and more a reality (Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Lowsky, Olshansky, Bhattacharya, & Goldman, 2014). Such evidence provides support for the exploration of the behavioral, cultural and social factors that may help to alter the course of aging for the better. As has already been said a decade ago, "one of the most striking changes in the aging paradigm since the mid-1960s is the recognition of both individual differences and plasticity in the aging process" (Aldwin, Spiro, & Park, 2006, p. 85). Explanations for the increasing heterogeneity seen in aging include a host of behavioral and psychological factors which can accelerate the biological aging process (e.g., obesity, smoking and stress), as well as those that may slow the process, including exercise, social support and control beliefs (Aldwin et al., 2006). And, although the role of biopsychosocial influences on aging is acknowledged by researchers, it is much less-well understood by the general public, who largely view aging as completely negative and beyond any sort of control (Lindland, Fond, Haydon, & Kendall-Taylor, 2015).

In light of the accumulating evidence which suggests a high degree of plasticity in adult development, then, efforts are needed to understand and address the psychosocial influences that have the potential to shape the aging trajectory. This dissertation provides an in-depth exploration of subjective aging as one psychological factor that shapes the course of aging. In particular, the three manuscripts comprising the dissertation focus primarily on a new construct *awareness of age-related change* (AARC; Diehl & Wahl, 2010), which represents a tool that can be utilized to increase understanding about the specific aspects of subjective aging that influence

later health and well-being. Furthermore, AARC affords the opportunity to capitalize on health promotion throughout adulthood by fostering individual involvement in the promotion of health and healthy aging throughout the lifespan. The dissertation manuscripts build upon the existing theoretical foundation of AARC with an empirical investigation of several yet unanswered questions in the subjective aging literature. Each manuscript addresses a distinct set of research questions that were designed to contribute to the understanding of how subjective aging is associated with health and well-being, and how subjective aging may be targeted for the purpose of health promotion throughout adulthood.

The following paragraphs provide an introduction of the AARC construct and describe how it complements and extends the existing subjective aging research. A detailed review of the literature connecting subjective aging and developmental outcomes is presented next, providing the foundational context for the three manuscripts included in the dissertation. Then, the potential for AARC to serve as a motivational process is examined, with particular emphasis on identifying ways in which it can be utilized to foster health promotion throughout adulthood. A review of mechanisms by which subjective aging is linked to health and well-being in later life is presented, and two candidate mechanisms for targeting through intervention are identified. Finally, the introductory chapter concludes with a list of open research questions regarding AARC which are addressed empirically in Chapters 2, 3, and 4.

AARC and its Potential Contributions to Subjective Aging Research

An Overview of Subjective Aging Research

Research about subjective aging is concerned with the idea that adults of all ages hold certain expectations and attitudes about growing older, and that the study of such attitudes has direct relevance for later life development. Subjective aging research builds on early work in the

1960's and 1970's by pioneers in the field such as Bernice Neugarten (Neugarten, 1968, 1979), Robert Kastenbaum (Kastenbaum, Derbin, Sabatini, & Artt, 1972), and Powell Lawton (Lawton, 1975). The early work of these scholars was concerned with making a case for the importance of considering individuals' perceived experiences of aging. For instance, Neugarten described tendencies for increased reflection about aging during mid-life: "the stock-taking, the heightened introspection, and above all, the structuring and restructuring of experience – that is the conscious processing of new information in the light of what one has already learned" (Neugarten, 1968, p. 98). She then noted that such introspection was utilized by successful middle-aged adults for pursuing and achieving their life goals (Neugarten, 1968).

Early work by subjective aging scholars also represents the first attempts to operationalize and quantify the perceived experience of aging, in order to allow for its empirical evaluation. Wrestling with the early formulations of a construct to measure subjective aging, Kastenbaum noted that, "There are neither suitable concepts nor techniques available for the experimental induction and modification of aging in the psychosocial sphere" (Kastenbaum et al., 1972, p. 198). Like Neugarten, Kastenbaum too saw value in understanding the perceived experiences of aging, and he engaged in efforts to fill the existing gap at the time in finding effective ways of studying this yet-uncharted territory. Similar to Neugarten and Kastenbaum, Lawton also wrestled with ideas on how to best capture subjective aging. His approach was to identify several domains of "morale" among older adults, including aging satisfaction, along with negative mood and loneliness (Lawton, 1975). As these three examples demonstrate, early efforts in subjective aging were focused on making the case for the importance of considering the perceived experience, and also in finding ways to conceptualize and assess it.

Early subjective aging constructs. Products of early subjective aging research include two constructs which became quite widely used, *felt age* and *attitudes toward own aging*. A brief review of these constructs follows here by way of introduction, because both are important features of the three dissertation manuscripts. For an in-depth review of these and other subjective aging constructs, see Diehl, Wahl et al. (2014).

Felt age. Kastenbaum's efforts to operationalize subjective aging resulted in the construct *felt age*, which captures subjective aging in one seemingly simple – yet powerful – question: *How old do you feel?* (Barrett, 2005). His aim in studying felt age was to complement and inform other measures of age, such as chronological age, biological age, and functional age. The now-substantial body of literature examining felt age documents a quite impressive predictive association with a host of relevant outcomes, including memory, walking function, psychological well-being, and coping responses to cancer, among others (Boehmer, 2007; Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008; Montepare, 2009; Westerhof & Barrett, 2005). Furthermore, there is evidence to suggest that felt age is more informative than chronological age per se for describing a person's developmental stage (Barrett, 2003), as it is often a stronger predictive abilities of survival compared to objective health status (Markides & Pappas, 1982). Research on felt age has shown that most adults report feeling younger than their chronological age, by an average of 20% (Rubin & Berntsen, 2006), and that feeling younger than one's age is associated with positive indicators of health and well-being (Kleinspehn-Ammerlahn et al., 2008; Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013).

Attitudes toward own aging. Another early construct that has received widespread attention in the subjective aging literature is *attitudes toward own aging* (Lawton, 1975), sometimes also referred to as satisfaction with aging or self-perceptions of aging. This construct

refers to an individual's global evaluation of his or her own aging process. It is commonly assessed with the attitudes toward own aging (ATOA) scale, a 5-item subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975). The ATOA scale uses dichotomous statements about how respondents evaluate their current life situation compared to younger years. For example, whether life is better/worse now, or whether they feel less useful now (yes/no). The brief and simple structure of the ATOA scale has resulted in its wide incorporation into large-scale epidemiological studies the world over, such as the Ohio Longitudinal Study of Aging and Retirement, the Interdisciplinary Longitudinal Study of Adult Development in Germany, and the Australian Longitudinal Study of Aging. The predictive ability of the ATOA scale is striking, as it consistently shows statistically and substantively meaningful associations with a host of outcomes, including physical function and longevity (Levy, Slade, & Kasl, 2002; Miche, Elsässer, Schilling, & Wahl, 2014; Sargent-Cox, Anstey, & Luszcz, 2014).

Advancing the early research on subjective aging. Early work in subjective aging, such as that described above, catalyzed a movement exploring the associations between subjective and objective indicators of aging throughout the next half-century. With the exception of a brief lull in the 1980's and early 1990's (reasons for which are postulated by Diehl, Wahl, Brothers, & Miche, 2015), research attention continues to thrive at a rapid rate today across many research groups from multiple countries and continents (e.g., Kleinspehn-Ammerlahn et al., 2008; Kotter-Grühn et al., 2009; Wurm, Tesch-Römer, & Tomasik, 2007). This renaissance of subjective aging research has contributed to a substantial and compelling body of evidence, demonstrating the influence of subjective aging on later life outcomes.

Limitations of the early subjective aging constructs. The early constructs of felt age and ATOA represent an important effort to advance understanding of the subjective experience of

aging and its relevance for developmental outcomes. However, there are several significant limitations inherent in these existing subjective aging constructs, and perhaps it is the case that several decades of reliance on them has stymied the development of more elaborated and theoretically-grounded measures. One limitation in the field is that there has been a lack of cohesion and conceptual distinction among existing subjective aging constructs (Diehl, Wahl et al., 2014). Although several constructs have been put forth, none have a highly elaborated theoretical or conceptual background, and the association or unique contributions of each have not yet been examined.

A second limitation is that there is a reliance primarily on the global and unidimensional assessment of subjective aging without explicit acknowledgement that individuals' subjective aging experiences certainly vary across different life and behavioral domains. For instance, the experience of aging may differ quite drastically depending on the area of life in question: Aging experiences in the family realm may be quite different than those in the physical or work-related realms. Interestingly, Kastenbaum originally conceptualized felt age as one of several facets of a broader term personal age (e.g. the age a person acts, the age a person is perceived to be by others, etc.), although the majority of research has relied on felt age as a stand-alone unidimensional measure.

Third, the unidirectional nature of existing subjective aging constructs fails to recognize a major principle of life-span developmental theory in which age-related gains and losses occur simultaneously. Existing constructs position evaluations about positive and negative subjective aging on the same continuum, which does not allow for the capture of simultaneous gains and losses. A classic example that such a scale would not be able to capture is the potential gain in emotional closeness and interpersonal connection that often arises with the dependence that

comes from a sudden loss of physical ability, say for instance, the ability to drive a car. In sum, limitations in the existing subjective aging literature have been recognized as areas for future development in a field that has become somewhat stagnant. If addressed, this can help to advance the understanding and assessment of subjective aging.

Emergence of Awareness of Age-Related Change (AARC) as an Elaborated Subjective Aging Construct

In response to many of the limitations described above, the AARC construct was introduced as a novel approach to conceptualizing (and eventually measuring) subjective aging. First articulated in a theoretical sense (Diehl & Wahl, 2010), AARC was developed as a multidimensional and multidirectional approach for understanding the specific psychological and behavioral situations that make individuals aware of their age. It arose from the issue that earlier subjective aging measures were a "black box" in that it was not well understood what went really into those rather simple ratings. That is, AARC tried to address the following question: What do individuals take into account when thinking about how old they feel or when they consider whether aging has been better or worse than they expected? Therefore, AARC was conceptualized as a way to "unpack" what may be captured by the global ratings, such as felt age or ATOA. In this way, the assessment of AARC was expected to contribute new information to the understanding of subjective aging by illuminating the explicit behavioral experiences that build the foundation for subjective aging ratings.

AARC represents self-knowledge of the aging self. At its essence, AARC is a form of tacit self-knowledge about a person's own aging experience, which becomes integrated into a person's self-concept as an essential aspect of the aging self and aging identity (Diehl & Brothers, in press; Diehl et al., 2015). The self-knowledge inherent in AARC develops from

daily experiences and self-observations, including the feedback from and interactions with others. Some of the earliest work investigating AARC showed that the awareness of age-related experiences occurred at a fairly regular base rate, reported by participants on approximately half (48%) of the 15 days included in a daily experience sampling study (Miche, Wahl, et al., 2014). This particular finding that individuals notice and interpret age-related experiences almost every-other-day, suggests that AARC is an ongoing process of accumulating and interpreting new information about the aging self. Up to this point, such self-knowledge about aging has remained untapped by existing constructs and measures in the subjective aging literature, and much remains to be understood about this construct, given its frequent occurrence in daily life.

AARC is multidimensional and multidirectional. Taking a multidirectional and multidimensional approach, the concept of AARC incorporates both positive and negative subjective experiences of aging in five hypothesized life domains: health and physical functioning, cognitive functioning, interpersonal relationships, socio-cognitive and socio-emotional functioning, and lifestyle/engagement. The theorized behavioral domains capture, at face value, many different aging experiences. However, whether these theorized domains are confirmed with empirical research, or whether a slightly different array of behavioral domains may emerge remains to be known. In addition to the behavioral domains, AARC captures experiences of both positive and negative valences, referred to as AARC-Gains and AARC-Losses, respectively. Because of the focus on different life domains, and on both positive and negative changes, it is expected that the assessment of AARC will allow for a greater understanding of the specific everyday situations and life events that make people aware of their own aging process (Diehl & Wahl, 2010). It is anticipated that this domain-specific and valence-

specific information will help to unpack the information individuals tend to draw on to derive their global ratings of age or aging.

To summarize, AARC is comprised of both positive and negative age-related changes across multiple behavioral domains, and represents explicit self-knowledge about aging that develops and changes throughout the adult years. Its introduction into the study of subjective aging requires that we pay attention to the specific experiences individuals notice about their own aging and how they cognitively represent these age-related experiences. AARC represents a valuable contribution to the literature because it has the potential to advance the understanding of connections between subjective aging and health and well-being.

The Relevance of AARC for Health and Well-Being

A rich history of empirical research demonstrates the association between subjective aging and developmental outcomes. However, much of this work has relied on primarily global ratings of subjective aging. Therefore, it is expected that the utility of an AARC questionnaire, as a more elaborated multidimensional tool, will further our understanding regarding the link between subjective aging and later health and well-being.

Empirical Associations between Subjective Aging and Health and Well-Being

There is now solid evidence that perceptions about aging exert tangible influences on later health and well-being (e.g., Westerhof et al., 2014; Levy, 2009; Levy et al., 2016; Meisner, 2012). Holding negative views of subjective aging is linked to a host of detrimental indicators of health and well-being, whereas positive views of subjective aging predict, in general, positive outcomes (Meisner, 2012). The following paragraphs provide a review of the decades of experimental and quasi-experimental research supporting this conclusion. Building on early associational research with overly simplistic constructs, measurement and methodological

approaches have grown increasingly sophisticated in recent years. The studies reviewed here include controlled experiments, quasi-experimental studies using nationally representative datasets, and prospective longitudinal studies applying advanced statistical modeling.

Experimental evidence. A growing body of experimental evidence has used priming techniques to examine age stereotypes, which represent an implicit form of subjective aging. Experimental procedures usually include a pre-assessment of self-perceptions of aging and a behavioral task followed by a subliminal priming exposure to either positive or negative age-stereotypic words (e.g., wise, accomplished, enlightened versus senile, demented, frail). After the priming task, the assessments are repeated and compared to baseline performance. This set of procedures has been well-documented as an efficacious way of changing participants' implicit attitudes about aging. In a series of studies by Levy and colleagues (for a review, see Levy, 2003), exposure to negative stereotype priming was subsequently associated with poorer performance on memory tasks (Levy, 1996), gait speed (Hausdorff, Levy, & Wei, 1999), handwriting quality (Levy, 2000), and likelihood of opting for life-prolonging medical measures in a hypothetical situation (Levy, Ashman, & Dror, 1999). This line of research demonstrates that implicit subjective aging can reliably be altered through a priming approach, and more importantly, that the effects of priming are linked to direct behavioral performance in the laboratory setting. Specifically, primed with negative subjective aging stimuli, participants' performance worsens. Primed with positive subjective aging stimuli, though, participants' performance can be significantly improved. Studies show a consistent pattern across multiple types of behavioral tasks, and have also been replicated by other research groups using similar experimental procedures (Hess, Auman, Colcombe, & Rahhal, 2003). However, inherent in experimental research is the issue of ecological validity. Thus, a very critical question is: What

are the implications of holding either positive or negative views of subjective aging in a natural setting? Are there meaningful and lasting effects on behavioral performance relevant to everyday situations, such as balance or gait speed?

Quasi-experimental research using large-scale datasets. Building on the experimental work linking subjective aging to behavioral performance, associational research has demonstrated the longer-term predictive effects of subjective aging on health and functioning outside of the laboratory. This line of research has applied a quasi-experimental approach to examine predictive associations using data from large-scale samples such as the Ohio Longitudinal Study (N = 443; N = 660), the Baltimore Longitudinal Study (N = 395; N = 440); the German Ageing Study (N = 1286); the Berlin Aging Study (N = 1285) the Lausanne Cohort Lc65+ study (N = 1,152); and The Irish Longitudinal Study on Aging (N = 4,803; N = 5,896). Studies typically included participants who completed a measure of subjective aging (usually the ATOA scale) and then were assessed for particular outcomes anywhere from 2 – 38 years later, with varying assessment frequencies throughout the duration of the study.

Overall, findings demonstrate that individuals holding a more negative perception of their own aging were more likely to later have a heightened risk of acute health events (Levy et al., 2015; Levy et al., 2009; Moser et al., 2011), slower walking speed (Robertson et al., 2015) and poorer cognitive performance (Robertson et al., 2016). Furthermore, more negative subjective aging has predicted poorer functional health (Levy, Slade, & Kasl, 2002) and shorter life expectancy by an average of 7.5 years (Levy, Slade, Kunkel, & Kasl, 2002). Recent evidence has found that negative views of subjective aging are even predictive of brain pathology associated with Alzheimer's disease, including volume of the hippocampus, and the presence of neurofibrillary tangles and amyloid plaques (Levy et al., 2016). This line of research addresses

the question of ecological validity that experimental research lacks, and demonstrates that perceptions of subjective aging do in fact show associations with meaningful developmental outcomes in natural settings. Furthermore, these studies demonstrate the lasting associations of subjective aging with outcomes as much as 38 years later. However, retrospective associational studies such as these have their own major limitation, in that causality between subjective aging and developmental outcomes cannot be established.

Prospective longitudinal and microlongitudinal subjective aging research. Given the clear evidence that self-perceptions of subjective aging are, in fact, predictive of behavioral and functional outcomes, researchers have begun to conduct prospective longitudinal studies in order to examine the question of causality. Longitudinal research allows for the examination of how subjective aging might change throughout adulthood. Early work showed a somewhat stable subjective age in Anglo- and Mexican-American adults ages 60 and older over an 8-year period (Markides & Ray, 1988). However, subjective aging exhibits a great deal of interindividual variability with regard to change over time, especially throughout mid-life (e.g. participants studied from ages 43 – 55 years old, on average). Among the young-old (e.g. those who were aged 62 – 74 years old on average), 12-year trajectories of ATOA have been characterized by steady decline (Miche, Elsässer, et al., 2014). In later life, age stereotypes (one form of subjective aging), have been shown to be relatively stable and resistant to decline in the face of stressful life events such as the death of a loved one or a hospitalization (Levy et al., 2015). However, with increasing age people tend to feel less satisfied with their aging and felt age more closely approximates chronological age (Kleinspehn-Ammerlahn et al., 2008). An important conclusion that has been drawn from longitudinal research is that perceptions of subjective aging tend to have a stronger effect on health than vice versa (Spuling, Miche, Wurm, & Wahl, 2013;

Wurm et al., 2007). Such a directionality of effects suggests that intervening to improve subjective aging should have potential benefits for later health and well-being.

Microlongitudinal research is recently appearing in the literature, in which subjective aging is assessed on a shorter time scale, employing daily diary methods to examine baseline occurrence rates and inter- and intra-individual variability. Kotter-Grühn, Neupert, and Stephan (2015) examined daily fluctuations in subjective age in an 8-day diary study and found that subjective age was largely stable on a day-to-day basis. Interestingly, participants reported feeling older on days when they experienced health symptoms, stressful events or higher negative affect. This finding suggests that ratings of subjective aging appear to be most strongly influenced by negative experiences regarding health, mood and stress. In a microlongitudinal study to investigate processes of self-stereotyping, Allen, Mejia and Hooker (2015) found that individuals with more positive self-perceptions of aging at baseline experienced, on average, higher daily ratings of feeling useful and productive; furthermore, these ratings of usefulness and productiveness showed less fluctuation among those who reported more positive self-perceptions of aging at baseline. Therefore, individuals who had more positive views of aging and who did not subscribe to negative ideas of what it means to be old appeared to be more or less protected from the negative effects of stereotypes, as they exhibited less variability in their sense of usefulness as a person. This finding suggests that positive subjective aging may serve a protective role in which self-stereotyping exerts a less-pronounced effect on an individual's daily experiences.

To conclude, there is a large body of evidence from various methodological and statistical approaches to confirm an empirical association between subjective aging and health and well-being. This finding holds for subjective aging within an experimental as well as natural

setting, and the association appears to remain even over the course of several decades. It also holds after accounting for other potential influences such as functional health, comorbidities, and demographic and socioeconomic influences. Furthermore, the finding is consistent for a variety of subjective aging constructs, including felt age, attitudes toward own aging, and others. Therefore, there is good reason to expect that the associations between AARC and developmental outcomes will be consistent with this large body of research. We expect that the awareness of positive age-related changes will be predictive of higher physical functioning and better well-being, whereas the perception of negative age-related changes will be associated with lower physical function and poorer levels of well-being. Each of the three dissertation manuscripts will explore AARC's associations with various measures of health and well-being.

Exploring Causal Mechanisms between AARC and Developmental Outcomes

The literature reviewed so far provides strong evidence that subjective aging is linked to important outcomes for later life, including functional health, disease status, psychological well-being and survival. Building on this now-established link, more recent efforts have turned to questions of *why* and *how* this association exists, employing the use of statistical methods to address this complex question.

Theoretical Basis for Investigating Potential Underlying Mechanisms

Self-stereotyping and stereotype embodiment theory. From a theoretical standpoint, stereotype embodiment theory (SET; Levy, 2009) was put forth to explain how and why views of subjective aging (negative age stereotypes in particular) are linked to health outcomes. SET posits that negative attitudes about aging start to develop early in life, become increasingly self-relevant with age, and eventually become directed inward toward the self in a process called *self-stereotyping.* As a result, then, the internalization of negative age stereotypes is postulated to

exert an influence on health and well-being, particularly when aging messages are deemed to be self-relevant. For example, individuals who begin to identify with "becoming old" are more likely to be susceptible to the internalization of negative messages about aging than are individuals for whom aging is not yet self-relevant. The process of internalizing negative age stereotypes is said to occur along multiple pathways, including physiological, psychological, and behavioral pathways. Evidence for mechanisms representing each of these three pathways has been documented, including cardiovascular stress response patterns in the physiological pathway (Levy et al., 2008; Levy, Hausdorff, Hencke, & Wei, 2000); attitudes and expectations of aging in the psychological pathway (Kornadt & Rothermund, 2012); and health behaviors in the behavioral pathway (Levy & Myers, 2004). Such a theoretical approach is useful in considering which specific aspects may explain, at least, in part, how perceptions of subjective aging may lead to later life outcomes. The focus of this dissertation will revolve primarily around the potential psychological and behavioral pathways, as these are the types of candidate mechanisms that can be targeted via behavioral interventions such as the one described in Chapter 4.

Attributional processes. In line with stereotype embodiment theory, attributions represent one potential psychological pathway between subjective aging and developmental outcomes. Attribution research suggests that the way in which individuals interpret and explain their own physical symptoms plays an important role with regard to their health and functioning. For instance, older adults are more likely to attribute health symptoms to age rather than to a specific illness and this results in more passive, rather than active, coping styles (Leventhal & Prohaska, 1986). Furthermore, the general tendency to consider aging from a negative and deterministic perspective means that often, negative changes are automatically attributed directly to aging. For instance, a recent study found that adults aged 80 and older who attributed a

chronic health condition to "old age" tended to report more bothersome symptoms, engaged in fewer health behaviors, and were also twice as likely to have died by the two-year follow-up (Stewart, Chipperfield, Perry & Weiner,2011). Similarly, adults who attributed symptoms of arthritis, heart disease and sleeping problems to normal aging rather than chronic disease were significantly less likely to have sought preventive medical services in the previous year (Goodwin, Black, & Satish, 1999). To this effect, perhaps it is not solely the awareness of physical changes that matters, but also the extent to which such symptoms are dismissed as inevitable and impossible to change. For example, thoughts such as, "my knee hurts, I must be getting old" or "I can't find my keys, I must be getting old" represent negative age-attributions for occurrences that are not necessarily age-related. Thought processes such as these reflect negative self-stereotyping in which a commonly held age stereotype (e.g. old people have bad knees or old people are forgetful) is directed inward toward oneself in a misattribution. Such age-specific attributions are not only inaccurate much of the time, but they also have detrimental effects on health and well-being because they keep individuals from engaging in behaviors that could address the given situation. Furthermore, negative age attributions absolve individuals of responsibility and control over the symptoms they are experiencing. The joint contributions of subjective aging and control beliefs will be explored more in the coming paragraphs and in the intervention described in Chapter 4.

Statistical Investigation of Potential Underlying Mechanisms

Following the theoretical basis described above, it is also helpful to consider which tools are available for testing potential mechanisms from a statistical standpoint. The role of potential mechanisms linking subjective aging and health can be explored using *mediation modeling*, provided that there is evidence that the three variables of interest have some degree of statistical

association. In statistical mediation, this is typically illustrated in a model as shown in Figure 1.1, in which a predictor (x) is associated with an outcome (y), and this association is accounted for, at least in part, by a mediator (m).

Mediation is said to exist if the effect of x on y becomes attenuated once the proposed mediator is entered into the equation; this can be determined by comparing the c' and c paths (Hayes, 2013). Specifically, after adding the mediator to the equation, if the c' path becomes smaller than c but remains statistically significant, then there is evidence of partial mediation. If the c' path becomes statistically non-significant after adding the mediator, then the findings are consistent with full mediation. Therefore, in addition to the link between subjective aging (x) and the health outcome (y), associations should exist between subjective aging (x) and the presumed mediator (m), and also between the mediator (m) and health (y). One way of assessing statistical mediation is through intervention research, which allows for the targeting and statistical assessment of the role of causal mechanisms.

Several potential mechanisms have been examined to date for their role in explaining the association between subjective aging and health outcomes. For one, self-regulatory strategies of selection, optimization and compensation have been explored (Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013). Second, there is evidence that trait optimism is a causal mechanism (Wurm & Benyamini, 2014). Third, the availability of health care providers appears to be an important mechanism by which subjective aging is linked to health outcomes (Wurm, Wolff, & Schüz, 2014). Beyond these examples, there are two potential mechanisms that have received the most theoretical and empirical attention. These are *control beliefs* (Wurm et al., 2007) and participation in *health-promoting behaviors* (Levy & Myers, 2004). The empirical and

theoretical support for the role of control beliefs and health behaviors to explain the association between subjective aging and outcomes is discussed in the following paragraphs.

Identified mechanism #1: Control beliefs. The degree of perceived control over the environment is a logical mechanism for explaining, at least in part, the link between subjective aging and physical health. For instance, it is plausible that individuals who hold more positive self-perceptions of aging may also possess a greater sense of control over their aging process, and may therefore take a more active role in maintaining and promoting their own physical health. Such a sense of control may be captured with the beliefs that, "I have some degree of control in shaping my own aging process" and that "What I do on a daily basis matters for my health as I grow older." Supporting this conceptual linkage, there is also empirical evidence to support the explanatory role of control beliefs between subjective aging and health. First, there is evidence for an association between subjective aging and control beliefs (e.g., the a-path in Figure 1.1). In a longitudinal study which aimed to disentangle the effects of views on aging on health versus control beliefs, Wurm et al. (2007) found that control beliefs and views on aging exerted independent effects on health outcomes, as measured by a health symptom checklist. Furthermore, another study found an association between positive subjective aging (e.g. the expectation of experiencing more gains in the second half of life) and higher control beliefs (Timmer, Bode, & Dittmann-Kohli, 2003). These findings suggest that there is the necessary link between subjective aging and control beliefs, but also that they seem to represent two distinct constructs that are conceptually not redundant.

Second, there is also a strong empirical foundation demonstrating the link between control beliefs and health throughout adulthood (e.g., the b-path in Figure 1.1), owing to a long-standing interest in the role of control beliefs for health and aging (e.g., Baltes & Baltes, 1986;

Heckhausen & Baltes, 1991; Lachman, 2006; Lachman, Neupert, & Agrigoroaei, 2011). More specifically, low control beliefs are predictive of hospitalizations and the onset of disease (Rodin, 1986a), poorer functional health (Lachman & Agrigoroaei, 2010), health declines over time (Gerstorf, Röcke, & Lachman, 2011), and physiological measures such as cortisol stress response levels (Agrigoroaei et al., 2013). Third, the mediating or indirect pathway (e.g., a*b) also has some emerging empirical evidence so far. For instance, the study by Levy, Slade and Kasl (2002), which showed that more positive self-perceptions of aging were predictive of physical functioning 18 years later, also found that the association was mediated by perceived control (Levy, Slade, & Kasl, 2002). That is, there was an indirect effect in which the effect of self-perceptions of aging on physical functioning was explained, in part, by perceptions of control. Taken together, this evidence suggests that a person's sense of control over the environment plays an explanatory role in the complex question of the associations between subjective aging and health.

Identified mechanism #2: Health-promoting behaviors. There is also evidence that engagement (or lack thereof) in health-promoting behaviors is another explanatory mechanism by which subjective aging is linked to health-related outcomes. Such a mechanism exemplifies the behavioral pathway proposed in stereotype embodiment theory, and includes behaviors such as engaging in physical activity, eating a healthy diet, having regular medical exams, and other health-related behaviors. The conceptual link is quite viable, as adults who mostly hold a negative and deterministic view of aging are likely less motivated to try to actively shape their own health (Lindland et al., 2015; Ory, Hoffman, Hawkins, Sanner & Mockenhaupt, 2003). Evidence clearly supports this possibility. For example, individuals aged 50-80 years holding highly favorable attitudes about their own aging experience have been shown to be significantly

more likely to engage in health-promoting behaviors 20 years later (Levy & Myers, 2004). Similarly, a study of more than 4,000 middle-aged and older adult participants showed that individuals holding more positive views on aging were more likely to engage in physical activity, specifically in organized sports and walking. Furthermore, this study found that older adults with more positive views on aging were more likely to engage in regular walking regardless whether they were in good health or bad health (Wurm, Tomasik, & Tesch-Römer, 2010). Significant findings even remained after controlling for optimism, which suggests that positive views on aging play an independent role in predicting health behaviors above and beyond an optimistic outlook on life (Wurm et al., 2010). It appears also that there is a domain-specific effect with regard to the association between subjective aging and health behaviors. Meisner and colleagues found that subjective aging specific to health-related issues (as assessed with the Age-Cog physical decline scale) predicted higher involvement in strenuous recreational and sporting activities, even after controlling for a host of relevant variables, including level of pain and presence of chronic disease (Meisner, Weir, & Baker, 2013).

Taken together, this set of studies suggests that the link between positive subjective aging and better physical health may be explained by the mediating role of engagement in health-promoting behaviors. The role of control beliefs and health promotion will be further explored in the coming section as it relates to potential opportunities for capitalizing on the role of AARC to promote healthy aging.

Capitalizing on the Motivational Function of AARC to Promote Healthy Aging

Individual Involvement in Health Promotion throughout Adulthood

The need to involve individuals in promoting their own healthy aging can be viewed as a public health mandate (Kohl et al., 2012; Lindland et al., 2015; Rothman, 2006; White House

Conference on Aging, 2015). For this reason, there is an urgent need to apply a prevention science lens to the study of adult development. Prevention throughout adulthood is an emerging area for growth, one that has been largely missing from the recent prevention research focus. Supporting this argument, the NIA commissioned a White Paper in which a conference of behavior change experts noted that the lack of motivation may be one specific reason that many individuals are not taking an active role in shaping their own aging process (Nielsen & Reiss, 2012). Therefore, the following paragraphs consider the potential motivational function of AARC and explore the extent to which it can be used directly as a way to motivate individuals to promote their own healthy aging process.

AARC as a Motivational Process for Health-Behavior Change

What remains to be explored in more detail is the extent to which a person's awareness of his or her own aging might function as a *motivational force*. To make this argument, first it is relevant to consider that AARC represents self-knowledge that undergoes a continual process of updating and revising throughout the lifespan and that becomes an integral aspect of each person's self-representations. Second, a self-representation can be viewed as a cognitive schema in which individuals build and revise their core identity over time. As age-related changes occur, individuals interpret these changes and update their aging self-representations at the same time, with the basic developmental goal of preserving the integrity of the ego. Third, as a self-representation of the aging self, AARC shapes the view of the self over time and influences the extent to which individuals take an active role in promoting their own healthy aging. Therefore, AARC can be said to serve a self-regulatory function (Diehl & Brothers, in press).

To test the theoretical argument that AARC is a motivational force that shapes human behavior, empirical investigations are needed (Diehl & Wahl, 2010). First, it must be tested

whether AARC can, in fact, be modified. Specifically, can the modification be done in such a way as to increase the number of perceived positive age-related experiences, and to decrease the number of perceived negative age-related experiences? Second, the subsequent area of investigation should ask whether modifying AARC is then associated with a noticeable change in behavior? That is, does increasing the number of perceived positive age-related experiences (and decreasing the number of perceived negative age-related experiences) translate into meaningful behavior change, such as increased engagement in health-promoting behaviors?

For the sake of this argument, it is worth distinguishing between *the perception* of the experience, and *the experience itself*, which are two separate issues. For example, an individual who has developed a chronic illness such as type 2 diabetes may report this change as a loss in health and physical function. However, if the person can make some behavioral changes to diet and lifestyle, there may be some subsequent perceived gains, such as increased energy, improved sleep, and a sense of satisfaction in taking active steps to promote his or her own health. Therefore, if AARC can in fact be modified such that negative perceptions are not denied, but rather are carefully considered in order to enact changes, this may help to offset the loss/gain ratio that may otherwise increase with advancing age. In sum, theoretical evidence suggests that AARC can be drawn upon to evoke positive and meaningful change in behavior, such as increased participation in health-promoting activities. However, empirical evidence is needed to support this proposition.

Targeting AARC through Behavioral Interventions

Given the theoretical and empirical evidence suggesting the role of AARC in health promotion, the timing is right to target AARC in the context of a behavioral intervention designed to promote healthy aging. Such an endeavor would ideally involve the ability to change

aging attitudes, as well as result in a meaningful behavioral or health status change. Furthermore, such a study would be driven by a theoretical model which describes hypothesized mechanisms and pathways by which the intervention is expected to operate.

Evidence for the modifiability of subjective aging. Evidence from experimental research suggests that negative views of subjective aging can, in fact, be effectively modified (Kotter-Grühn, 2015). Change in subjective aging was subsequently associated with improved outcomes, such as handgrip strength (Stephan et al., 2013). Beyond laboratory studies, intervention studies show that it is possible to improve individuals' views of subjective aging (Klusmann, Evers, Schwarzer, & Heuser, 2012; Sarkisian, Prohaska, Davis, & Weiner, 2007) and control beliefs within natural settings (Tennstedt et al., 1998). For example, a recent study incorporated a brief subjective aging module into an existing exercise program and was successful in improving both subjective aging and exercise behavior (Wolff, Warner, Ziegelmann, & Wurm, 2014). From a theoretical background, AARC is also expected to be modifiable, given it was developed in the context of developmental plasticity and its expected role as a continually-updated piece of self-knowledge (Diehl & Wahl, 2010). Taken together, this evidence strongly supports the assumption that negative views of subjective aging, and AARC in particular, can be altered in order to affect meaningful outcomes, including engagement in health behaviors. Therefore, the manuscript in Chapter 4 positions AARC in a prominent role within an intervention to increase physical activity as a way to ultimately influence health status.

Identification of additional mechanisms to target via intervention. As reviewed in the previous section, there are a number of potential explanatory mechanisms by which subjective aging may influence health and well-being, operating from the behavioral and psychological pathways proposed in SET. Control beliefs and health-promoting behaviors were identified as

two of these potential mechanisms, and they represent the psychological and behavioral pathways, respectively. Incorporating control beliefs and health-promoting behaviors, namely physical activity, into a subjective aging intervention makes sense for several reasons. First, the theoretical and empirical support is beginning to accumulate for each one to suggest a mediating role between subjective aging and health. Second, evidence suggests that control beliefs and health-promoting behaviors are both modifiable through intervention (Rodin, 1986b; Tennstedt et al., 1998; King, 2001). Third, evidence suggests that improvements in both control beliefs and health-promoting behaviors such as physical activity are associated with health benefits (Lachman & Agrigoroaei, 2010; Stewart, et al., 2011; Pahor et al., 2014). However, the associations and interactions among AARC, control beliefs, and health behaviors for predicting health outcomes have not yet been examined all in the same model. Therefore, the role of AARC, control beliefs, and physical activity as they relate to health outcomes, both individually and in conjunction, deserves further attention in correlational and intervention research alike. From an intervention standpoint, this line of reasoning suggests that intervening to maintain or increase control beliefs and physical activity along with views of subjective aging represents a viable approach for fostering health and well-being into later life. The development and evaluation of such an intervention is the focus of Chapter 4, including a first attempt to investigate select aspects of a causal model.

Remaining Research Questions to be Addressed in the Dissertation Manuscripts

To summarize the literature reviewed so far, the introduction of AARC into the subjective aging literature presents several opportunities to advance the field with regard to the improved measurement of subjective aging, the introduction of a theoretically grounded and more fully elaborated construct, and the ability to concurrently assess positive and negative

subjective aging. These potential benefits afforded by AARC will also allow for the examination of associations with developmental outcomes, such as health and well-being, in a differentiated manner. Finally, the theoretical foundation of AARC acknowledges the room for developmental plasticity, and therefore the implementation of a behavioral intervention aimed at modifying AARC will provide new information regarding the potential to capitalize on subjective aging to support and motivate individuals to engage in health promotion efforts throughout adulthood.

This dissertation builds upon a rich body of literature and employs AARC, a new multidirectional and multidimensional subjective aging construct, to examine a series of yet unanswered empirical questions. These questions are scaffolded upon one another in a logical and progressive fashion, and can be summarized as representing issues of measurement, issues of the conceptual status of AARC, and issues of modifiability and utility of the AARC construct for health promotion. Furthermore, there are three overarching questions explored in each of the manuscripts, including the associations between AARC with developmental outcomes, the differing roles of positive and negative AARC, and questions of how chronological age relates to AARC.

Chapter 2: Exploring Measurement Issues

To date, there has not yet been an established assessment tool for the measurement of AARC. Therefore, building upon the theoretical elaboration of the AARC construct (Diehl & Wahl, 2010), Chapter 2 describes an approach that was used to develop the associated measurement tool in U.S. and German adults. The process began with conducting focus groups and interviews to generate a large pool of potential items in both countries so that the specific content would resonate with individuals regardless of nationality. This process is further

described in Chapter 2, as is the establishment of a psychometrically-sound version of the AARC questionnaire. Specific questions addressed in this chapter include:

1) Can AARC be measured in a valid and reliable way?

2) Is the theorized multi-dimensional structure supported by empirical data?

Chapter 3: Exploring the Conceptual Status of AARC

With the newly available multidimensional questionnaire, Chapter 3 pursues further investigation of AARC, and reports empirical findings with regard to the newly designed assessment instrument. The addition of AARC to the field of subjective aging research has the potential to advance the measurement and conceptual space of how individuals experience and interpret aging. Therefore, an empirical investigation of associations between AARC and existing subjective aging measures is essential so that the degree of overlap and differential predictive relevance can be determined. Specific questions addressed in this chapter include:

1) What are the empirical associations between AARC and existing measures of subjective aging?

2) How do unidimensional subjective aging measures interact with AARC to predict developmental correlates of health and well-being?

3) What are the unique conceptual contributions of AARC in predicting health and well-being, relative to existing subjective aging measures?

Chapter 4: Exploring the Modifiability of AARC and Its Role in Health Promotion

The study presented in Chapter 4 builds on the theoretical and empirical literature and extends it into the intervention realm. It is not yet known whether targeting AARC via behavioral intervention will be an effective strategy for promoting health behaviors and physical functioning. However, the translation of basic research into the development and evaluation of

behavioral interventions is plausible in light of previous research on subjective aging. It is also consistent with the strategic directions for research set forth by the National Institute on Aging (NIA), which prioritizes the development of cost-effective interventions to promote health maintenance strategies among older adults (National Institute on Aging, 2014; Nielsen & Reiss, 2012). Delving into this translational application of basic research involves two primary research questions:

1) Can AARC effectively be modified through a behavioral intervention?

2) Does a behavioral intervention targeting AARC also result in tangible improvements in health-promoting behavior?

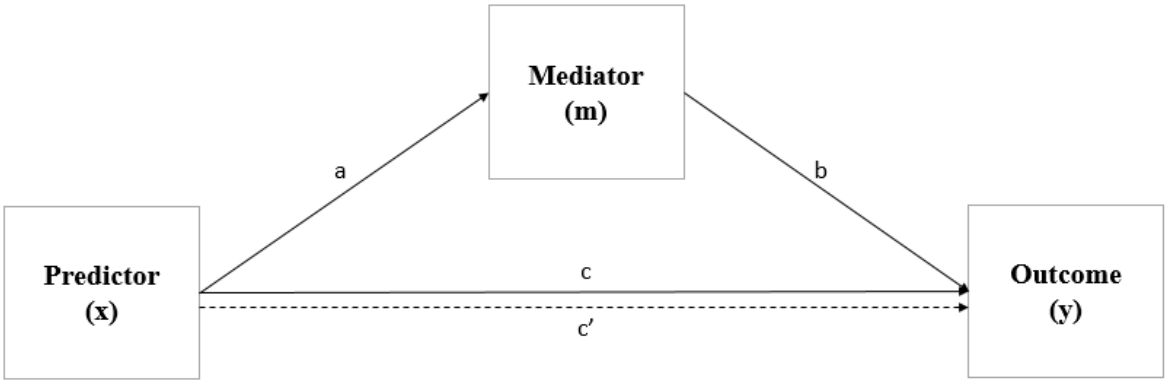

Figure 1.1. *A typical statistical mediation model. The direct effect of x on y (including m in the equation) is denoted as c'. The indirect effect is calculated by multiplying a*b. The total effect of x on y (the sum of the direct and indirect effects) is represented by c. Adapted from Hayes, 2013.*

CHAPTER 2.

Measuring Awareness of Age-Related Change (AARC): A New Multidimensional Questionnaire to Assess Positive and Negative Subjective Aging in Adulthood[1]

Summary

We conducted three studies to develop and evaluate a multidimensional questionnaire to assess the new subjective aging construct of awareness of age-related change (AARC). In Study 1, a first version of the AARC questionnaire containing 189 items was administered to 396 adults aged 40–95 years old. Exploratory and confirmatory factor analyses suggested a two-factor structure of the questionnaire, representing the awareness of positive age-related changes (AARC-Gains) and the awareness of negative age-related changes (AARC-Losses), respectively. In Study 2, a reduced 100-item AARC questionnaire was tested with a more demographically diverse sample of 586 adults aged 40–102 years old. The two-factor structure was confirmed, and the subscales demonstrated acceptable reliability. In Study 3, the AARC questionnaire was further refined to a 50-item version (AARC-50) and was tested with a subsample of 425 returning participants from Studies 1 and 2 approximately 2.5 years later. The AARC-50 demonstrated the strongest psychometric properties of the three versions. Results from Study 3 further confirmed the two-factor structure of perceived gains and perceived losses, and supported the measure's convergent and divergent validity. Study 3 also provided support for the predictive

[1] Brothers, A., Gabrian, M. Diehl, M., Wahl, H-W. (2016). *Measuring awareness of age-related change (AARC): A new multidimensional questionnaire to assess positive and negative subjective aging in adulthood.* Manuscript submitted for publication, Department of Human Development and Family Studies, Colorado State University.

validity of the questionnaire, as the two latent factors were significant predictors of multiple physical and mental health outcomes at the second measurement occasion. The availability of a reliable and valid assessment tool for measuring AARC-Gains and AARC-Losses has a number of potential applications, including the ability to provide detailed information about adults' self-perceptions of aging, which are instrumental for promoting successful aging.

Introduction

It is well-documented that measures of subjective aging, covering a number of different theoretical concepts (Diehl, Wahl, et al., 2014), have significant and meaningful associations with health and well-being throughout adulthood (Westerhof et al., 2014). In recent years, several new concepts have been introduced to the literature in an attempt to elucidate these associations (Diehl, Wahl, et al., 2014). One of these concepts is the construct of Awareness of Age-Related Change (AARC; Diehl & Wahl, 2010). This paper describes the development and psychometric evaluation of a multidimensional questionnaire for assessing adults' AARC, a conceptualization of subjective aging that is explicitly rooted in individuals' self-perceptions and behavioral experiences.

Measuring Adults' Subjective Experience of Aging

Adults' subjective aging experiences have been conceptualized in various ways throughout the past several decades of research (for an in-depth review, see Diehl, Wahl, et al., 2014). Although existing measures have been used quite successfully, there are several limitations owing to the fact that they tend to be overly simplistic and not grounded in an explicit theoretical framework. Therefore, we aim to advance the assessment of subjective aging by introducing the AARC questionnaire as a new approach to measuring adults' subjective aging experiences. The theoretical framework of AARC was elaborated by Diehl and Wahl (2010).

Specifically, AARC was defined as, "all those experiences that make a person aware that his or her behavior, level of performance, or ways of experiencing his or her life have changed as a consequence of having grown older (Diehl & Wahl, 2010; p. 340).

AARC represents a novel approach to the assessment of subjective aging for several reasons. First, it conceptualizes subjective aging in both a multidimensional and multidirectional way. Previous measures have predominantly relied on one or a couple of items that assess a unidimensional view of subjective aging, without taking into account that the experience of aging may differ across different life domains (for an exception, see the Scale of Aging-Related Cognitions by Steverink, Westerhof, Bode, & Dittmann-Kohli, 2001). In contrast, AARC represents a multidimensional approach to subjective aging, as it defines five behavioral domains in which the awareness of age-related changes may be most salient. These domains are: Health and Physical Functioning, Cognitive Functioning, Interpersonal Relations, Social-Cognitive and Social-Emotional Functioning, and Lifestyle and Engagement. Furthermore, existing approaches focus on aging as entailing mostly negative experiences, and disregard the presence of positive experiences known to occur in later life (Carstensen et al., 2011; Diehl, Chui, et al., 2014; Rothermund & Brandtstädter, 2003). To address this limitation, AARC was conceptualized as a multidimensional construct in terms of the valence of adults' age-related self-perceptions. That is, the questionnaire was designed with the intention to capture *a priori* both positive and negative self-perceived age-related changes.

Another novel aspect of AARC is its elaborated structure which is directly grounded in life-span developmental theory. Existing approaches rely on very brief (1- to 5-item) measures which assess the experience of aging in a global way, but neglect to capture detailed information about individuals' actual age-related experiences. By definition, AARC tries to capture a more

conscious and self-reflective form of individuals' awareness of their own aging and, therefore, represents a form of tacit knowledge that can be brought to explicit awareness through appropriate priming. Furthermore, AARC draws on several key tenets of life-span developmental theories of adult development, including multidimensionality, multidirectionality, agency, and plasticity (Baltes, Lindenberger, & Staudinger, 2006). Commonly, these concepts are not explicitly considered in any of the other measures of subjective aging. For instance, AARC reflects an underlying assumption that aging is characterized by both gains and losses, as its treatment of item valence acknowledges the possibility that both positive and negative age-related changes may both occur in adults' actual experiences.

Applied Relevance of a Scale to Assess AARC

A multidimensional questionnaire to assess subjective aging, which is both psychometrically sound and theoretically grounded, has direct and beneficial applications across multiple fields, including gerontology, life-span psychology, health promotion, and prevention. Indisputable evidence now links subjective aging – the attitudes, expectations, and evaluations people hold about old age as a state and aging as a process – to a host of outcomes in adulthood that are relevant for healthy and successful aging (Westerhof et al., 2014). Specifically, individuals who have more positive views of aging – for instance those who expect positive experiences and opportunities for growth – are more likely to maintain better physical functioning, recover faster from disability, have better memory performance, and live an average of 7.5 years longer (Levy, 2009; Levy, Slade, Kunkel, & Kasl, 2002; Levy, Slade, Murphy, & Gill, 2012; Sargent-Cox, Anstey, & Luszcz, 2012a; Stephan, Caudroit, Jaconelli, & Terracciano, 2014). These are just a few of the many behavioral and health-related outcomes that are linked to subjective aging, and they are supported by a large body of empirical evidence. The availability

of an elaborated and domain-specific tool, such as the AARC questionnaire, will allow for a more precise and nuanced assessment of subjective aging. Such a tool can be used to identify individuals who may have predominantly negative aging experiences and may, therefore, be more susceptible to adopt negative attitudes toward aging. In the clinical or counseling arena, the AARC questionnaire may be used to identify individuals who are prime candidates for intervention and programming designed to promote positive aging. Furthermore, because negative views of aging have been identified as a barrier to health promotion, the AARC questionnaire may be added to exercise or nutrition interventions to assess a program's effect on specific aspects of subjective aging.

Study Objectives

The present paper builds on the theoretical development of the AARC construct (Diehl & Wahl, 2010) and describes the psychometric development of a multidimensional self-report questionnaire for assessing AARC in a reliable and valid way. We conducted three separate studies in which progressively shorter versions of the AARC questionnaire were developed and evaluated. The objectives of Study 1 were twofold: To generate an exhaustive item pool for the development of a first version of the AARC questionnaire (AARC-189), and to evaluate the measurement structure and reliability of this first version. The objectives of Study 2 were to reduce the length to a 100-item version (AARC-100), and to evaluate the utility of this version in a randomly selected representative sample. Finally, the objective of Study 3 was to engage in further scale reduction and to derive and evaluate a 50-item version (AARC-50). This work was done with a subset of participants from Studies 1 and 2 approximately two years later, allowing also for the assessment of the questionnaire's test-retest stability and predictive validity.

Study 1

Methods

Development of the AARC questionnaire. We set out to create a first version of an AARC questionnaire from which we could select the best-performing items with regard to reliability and validity. Therefore, we followed established methods of measurement development (Nunnally & Bernstein, 1994) and generated a large pool of potential questionnaire items in order to ensure the ecological validity of the new measure, and to achieve content saturation across the five behavioral domains proposed by Diehl and Wahl (2010).

Item generation and scale construction. Building on an existing base of potential items generated from our earlier work (Miche, Wahl et al., 2014; Wahl, Konieczny, & Diehl, 2013), Study 1 began with a series of focus groups in which attendees ages 51–90 years old (M_{age} = 51.82 years, SD_{age} = 20.38 years) were asked to think about what experiences they had encountered that made them realize they were growing older, including both positive and negative experiences. Attendees reflected the overall demographic characteristics of the university town in which the research was conducted, predominantly of White-European descent, with above-average education (M = 16.70 years, SD = 2.49 years) and income levels (annual household income M = \$62,500, SD = \$30,420). Focus groups were audio-recorded and transcribed verbatim. Trained raters then extracted statements from the transcripts that could be crafted into questionnaire items while preserving the original wording to the greatest extent possible. Of 351 potential items, 85 new questionnaire items were selected by applying the following criteria: a) the selected item added new content to the existing items; b) the item represented a single concept; c) the item could be widely understood and related to. Adding the new items to those devised from previous research, we created a 189-item version of the AARC

questionnaire, which represented both positive and negative age-related changes across five behavioral domains.

The 189 items were compiled and distributed throughout the questionnaire in a pre-determined pattern of alternating domains and valences. The stem for all items was generated in consultation with several experts in the area of subjective aging and the following wording was chosen: "With my increasing age, I realize that…" The response options ranged from 1 (Not at all) to 5 (Very much).

Participants and Procedures. The resulting AARC questionnaire (AARC-189) was administered to 396 community-residing adults, recruited from a mid-sized university town in the U.S. (age range: 40-98 years, *M* = 65.45 years, *SD* = 13.75 years). Participants reported above-average education (*M* = 16.80 years, *SD* = 2.67 years) and income (median gross annual income $70,000 - $79,999), and rated their health as very good (*M* = 5.24, *SD* = .85; 6 = Excellent). Demographic characteristics of the sample are reported in Table 2.1.

Eligibility criteria included that individuals were community-residing, free of memory complaints, and primarily English-speaking. All participants provided informed consent in accordance with institutional policies. Participants completed a self-report questionnaire packet about attitudes toward aging.

Data were collected primarily by mail survey, with the exception of 50 participants who were randomly selected to complete the questionnaire packet in the lab setting. This feature was included in order to evaluate the extent to which responses were consistent across in-home and in-lab settings. In addition to testing the effects of study location, we also tested for effects related to the order of administration. The order of the questionnaires was counterbalanced in two ways: 1) The order of the questionnaires within the packet was reversed for half of the

participants; 2) the order of items within the AARC questionnaire was reversed for half of the participants. The questionnaire packet took approximately 60-90 minutes to complete. Those who completed the questionnaire were eligible to win one of five small cash prizes ($20 each).

Measures. The questionnaire packet included the AARC-189, demographic information, and four additional measures of subjective aging, each selected for their reliability and validity.

Demographic information. Using a standardized personal data form, we assessed key demographic characteristics, including gender, marital status, and household income.

Additional subjective aging measures. We assessed *subjective age* using a single item in which participants indicated the age they tended to feel most of the time (Kastenbaum et al., 1972). A proportional score was calculated ((Subjective Age – Chronological Age) / Chronological Age) to represent the extent to which a person's subjective age differed from his or her chronological age. For instance, a score of -.20, indicated that an individual felt 20% younger than his or her chronological age (Rubin & Berntsen, 2006).

We measured *attitudes toward own aging* (ATOA) with the widely used 5-item subscale from the Philadelphia Geriatric Center Morale Scale (PGCMS; Lawton, 1975). Individuals provided a dichotomous rating of their satisfaction with aging to questions such as, "Do things keep getting worse as you get older?" (Yes/No). Cronbach's α in the present sample was satisfactory (α = .72).

The scales for aging-related cognitions (AgeCog Scales; Steverink et al., 2001) was included to assess *self-perceptions of aging* in three domains: physical losses, social losses, and ongoing development. This 12-item scale includes 4 items per domain and its reliability and validity have been established (Wurm et al., 2007). The three scales demonstrated acceptable reliability in the current sample (Cronbach's α = .57, .62, and .73, respectively).

Finally, *domain-specific age stereotypes* were assessed with the Views on Aging scale (Kornadt & Rothermund, 2011). This questionnaire assesses perceptions of "old persons" in eight life domains, including Personality and Way of Living, Work and Employment, and Physical and Mental Fitness. An eight-point rating scale appears in the middle of two opposing statements which reflect quite negative (1) to quite positive (8) behaviors or ways of being. For instance, in the Family and Partnership domain, respondents are asked to rate on a continuum from (1) "Old persons have many conflicts in their relationship with family" to (8) "Old persons have a harmonious relationship with their family." Each domain was measured with three to five questions and mean scores were calculated for each. Reliability for each scale was satisfactory to good (Cronbach's α ranged from .66 – .86). For a more detailed description of the additional subjective aging measures, see Diehl, Wahl et al. (2014).

Results and Conclusion

Measurement structure. To evaluate the measurement structure of AARC, exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) were performed with separate randomly generated halves of the sample (Anderson & Gerbing, 1988).

Exploratory factor analyses. EFA was performed using the calibration sample (N = 196) in which the ten behavioral domain scores were entered into a principal axis factor analyses (PAF). Promax rotation was performed to rotate the initial factor solution to simple structure (Table 2.2).

The total amount of variance explained by this EFA was 68.23%. In order to determine how many factors to retain, we applied the criteria of Eigenvalue > 1.0 and scree test (Tabachnick & Fidell, 2007). Two factors emerged with Factor 1 accounting for 47.54% and Factor 2 accounting for 20.69% of the variance. Examining the pattern matrix, which shows the

unique contribution of each variable to the factors, the expected factor loading pattern emerged. Specifically, the five behavioral domains reflecting negative age-related changes loaded onto Factor 1, which we interpreted as *Perceived Age-Related Losses*. Conversely, the five behavioral domains reflecting positive age-related changes loaded onto Factor 2, which we interpreted as *Perceived Age-Related Gains*. Factor loadings ranged from .58 - .99. The two factors were moderately correlated (r = .40), providing further support for the use of oblique rotation.

Scale reliabilities. Given the results from the EFA, reliability statistics were calculated for all sub-scales, including internal consistency reliability and item-total correlations (see Table 2.2). Scale reliability coefficients ranged from α = .79 for the scale Interpersonal Relations Negative to α = .92 for Cognitive Functioning Negative and were satisfactory (α > .70; Nunnally & Berstein, 1994). Item-total correlations indicated that this version of the questionnaire contained a number of items that did not contribute very much to their respective scale. Thus, items with low item-total correlation (e.g. ITC < .30) were targeted for removal in the scale reduction process described in Study 2.

Confirmatory factor analyses. We performed confirmatory factor analysis with the cross-validation sub-sample (N = 200) in order to test the 2-factor AARC structure that had emerged from the EFA. Analyses were performed using M*plus* (Version 7). Following standard procedures for structural equation modeling (SEM), several different goodness of fit indices (GFI) were evaluated, including the Chi-square statistic, the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standard root mean square residual (SRMR). Criteria for acceptable model fit were as follows: CFI and TLI > .90; RMSEA < .08 and SRMR $\leq$ .05 (Byrne, 2012). Maximum likelihood

estimation was used, as there were no major concerns regarding univariate or multivariate non-normality (absolute skewness and kurtosis values were all < 1.0).

The hypothesized two-factor model of AARC, as illustrated in Figure 2.1, rested on the following assumptions: 1) A congeneric loading pattern in which the positive scale scores were expected to load on the Gains factor and negative scale scores were expected to load on the Losses factor; 2) the two factors were allowed to be correlated; and 3) error terms were uncorrelated.

This model did not provide an acceptable fit to the data according to the GFI coefficients (see Table 2.3). Modification indices suggested that the domain score error terms should be allowed to correlate (e.g. physical-positive with physical-negative, etc.), and adding this set of parameters was determined to be theoretically meaningful. Adding correlated error terms to the model resulted in a significant improvement in fit and a good overall fit to the data (see Table 2.3).

Mean response selection for AARC domains. Based on the theoretical work guiding the measurement development process, we used unit-weighting to calculate mean response scores for both positive and negative experiences in the five behavioral domains, as well as for the overarching gains and losses subscales (Table 2.4). For the perceived gain-related domains, the average response selections were near the midpoint of 3 on the 5-point rating scale, which corresponds with a rating of "moderately." For the perceived loss-related domains, the response selections were slightly lower, reflecting substantive endorsement of a rating of "A little bit."

Test of potential order and location effects on AARC responses. A 2 (questionnaire order) x 2 (AARC order) x 2 (test location) analysis of variance (ANOVA) was performed to test the effectiveness of the counterbalancing design implemented in the study. There were no

significant differences for the AARC domain responses with regard to the order of the questionnaires within the packet, the order of items within the AARC questionnaire, or the test location (all *p's* > .05).

From Study 1, we concluded that the initial version of the AARC questionnaire provided a promising start for the reliable assessment of adults' awareness of age-related change. Furthermore, we found preliminary evidence for a 2-factor structure of AARC, representing perceived age-related gains and age-related losses. We designed Study 2 to address the following steps: First, we focused on the extraction of the best-performing items from the large item pool for use in a shorter version of the questionnaire. Second, we wanted to replicate the 2-factor structure on a demographically representative sample from a larger metropolitan area.

Study 2

Methods

Procedures for scale reduction. The AARC-189 underwent a rigorous shortening process in order to obtain a 100-item version. Criteria for retaining items were specified a priori as follows: First, we ordered items by domain and valence in terms of the corrected item-total correlation coefficients, marking items with an ITC of .30 or lower for removal. Second, we calculated Cronbach's α for each behavioral domain, and examined the alpha value if each item was deleted. We marked items for possible removal if doing so would not result in a significant decrease in reliability. Throughout the shortening processes, we aimed to have an equal number of items for all domains and valences, which resulted in 10 items per scale on the AARC-100. The previous item stem was retained, and an alternating order of domain and valence was used to distribute items evenly throughout the questionnaire.

Participants. The AARC-100 was tested with a sample of 586 adults in the Denver metropolitan area (age range: 42-102 years, *M* = 64.42 years, *SD* = 13.84 years). Demographic characteristics were more diverse than in Sample 1 in terms of education, income and ethnicity (see Table 2.1). Participants were recruited using a random-sampling procedure. With the assistance of a private research company, we started with a random sample of 10,000 individuals in the surrounding metropolitan areas who were similar in demographic make-up to the most recent U.S. census data. Invitation letters were mailed to randomly selected subgroups of 2,000 individuals at a time until our target enrollment of approximately 600 participants was achieved. Participants were given the option to take the survey in pencil-and-paper format or online; about half of the participants selected the online version (49.8%). The questionnaire packet took approximately 45–60 minutes to complete. In exchange for their time and effort, participants received a small compensation in the amount of a $20 gift certificate or personal check. Informed consent was obtained in accordance with the university's Institutional Review Board (IRB).

Measures. In addition to the AARC-100, we collected demographic information, using the same personal data form described in Study 1. We also included the same measures of subjective aging as described in Study 1.

Results and Conclusion

Factor structure of AARC. To test the 2-factor Gains-Losses structure that emerged in Study 1, we performed CFA with the 10 domain scale scores calculated for AARC-100 and followed the same set of analytic procedures as described in Study 1. A 2-factor model in which the five positive valence subscales loaded on one factor and the five negative valence subscales loaded on the other factor was tested first. Model fit was less than satisfactory (see Table 2.3). To further specify the model, we added correlated error terms, as in Study 1 (e.g., physical positive

and physical negative error terms were allowed to correlate). According to the model misspecification indices, we tested one additional re-specification to allow the physical negative and lifestyle negative scales to be correlated. This modification made substantive sense as adults' perceived negative age-related changes in the physical domain may be linked to perceived negative age-related changes in the lifestyle domain (e.g., increasing problems with eyesight may impact the ability to drive a car). The resulting model fit was quite good (see Table 2.3), providing further support for a 2-factor model of AARC which represented both perceived age-related gains and perceived age-related losses.

Mean response selection for AARC domains. As in Study 1, unit-weighted subscale scores were calculated. The mean response selections for subscales are presented in Table 2.4. Comparable to the AARC-189 sample in Study 1, the average response selection for the AARC-100 sample on positive valence scales was near the midpoint of 3 out of 5 ("moderately") and for the negative valence scales was 2 out of 5 ("a little bit").

Test for potential administration effects. Independent samples t-tests were performed to examine the extent to which paper-and-pencil and online respondents endorsed similar or different levels of the AARC subdomains. Respondents in the paper-and-pencil condition reported significantly more perceived age-related losses in three behavioral domains: Health and Physical Functioning, Interpersonal Relationships, and Lifestyle and Engagement. However, the difference between paper-and-pencil and online respondents became non-significant after controlling for age and physical functioning. Therefore, we concluded that the differential responding pattern was a function of older age and poorer health rather than the mode of administration per se.

We concluded from Study 2 that the AARC-100 questionnaire showed promise for assessing adults' AARC in a psychometrically reliable way. Study 3 was designed to arrive at an even shorter, and therefore more widely useable, version of the AARC questionnaire. We used a subset of participants from Studies 1 and 2 to address this objective.

Study 3

Methods

Procedures for scale reduction. To develop the AARC-50, we began with a similar approach used in Study 2 in which we eliminated poorly performing items based on item and scale reliability coefficients. In addition, we revisited the AARC-189 to assure that items representing essential substantive content were not omitted from the questionnaire. Those items that reflected essential substantive content and that also had acceptable reliability coefficients were added back into the AARC-50. Next, we examined all items in AARC-50 by domain to identify potential areas of redundancy. If there were two very similar items, we dropped the item with the lower item-total correlation. We again strove for an equal number of items across domains and valences to allow for comparable domain scores. As a result of this iterative process, the AARC-50 represents a careful balance of empirical and substance-based reasoning to item selection. Regarding scale construction of the AARC-50, we retained the item stem that had proved effective in the previous studies, and adopted again an alternating order of domain and valence for even distribution of items throughout the questionnaire. The final items included in the AARC-50 are provided in Appendix 1, broken down by domain and valence.

Participants. The AARC-50 was tested with a subset of individuals from Samples 1 and 2 approximately two years later. Demographic characteristics are provided in Table 2.1. We mailed a detailed invitation letter to the approximately 800 individuals from Studies 1 and 2 who

had indicated on an IRB-approved form that they would be willing to be contacted for future research; 425 participants responded and took part in Study 3 (53.13% response rate). From Study 1, 46.96% of participants returned; from Study 2, we had a 41.30% return rate. The Time 2 assessment occurred, on average, 2.43 years (*SD* = .70 years) later for Study 1 participants and 1.73 years (*SD* = .18 years) later for Study 2 participants. Attrition analyses showed that participants who returned for a second measurement occasion tended to be older by 6.71 years, $t(394) = 4.98$, $p < .001$. Returning participants had slightly more education by an average of .61 years, $t(394) = 2.27$, $p = .024$, but had lower income levels, $t(377) = -2.90$, $p = .004$. There were no differences with regard to gender or health status of those who completed the second assessment. Again, participants could opt to take the survey either on paper or online; 50.9% selected the online condition. The questionnaire packet took approximately 30-45 minutes to complete. Individuals who completed the questionnaire packet were entered into a drawing to win one of ten cash prizes in the amount of $50 each. Informed consent was obtained in accordance with IRB procedures.

Measures. As in Studies 1 and 2, we collected demographic information using a standardized personal data form. In addition to the AARC-50 (provided in Appendix 2), we assessed several other facets of subjective aging as described in Study 1. Finally, we assessed physical and mental health functioning as described below.

Health and well-being. Four measures were included to assess multiple facets of physical and mental health. Depressive symptoms were assessed using the 10-item Centers for Epidemiological Studies Depression Scale (CES-D), a well-established depression screening tool for use with older adults (Andresen, Malmgren, Carter, & Patrick, 1994). Reliability in the present study was good ($\alpha = .84$). The 5-item satisfaction with life scale (SWLS) was used as a

rating of life satisfaction, and this scale too has been widely used in research with older adults (Diener, Emmons, Larsen, & Griffin, 1985; Diener, Inglehart, & Tay, 2013). Reliability for the SWLS in the present study was good (α = .85). The Short-Form 36, Version 2 (SF-36; Ware et al., 2007) was used to assess physical functioning and mental health functioning. The physical component score (PCS) and the mental component score (MCS) evaluate the extent to which performance on daily tasks is limited by physical or mental health symptoms, respectively. The SF-36 is a well-validated measure, used extensively in gerontological as well as medical and epidemiological research. Scale reliability in the present study was good (α's = .83).

Results and Conclusion

Factor structure of AARC. We again tested the 2-factor Gains-Losses structure that had been supported in Studies 1 and 2, following the same set of analytic procedures for CFA as described previously. This time, testing the 2-factor model of gains and losses resulted in acceptable model fit without specifying correlated error terms as in Studies 1 and 2 (see Table 2.3). In a second step, according to the model misspecification indices, we added one more re-specification to allow the error term for the physical negative and lifestyle negative domains to be correlated. This change in model specification resulted in a good model fit compared to the baseline model, providing further support for the 2-factor model of AARC.

Mean response selection for AARC domains. As in Studies 1 and 2, a unit-weighted approach was used to calculate mean subscale scores. Consistent with the findings from previous samples, the mean positive valence responses reflected the midpoint (3 out of 5: "moderately") of the scale, and the mean negative valence responses were a bit lower (2 out of 5: "a little bit"). Table 2.4 presents the scores for the theoretically substantiated ten behavioral domains, in addition to the empirically supported gains-losses scores. Given that the factor analyses

consistently supported a two-factor structure of the questionnaire, the subsequent analyses were conducted with the overarching Gains and Losses scale scores.

Reliability between versions and measurement occasions. Cross-sectional correlations between AARC-189 and AARC-100 scales with AARC-50 scales collected in Study 1 ranged from r = .82 - .98. The size of the correlation coefficients between questionnaire versions suggested that little, if any, substantive content was lost in the process of moving from the longer versions to the shorter version of the questionnaire. The correlation coefficients examining test-retest stability of the 50-item version over the 2-year period ranged from r = .60 – .79. The size of the test-retest stability coefficients suggested a moderate degree of stability of AARC over a 2-year period. The overarching scale scores for AARC-Gains and AARC-Losses exhibited correlations at the higher end of the range, (cross-sectionally: r = .96 – .98; longitudinally: r = .71 – .79).

Convergent and divergent validity. Examination of the convergent and divergent validity showed that AARC was significantly correlated with other measures of subjective aging, such as felt age, ATOA, and AgeCog scales (see Table 2.5).

A more positive view of one's own aging process – such as feeling younger than one's age, being more satisfied with one's aging process, and noticing more positive development – was positively associated with AARC-Gains. A similar pattern was also found for negative dimensions of subjective aging. That is, a more negative view of the aging process was associated with a higher score for AARC-Losses. Overall, the magnitude of the associations with the other measures of subjective aging tended to be significantly stronger for AARC-Losses compared to AARC-Gains, as tested using Fisher's r-to-Z transformations (Lee & Preacher, 2013). We also examined statistical associations between the AARC and subjective aging

constructs that we expected to be conceptually different (i.e., divergent validity). The eight domain-based stereotype scales showed small associations with AARC. As expected, there was a small degree of overlap, which indicated that age stereotypes and awareness of age-related change were distinct constructs.

Predictive validity. To provide evidence of the predictive validity of the AARC questionnaire, we examined the extent to which the AARC scores were able to predict physical and mental health functioning both cross-sectionally and longitudinally (Table 2.6). To this effect, we performed linear multiple regression analyses, in which the AARC Gains and Losses scores were used as predictors of four outcomes collected at Time 2 (e.g. Study 3): depressive symptoms (CES-D), life satisfaction (SWLS), physical functioning (SF-36 PCS), and mental health functioning (SF-36 MCS). Longitudinal prediction was assessed by using the three versions of AARC from Study 1 as the predictor variables; cross-sectional associations were assessed by using AARC-50 from Study 3. AARC-Gains and AARC-Losses were significant predictors of all four health and well-being outcomes (see Table 2.6); participants who reported more perceived age-related gains tended to report fewer depressive symptoms and higher life satisfaction, as well as better physical and mental health functioning. Conversely, participants who reported more perceived age-related losses tended to report more depressive symptoms and lower life satisfaction, as well as poorer physical and mental health functioning. The same pattern of findings was found for all versions of the AARC questionnaire, providing further support that the shortened AARC-50 version is as useful for predicting outcomes as the longer versions. The findings also held for both longitudinal and cross-sectional analyses. Table 2.6 provides a summary of model results.

Overall, we concluded from Study 3 that the more parsimonious 50-item version of the AARC questionnaire represented the most ideal version with regard to reliability and validity. The 2-factor structure of age-related gains and losses was further confirmed, and all items and subscales showed acceptable reliability. The AARC-50 correlated highly with the longer versions, and there was a moderate degree of stability of AARC over a two year-period. Finally, the AARC questionnaire was effective in predicting health and well-being outcomes in later life.

General Discussion

The measurement development process described in this paper resulted in a 50-item multidimensional questionnaire to assess AARC in middle-aged and older adults—the AARC-50 (See Appendix 1). Taking a rigorous approach and beginning with a large item pool allowed for the selection of the top-performing items. These three studies provide evidence that AARC can be assessed in a psychometrically sound way with the AARC-50 questionnaire.

The findings presented here complement and build upon a rich history of literature on subjective aging, including concepts such as age identity, self-perceptions of aging and age stereotypes (Barrett, 2003; Diehl, Wahl, et al., 2014; Kastenbaum et al., 1972; Levy, 2003). Recent decades have yielded a steady stream of evidence demonstrating the many connections between measures of subjective aging and health and well-being (e.g., Westerhof et al., 2014). This connection is now undisputed and researchers have begun to examine longitudinal trends and underlying mechanisms to explain this association (Kornadt & Rothermund, 2012; Sargent-Cox, Anstey, & Luszcz, 2012b). Therefore, to allow for the advancement of knowledge regarding the complex associations between measures of subjective aging and developmental outcomes, a theoretically grounded and psychometrically sound measurement instrument becomes an essential research tool.

The AARC-50 is a measure that reflects the multidimensional nature of subjective aging (Hummert, 2011), assessing adults' positive and negative subjective aging experiences across five behavioral domains: Health and Physical Functioning; Cognitive Functioning; Interpersonal Relations; Social-Cognitive and Social-Emotional Functioning; and Lifestyle and Engagement (Diehl & Wahl, 2010). Although these five behavioral domains are not completely exhaustive, they capture those areas in adults' daily lives that give rise to probably the majority of subjective aging experiences (Miche, Wahl et al., 2014). Recent empirical evidence supports the utility of such a multidimensional approach to measuring AARC, as the AARC domains predicted health and well-being over and above existing unidimensional measures of subjective aging (Brothers, Miche, Wahl, & Diehl, 2015). Few other measures of subjective aging have been designed to capture the nuanced differences in self-perceptions of aging across multiple life domains. Three notable exceptions are 1) the AgeCog scales; 2) a multidimensional assessment of age stereotypes (Kornadt & Rothermund, 2011); and 3) the attitudes to ageing questionnaire. Taken together, these examples in conjunction with the present study represent growing support for taking a multidimensional approach to the study of subjective aging.

In contrast to many existing subjective aging measures, the AARC-50 questionnaire allows for the simultaneous assessment of perceived age-related changes along both positive and negative dimensions. The gain-loss factor structure of the AARC questionnaire that emerged from this study directly addresses the life-span developmental proposition that aging is not solely characterized by loss experiences, but rather by both gains and losses (Baltes, 1987). Measuring subjective aging with a gains-losses approach is also consistent with previous research showing that individuals of all ages have expectations about aging that represent both positive and negative changes (Heckhausen & Baltes, 1991), although expectations shift increasingly toward

losses after mid-life (Baltes, 1987). The unique ability of the AARC-50 to differentiate between perceived gains and losses is beneficial, given that gains and losses represent separate aspects of the perceived aging experience. Perceived gains appear to serve as a protective factor, for instance in the face of a serious health condition (Wurm, Tomasik, & Tesch-Römer, 2008), whereas perceived losses are predictive of negative outcomes (Meisner, 2012).

The evidence of convergent and divergent validity of the AARC-50 demonstrated that AARC is a distinct subjective aging construct. Existing subjective aging constructs such as felt age, ATOA, and the AgeCog scales shared between 1.0% – 4.8% of the variance with AARC-Gains and about 7.8% – 44.9% with AARC-Losses. This small to moderate degree of empirical overlap suggests that AARC-Gains and AARC-Losses assess unique information about subjective aging not already captured by existing constructs. As expected, the associations between AARC and age stereotypes represented even less empirical overlap (.04%–10.24% shared variance), further establishing AARC as a distinct construct in the literature. This lack of empirical overlap is important because it indicates that the AARC questionnaire assesses adults' self-perceptions of aging that is distinct from the stereotypes they may hold about aging and older adults in general.

Evidence of predictive validity was consistent with previous research showing the empirical association between subjective aging and developmental outcomes (e.g., Levy, 2003). AARC-Gains and AARC-Losses were significant predictors of four different measures of health and well-being, including depressive symptoms, satisfaction with life, physical functioning, and mental health functioning. Evidence of the predictive relevance of AARC was even stronger longitudinally across two and a half years than it was cross-sectionally. For instance, AARC-Gains was not a significant cross-sectional predictor of physical functioning, but its predictive

relevance for physical functioning across the span of two and a half years was robust. This finding suggests that the influence of awareness of perceived age-related gains and losses on developmental outcomes may be particularly important over time.

The AARC-50 has many potential applications in research and practice alike. With regard to research applications, there are many questions to be explored with the AARC-50, with regard to possible antecedents and outcomes (Diehl & Wahl, 2010). For instance, what might be the connection between the awareness of age-related change and the awareness of remaining lifetime, as conceptualized in socioemotional selectivity theory (Carstensen, 2006)? How might personality characteristics influence – and be influenced by – AARC? Is it possible to modify AARC through intervention, and will such changes facilitate positive developmental outcomes (Miche, Brothers, Diehl, & Wahl, 2015)? What is the association with coping and adaptation in later life, such as the use of primary vs. secondary control strategies? The use of the AARC-50 within clinical and practice settings also has a great deal of potential. One valuable application would be as a tool to identify individuals holding negative attitudes and experiences about growing older, which are well-known risk factors that can impede healthy and optimal aging (Westerhof et al., 2014).

Currently there are several additional refinements of the AARC questionnaire underway. First, item response theory (IRT) theory is used to identify and select a small number of highly discriminatory items in order to develop a 10-item version of the questionnaire. Such an ultra-short version will provide a parsimonious, yet reliable way to assess AARC-Gains and AARC-Losses in large-scale, nationally representative studies. Second, a German version of AARC has been developed in conjunction with the English version, and shows equally strong psychometric properties to be reported in a forthcoming publication. The availability of a cross-culturally

relevant assessment tool of subjective aging will allow for the examination of similarities and differences between middle-aged and older adults in the U.S. and Germany, a topic which has already received some attention (Staudinger, 2015; Westerhof & Barrett, 2005).

In summary, the three studies reported here demonstrated that adults' perceived age-related gains and losses can be assessed in a psychometrically reliable and valid way using the AARC questionnaire. Furthermore, this tool advances the assessment of adults' subjective aging experiences and allows for the more differentiated examination of the influences of subjective aging on health and well-being throughout adulthood.

Table 2.1.

Demographic Characteristics for the Three Samples

	AARC-189 Sample (*N* = 396)	AARC-100 Sample (*N* = 586)	AARC-50 Sample (*N* = 424)
Age (years) *M (SD)*	65.45 (13.75) Range: 40– 95	64.42 (13.84) Range: 40 - 102	69.53 (12.52) Range: 42.15 – 98.49
Gender (% Women)	55.3%	46.5%	52.4%
Marital Status			
Single	6.6%	12.3%	9.9%
Married/Partnership	62.9%	54.4%	55.9%
Separated/Divorced	18.0%	17.8%	17.0%
Widowed	12.4%	14.4%	16.0%
Education (years) *M (SD)*	16.81 (2.67)	15.83 (2.76)	16.55 (2.72)
Degree			
Less than high school	1.0%	3.9%	0.2%
High School (GED)	21.2%	31.9%	21.7%
Associates	8.6%	8.0%	9.5%
Bachelors	35.6%	28.2%	32.9%
Graduate Degree	33.6%	26.6%	33.9%
Race/Ethnicity			
White	97.2%	86.9%	94.3%
American Indian	.3%	0.3%	0.2%
African American	.3%	3.5%	1.2%
Hispanic	.3%	5.9%	3.1%
Asian	1.5%	0.7%	0.2%
Other	.5%	2.8%	0.9%
Employment Status			
Full-time	31.2%	32.3%	23.2%
Part-time	12.2%	6.8%	7.8%
Retired	52.0%	44.3%	57.7%
Unemployed	2.8%	4.4%	1.4%
Other	1.8%	12.2%	9.9%
Household Income			
< $50K	31.9%	37.4%	35.6%
$50K – $100K	36.7%	36.4%	35.9%
$100K – $150K	16.6%	15.5%	16.6%
> $150K	14.8%	10.7%	12.5%
Self-Rated Health *M (SD)*	5.24 (.85)	5.11 (.90)	5.20 (.89)

Note. Self-rated health ratings range from 1 (very poor) to 6 (very good).

Table 2.2.

Study 1: Principal Axis Factor Analyses (PAF) Representing the First-Order Factor Structure of AARC

	Rotated Factor Loadings			**Reliabilities**	
	Factor 1 "Losses"	Factor 2 "Gains"	Communalities	Cronbach's alpha	Item-Total Correlations
AARC Subscales					
PHYS –	.88		.72	.90	.23-.75
COG –	.80		.64	.92	.43-.75
INT –	.73		.59	.79	.11-.57
SC/SE –	.80		.70	.85	.09-.63
LIFE –	.99		.89	.85	.26-.66
PHYS +		.58	.30	.84	.33-.64
COG +		.83	.64	.86	.40-.64
INT +		.73	.70	.88	.25-.65
SC/SE +		.95	.88	.89	.15-.63
LIFE +		.86	.77	.85	.13-.66
Factor Statistics					
Cronbach's alpha	.91	.88			
Item-Total Correlations	.76-.86	.51-.88			
Eigenvalue	4.75	2.07			
% Variance	47.54	20.69			

Note: Oblique (Promax) rotation was applied. Results from the Pattern Matrix are reported. Analyses were performed using the calibration sample, a randomly selected half of the sample in Study 1 (N = 196). AARC Domain Abbreviations: PHYS = Health and Physical Functioning; COG = Cognitive Functioning; INT = Interpersonal Relations; SCSE = Social-Cognitive and Social-Emotional Functioning; LIFE = Lifestyle and Engagement. '+' positive domains; '-' = negative domains.

Table 2.3.

Confirmatory Factor Analyses: Summary of Model Fit Statistics

	χ^2	*df*	$\Delta\chi^2$	Δ *df*	Sig	CFI	TLI	RMSEA	SRMR
Study 1: Model Results for the 189-item Version									
Baseline Model: Two-Factor Model of AARC	134.02	34	-	-	.00	.93	.91	.12	.07
Two-Factor Model of AARC with domain score error terms correlated	72.98	29	61.04[a]	5	.00	.97	.95	.087	.06
Study 2: Model Results for the 100-item Version									
Baseline Model: Two-Factor Model of AARC	310.28	34	-	-	.00	.92	.90	.12	.06
Two-Factor Model of AARC with domain score error terms correlated	256.28	29	54.00[a]	5	.00	.94	.90	.12	.06
Final Two-Factor Model of AARC with domain score error terms correlated; Phys– correlated with Life–	162.02	28	94.26[a]	1	.00	.96	.94	.09	.05
Study 3: Model Results for the 50-item Version									
Baseline Model: Two-Factor Model of AARC	99.67	34	-	-	.00	.97	.96	.07	.04
Two-Factor Model of AARC with domain score error terms correlated	93.36	29	6.31	5	.00	.97	.96	.07	.04
Final Two-Factor Model of AARC with Phys– correlated with other four losses domains	51.11	30	48.56[b]	4	.00	.99	.99	.04	.03

Note: CFI = Comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = square root mean residual; Phys– = AARC Physical Negative; Life– = AARC Lifestyle Negative.

[a]Indicates significantly better fit compared to the previous model, based on chi-square critical value for specified change in degrees of freedom, $p < .05$.

[b]Indicates significantly better fit compared to the baseline model, based on chi-square critical value for specified change in degrees of freedom, $p < .05$.

Table 2.4.

Descriptive Statistics for the AARC Subscales across the Three Studies

	Study 1 (N = 396)			Study 2 (N = 586)			Study 3 (N = 424)		
	M (SD)	α	ITCs (Range)	*M (SD)*	α	ITCs (Range)	*M (SD)*	α	ITCs (Range)
Positive-Valence									
PHYS+	2.83 (.78)	.85	.33 - .72	2.87 (.80)	.87	.36 - .72	3.08 (.92)	.81	.44 - .65
COG+	3.13 (.68)	.88	.42 - .64	3.13 (.73)	.85	.47 - .65	3.02 (.82)	.81	.50 - .66
INT+	2.94 (.57)	.87	.29 - .65	2.98 (.76)	.85	.32 - .69	3.19 (.83)	.75	.29 - .64
SCSE+	3.14 (.58)	.89	.15 - .63	3.35 (.78)	.86	.35 - .67	3.48 (.91)	.83	.63 - .68
LIFE+	3.13 (.63)	.84	.13 - .65	2.97 (.74)	.80	.22 - .67	3.14 (.97)	.81	.53 - .71
AARC-Gains	3.06 (.53)	.88	.52 - .88	3.06 (.62)	.86	.51 - .81	3.18 (.74)	.89	.63 - .85
Negative-Valence									
PHYS-	2.68 (.66)	.90	.23 - .75	2.60 (.86)	.91	.48 - .78	2.65 (.92)	.87	.62 - .76
COG-	2.33 (.70)	.92	.43 - .76	2.20 (.76)	.90	.41 - .77	2.00 (.73)	.85	.60 - .74
INT-	2.11 (.46)	.79	.11 - .57	1.73 (.60)	.81	.30 - .64	1.54 (.60)	.74	.44 - .57
SCSE-	2.20 (.53)	.86	.09 - .63	2.35 (.63)	.76	.35 - .54	1.95 (.71)	.75	.44 - .67
LIFE-	2.25 (.66)	.85	.26 - .66	2.36 (.82)	.88	.47 - .76	2.27 (.82)	.73	.26 - .64
AARC-Losses	2.33 (.53)	.92	.78 - .87	2.25 (.62)	.89	.67 - .86	2.08 (.63)	.88	.63 - 84

Note: AARC Domain Abbreviations: PHYS = Health and Physical Functioning; COG = Cognitive Functioning; INT = Interpersonal Relations; SCSE = Social-Cognitive and Social-Emotional Functioning; LIFE = Lifestyle and Engagement. '+' positive domains; '-' = negative domains. ITC = item-total correlation.

Table 2.5.

Convergent & Divergent Validity for Study 3 (N = 414)

	AARC-Gains	AARC-Losses	Fisher's *r* to *Z* transformation
Convergent Validity			
Felt Age	-.10*	.28**	-2.83**
ATOA	.11*	-.67**	-10.43**
AgeCog- Ongoing Development	.22**	-.54**	-5.60**
AgeCog- Physical Decline	-.21**	.64**	-7.99**
AgeCog-Social Loss	-.12*	.51**	-6.61**
Divergent Validity			
Age Stereotype – Family & Partnership	.02	-.31**	-4.56**
Age Stereotype – Friends & Acquaintances	.06	-.29**	-3.61**
Age Stereotype – Religion & Spirituality	.22**	-.04	2.78**
Age Stereotype – Leisure/ Civic Commitment	.16**	-.32**	-2.55*
Age Stereotype – Personality	.14**	-.26**	-1.88
Age Stereotype – Financial Situation	.02	-.26**	-3.73**
Age Stereotype – Employment	.21**	-.22**	-.16
Age Stereotype – Physical Fitness/Appearance	.18**	-.32**	-2.24*

Note: Felt age is coded such that a negative score indicates feeling younger (e.g. reflecting a more positive perception of aging). ATOA = attitudes toward own aging scale. AgeCog = Scales for aging-related cognitions.
* $p < .05$; ** $p < .01$

Table 2.6.

Predictive Validity of AARC-Gains and AARC-Losses for Health and Well-Being at Time 2

	Depressive Symptoms		Satisfaction with Life		Physical Functioning		Mental Health Functioning	
	B	*SE (B)*	*B*	*SE (B)*	*B*	*SE (B)*	*B*	*SE (B)*
AARC-189 (Study 1)								
N = 164								
AARC-Gains	-1.68*	.65	2.22**	.83	3.55**	1.13	2.18*	1.09
AARC-Losses	5.36***	.67	-5.11***	.85	-8.83***	1.16	-7.27***	1.12
Total R^2	.27		.17		.25		.19	
Adjusted R^2	.26		.16		.24		.18	
F	32.33***		18.51***		29.16***		20.98***	
AARC-100 (Study 1)								
N = 164								
AARC-Gains	-1.32*	.56	1.57*	.71	2.36*	.94	1.98*	.93
AARC-Losses	4.14***	.55	-3.60***	.70	-7.48***	.93	-5.50	.92
Total R^2	.24		.13		.27		.17	
Adjusted R^2	.24		.12		.26		.16	
F	28.87***		13.75***		32.95***		18.15***	
AARC-50 (Study 1)								
N = 164								
AARC-Gains	-1.12*	.51	1.35*	.65	2.12*	.87	1.83*	.86
AARC-Losses	4.14***	.55	-3.91***	.69	-7.43***	.92	-5.59***	.91
Total R^2	.25		.16		.27		.18	
Adjusted R^2	.24		.15		.26		.17	
F	29.27***		16.74***		33.13***		19.41***	
AARC-50 (Study 3)								
N = 423								
AARC-Gains	-1.11***	.27	1.53***	.36	.66	.46	1.43**	.50
AARC-Losses	4.99***	.32	-4.18***	.43	-7.77***	.54	-5.93***	.59
Total R^2	.38		.20		.33		.20	
Adjusted R^2	.38		.20		.32		.20	
F	128.46***		53.33***		101.97***		52.87***	

*Note. * p < .05; ** p < .01; *** p < .001.* Study 1 models represent longitudinal predictions to health and well-being, whereas Study 3 represents cross-sectional data.

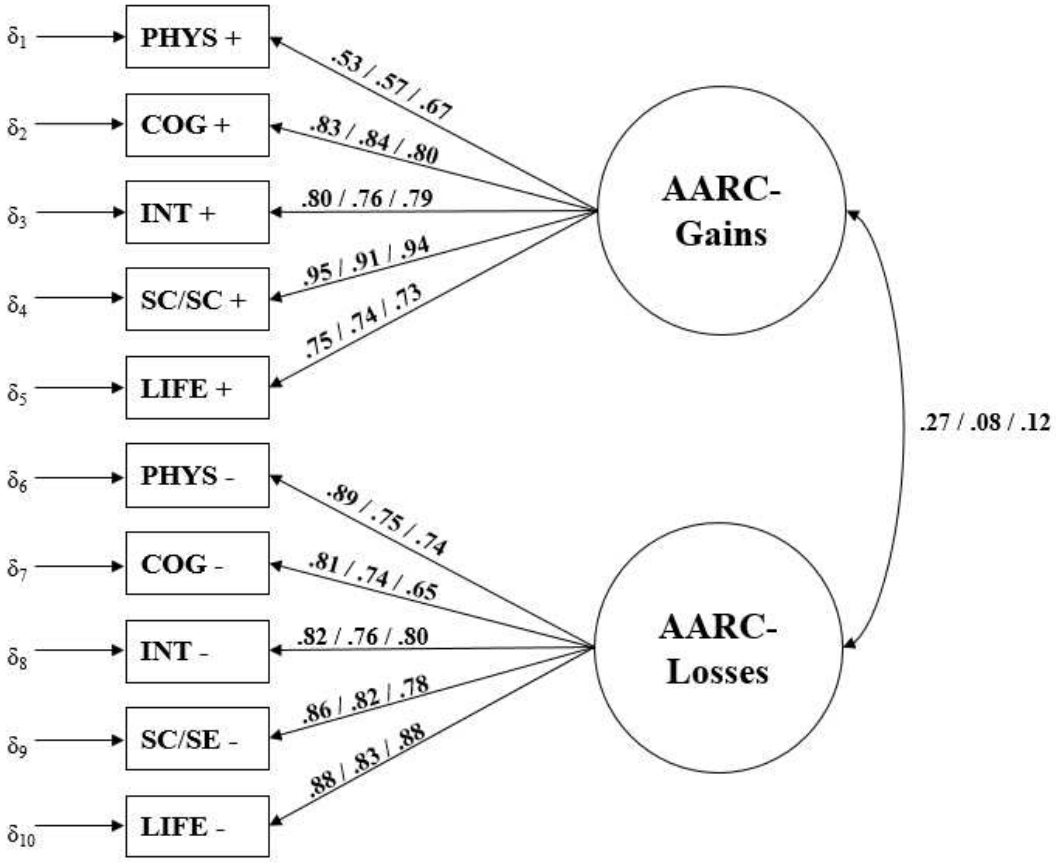

Figure 2.1. Measurement model of AARC. Fully standardized coefficients from the final models are reported for Study 1, Study 2, and Study 3, respectively.

CHAPTER 3.

Examination of Associations Among Three Distinct Subjective Aging Constructs and their Relevance for Predicting Developmental Correlates[2]

Summary

Objectives: Given the variation in approaches to conceptualizing Awareness of Aging (AoA) this study examined: 1) The empirical associations among three AoA constructs: Felt Age, Attitudes toward Own Aging (ATOA) and Awareness of Age-Related Change (AARC); and 2) the predictive relevance of the AoA constructs with regard to two developmental correlates: Physical functioning and satisfaction with life. Methods: Participants were 819 adults ages 40-98 from the U.S. and Germany. Parallel multiple mediation analyses and hierarchical regression were used. Results: Correlational findings suggested that the three constructs represent related, yet distinct, facets of AoA. AARC mediated the association between the two more implicit measures of AoA (Felt Age and ATOA) and the developmental correlates. Specifically, feeling older than one's actual age predicted more AARC-Losses, which predicted poorer health and well-being. Holding negative ATOA predicted more AARC-Losses and fewer AARC-Gains, which predicted poorer health and well-being. The multidimensional measure, AARC, accounted for a significant amount of the variance in the developmental correlates over and above the unidimensional AoA constructs. A consistent pattern emerged supporting the role of domain-specificity and valence. Discussion: These findings support the need for

[2] Brothers, A., Miche, M., Wahl, H.-W., & Diehl, M. (2015). Examination of Associations Among Three Distinct Subjective Aging Constructs and Their Relevance for Predicting Developmental Correlates. *The Journals of Gerontology, Series B: Psychological Sciences, Advance access publication October 1, 2015*. doi:10.1093/geronb/gbv085

conceptualizing AoA across different behavioral domains, and for distinguishing between positive and negative AoA.

Introduction

Recent research has focused a great deal on individuals' perceptions of their own aging, often referred to as *subjective aging* (SA; Diehl, Wahl et al., 2014). SA is an overarching term, referring to many different conceptualizations of the ways in which individuals experience the aging process. Although extensive evidence documents the association between measures of SA and important outcomes such as health and well-being (Westerhof et al., 2014), the empirical associations *among* various SA constructs are currently not well understood.

Given the variety of ways in which SA has been conceptualized over the past several decades, the objective of the present study was to explore the empirical inter-relations among three constructs that differ in complexity of measurement (Diehl, Wahl et al., 2014): Felt Age, Attitudes Toward Own Aging (ATOA), and a new construct, Awareness of Age-Related Change (AARC). Using data from a combined sample of U.S. and German adults, we examined these constructs as they relate to one another and as they relate to two key developmental correlates: Functional health and life satisfaction. Both physical and psychological correlates were of interest because they are common outcome variables in subjective aging research (Mock & Eibach, 2011; Westerhof et al., 2014) and represent key indicators of successful aging. Moreover, the three SA constructs may show differential associations with these developmental correlates, yet this question has not been addressed in the literature.

Rationale for the Selection of the Three Measures of Subjective Aging

Traditional approaches to conceptualizing SA have relied primarily on measures that are quite simple in their approach, yet show robust associations with important outcomes in later life.

Felt Age (Kastenbaum et al., 1972) draws upon the notion that an individual's perceived age may deviate from his or her chronological age as a consequence of "anchoring and adjusting one's age" (Montepare, 2009, p. 43) in response to situational age-relevant experiences. The lack of explicit reference to individuals' specific personal aging experiences might be regarded as a limitation of felt age ratings (Diehl, Wahl et al., 2014). Thus felt age captures SA at a rather general level, but is nonetheless a powerful predictor of developmental outcomes, including health and well-being (Barrett, 2003; Hubley & Russell, 2009; Westerhof & Barrett, 2005). (Although Kastenbaum and colleagues (1972) proposed several dimensions of subjective age (e.g., look age, feel age, do age, and interest age), felt age is the most commonly used stand-alone measure in psychological aging research and therefore is not actually treated as the multidimensional construct it was first conceptualized to be; Kastenbaum et al., 1972).

The ATOA scale (Lawton, 1975) uses a global evaluation of a person's aging process and can be regarded as reflecting a general attitude with which an individual approaches his or her own aging. In general, attitudes are composed of affective, cognitive, and behavioral components (cf., Eagly & Chaiken, 1998; Fiske & Taylor, 1991). The way the items of the ATOA scale are phrased (e.g., "Do things keep getting worse as you get older?") suggest that ATOA captures mainly affective and cognitive responses to a person's own aging. Like felt age, ATOA is associated with many developmental outcomes, including health and well-being (Bryant et al., 2012; Levy, 2003; Moser et al., 2011).

The AARC construct (Diehl & Wahl, 2010) is presented as a third variant of SA assessment because of its emphasis on multidimensionality and the valence of adults' reported experiences. Although multidimensional approaches of SA have been suggested for some time (e.g. Steverink et al., 2001), recent theoretical advances (Diehl et al., 2015; Diehl, Wahl et al.,

2014) allow for a more elaborated conceptualization of SA. Based on this background, AARC captures a person's experienced age-related change in terms of gains and losses in a total of five behavioral domains, such as physical health or cognitive functioning (Diehl & Wahl, 2010). According to the definition provided by Diehl and Wahl (2010), AARC is comprised of "all those experiences that make a person aware that his or her behavior, level of performance, or ways of experiencing his or her life have changed as a consequence of having grown older (i.e., increased chronological age)" (p. 340). The authors assume that as individuals age AARC becomes part of their self-knowledge incorporating both content-related and evaluative information about subjectively experienced age-related changes. Therefore, in contrast to Felt Age and ATOA, AARC relies on actual behavioral experiences, self-reflection, and conscious awareness, which require individuals to recognize or evaluate specific experiences of age-related change. AARC thus is viewed as being rooted in adults' every-day age-related behaviors and experiences (Miche, Wahl et al., 2014) and is considered a behavior-specific measure of SA.

Empirical Associations among the SA Constructs

Although the three SA constructs have been shown to be associated with developmental correlates, the extent to which the different SA constructs may interact with one another to influence developmental outcomes has not yet been examined. One way of understanding how various SA constructs are related to one another is to consider the extent to which they rely on global versus behavior-specific evaluations. Thus, based on their conceptual distinctions, the SA constructs in this study can be ordered on a continuum of rating specificity, such that Felt Age and ATOA are at the "global" end of the continuum, whereas AARC is at the "behavior-specific" end (Diehl, Wahl et al., 2014).

We argue based on theoretical reasoning that negative global SA ratings operate as a cognitive schema (Hummert, 2011) priming individuals to expect and notice primarily negative age-related changes (e.g. AARC-Losses), thereby impeding behaviors that promote physical and psychological well-being. Conversely, positive global SA prime individuals to experience more positive age-related changes (e.g. AARC-Gains) and therefore motivate behaviors that promote physical and psychological well-being (Diehl & Wahl, 2010). Such a pathway is consistent with stereotype embodiment theory, which posits that SA exerts its influence on health and well-being through a series of psychological, behavioral, and physiological pathways (Levy, 2009). However, pathways by which behavior-specific SA mediates the effects of global SA on health and well-being have not yet been empirically tested.

Furthermore, it seems reasonable to assume that such pathways may function differently depending on an individual's age. With age, individuals become increasingly heterogeneous as a result of varying life experiences and differential developmental trajectories (Löckenhoff et al., 2009). Furthermore, subjective aging experiences occur throughout the adult lifespan, but very likely take on different meaning at different life stages (Barrett & Montepare, 2015). For instance, perceptions of growing older in one's 50's may involve fairly benign physical changes such as graying hair or wrinkles. In contrast, the experience of growing older in one's 80's or 90's may involve more serious losses in physical health, social relationships, and functional independence (Nilsson, Sarvimäki, & Ekman, 2000). Therefore, the associations among measures of global SA, specific SA, and developmental correlates are likely moderated by chronological age, but this connection has not yet been studied empirically.

Differential Associations of SA Constructs With Health and Well-Being

Because of their differing measurement structures with regard to multidimensionality and valence, the three SA measures are expected to be differentially related to health and well-being. The role of multidimensionality is important for understanding the associations between SA and developmental correlates because domain-specific effects have been found in experimental and longitudinal research with regard to age stereotypes (Levy & Leifheit-Limson, 2009; Wurm et al., 2013). For instance, in an experimental task, participants exposed to negative age stereotype words experienced the strongest effects on performance for behaviors in a corresponding domain. Specifically, exposure to words such as *feeble* and *shaky* exerted a stronger negative effect on a domain-similar balance task than on a cognitive task (Levy & Leifheit-Limson, 2009). In a similar vein, Kornadt and Rothermund (2012) showed that the integration of age stereotypes into adults' self-views was dependent upon life domain and, thus, highlighted the importance of considering domain-specific age stereotypes. However, domain-specificity for SA constructs other than age stereotypes has not yet been systematically evaluated.

The valence of aging experiences is also an important measurement characteristic to take into account when evaluating the associations between SA and health and well-being. Although traditional SA constructs treat positive and negative attitudes toward aging as two ends of the same continuum, newer SA constructs acknowledge positive and negative experiences as being mostly independent of one another. AARC considers both age-related gains and losses across all five behavioral domains, positioning valence as a superordinate dimension of domain-specific SA (Wahl et al., 2013). The distinction of valence is important because negative SA may have a stronger detrimental and more pervasive effect on adults' behavior than the potentially protective effects of positive SA. For example, a meta-analysis found that priming negative age stereotypes

exerted almost three times as large of an effect on behavioral outcomes, such as memory and motor tasks, compared to priming positive age stereotypes (Meisner, 2012).

Research Questions and Expectations

Given the variation in approaches to assessing SA, this study had three objectives: (1) To investigate empirical relationships among the SA measures and developmental correlates using mediation analyses; (2) to examine the extent to which age has a moderating effect on these mediation pathways; and (3) to examine the predictive relevance of three SA measures with regard to functional health and satisfaction with life, while evaluating the role of multidimensionality and valence. Regarding the first question, we expected that the measure of AARC would mediate the association between the global SA measures (i.e., Felt Age, ATOA) and the developmental correlates because it draws on specific behavioral experiences. Regarding the second question, we expected that the association between SA and the developmental correlates would be stronger for older individuals compared to younger individuals. Finally, regarding the third research question, compared to the unidimensional measures, we expected that the multidimensional measure would account for a significantly greater portion of variance in both developmental correlates after controlling for a number of covariates. We also expected a domain-specific effect such that a match between the respective SA dimension (e.g., SA in the physical functioning domain) and developmental correlate (e.g. functional health) would result in a relatively stronger association compared to non-matching dimensions. Further, we expected that the associations between SA and the developmental correlates would be relatively stronger for negative SA compared to positive SA.

Method

Participants and Procedures

The sample was comprised of 819 community-residing adults ages 40-98 years old (*M* = 64.13 years, *SD* = 12.85 years) from the U.S. and Germany (see Table 3.1). More than half of participants were women (60.0%), 62.1% were married, and 49.2% were retired. Participants reported above-average education (U.S.: *M* = 16.80 years, *SD* = 2.67 years; Germany: *M* = 11.53 years, *SD* = 1.96 years) and income (U.S.: median gross annual income $70,000 - $79,999; Germany: median monthly net income: € 2,500 – € 2,999), and rated their health as very good *(M* = 5.05, *SD* = .89, with 6 = Excellent). The sample was analyzed in the aggregate for the present study. Although statistically significant mean differences were found between the two samples with regard to several of the key variables of interest, the differences were small in terms of practical significance (Cohen's *d* range: .12 - .29), reflecting small effect sizes (Cohen, 1988).

Participants were recruited by posting study announcements in public locations and by word of mouth. They completed a self-report questionnaire packet, which took approximately 1 to 1 ½ hours. Both sites followed identical procedures for data collection, and all participants provided informed consent as required by institutional policies at the respective universities. No financial compensation was provided. Participants were free of self-reported memory complaints, and their primary language matched the language of the questionnaire (English or German).

Measures

To ensure consistency of measurement across countries, the questionnaire packet was formatted identically in the U.S. and in Germany. Existing English and German versions have

been used successfully in in the literature for felt age (e.g., Westerhof & Barrett, 2005), ATOA (Moor, Zimprich, Schmitt, & Kliegel, 2006), SF-36 (Bullinger & Kirchberger, 1998), and SWLS (Schumacher, Klaiberg, & Brähler, 2003). A rigorous translation/back-translation process (involving four independent bilingual speakers, two of whom were native English speakers and two of whom were native German speakers), was employed for the AARC questionnaire to ensure that similar meaning was conveyed in both English and German.

Felt Age. Felt Age was measured by the one-item question adapted from the National Survey of Midlife Development in the United States (MIDUS): "Many people feel older or younger than they actually are. Fill in the age (in years) that you feel most of the time: ___" (Barrett, 2003, p. S104). Answers were provided in whole numbers that represented ages, and a proportional discrepancy score between a person's actual chronological age and Felt Age was computed according to the procedures described by Rubin and Berntsen (2006). Calculating proportional discrepancy scores rather than absolute difference scores has the advantage that the difference between actual and Felt Age can be expressed relative to a person's actual age. That is, a score of -.10 indicates that a person feels 10% younger relative to his or her actual age. The reliability and validity of this single-item measure of Felt Age are well established, nationally and cross-culturally (Barak, 2009).

Attitudes toward own aging. Attitudes toward one's own aging were measured using the Attitudes Toward Own Aging measure, a 5-item subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975). The items reflect an overall evaluation of an individual's aging experience, and ask respondents to consider whether life is better or worse now compared to younger years. The response format for the items is dichotomous (better/worse, yes/no), and a higher score indicates a more positive view toward aging. Scores were summed and divided by

the number of responses to devise a proportion score, such that a score of 1.00 reflected all positive responses and a score of 0.00 reflected all negative responses. The ATOA measure is widely used in SA research (Miche et al., 2014). Evidence for the unidimensional factor structure of the items was provided by Liang and Bollen (1983). The internal consistency reliability for the current sample was acceptable (Cronbach's $\alpha = .69$).

Awareness of age-related change. A long version (189 items) of a newly developed questionnaire was used to assess perceived age-related changes across five behavioral domains (Diehl & Wahl, 2010): Health and physical functioning (PHYS); cognitive functioning (COG); interpersonal relations (INT), social-cognitive and social-emotional functioning (SC/SE); and lifestyle and engagement (LIFE). Items in each domain assess either positive (gains) or negative (losses) perceptions of age-related changes. The item stem is, "With my increasing age, I realize that… ." and the response format ranges from 1 (not at all) to 5 (very much). A sample gain item (INT+ domain) is, "… my family has become more important to me." A sample loss item (LIFE- domain) is, "… I have not accomplished the things that I wanted to accomplish." Unit-weighted scale scores were calculated, such that higher scores reflect more age-related changes.

The psychometric properties of the AARC questionnaire are well-supported in our sample (Diehl, Brothers, Wettstein, Miche, & Wahl, 2013). First, exploratory and confirmatory factor analyses support an overarching 2-factor structure, representing perceived age-related gains and perceived age-related losses across all five domains. AARC-Gains and AARC-Losses scores are primarily used for the analyses reported here, although scale scores from the theoretically derived 5 behavioral domains are used for the domain-specific correlational analyses. In the present study, scale reliabilities were very good regarding the overarching

dimensions and good regarding the behavioral domains (AARC-Gains: α = .96; AARC-Losses α = .96; 10 behavioral domains: α = .79 - .92).

Functional health. Functional health was measured using the Short Form 36 Health and Well-Being questionnaire, version 2 (SF-36v2; Ware et al., 2007). The SF-36 is widely used in public health studies and medical research. The physical component summary score was used, which represents a composite of four scale scores: physical functioning, ability to complete daily tasks, bodily pain, and general health. Items are rated on a 3- or 5-point rating scale and a higher score represents better functional health. The reliability and validity of the SF-36 are well-established (Ware et al., 2007), and the internal consistency reliability for the current sample was satisfactory (α = .83).

Satisfaction with life. The satisfaction with life scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was used to measure subjective well-being. The SWLS includes five items, such as, *I am satisfied with the overall state of affairs in my life.* Items are rated on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree). A higher score indicates greater satisfaction with life. The scale requires an overall cognitive evaluation of one's life, and has been extensively used as an indicator of subjective well-being. Reliability and validity of this scale are well established (Diener et al., 1985). Cronbach's alpha in the present study was .87.

Demographic and control variables. Because the experience of aging has been shown to differ as a function of various demographic characteristics, such as socio-economic status (Settersten & Hagestad, 2015), we included age, sex, education, and income as control variables. Education was classified into three categories based on the highest degree that was received: low (U.S.: high school degree or equivalent or below; GER: secondary school or below); medium (U.S.: Associate's or Bachelor's degree; GER: vocational training or associate degree); and high

education (U.S.: Master's, Doctorate, Medical/Dental, or Law degree; GER: academic degree). A three-category variable was computed for low, medium, and high income, based on tertiles of the entire sample.

Analyses

Analyses were performed using SPSS (Version 22). We tested the main assumptions required for performing analyses based on the general linear model, including linear associations among variables, univariate and multivariate normality, and multicollinearity. Fifteen cases were identified as outliers (z-scored variable > 3.29; Tabachnick & Fidell, 2007). We conducted analyses twice: once with the outliers included and another time with them excluded. Because the results of both sets of analyses were basically identical, we deemed that the outliers were not influential cases. Therefore, all outliers were retained for all analyses. Mediation and moderated mediation models were performed using the SPSS MEDIATE macro (Hayes, 2012), and moderated mediation models were estimated with the PROCESS macro for SPSS (Hayes, 2013). To evaluate the statistical significance of the indirect effects and conditional indirect effects, 10,000 bootstrapped samples were drawn and 95% confidence intervals were calculated. Confidence intervals that do not include zero indicate a statistically significant effect (Hayes 2013). To evaluate the statistical significance of the indirect effects, 10,000 bootstrapped samples were drawn and 95% confidence intervals were calculated (Hayes 2013). Due to problems with multicollinearity when the ten behavioral AARC scale scores were used and for reasons of parsimony, the regression and mediation models were performed using the two overarching first-order factors of AARC-Gains and AARC-Losses.

Results

Research Question 1: Examining Associations Among the SA Constructs

Descriptive statistics. Table 3.2 presents bivariate correlations among the SA constructs and the two developmental correlates. Overall, associations among the measures were in the expected directions. Correlations among the SA constructs ranged from no association to large effects. Felt Age showed a small-to-medium correlation with ATOA (r = -.26, p < .001) and with AARC-Losses (r = .24, p < .001). ATOA showed a small association with AARC-Gains (r = .12 p < .001), and a large association with AARC-Losses (r = -.53, p < .001). The correlation between Felt Age and AARC-Gains reached statistical significance but did not represent a substantively meaningful relationship (r = .09, p = .014). AARC-Gains and AARC-Losses showed a medium-sized association (r = .35, p < .001). This pattern of findings suggests that, although the various constructs are related, they are also assessing different aspects of SA. In addition, the correlational findings suggest that SA captures something quite distinct from chronological age, as shown by correlation coefficients ranging in magnitude from .06 to .33.

The three SA constructs were associated with the developmental correlates to varying degrees, a pattern which supports the idea of differential contributions. The strongest correlation with functional health was found for AARC-Losses (r = -.51, p < .001). Satisfaction with life was most strongly associated with ATOA (r = .47, p < .001).

Going further, a pattern of domain-specificity for the multidimensional construct of AARC was apparent in the bivariate correlations (Table 3.2). AARC in the domains of physical health (r = -.58; p < .001) and lifestyle and engagement (r = -.56; p < .001) both showed a strong association with the functional health outcome measure, likely reflecting increasing difficulty to engage in activities requiring certain physical abilities. Furthermore, AARC in the domains for

interpersonal relationships (r = -.20, p < .001) and social-cognitive/social-emotional development (r = -.34, p < .001) showed the strongest associations with satisfaction with life, a pattern which reflects the importance of social-emotional development for well-being.

AARC as a mediator between global SA and the developmental correlates. To evaluate the role of a behavior-specific SA measure (e.g. AARC) as a potential mediator of the association between global measures of SA (e.g. Felt Age, ATOA) and the developmental correlates, we performed four separate parallel multiple mediator analyses. Each analysis is described in detail below and results are illustrated in Figure 3.1.

AARC as a mediator between Felt Age and functional health. Results of the mediation analysis showed that feeling older than one's chronological age predicted the awareness of more negative age-related changes, which, in turn, was associated with poorer functional health (Figure 3.1, Panel A). There was no significant association between Felt Age and AARC-Gains. The 95% bootstrapped confidence intervals sample for the indirect effect through AARC-Losses did not include zero, indicating that the indirect effect through AARC-Losses was significantly different from zero. This model accounted for a significant amount of the variance in functional health (R^2 = .33, p < .001). The findings were indicative of partial mediation, as the direct effect of Felt Age on functional health was attenuated but remained significant when the mediators were added to the model. Calculating the ratio of the indirect effect to the total effect indicated that approximately 59% of the effect of Felt Age was mediated by AARC. These results supported the role of AARC-Losses as a partial mediator of the association between Felt Age and functional health.

AARC as a mediator between Felt Age and satisfaction with life. In the corresponding analysis with satisfaction with life as the outcome variable, we found that feeling older than

one's chronological age was predictive of more AARC-Losses (but not of AARC-Gains), which was predictive of lower satisfaction with life (Figure 3.1, Panel B). The ratio of the indirect effect to the total effect indicated that approximately 87% of the effect of Felt Age was mediated by AARC. The indirect effect through AARC-Losses was significantly different from zero, indicating that AARC-Losses was a full mediator of the effect of Felt Age on satisfaction with life.

AARC as a mediator between ATOA and functional health. Results of this analysis showed that holding more positive ATOA predicted the perception of positive age-related changes (i.e., AARC-Gains), which was then associated with better functional health (Figure 3.1, Panel C). In contrast, holding more negative ATOA predicted the perception of more negative age-related changes (i.e., AARC-Losses), which was then associated with poorer functional health. The ratio of the indirect effect to the total effect indicated that approximately 51% of the effect of ATOA on functional health was mediated by AARC. The indirect effects through AARC-Gains and AARC-Losses were significantly different from zero, suggesting that both AARC scales functioned as partial mediators in the association between ATOA and functional health.

AARC as a mediator between ATOA and Satisfaction with Life. In the corresponding analysis related to satisfaction with life, we found that holding positive ATOA was predictive of more AARC-Gains, which was predictive of higher satisfaction with life (Figure 3.1, Panel D). Similarly, holding more negative ATOA was predictive of more AARC-Losses, which was then predictive of lower satisfaction with life. The ratio of the indirect effect to the total effect indicated that approximately 38% of the effect of ATOA was mediated by AARC. AARC-Gains

and AARC-Losses served as partial mediators of the effect of ATOA on satisfaction with life, as the indirect effects were significantly different from zero.

Finally, the mediation models also provided evidence for the differential role of valence, as the indirect effect through AARC-Losses was relatively larger compared to the indirect effect through AARC-Gains. This finding provides further evidence to support our hypothesis that the awareness of negative age-related changes plays a stronger role in explaining the effect of negative implicit views of aging on negative developmental correlates than does the awareness of positive age-related changes.

Research Question 2: Moderated Mediation Analyses

Because our study sample covered a wide age range, we examined whether chronological age moderated the mediating pathways analyzed in Research Question 1. We performed conditional process analyses (Hayes, 2013) for each of the four models depicted in Figure 3.1 and tested the moderating effect of age on the indirect effect. The conditional effect was calculated for three levels of the moderator: the mean sample age and one standard deviation above and below the mean. Furthermore, because it is plausible to expect that age could exert its moderating effect on the pathway between global SA and AARC, or between AARC and the outcome, age was tested as a potential moderator on both individual pathways. To summarize the results of these analyses, the effect of global measures of SA on functional health through AARC depended on age, with this effect being stronger for older individuals. Age did not function as a moderator of the effect of global SA on well-being through AARC. The results from the significant models are described below and model coefficients are presented in Tables 3.3 and 3.4.

Age moderation of felt age to functional health through AARC. As can be seen in Table 3.3, age did not moderate the pathways from felt age to AARC-Gains (B = -1.53, p = .12) or from felt age to AARC-Losses (B = -1.31, p = .17). Similarly, age did not function as a moderator on the direct effect from felt age to functional health (B = -.01, p = .93). However, age did moderate the pathway from AARC-Gains to functional health (B = .001, p = .006) as well as from AARC-Losses to functional health (B = -.001, p = .001). Specifically, the effect of AARC-Losses on physical function was stronger for older individuals. The conditional indirect effect of felt age on functional health was relatively stronger for older individuals (See Table 3.4 and Figure 3.2).

We generated two plots (Figure 3.2) to illustrate the nature of the moderating effect of age on functional health. Panel A depicts the conditional nature of the relationship between AARC-Gains and functional health at three levels of the moderator, and Panel B illustrates the relationship between AARC-Losses and functional health as a function of age.

Research Question 3: Examining the Predictive Relevance of the SA Constructs

Hierarchical regression analysis was used to examine the predictive relevance of the three SA constructs with regard to the two developmental correlates (see Table 3.5). This approach allowed us to examine whether the multidimensional measure of SA accounted for significant amounts of variance over and above the unidimensional measures as follows: In the first step, the control variables age, sex, education and income were entered into the model. In Steps 2 and 3, the unidimensional SA measures were entered into the model, followed by the AARC-Gains and AARC-Losses scale scores together in the final step.

As shown in Table 3.5, AARC-Gains and AARC-Losses significantly predicted the developmental correlates over and above the control variables and the unidimensional measures

Felt Age and ATOA. The control variables and unidimensional SA measures accounted for 26.6% of the variance in functional health, and the AARC scales accounted for an additional 7.6%. Regarding satisfaction with life, the control variables and unidimensional SA measures accounted for 31.0% of the variance, and the AARC scales accounted for an additional 5.3%. In both cases, the addition of the AARC scales represented a statistically significant change in R^2. Controlling for the other variables in the model, AARC-Losses was the strongest predictor of functional health ($\beta = -.37$, $p < .001$). With regard to satisfaction with life, both AARC-Gains ($\beta = .24$, $p < .001$) and AARC-Losses ($\beta = -.28$, $p < .001$) were significant predictors after taking into account the control variables. The demographic variables chronological age ($\beta = .28$, $p < .001$) and income ($\beta = .27$, $p < .001$) were also comparably strong predictors of satisfaction with life. Felt Age predicted functional health ($\beta = .08$, $p < .05$), but did not significantly predict satisfaction with life once the other SA measures were added to the model. ATOA was a significant predictor of functional health ($\beta = .18$, $p < .001$), and of satisfaction with life ($\beta = .26$, $p < .001$). Altogether, the predictors accounted for 34% of the variance in functional health, and 36% of the variance in satisfaction with life.

In order to determine the variance accounted for by the behavior specific SA measures before adding the global measures into the model AARC, we repeated the above analyses by reversing the order of the subjective aging measures. AARC-Gains and AARC-Losses accounted for 21.9% of the variance in functional health and 19.6% of the variance in satisfaction with life, respectively, when entered before the other subjective aging variables. The unidimensional measures then added an additional 2.8% of the variance in functional health and 4.2% of the variance in satisfaction with life.

The regression results provided support for the differential effects of positive and negative valence (Table 3.5). Controlling for other variables in the model, AARC-Losses was a significantly stronger predictor of functional health (β = -.37) than was AARC-Gains (β = .07). With regard to the prediction of satisfaction with life, the AARC valences predicted the outcome in a comparable way (AARC-Gains β = .24; AARC-Losses β = -.28).

Discussion

Renewed interest in the topic of SA has been accompanied by increased variation in the conceptualization and measurement of its underlying constructs. The contributions of the present work include: 1) Providing new insights about the associations among three distinct SA constructs; 2) Illustrating the conditional effect of chronological age upon such associations; and 3) Showing how the three SA constructs differentially relate to functional health and satisfaction with life.

The first contribution of this study is the finding that Felt Age, ATOA, and AARC represent related, yet distinct facets of SA. Furthermore, we found support for the theoretical argument posited by Diehl, Wahl et al. (2014) that a behavior-specific measure of SA (i.e. AARC) would mediate the associations between more global measures of SA (i.e. Felt Age and ATOA) and measures of functional health and life satisfaction. A consistent pattern emerged across four mediation analyses: Holding global negative SA – in the form of feeling older than one's age or espousing negative attitudes about one's own aging – was associated with reporting more negative behavior-specific age-related changes, and this pathway was consistent with lower physical and psychological functioning. In the case of ATOA (but not Felt Age), there was also a significant mediating pathway through positive SA, such that more positive ATOA was

associated with the awareness of more positive behavior-specific age-related changes (e.g. AARC-Gains), which was, in turn, predictive of better physical and psychological functioning.

The finding that AARC-Losses was a stronger mediating variable than AARC-Gains was consistent with previous research showing that negative SA tends to exert a stronger influence on behavioral outcomes than positive SA. For example, Hummert (2011) discussed that negative age stereotypes have considerable persuasive power in Western societies and, hence, can also be expected to become more behaviorally relevant than positive age stereotypes. Similarly, a meta-analysis showed that negative SA had about twice the influence on negative outcomes than positive aging attitudes had on positive outcomes (Meisner, 2012). Therefore, as others have argued, we also conclude that the negative constructions of one's own aging experience may be relatively more important for affecting behavioral outcomes than positive SA. Behavioral interventions represent one approach to counteracting the harmful effects of negative SA among adults, and these findings should be taken into account when designing such interventions. For example, it may be that mitigating negative loss-oriented views of aging results in stronger and more lasting intervention effects than strengthening a gain-oriented view of aging.

As a result of the mediation analyses we found that more global measures of SA showed little to no association with the behavior-specific measures of positive SA (AARC-gains). Therefore, we conclude that it is primarily the negative experiences that people draw upon when asked to evaluate their own aging experience in a spontaneous and global way, such as with Felt Age or ATOA. This is not to say, however, that positive experiences of aging are irrelevant; rather, we expect that cognitions about positive age-related changes simply require more deliberate and effortful processing and are not accessed as automatically as negative experiences.

Second, the present study contributes to the literature by illustrating that the associations between measures of SA and developmental correlates is conditional upon age. With the wide age range of our sample (40 – 98 years old), we found that with increasing age, the experience of more negative age-related changes is more strongly associated with poorer functional health. Similarly, the experience of more positive age-related changes at an older age is more strongly tied to better functional health. One possible explanation for this finding is that, because physical and psychological resource losses become more severe at older ages, it might become increasingly difficult for older adults to counter the detrimental effects of negative views of aging, for example through the use self-regulation strategies (Wurm et al., 2013). The pattern of findings from the present study suggests that when it comes to the effects of AARC on developmental outcomes, functional health may be a more salient and self-relevant marker than life satisfaction. Such a finding underscores the importance of combatting negative views on aging throughout adulthood in order to minimize negative effects of SA on later life outcomes. To our knowledge, there is limited evidence to date regarding the moderating role of age on the association between SA and health and well-being. For instance, Spuling et al.(2013) found no evidence for differential effects of SA on health as a function of age. However, age was examined as a dichotomous variable, comparing middle-aged to older adults, and this approach may explain the lack of an age-moderation effect. Therefore, additional inquiry is warranted in this area.

A third contribution of the study is the finding that the three SA constructs showed differential predictive relevance with regard to functional health and satisfaction with life. As expected, the multidimensional SA measure, AARC, accounted for a significant amount of variance in the outcome variables over and above the unidimensional SA constructs. We found

evidence for a pattern of domain-specificity in that SA specific to physical functioning had a relatively stronger predictive association with the functional health outcome variable. Similarly, there was a differential valence effect in that negative SA predicted functional health much more strongly than did positive SA. Interestingly, there was no effect of valence for predicting satisfaction with life, as both positive and negative SA coefficients were of similar magnitude.

Limitations and Future Directions

A few limitations must be considered. First, the nature of the sample carries some limitations. It should be kept in mind that the current data are cross-sectional and correlational in nature. A more definitive analysis of the causal mechanisms in the interplay between measures of SA and developmental outcomes will require longitudinal extensions (Preacher, 2015). For instance, it remains to be tested whether opposite mediating pathways may exist: Does poorer (better) functional health lead to more awareness of negative (positive) age-related changes which then leads to more negative (positive) global subjective aging? Another limitation of the sample is that includes individuals in relatively good health, and therefore, the relationships between SA and the developmental correlates is not representative of individuals experiencing significant health problems.

A second limitation of the study is that it is impossible to untangle differential effects of chronological age and cohort given the present sample. We included a wide age range and used age 40 as the entry age into our study as an indicator of entering midlife—a life phase when reflections about one's own age and aging start to increase noticeably (Dörner, Mickler, & Staudinger, 2005). With regard to cohort issues, it may be the case that cohort effects are present because current cohorts of old and very old adults may have internalized more negative views of aging than more recent cohorts of adults such as the baby boom cohort, given tendencies of this

generation to eschew traditional social conventions (Miche et al., 2015). However, longitudinal data are needed to explore the nature of cohort differences and similarities. Third, we focused on only three well-established measures of SA. As Diehl, Wahl et al. (2014) have shown, there are additional SA measures available, including some multidimensional measures (e.g. Steverink et al., 2001). If the findings reported here can be generalized to these other measures remains an open question.

Because we expected an overall similar pattern of findings in the U.S. and German samples (Barak, 2009; Löckenhoff et al., 2009), we conducted analyses in the aggregate. However, the examination of cultural similarities and differences will become a focus of future work, in which we examine potential differences and similarities between the subsamples in order to provide insight into the more subtle cultural nuances in SA. Some differences in SA may be expected due to differing political structures, described as a neoliberal market orientation in the United States and a social welfare state in Germany (Staudinger, 2015). To the extent that these political structures provide the background within which individuals' personal aging expectations are formed it seems reasonable to expect some cultural differences. Furthermore, previous research has shown that in the U.S., a younger age identity is more strongly related to facets of well-being such as life satisfaction, positive affect and negative affect, whereas in Germany, well-being is not as strongly tied to age identity (Westerhof & Barrett, 2005). The present sample allows for the examination of cross-cultural differences between the U.S. and Germany on several SA measures.

Testing the associations among different measures of SA and their predictive relevance regarding developmental correlates represents one necessary step to clarify conceptual similarities and differences of alternative SA constructs (Diehl, Wahl et al., 2014). A clearer

understanding of how these varying measures function with regard to different outcome variables will help to inform future use of these measurement instruments. Such clarification is also important from a conceptual standpoint, as future research is needed for designing effective programs to help individuals avoid the internalization of negative beliefs about aging.

Table 3.1.

Descriptive Statistics of Demographic Variables and Key Constructs

	US Sample *n* = 396 *M (SD)* or %	German Sample *n* = 423 *M (SD)* or %	Total Sample *N* = 819 *M (SD)* or %
Age (years)	65.45 (13.75)	62.89 (11.83)	64.13 (12.85)
Gender			
Women	55.3%	64.3%	60.0%
Marital Status			
Married	62.9%	61.3%	62.1%
Education			
Low	22.2%	18.0%	20.0%
Medium	44.2%	34.5%	39.2%
High	33.6%	47.5%	40.8%
Employment Status			
Retired	52.0%	46.5%	49.2%
Self-Rated Health *Possible range: 1 (very poor) – 6 (very good)*	5.24 (.85)	4.87 (.89)	5.05(.89)
Felt Age	-.19 (.14)	-.14 (.12)	-.16 (.14)
ATOA *Possible range: 0 (all negative) – 1 (all positive)*	.78 (.28)	.70 (.30)	.74 (.29)
AARC *Possible range: 194 (low) – 970 (high)*			
Gains	277.79 (48.08)	259.42 (47.75)	268.30 (48.75)
Losses	228.07 (51.44)	223.59 (49.21)	225.75 (50.32)
Functional health *(T-score)*	47.07 (8.15)	48.68 (8.56)	47.89 (8.39)
Life Satisfaction *Possible range: 5 (low) – 35 (high)*	26.12 (6.18)	24.52 (5.99)	25.29 (6.13)

Note. ATOA = Attitude Toward Own Aging Scale. AARC = Awareness of Age-Related Change.

Table 3.2.

Bivariate Correlations among the SA Measures, Developmental Outcomes, and Age

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Felt Age		-.26*	-.09*	.24*	-.10*	.24*	-.14*	.21*	-.001	.14*	-.09*	.22*	-.08*	.24*	-.21*	-.19*
2. ATOA			.12*	-.53*	.15*	-.49*	.12*	-.39*	.02	-.38*	.12*	-.49*	.15*	-.54*	.44*	.47*
3. Gains				.35*	.64*	.28*	.86*	.28*	.87*	.38*	.94*	.37*	.86*	.25*	-.06	.20*
4. Losses					.16*	.89*	.24*	.84*	.43*	.83*	.30*	.88*	.29*	.90*	-.51*	-.29*
5. PHYS+						.09*	.49*	.15*	.42*	.22*	.50*	.19*	.55*	.07*	.07*	.16*
6. PHYS-							.20*	.68*	.33*	.63*	.24*	.69*	.26*	.79*	-.58*	-.21*
7. COG+								.13*	.68*	.28*	.79*	.28*	.66*	.20*	-.02	.10*
8. COG-									.35*	.64*	.24*	.64*	.27*	.69*	-.36*	-.14*
9. INT+										.42*	.79*	.45*	.64*	.36*	-.14*	.12*
10. INT-											.32*	.74*	.31*	.70*	-.33*	-.20*
11. SCSE+												.31*	.75*	.23*	-.04	.18*
12. SCSE-													.27*	.75*	-.34*	-.34*
13. LIFE+														.14*	-.05	.27*
14. LIFE-															-.56*	-.38*
15. SF-36																.18*
16. SWLS																
Age	-.06	-.13*	.14*	.27*	.07	.25*	.06	.33*	.13*	.24*	.08*	.12*	.23*	.28*	-.28*	.14*

Note: $*p < .05$. Variables 5-14 refer to the AARC behavioral domain scores. "+" denotes an AARC-Gains domain; "–" denotes an AARC-Losses domain. PHYS = Health & Functional health; COG = Cognitive Functioning; INT = Interpersonal Relations; SC/SE = Social-Cognitive/Social-Emotional functioning; LIFE = Lifestyle and Engagement.

Table 3.3.

Age as a Moderator of the Mediating Pathway from Global SA to the Developmental Correlates through AARC

Outcome →	AARC Gains		AARC Losses		Functional Health	
Predictor	*B (se)*	*p*	*B (se)*	*p*	*B (se)*	*p*
Model 1						
Age	.29 (.22)	.19	**.89 (.21)**	**< .001**	**.21 (.10)**	**.046**
Felt Age	67.32 (61.10)	.27	**175.21 (59.32)**	**.003**	-7.47 (9.23)	.42
AARC Gains					-.06 (.03)	.06
AARC Losses					.01 (.03)	.57
Felt Age x Age	-1.53 (.99)	.12	-1.31 (.96)	.17	-.01 (.15)	.93
AARC Gains x Age					**.001 (.0005)**	**.006**
AARC Losses x Age					**-.0013 (.0004)**	**.001**
Model R^2	.041		.156		.339	
Model *F*	5.32	< .001	22.74	< .001	42.00	< .001
Model 2						
Age	**.98 (.36)**	**.01**	.49 (.31)	.11	-.11 (.15)	.45
ATOA	**59.10 (30.81)**	**.06**	**-118.31 (27.01)**	**< .001**	3.46 (5.61)	.54
AARC Gains					**-.06 (.03)**	**.04**
AARC Losses					.03 (.03)	.42
ATOA x Age	-.53 (.47)	.26	.51 (.41)	.21	.03 (.08)	.68
AARC Gains x Age					**.001 (.001)**	**.01**
AARC Losses x Age					**-.002 (.001)**	**.01**
Model R^2	.057		.321		.353	
Model *F*	7.61	< .001	59.52	< .001	40.98	<.001
Outcome →	AARC Gains		AARC Losses		Satisfaction with Life	
	B (se)	*p*	*B (se)*	*p*	*B (se)*	*p*
Model 3						
Age	.29 (.22)	.17	**.89 (.21)**	**< .001**	.07 (.08)	.40
Felt Age	66.41 (60.49)	.27	**172.67 (58.68)**	**.003**	-9.90 (7.03)	.16
AARC Gains					.04 (.02)	.05
AARC Losses					**-.08 (.02)**	**.0001**
Felt Age x Age	-1.50 (.98)	.13	-1.27 (.95)	.18	.15 (.11)	.16
AARC Gains x Age					.0000 (.0003)	.99
AARC Losses x Age					.0004 (.0003)	.19
Model R^2	.041		.156		.328	
Model *F*	5.31	< .001	23.00	< .001	36.28	<.001
Model 4						
Age	**.97 (.34)**	**.005**	.43 (.30)	.15	.11 (.11)	.30
ATOA	58.14 (30.26)	.06	**-122.31 (26.55)**	**< .001**	**12.75 (3.99)**	**.001**
AARC Gains					.02 (.02)	.45
AARC Losses					-.04 (.02)	.08
ATOA x Age	-.50 (.46)	.28	.59 (.40)	.14	-.11 (.06)	.08
AARC Gains x Age					.0002 (.0003)	.58
AARC Losses x Age					.0002 (.0004)	.65
Model R^2	.058		.320		.371	
Model *F*	7.84	<.001	60.00	< .001	44.89	< .001

Table 3.4.

Conditional Indirect Effects of Subjective Age Measures on the Developmental Correlates through AARC-Gains and AARC-Losses at Three Values of Chronological Age

	Functional Health			Satisfaction with Life		
	Age	Point Estimate	95% CI	Age	Point Estimate	95% CI
Felt Age through AARC-Gains						
	50.85	-.10	[-.67, .09]	50.91	-.42	[-1.57, .67]
	63.64	**-.76**	**[-1.63, -.19]**	63.79	-1.23	[-2.27, -.24]
	76.43	**-2.06**	**[-4.32, -.64]**	76.67	-2.04	[-3.81, -.58]
Felt Age through AARC-Losses						
	50.85	**-5.84**	**[-9.46, -3.81]**	50.91	-4.53	[-8.72, -4.25]
	63.64	**-6.53**	**[-10.10, -5.16]**	63.79	-3.38	[-6.69, -3.31]
	76.43	**-6.64**	**[-12.40, -3.45]**	76.67	-2.39	[-6.21, -1.54]
ATOA through AARC-Gains						
	50.89	-.01	[-.59, .47]	50.97	.88	[.40, 1.67]
	63.71	**.40**	**[.14, .83]**	63.87	.77	[.44, 1.20]
	76.52	**.59**	**[.12, 1.36]**	76.77	.63	[.18, 1.21]
ATOA through AARC-Losses						
	50.89	**4.37**	**[2.36, 6.58]**	50.97	3.10	[1.92, 4.49]
	63.71	**5.66**	**[4.36, 7.25]**	63.87	2.66	[1.79, 3.55]
	76.52	**6.69**	**[4.99, 8.87]**	76.77	2.25	[1.19, 3.49]

Notes: 95% CI = 95% Bias-corrected bootstrapped confidence interval. The three values of the moderator were selected to represent 1 the mean + / - 1 standard deviation

Table 3.5.

Hierarchical Multiple Regression of Functional Health and Satisfaction with Life

	Functional health		Satisfaction with Life	
	β	ΔR^2	β	ΔR^2
Step 1: Control Variables		.095***		.126***
Age	-.16***		.28**	
Sex	-.02		-.03	
Education	.05		.03	
Income	.04		.27***	
Step 2: Felt Age		.054***		.025***
Felt Age	-.08*		.002	
Step 3: ATOA		.117***		.159***
ATOA	.18***		.26***	
Step 4: AARC		.076***		.054***
AARC-Gains	.08*		.24***	
AARC-Losses	-.37***		-.28***	
Total R^2	.342		.364	
Adjusted R^2	.335		.357	
F	47.92***		53.31***	

*Note. * p < .05; ** p < .01; *** p < .001*. Coefficients from the final step of the model are reported.

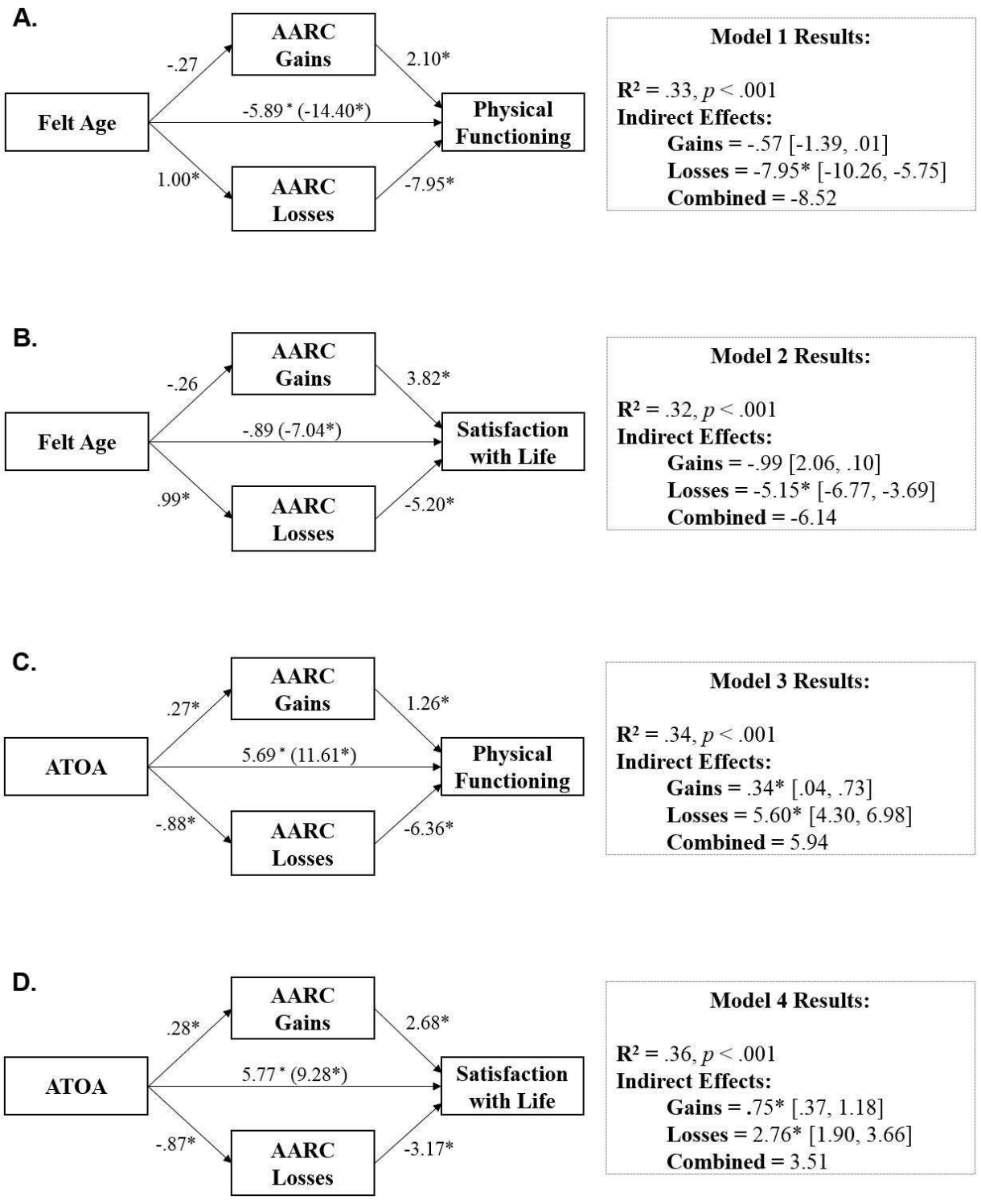

Figure 3.1. AARC Scales as mediators between global measures of subjective aging and two developmental correlates. Unstandardized regression weights are reported in accordance with Hayes (2013). Analyses control for age, sex, education, and income.

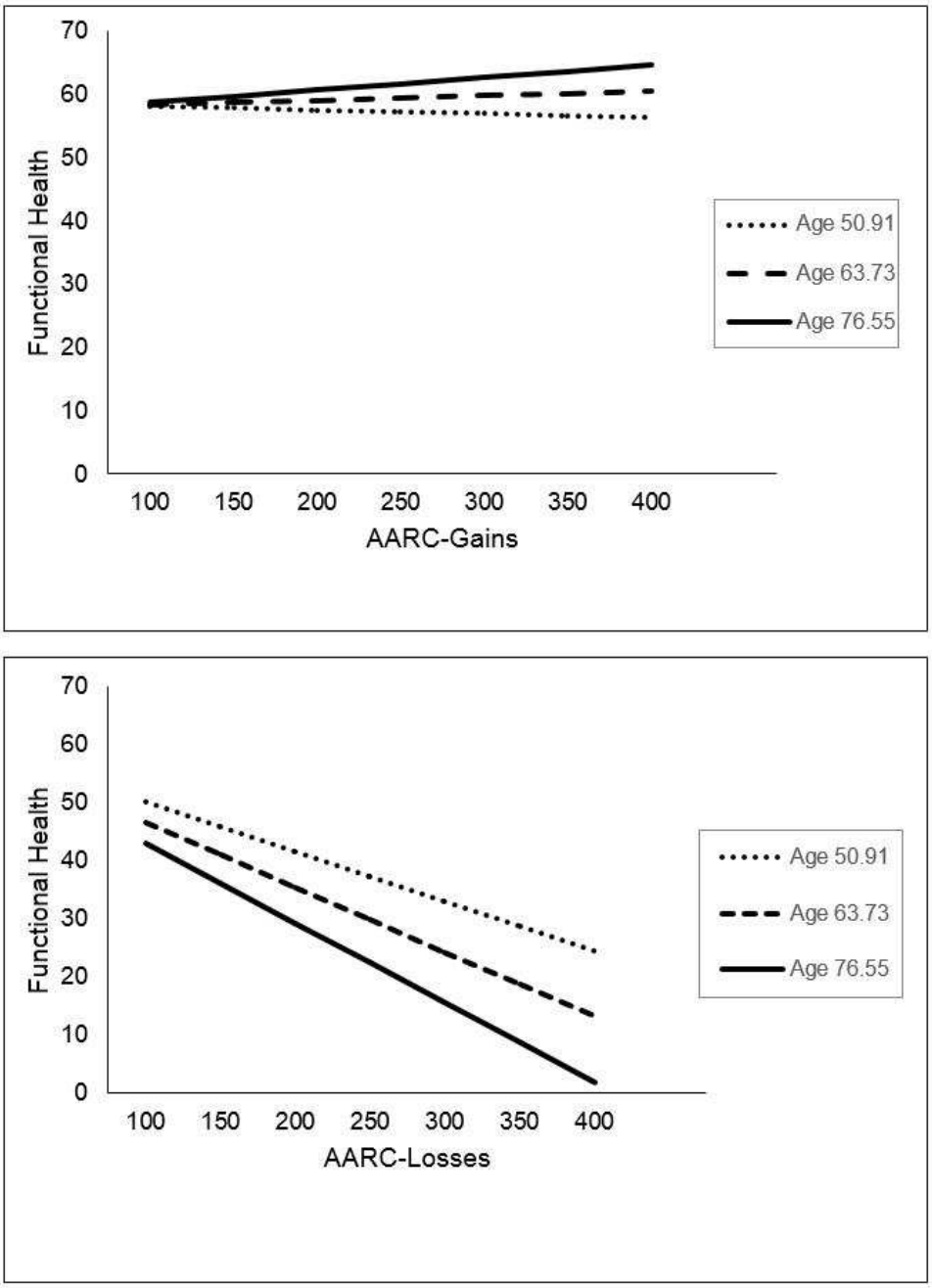

Figure 3.2. Interaction plots illustrating the moderating effect of age between AARC and Functional Health. AARC-Gains is illustrated in Panel A, and AARC-Losses is illustrated in Panel B. Using the pick-a-point approach, the conditional effects are estimated at three levels of the moderator. Analyses control for age, sex, education, and income.

CHAPTER 4.

Modifying Adults' Negative Views on Aging to Facilitate Engagement in Physical Activity: Findings from a Feasibility Study[3]

Summary

This study evaluated the feasibility and efficacy of the Aging^{Plus} intervention program. Aging^{Plus} is an 8-week multi-modal motivational program which promotes increased physical activity by targeting adults' negative views on aging (NVOA) and perceptions of control, two known barriers to physical exercise. 62 adults, ages 50–82 years, participated in this feasibility study. We assessed NVOA, perceptions of control, and physical activity level at baseline (Week 0), immediate posttest (Week 4), and delayed posttest (Week 12). High attendance rates, low attrition, and positive participant feedback indicated that the program had high acceptability. Repeated measures multivariate analyses of variance (RM-MANOVA) showed statistically and substantively meaningful improvements in NVOA, control beliefs, and physical activity from pretest to immediate and delayed posttest. The program effects did not differ between those younger or older than age 65. These findings provide promising support for the feasibility and efficacy of the Aging^{Plus} program.

Introduction

Misperceptions about aging and old people are widely held in the general public, and can be characterized as mostly negative and deterministic. Such views are in stark contrast from what

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is known from gerontological research and practice (Lindland et al., 2015). For example, aging is often thought to be synonymous with frailty, illness, and senility, and these negative outcomes are expected to be unavoidable and out of a person's control (Ory, Hoffman, Hawkins, Sanner, & Mockenhaupt, 2003; Stewart et al., 2011). Such attitudes are known as negative views on aging (NVOA), which we define as knowledge, beliefs, and expectations an individual holds about the process of aging and older people as a group. A growing body of research shows that holding predominantly negative views on aging exerts long-term detrimental effects on adults' health and well-being (Hummert, 2011; Levy, 2009; Westerhof et al., 2014). For instance, NVOA in midlife predict a greater risk of late-life vulnerabilities, such as falls and hospitalizations, and shorter longevity (Levy, Slade, Kunkel, & Kasl, 2002; Moser et al., 2011).

What is not yet known is whether NVOA can be systematically altered through an intervention program, and whether doing so increases engagement in health-promoting behaviors. Therefore, we designed the Aging^{Plus} program with a focus on changing adults' perceptions and expectations about aging in order to motivate greater participation in physical activity. This study evaluated the feasibility and efficacy of the program.

The Relevance of Negative Views on Aging for Health in Adulthood

The connection between NVOA and health outcomes is unequivocal. Findings from past research consistently show that holding NVOA is associated with a host of detrimental effects, such as increased cardiovascular risk (Levy et al., 2009), lower likelihood of recovery from disability (Levy et al., 2012) and shorter life expectancy (Levy et al., 2002). One likely reason that NVOA influence health and functioning is that they represent a known barrier to physical activity and other health-promoting behaviors. Individuals holding NVOA in midlife are significantly less likely to engage in health-promoting behaviors as they grow older over the next

20 years (Levy & Myers, 2004) and are less likely to participate in physical activity altogether, regardless of health status (Wurm et al., 2010). In contrast, positive views on aging (PVOA) serve a protective role for health in middle age and later life. For example, PVOA have been shown to be associated a higher rate of recovery from disability (Levy et al., 2012). Thus, it seems reasonable to conclude that PVOA may facilitate adults' engagement in behaviors that promote healthy and successful aging.

Promoting Physical Activity in Later Life

One of the most effective strategies for promoting health in later life is engagement in physical activity. Contrary to beliefs held by the general public (Lindland et al., 2015), many steps can be taken to maintain healthy and independent living well into later life, including being physically active. Not only can physical activity help to prevent obesity and related chronic disease in midlife (Nejat, Polotsky, & Pal, 2010), it is also linked to preserved brain volume in later life (Tian, Studenski, Resnick, Davatzikos, & Ferrucci, 2016), it stimulates neuronal regeneration in the hippocampus (Erickson et al., 2011), and it reduces the risk of mobility-related disability in late life (Pahor et al., 2014). However, despite strong empirical evidence supporting the benefits of physical activity for individuals of all ages, only one in five adults meets the recommended physical activity guidelines for aerobic exercise (Healthy People 2020, 2014). Moreover, physical activity levels drop off in midlife (Schrack et al., 2014), making individuals age 50 and older the most sedentary segment of the population (Harvey, Chastin, & Skelton, 2013).

Given the pervasive evidence that most adults are not sufficiently physically active, how can engagement in physical activity be promoted? Although many attempts have been made to this effect with varying degrees of success (King, 2001; Powell, Paluch, & Blair,

2011), one approach that has so far been underutilized is to directly target the *attitudes* that keep people from engaging in physical exercise (King, 2001). Therefore, based on the extensive research evidence that NVOA are linked to poorer health, intervening to promote PVOA represents a promising approach to increasing physical activity.

Modifiability of Views on Aging

Although the detrimental effects of NVOA are well documented, NVOA appear to be modifiable (Kötter-Gruehn, 2015). Moreover, such a change is subsequently associated with improved behavioral performance such as improved grip strength (Stephan et al., 2013), faster walking speed (Hausdorff et al., 1999), improved memory (Eibach, Mock, & Courtney, 2010) and increased exercise behavior (Sarkisian et al., 2007; Wolff, Warner, Ziegelmann, & Wurm, 2014). Because NVOA exert a stronger effect on health than vice versa (Spuling, Miche, Wurm, & Wahl, 2013; Wurm, Tesch-Römer, & Tomasik, 2007), targeting adults' NVOA should, therefore, result in favorable consequences for health and physical functioning. Taken together, the presented evidence provides the foundation upon which we have developed the Aging^{Plus} program.

Overview of the Aging^{Plus} Intervention Program

Aging^{Plus} is a multimodal program that targets two distinct but interrelated mechanisms important for physical activity promotion: NVOA and control beliefs. Because NVOA become self-relevant in midlife, and subsequently lead to undesirable outcomes with regard to health and well-being (Levy, 2009), Aging^{Plus} aims to (a) interrupt this sequence of events by teaching adults how to recognize and counteract NVOA, and (b) provide strategies for how they can avoid the internalization of NVOA. Second, a solid body of literature on social-cognitive theory and control beliefs in aging (Baltes & Baltes, 1986; Bandura, 1997; Lachman et al., 2011) indicates

that a sense of perceived control over the environment is essential for increasing physical activity in adulthood. Behavior change is unlikely to occur unless an individual believes that he or she can enact a desired behavior, and also believes that the behaviors will in fact lead to the desired result (Bandura, 1997). Therefore, the curriculum targets the personal beliefs that: (1) "I can implement a physical activity program into my daily life;" and (2) "Becoming more physically active will help me to age in a healthier way." In order to promote a greater sense of control, the curriculum emphasizes key skills of goal planning and self-monitoring, as they are associated with increased control beliefs and stronger maintenance of post-intervention physical activity levels (Sniehotta, Scholz, & Schwarzer, 2005).

The 8-week Aging^{Plus} program is comprised of two segments: an educational and experiential period. During the *educational period* (Weeks 1-4), participants attend four classroom sessions which focus on the attitudinal and motivational pieces for enacting behavior change. During the *experiential period* (Weeks 5-8) participants work toward their personalized physical activity goal with support from the research staff. These two segments align theoretically with the Health Action Process Approach (HAPA) model (e.g. Schwarzer, Lippke, & Luszczynska, 2011), which recognizes the importance of addressing key attitudinal processes to enact behavior change. The conceptual model proposes NVOA and control beliefs as causal mechanisms by which the effect of the program leads to increased physical activity (Figure 4.1).

In this study we evaluated the feasibility and efficacy of the Aging^{Plus} program among community-residing adults using a single-group pre-test post-test design. We addressed three specific questions. First, we evaluated the feasibility of the program, as measured by attendance and completion rates as well as anonymous participant feedback. Second, we examined the changes in the key outcome variables throughout the program at three

measurement occasions: Pre-test, post-test, and delayed post-test. Specifically, we tested for change in NVOA and control beliefs, as well as in the health-promoting behavior of interest, physical activity. Third, we tested age as a moderator in order to examine whether middle-aged (< 65 years old) and older (> 65 years old) participants benefitted differentially from participating in the program.

Methods

Participants and Procedures

Participants included 62 community-residing adults age 50-82 years (*M* = 64.7 years, *SD*= 6.0 years; 83.9% women). Of the 62 participants, approximately half were younger than 65 (*n* = 32; 51.6%; range = 53.20 - 64.72 years), and half were age 65 or older (*n* = 30, 48.4%; range = 65.07 - 82.63 years). The majority of participants (67.7%) did not exercise regularly at baseline. Demographic characteristics of the sample are presented in Table 4.1. Eligibility criteria included: (1) desire to increase current physical activity level; (2) willingness to complete the program in its entirety; and (3) English-speaking. Participants were recruited via flyers and announcements to local service organizations. Participants earned up to three $20 gift certificates throughout the study as reimbursement for their time and effort. The CONSORT diagram is provided in Figure 4.2.

Procedures

The 12-week study period for each participant included the 8-week program plus a 1-month delayed follow-up assessment. Assessments were administered on standardized forms, and were collected at Week 0 (baseline), Week 4 (immediate post-test), and Week 12 (delayed post-test). During the educational period, participants attended four weekly meetings in small groups of 8-12 participants each. There were a total of six small groups. Classroom meetings

lasted approximately two hours each and were taught by the same trained facilitator who was not involved in the data collection procedures. Details about the classroom curriculum are summarized in Table 4.2 During the experiential period, participants worked toward a self-defined physical activity goal for four weeks. Participants formulated their goal in terms of the number of weekly minutes of physical activity they would strive to accumulate, in accordance with the structure of the national guidelines (e.g., that 150 minutes of moderate physical activity are associated with substantial health benefits; Healthy People 2020, 2014). During this period, participants completed daily logs of their physical activity and also completed four weekly phone visits with a trained research staff member.

Measures

Demographic characteristics. At baseline (Week 0), an established personal data form was used to assess participants' age, sex, education, marital status, ethnicity, employment status, and household income. Health status was assessed with a single rating of self-rated health (1 = *Very poor*, 6 = *Very good*).

Views on aging. Multiple facets of NVOA were measured at Weeks 0, 4, and 12. *Awareness of Age-Related Change (AARC)* assessed individuals' positive (AARC-Gains) and negative (AARC-Losses) experiences of growing older (Diehl & Wahl, 2010). Ten items beginning with the stem, "With my increasing age, I realize that…" were followed by either positive or negative statements (e.g. "I have more time for the things I enjoy"). Items were rated on a five-point scale (1 = *Strongly disagree*; 5 = *Strongly agree*) and sum scores were calculated for AARC-Gains and AARC-Losses. Reliability and validity of the 50-item version have been established (Diehl, Brothers, Wettstein, Miche, & Wahl, 2013). Scale reliabilities for the present sample were acceptable at Week 0 and Week 12 (range: .67 - .83), but were somewhat lower at

Week 4 (.51 and .63 for gains and losses, respectively). *Age stereotypes* were measured with the Views of Aging scale (Kornadt & Rothermund, 2011) which assesses general opinions about "older people" in eight life domains. A brief 8-item version was used for the purposes of this study, and a sum score was calculated. Cronbach's alpha for the summary score ranged from .84 to .93. *Expectations Regarding Aging (ERA)* assessed the extent to which individuals expected to experience positive or negative age-related changes as they grow older (Sarkisian, Steers, Hays, & Mangione, 2005). A total scale score was calculated in accordance with the published instructions for this 12-item self-report questionnaire. Cronbach's alpha was .88 and .91 at the two measurement occasions. *Subjective Age* (Kastenbaum et al., 1972) was assessed with a 1-item measure asking how old a person tends to feel. A proportion score was calculated [(subjective age - chronological age)/chronological age] such that a negative score indicated feeling younger than one's chronological age (e.g., an individual scoring -.10 felt 10% younger than his or her age; Rubin & Berntsen, 2006).

Control beliefs. At Weeks 0 and 12, participants' control beliefs were assessed in terms of dispositional self-efficacy using the *General Self-Efficacy Scale* (Schwarzer & Jerusalem, 1995). This measure was not administered at Week 4 as it assesses more trait-like tendencies not expected to change after one month. The scale included 8 items, such as "I am certain that I can always accomplish my goals," which were rated from 1 (not at all true) to 4 (completely true). The psychometric properties of this scale are well-established; scale reliabilities in the current study at Week 0 and 12 respectively were $\alpha = .90$ and .92. The *Motivational Self-Efficacy* scale was used to assess domain-specific self-efficacy regarding one's perceived ability to enact a physical activity program (Schwarzer et al., 2011). This measure was administered at Week 2 (when exercise was first discussed), Week 3 (when individuals entered the practice week of goal

pursuit), and at Week 12. The motivational self-efficacy scale includes 3 items beginning with the stem "I am certain that I can be physically active on a regular basis…," followed by statements such as, "… when it is difficult." Items were rated from 1 (totally disagree) to 6 (totally agree). The scale showed good reliability at all measurement occasions (range: α = .84 – .87).

Physical activity. *Average Physical Activity Levels* were measured at Week 0 and 12 using an established self-report measure (Fleig, Lippke, Pomp, & Schwarzer, 2011), in which participants reported the number of times they engaged in mild, moderate, or vigorous physical activity per week in the last month, and the average number of minutes per session. Total *Weekly Active Minutes* were calculated for Weeks 5 – 8 based on participants' daily activity logs on which participants recorded the number of minutes, the type of activity, and the intensity (mild, moderate, or vigorous). The mean number of weekly minutes was calculated for Weeks 5-8.

Results

Question 1: Feasibility Assessment

We assessed program feasibility in three ways. First, we examined attendance rates for classroom meetings. On average, the attendance rate was 93.64%, taking into consideration all four classroom meetings across all six small groups. Second, we examined the rate of attrition, which we defined as the percentage of participants who attended at least one classroom session but did not remain in the program up to the end of program at Week 8. The average attrition rate was 11.11% between Weeks 0 and 4 (n = 7), and 5.36% (n = 3) between Weeks 4 and 8. Reasons given for not returning to classes included: changed mind/program was not as expected (n = 2), scheduling conflict (n = 1), and something unexpected occurred that interfered with program attendance (n = 4). Reasons for not continuing in the daily diary portion of the study included:

too busy (n = 2) and no longer interested (n = 1). One participant was lost to follow-up at Week 12. Third, we solicited structured voluntary participant feedback about the program using an online survey. The program satisfaction assessment was comprised of 8 questions and included both forced response and open-ended questions. Thirty-one participants (50.0%) provided feedback, indicating a high level of satisfaction with the program. For instance, in response to the following questions, a large percentage of participants endorsed either the options "Strongly Agree" or "Agree": *The program taught me new information* (100%); *The program was a good use of my time* (96%); and *Overall the program was beneficial for me* (100%).

Question 2: Assessing Change on the Key Variables

Repeated measures multivariate analyses of variance (RM-MANOVA) were used to examine mean differences on the key outcome variables at three measurement occasions: Pre-test (Week 0), post-test (Week 4), and delayed post-test (Week 12). For general self-efficacy, which was administered only at two time points, the univariate F-test is reported. In the presence of a positive multivariate effect, pairwise comparisons were examined to determine which measurement occasions differed and in which direction.

Negative views on aging. Significant multivariate effects were found for all NVOA measures, indicating an overall decrease in NVOA and a corresponding increase in PVOA throughout the program (Table 4.3). Specifically, participants' perceived age-related gains increased significantly over the course of the program, $F(2, 102) = 24.32$, $p < .001$, $\eta_p^2 = .32$, whereas perceived age-related losses significantly decreased, $F(2, 102) = 3.73$, $p = .03$, $\eta_p^2 = .07$. Similarly, age stereotypes became significantly more positive, $F(2, 102) = 22.70$, $p < .001$, $\eta_p^2 = .31$, as did expectations regarding aging, $F(2, 102) = 26.15$, $p < .001$, $\eta_p^2 = .34$. Finally, participants reported a younger subjective age after taking part in the program, $F(2, 102) = 5.47$,

p = .01, η_p^2 = .10. For all NVOA variables, effect sizes were in the medium (η_p^2 = .06 – .14) to large (η_p^2 > .14) range (Cohen, 1988). Upon examination of pairwise comparisons, there was significant improvement from Week 0 to Week 4 on AARC-Gains, Age Stereotypes, Expectations Regarding Aging, and Subjective Age (p's < .05), but not for AARC-Losses. Similarly, pairwise comparisons showed significant improvement from Week 0 to Week 12 on all NVOA measures, including AARC-Losses (p's < .05). However, there was a significant decline between Week 4 and Week 12 for AARC-Gains and Age Stereotypes (p's < .05), suggesting a slight decay effect after the program ended.

Control beliefs. General self-efficacy, which was measured at Weeks 0 and 12, showed significant improvement after participation in the program, $F(1, 51) = 14.48$, $p < .001$, $\eta_p^2 = .22$. A significant multivariate effect was found for motivational self-efficacy, $F(2, 102) = 6.89$, $p < .01$, $\eta_p^2 = .22$, and pairwise comparisons indicated a significant improvement from Week 2 to Week 3 (p = .006). However, the Week 12 levels were not significantly different from baseline (p = .997). Means and standard deviations are displayed in Table 4.3.

Physical activity. Physical activity increased significantly throughout the program, $F(2, 98) = 24.70$, $p < .001$, $\eta_p^2 = .34$. As can be seen in Table 4.3, the average reported number of minutes spent in moderate and vigorous physical activity was significantly higher during Weeks 5 – 8 (M = 176.25; SD = 89.92) than at baseline (M = 84.95; SD = 91.17; $p < .001$). The average physical activity level remained significantly higher at Week 12 (M = 171.55; SD = 97.26; $p < .001$) compared to baseline. Furthermore, there was no evidence of decay between weeks 5 – 8 and Week 12 (p = .97).

Question 3: Age as a Moderator of the Training Effects

In order to examine whether pre-test post-test scores differed as a function of age, we performed a series of 2 x 3 (Age Group x Time of Measurement) RM-MANOVAs. The age group interaction term was not statistically significant for any of the views on aging measures, nor for physical activity ($p > .05$). Therefore, middle-aged adults and older adults did not differ with regard to the pattern of change they exhibited over the course of the study. Regardless of age, participants showed a similar pattern of change by which views on aging became more positive and physical activity increased significantly after taking part in the program.

Discussion

Rapid population aging poses a number of societal challenges, such as how to motivate middle-aged (age 40-64) and older adults (age 65+) to engage in behaviors that promote healthy and successful aging (Nielsen & Reiss, 2012). Based on extensive evidence that NVOA and low control beliefs represent barriers to physical activity, we developed Aging^{Plus}, a multi-modal program that targets views on aging and control beliefs to promote engagement in physical activity in middle-aged and older adults. The present study provides promising evidence of both the feasibility and efficacy of the Aging^{Plus} program.

With regard to the feasibility of the program, results showed that participants attended the program regularly with a fairly low drop-out rate. Furthermore, anonymous voluntary feedback was quite positive. This pattern of findings suggests that the program contains information and content that was useful to those who attended, and warrants the continued refinement and evaluation of the program. With regard to program efficacy, we found significant improvement on the key variables of interest, including views on aging, control beliefs, and physical activity at both the post-test and the delayed post-test occasions.

Furthermore, effect sizes were in the medium and large ranges, signifying not only statistically significant improvements, but also substantively meaningful changes.

We assessed change in five different facets of NVOA in order to detect whether our program affected various facets of NVOA differentially. That all five facets of NVOA showed statistically significant and substantively meaningful improvements throughout the program is very reassuring. Specifically, after the program, participants perceived more positive and less negative age-related changes; had more positive attitudes about older people in general; more positive expectations for their own aging; and even felt significantly younger than they did at the beginning of the program. Improvements in views on aging have been documented in just a few intervention studies in past years. For example, Sarkisian et al. (2007) designed an intervention in which adults living in a retirement community learned through attribution retraining that the typical decrease in physical activity that comes with age is not inevitable. Participants' expectations regarding aging became significantly more positive, and they also walked significantly more steps per day compared to baseline. Wolff et al. (2014) included a brief segment about the importance of views on aging into an existing physical activity program and were able to show that one of four assessed facets of NVOA improved.

Previous research has shown that interventions promoting engagement in physical activity may also be able to exert an effect on adults' NVOA (Klusmann et al., 2012). This finding suggests that the experiential period in Weeks 5-8 in which participants engage in physical activity may contribute to a feedback loop to further promote more positive views on aging. In sum, the emergence of behavioral interventions targeting PVOA is quite promising because they represent a cost-effective avenue to promote health and functioning in later life. Behavioral interventions have the potential to prevent or even reverse mobility limitations

(Pahor et al., 2014) which are directly associated with the clinical phenotype of frailty (Fried et al., 2001). Thus, preventing or delaying mobility-related disability has a great overall impact in terms of functioning and quality of life. Although NVOA interventions such as Aging^{Plus} are in the early stages of development, they nonetheless have a solid theoretical and empirical foundation (Miche et al., 2015).

In addition to NVOA, we also found improvements in perceptions of both global and domain-specific control beliefs, which are known to function quite differently from one another (Lachman, 1986). With regard to global control beliefs, common misperceptions of aging tend to reflect a low and decreasing sense of control: Many people believe that negative aging-related declines such as forgetfulness and frailty are unavoidable (Lindland et al., 2015). The finding that global control beliefs improved after the program is encouraging, as it suggests that the curriculum effectively empowered community-residing adults to enact change. This aim of the program to promote a greater sense of control over the aging process builds upon decades of research showing that a general sense of control over the environment is a valuable resource for adaptation, resilience and well-being in later life (Diehl & Hay, 2010; Rodin, 1986b), as well as for promoting and preserving health and physical functioning (Gerstorf et al., 2011; Lachman & Agrigoroaei, 2010).

In addition to global control beliefs, domain-specific control beliefs (e.g. motivational self-efficacy) improved during the educational period, albeit with some deterioration by the delayed post-test. An extensive body of exercise literature indicates the importance of exercise self-efficacy for initiating a physical activity program (Bandura, 1997; King, 2001). Low domain-specific control beliefs are reflected in the common attitude that one is not capable of initiating and maintaining a physical activity program. The deterioration effect suggests that a

greater number of successful behavioral experiences may be necessary to enact durable improvements in domain-specific control beliefs. This finding is not entirely surprising, as unanticipated obstacles and challenges likely arose after the supportive phone calls ended. Future iterations of the program will address this issue in a systematic fashion.

From a cautionary standpoint, emphasizing the controllability of aging in an intervention for the general public must be done in a sensitive and realistic manner. The positive and empowering message that daily lifestyle habits contribute a substantial amount of the variance in later health and functioning is based on solid research evidence (e.g., Aldwin et al., 2006; Ip et al., 2013) and is important information to convey. However, not all aging-related declines are preventable. Therefore, the Aging*Plus* curriculum tempers this message by conveying that health in later life is also shaped by environmental, social, and genetic influences which may be out of a person's control. Nonetheless, we regard an improved general sense of control over the environment, as well as over one's ability to become more physically active, as essential components for improving physical activity levels.

Finally, the finding that physical activity levels significantly increased throughout the study was also quite promising. Participants were largely successful in implementing their individualized physical activity plan during the experiential period and they exceeded, on average, the national guideline of 150 minutes of moderate-to-vigorous intensity per week. We were further encouraged to find that physical activity levels at the delayed follow-up continued to exceed the recommended levels.

There were no age-group differences between middle-aged and older adults with regard to the pattern or magnitude of change on the key outcome variables. On one hand, middle-aged adults may have been expected to benefit more from the program given that they tend to have a

longer time horizon to reap the benefits from enacting positive lifestyle changes. Furthermore, midlife presents a developmentally-sensitive period because there is a heightened sense of awareness of age-related changes (Levy, 2009) and a greater likelihood of internalizing negative beliefs about aging (Eibach et al., 2010; Lachman, 2015; Levy, 2009). On the other hand, the fact that older adults benefitted equally from the program suggests that an intervention program such as Aging^{Plus} can be advantageous at any age. This finding supports the idea of developmental plasticity and provides evidence that it is never too late to support individuals to take a more active role in promoting their own healthy aging.

This initial feasibility study has several limitations that must be considered when interpreting the results. First and foremost, the present study did not employ a randomized-controlled design. However, a single-group design was an important first step in the initial program evaluation. Clearly, it is not possible to know whether changes in NVOA and physical activity which occurred throughout the study period were, perhaps to some extent, attributable to other circumstances, such as the social contact received throughout the program. However, in a follow-up study with randomization, we will statistically test causal models in order to draw definitive conclusions about the program effects and pathways specified in the conceptual model (Figure 4.1). Second, we had a highly motivated study sample of individuals who were already considering a behavior change. However, to put this caveat into perspective, the intentional stage of behavior change is necessary for individuals to commit to participate in a behavior change intervention (Schwarzer et al., 2011). Third, the majority of participants were women, limiting the generalizability of our findings to both sexes. In follow-up studies, we will oversample men to achieve a more balanced sex distribution. Fourth, the present study relied on self-report measures for physical activity, which are only moderately correlated with

objective measures. Because experts recommend using subjective measures in conjunction with objective ones to further bolster reliability and validity (Murphy, 2009), future evaluation efforts will add an objective measure such as a triaxial pedometer or an accelerometer. Finally, the present study included uneven spacing between measurement occasions. Although uneven spacing is not ideal for general linear model approaches, the Greenhouse-Geisser correction in RM-MANOVA can test and account for any violations of the sphericity assumption (Tabachnick & Fidell, 2007). Therefore, the use of RM-MANOVA was appropriate, especially given its statistical advantages of controlling the Type I error rate.

In summary, the Aging^{Plus} program was designed to equip middle-aged and older adults with effective ways of countering negative misperceptions of aging that would otherwise undermine their health. This feasibility study represents the first step in the development, evaluation, and refinement of the Aging^{Plus} program. The promising findings of this study warrant continued efforts toward establishing Aging^{Plus} as an evidence-based program.

Table 4.1.

Aging^{Plus} Feasibility Study Summary of Demographic Variables (N = 62)

	M (SD) or %
Age (years)	65.26 (6.62) range: 53.20 – 82.63
Gender	
Women	83.9%
Marital Status	
Single	3.0 %
Married/Partnership	58.2%
Separated/Divorced	29.9%
Widowed	9.0%
Race/Ethnicity	
White	94.0%
Hispanic	4.5%
Other	1.5%
Education (years)	16.22 (2.05)
Employment Status	
Full Time	16.4%
Part-Time	16.4%
Second Career	6.0%
Retired	56.7%
Unemployed	3.0%
Highest Degree Completed	
High School Diploma/GED	26.9%
Associate's	10.5%
Bachelor's	40.3%
Master's or Doctorate	22.4%
Household Income	
< $50K	42.9%
$50K – $100K	34.9 %
$100K – $150K	15.8%
> $150K	6.0%
Self-Rated Health *possible range: 1 (very poor) to 6 (very good)*	4.84 (.88)
Baseline Physical Activity Status	26.90% Not physically active, but thinking about it 41.80% Not physically active, but plan to start 13.40%Physically active and started in the past 6 months 17.90%Physically active for longer than 6 months

Table 4.2

Summary of Classroom Curriculum for the Aging^{Plus} Program

	Primary Component	Presentation Content	Workbook & Discussion Activities
Week 1	Negative Views on Aging	• What are age stereotypes? • Combatting 3 myths of aging: Common beliefs about aging and why the evidence does not support them • Why stereotypes matter: Implications for prejudice and self-stereotyping	• Thinking about Aging • Stereotype Watch Homework for Week 2
Week 2	Negative Views on Aging; Control Beliefs	• What is plasticity? • How does physical activity promote brain plasticity and cognitive health? • Physical activity as the single most important strategy for promoting successful aging • National guidelines for physical activity • Review of the many benefits of physical activity	• Group Discussion: Stereotype Watch Report • Your Future Self • Risks & Benefits: Considering individual benefits of starting physical activity (and risks if no change is made) • Assessing Your Confidence to Become more Physically Active • Stereotype Watch Homework for Week 3
Week 3	Control Beliefs (via goal planning and self-monitoring)	• Effective strategies for goal setting • Importance of commitment • Effective strategies for goal achievement • How to effectively monitor progress • Prepare to pursue goal starting this week	• Group Discussion: Stereotype Watch Report • Brainstorming Enjoyable Activities • Setting a Personalized goal • Making Specific Plans and Planning for Obstacles • Assessing Your Confidence to Become more Active • Stereotype Watch Homework for Week 4
Week 4	Control Beliefs (via goal planning and self-monitoring)	• Checking in: Self-reflection strategies for monitoring successes and challenges • Finding opportunities for improvements and looking for patterns in the daily log	• Group Discussion: Stereotype Watch Report • Reflecting on Last Week's Successes and Challenges • Assessing Your Commitment and Confidence • Generating Additional Plans and Backup Plans

Table 4.3.

Change in Mean Values of Primary Outcome Variables throughout the Study (N = 52 unless otherwise specified)

Measure	Week 0 *M(SD)*	Week 4 *M(SD)*	Week 12 *M(SD))*	*Statistical Test (degrees of freedom)*	*Significance*	Effect Size η_p^2
Views on Aging:						
Age Stereotypes	40.85 (7.14)	47.40 (7.64)[a]	43.50 (7.30) [a]	*F* (2, 102) = 22.70	*p* < .001	.31 (large)
AARC – Gains	17.67 (2.83)	20.58 (2.46) [a]	19.21 (3.47) [a]	*F* (2, 102) = 24.32	*p* < .001	.32 (large)
AARC – Losses	11.08 (3.45)	10.83 (2.46)	10.02 (3.76) [a]	*F* (2, 102) = 3.73	*p* = .028	.07 (medium)
Expectations Regarding Aging	50.18 (16.58)	64.05 (16.39) [a]	60.04 (18.20) [a]	*F* (2, 102) = 26.15	*p* < .001	.34 (large)
Subjective Age	-.16 (.12)	-.20 (.11) [a]	-.22 (.13) [a]	*F* (2, 102) = 5.47	*p* = .01	.10 (medium)
Control Beliefs:						
General Self-Efficacy	26.37 (4.23)	--	28.13 (3.98) [a]	*F (*1, 51) = 14.48	*p* < .001	.22 (large)
Motivational Self-Efficacy	5.07 (.82) (Week 2)	5.50 (.67) [a] (Week 3)	5.04 (.93)	*F* (2, 102) = 6.89	*p* = .002	.22 (large)
Physical Activity:						
Total weekly physical activity (# moderate + vigorous minutes) *N* = 50	84.95 (91.17)	176.25 (89.92) [a] (Week 5-8 Avg)	171.55 (97.26) [a]	*F (2, 98)* 24.70	*p* < .001	.34 (large)

Notes: [a]Indicates a statistically significant improvement compared to baseline (*p < .01).*

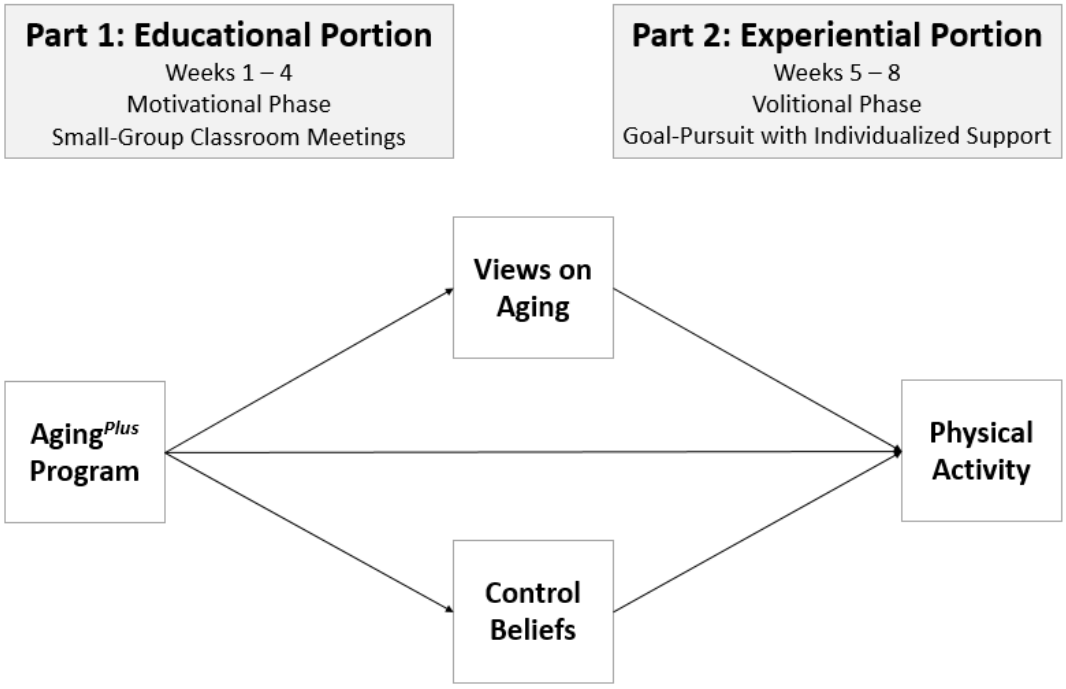

Figure 4.1. Conceptual model for the Aging*Plus* program.

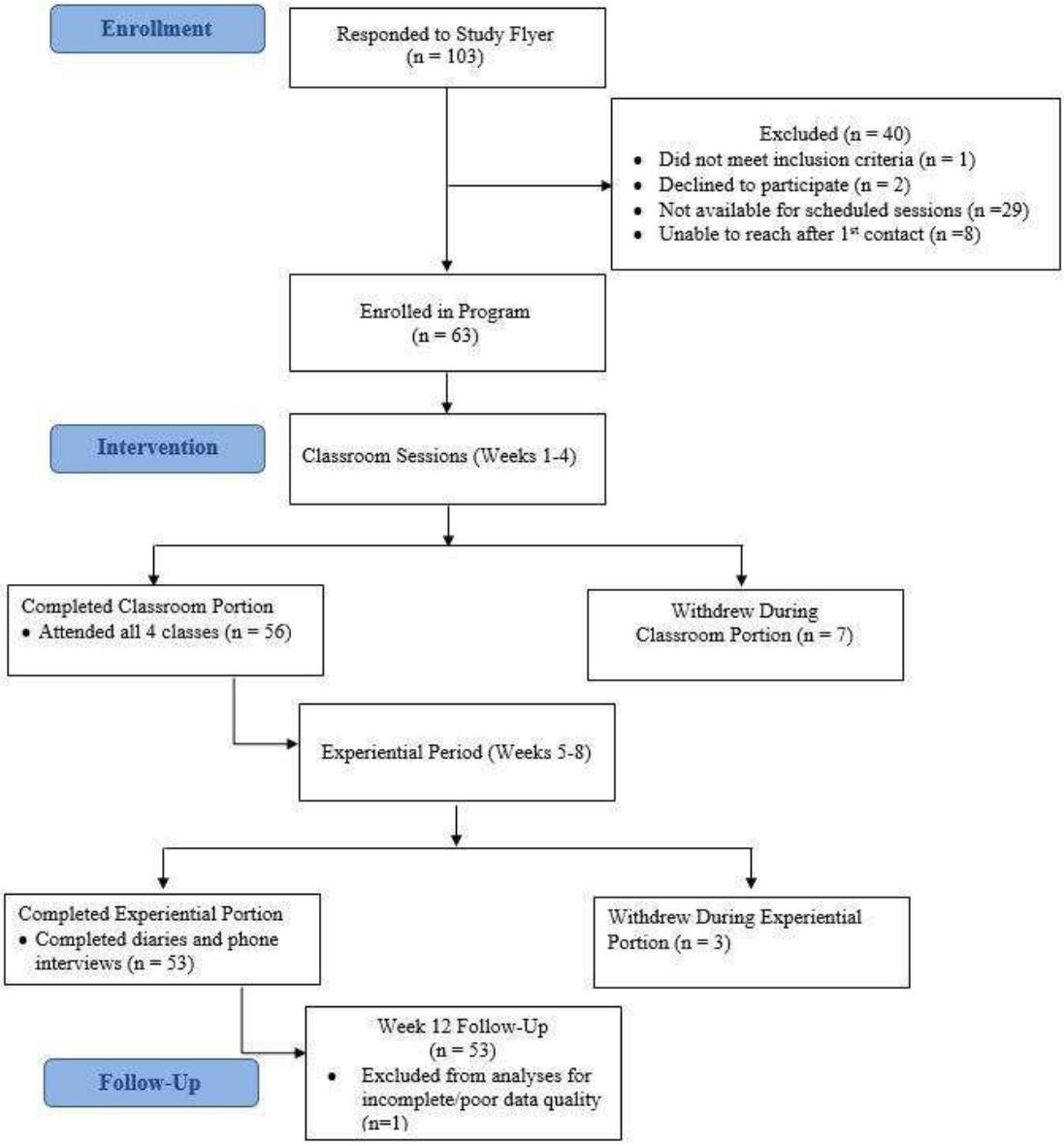

Figure 4.2. Consort Diagram prepared in accordance to Schulz, Altman, Moher & CONSORT Group, 2010)

CHAPTER 5.

GENERAL DISCUSSION

The dissertation research presented here centers around the common theme of examining the role of awareness of age-related change as it relates to health and well-being throughout adulthood. Health and well-being were selected as overarching indicators of successful aging, given that they encapsulate much of what it means to grow older in a healthy and successful way. Successful aging has been defined in many ways, but most commonly as, "the avoidance of disease and disability, the maintenance of high physical and cognitive function, and sustained engagement in social and productive activities" (Rowe & Kahn, 1997, p. 433). Each of these criteria depend to a large degree on the physical and mental well-being of an individual.

The manuscripts included in the dissertation were designed to address three distinct, yet related, research questions. These questions covered the following topic areas: (1) the reliable and valid measurement of AARC; (2) the empirical contributions of AARC relative to existing subjective aging constructs; and (3) the modifiability of AARC and other subjective aging constructs via intervention. The following paragraphs provide a brief summary of the key findings presented in Chapters 2 - 4. Then, the main contributions of the dissertation are discussed within the context of the relevant theoretical and empirical literature, and within the context of promoting successful aging. Avenues for future research are discussed throughout the chapter, which ends with an exploration of implications for practice.

Summary of the Dissertation Manuscripts

Summary of Chapter 2

In Chapter 2, the psychometric properties of a new questionnaire were examined. The AARC questionnaire was designed from a starting point of almost 200 potential items, and the factor structure, reliability, and validity of three versions were evaluated in three samples with a total of approximately 1,000 individuals. In an iterative process, a set of stringent statistical and conceptual criteria were applied to arrive at a more user-friendly 50-item version. Results from all three studies supported a 2-factor structure of AARC, representing the two latent dimensions of perceived age-related gains and losses, henceforth referred to as AARC-Gains and AARC-Losses. However, the theorized 5-domain structure was not supported, and possible explanations will be explored in the following sections. Scale reliabilities and intercorrelations provided further support for the two latent dimensions of AARC-Gains and AARC-Losses. That is, the factor scores calculated using a unit-weighting approach resulted in two scales with good item-total correlations and internal consistency reliabilities. Convergent validity was supported by a pattern of bivariate correlations exhibiting partial concordance with similar subjective aging measures, such as the AgeCog scales, the ATOA scale and Felt Age. Similarly, discriminant validity was also supported, evidenced by a low concordance with dissimilar measures of subjective aging, namely domain-specific scales assessing age stereotypes. Support for the predictive validity of the measure was found in the ability of AARC to predict health and wellness-related outcomes approximately two years later. Specifically, the AARC-50 measured at Time 1 predicted four indicators of health and well-being at Time 2, including depressive symptoms, satisfaction with life, functional health, and mental health functioning. The

establishment of a reliable and valid AARC-50 questionnaire in Chapter 2 allows for further empirical investigation of the AARC construct in the following chapters.

Summary of Chapter 3

With the availability of a reliable and valid questionnaire, the foundation was laid to focus on substantive research questions related to the new concept of AARC. One of these questions focused on how the AARC construct fits into the nomological network of related subjective aging constructs. Therefore, Chapter 3 examined how the new AARC construct fits into the existing literature by employing a large cross-cultural sample of U.S. and German participants. First, we assumed that existing measures of Felt age and ATOA represent unidimensional and global ratings of subjective aging that are generalizations of the specific behavioral experiences that make people aware of their own aging. To this effect, we expected that AARC, a behavior-specific subjective aging construct, would mediate the association between global subjective aging constructs and health and well-being. As expected, in a series of mediation models we found that AARC accounted for a substantial proportion of the variance in the associations between the global measures of subjective aging and health and well-being. Specifically, AARC-Gains mediated the association between the ATOA scale and health and well-being as follows: More positive ATOA were associated with more perceived age-related gains, which were, in turn, associated with better functional health and higher life satisfaction. Similarly, AARC-Losses mediated the association between both types of global subjective aging (e.g. Felt Age and ATOA) with health and well-being as follows: Feeling subjectively older and more negative ATOA were associated with more perceived age-related losses, which were, in turn, associated with poorer functional health and lower life satisfaction.

This set of finding suggests that individuals who have a generally positive perception of aging may be poised to notice more positive age-related changes, and are more likely to experience better health and well-being. On the flip side, individuals who have a more globally negative perception of aging may be particularly tuned into noticing specific negative age-related changes on a daily basis, and are therefore also more likely to experience poorer health and lower well-being. Thus, it seems reasonable to conclude that adults' global feelings of subjective aging may trigger a cascade of either upward or downward interpretations about specific age-related experiences, which then play out in tangible ways with regard to poorer functional health and lower life satisfaction.

Second, in this manuscript, my co-authors and I examined the potential role of chronological age as it relates to subjective aging. The wide age range that was represented in this sample (e.g., participants ranged in age from 40 – 98 years old) permitted us to examine the influence of chronological age via moderated mediation analysis. Moderated mediation allows for the examination of whether the mediating pathway might depend on certain factors, in this case age. When positioning chronological age as a moderator in the mediation pathways described above, the association between subjective aging and functional health (but not satisfaction with life) was significantly stronger for older participants. Furthermore, the moderating effect of age was present for the effect of AARC and functional health as follows: The beneficial effect of positive age-related changes on functional health was stronger for older participants; similarly, the detrimental effect of negative age-related changes on functional health was stronger among older participants. When plotting the effects, it became apparent that those who were one standard deviation above the sample's mean age, that is, individuals aged 76 years

old, saw the strongest effects of AARC on functional health. There was no moderating effect of age for the mediation pathways involving satisfaction with life.

Third and finally, this manuscript examined the extent to which the two dimensions of AARC can uniquely predict health and well-being over and above unidimensional measures of subjective aging. Is AARC potentially a duplicative construct or does it add something new to the literature? Hierarchical linear regression was used to examine this question. Findings showed that the two dimensions of AARC did in fact account for a significant amount of the variance in the outcomes, above and beyond that which felt age and ATOA contributed. Specifically, adding AARC-Gains and AARC-Losses in the equation to predict functional health contributed an additional 7.6% of the variance after the control variables (age, sex, education, and income), Felt Age, and ATOA. Similarly, AARC-Gains and AARC-Losses contributed an additional 5.4% of the variance to satisfaction with life over and above the control variables, Felt Age and ATOA. In summary, Chapter 3 provides new information to support the unique contributions of AARC to existing subjective aging measures, as well as the associations between AARC-Gains and AARC-Losses with measures of health and well-being.

Summary of Chapter 4

Chapter 4 examined the modifiability of AARC and other forms of subjective aging in an intervention study. This study represents a translational research approach in which basic research knowledge was used to inform the development of a new behavioral intervention called Aging^{Plus} to promote healthy aging in middle-aged and older adults. The Aging^{Plus} intervention was designed to help individuals become aware of pervasive – but largely inaccurate – negative aging attitudes and stereotypes that exert negative effects on many aspects of life. By targeting subjective aging and a sense of control over the aging process as the two primary mechanisms,

this study had two primary objectives. First, we examined the extent to which the Aging^{Plus} intervention was feasible to implement. Second, we examined the efficacy with regard to promoting more positive views on aging, increasing perceived control, and increasing engagement in physical activity. The multi-modal Aging^{Plus} intervention included educational presentations, work-book activities, group discussions, and an experiential goal-pursuit phase during which participants engaged in their self-selected physical activity. Results of this study, which included 62 participants aged 53 – 82 years, demonstrated that the program was feasible to implement and was well-received by participants. The findings also provided evidence of the program's efficacy, as the key variables of interest significantly improved from pre-test to post-test. Specifically, there were statistically significant as well as substantively meaningful improvements on all five indicators of subjective aging, including AARC, as well as for control beliefs and self-reported physical activity levels. Furthermore, these improvements were sustained at the delayed post-test (i.e., one month after the 8-week program ended). The findings suggest that subjective aging and control beliefs are indeed modifiable. Additionally, this study provides promising preliminary evidence that the new Aging^{Plus} behavioral intervention can be used to promote healthy aging by targeting views on aging, control beliefs, and engagement in physical activity.

Contributions of the Dissertation

The manuscripts included in this dissertation contribute to the literature by addressing several current questions on the topic of subjective aging. In addition to open questions about the measurement, empirical status, and modification of negative views on aging, it also addressed questions relating to the role of AARC for health and well-being, the differential function of positive versus negative AARC, and associations between AARC and chronological age. The

following paragraphs will situate the key findings and conclusions within the context of the broader subjective aging literature.

The Associations between AARC and Health and Well-being

Consistent with the previously established body of literature, the studies comprising this dissertation provided empirical evidence that AARC-Gains and AARC-Losses are associated with health and well-being, both of which are important indicators of successful aging. To provide further assurance of the associations between AARC and developmental outcomes, health and well-being were assessed in multiple ways throughout the three studies. Physical health was assessed using a well-validated and widely used measure of functional health, the physical health component score of the SF-36 (Chapters 2 and 3), as well as by daily diary of physical activity (Chapter 4). Well-being was assessed using several commonly applied measures of emotional and cognitive well-being, including the SF-36 mental health component score (Chapter 3), an established measure of depressive symptoms (Chapter 3), and a satisfaction with life rating scale (Chapters 2 and 3). The selection of the SF-36 reflects a particularly important aspect of successful aging because the component scores are a measure of the ability to engage in daily tasks and social roles without being limited by physical or mental health symptoms. Therefore, rather than simply a measure of fitness, the SF-36 indicates the extent to which individuals are able to remain engaged in their life activities.

The associations between AARC and the selected developmental outcomes were in the expected directions. Specifically, the awareness of age-related gains was associated with better physical and mental functioning, whereas the awareness of age-related losses was associated with poorer physical and mental functioning. This pattern of findings was consistent with my hypotheses, given the strong evidence in the literature that various subjective aging constructs

are associated with measures of physical and mental health outcomes. Furthermore, the evidence reported here, particularly in Chapter 2, demonstrates that subjective aging predicts later health and well-being. Although a plausible expectation might be that poor health causes negative views on aging, the evidence reported in this dissertation is consistent with previous work showing that subjective aging is actually the stronger predictor of physical health than vice versa (e.g., Spuling et al., 2013).

Measurement Issues in Subjective Aging and AARC

This dissertation included the development and psychometric evaluation of a new questionnaire to assess the AARC construct. To address limitations of many of the existing subjective aging constructs, AARC was put forth as a multidimensional and highly elaborated approach to conceptualizing the specific behavioral experiences that make people aware of their own aging process. Therefore, the ability to assess AARC in a psychometrically sound way is of fundamental importance if it is expected to allow for a more nuanced understanding of individuals' perceived aging experiences than has been possible with previously existing measures and concepts.

It deserves to be mentioned that the psychometric analyses supporting a two-domain structure of AARC was not completely consistent with our original theoretical expectations. A priori, the factor structure was expected to support the five theoretically-elaborated behavioral domains (e.g., physical, cognitive, interpersonal, social-cognitive, and lifestyle), but the positive/negative valence of the items seems to be a stronger latent dimension than the actual domain content. The item generation process involved an intentional effort to ensure a balanced number of positive and negative age-related experiences, and therefore there was an equal number of items representing each of the behavioral domains in the AARC-Gains and AARC-

Losses factors. It can be said that the factor scores were nonetheless informed in a multidimensional way by AARC experiences across all five behavioral domains.

The development of the AARC-50 is one of few attempts to develop a multidimensional measure for subjective aging research, although two notable previous efforts deserve recognition. First, the Scales of Aging-Related Cognitions (AgeCog Scales; Steverink et al., 2001) were developed to better understand the personal experience of aging and its association with well-being. Second, the Attitudes to Ageing Questionnaire (AAQ; Laidlaw, Power & Schmidt, 2007) was developed as part of the World Health Organization Quality of Life (WHOQOL) efforts and included multiple countries in the item generation and scale evaluation process (Laidlaw et al., 2007). Interestingly, both AgeCog and AAQ arrived at three conceptually similar dimensions, which capture aspects of physical losses and decline, psycho-social losses, and views of aging as a time for opportunity and growth.

The AgeCog and AAQ represent laudable and important efforts to study aging attitudes using a multidimensional approach. To the best of our knowledge, these were the first multi-item measures in the subjective aging literature to recognize both the complexity and multidimensionality of adults' aging experiences. However, there are several key differences between the AARC questionnaire and these scales. First, there is quite a bit of conceptual distinction from AARC: The AgeCog and AAQ capture still more global attitudes about aging (e.g., *Aging means to me that I continue to make plans*), whereas AARC captures behavior-specific experiences that make people aware that they are becoming older (e.g., *With my increasing age I realize that others are treating me more respectfully)*. This conceptual distinction is evident from the low to moderate correlations found in Chapter 3 between AARC and the AgeCog scales (*r*'s = .12 - .64). The size of these correlations suggests plenty of

conceptual uniqueness between AARC and AgeCog. A second important difference between AARC and the AAQ and AgeCog scales is that AARC allows both gains and losses to be reported simultaneously in a given domain. For instance, an individual may report both an interpersonal loss (e.g. "I feel more dependent on the help of others"), and an interpersonal gain (e.g. "My friendships and relationships have become stronger"). This structure is in contrast to AgeCog and the AAQ which only capture interpersonal losses but not gains. A third key difference is that the AARC measure benefits from a highly elaborated theoretical background described by Diehl and Wahl (2010), which then informed the development of the measure and the entire psychometric work. Thus, AARC-50 questionnaire measures a construct that is rooted in a life-span developmental framework and recognizes key assumptions about adult development, such as the ability to simultaneously experience gains and losses, the possibility of plasticity in functioning, and the role of personal agency in the course of development. This is in contrast to the other two scales which did not follow a theoretical approach in the item generation or selection process.

To summarize, the AARC construct represents a theoretically-grounded and conceptually unique contribution to subjective aging research. This dissertation described the development and evaluation of a multidimensional self-report questionnaire to measure AARC in a reliable and valid way (Chapter 2). The evidence provided in Chapter 2 laid the foundation for the use of the AARC-50 questionnaire in subsequent substantive studies.

Conceptual Status of AARC within the Subjective Aging Literature

Another notable contribution of the dissertation is the empirical evaluation of AARC relative to existing concepts of subjective aging. Such an empirical comparison of subjective aging constructs had not, to the best of my knowledge, been performed previously. With the

recent renewed interest in the field has come an increasing variation in the conceptualization of subjective aging. However, it was previously not known to what extent various conceptualizations represented different or overlapping aspects of subjective aging. The evidence provided in the three manuscripts points to several conclusions. First, the scales of AARC-Gains and AARC-Losses represent related, yet distinct aspects of subjective aging compared to other conceptualizations, including a measure of Felt Age, the ATOA scale , the AgeCog scales, and a multidimensional measure of age stereotypes. Second, the assessment of subjective aging in a multidimensional way, as allowed by the AARC-Gains and AARC-Losses scales, explains a significant amount of the variance in health and well-being, over and above unidimensional constructs of subjective aging. Third, evidence from mediation analyses suggests a relationship between global and behavior-specific subjective aging. Specifically, negative global attitudes about aging seem to prime individuals to become aware of specific negative age-related experiences, and that this process has negative influences on physical function and life satisfaction. A fourth conclusion that can be drawn is that a behavioral intervention designed to change attitudes toward aging affects various subjective aging constructs somewhat differently. All five included measures of subjective aging (e.g., Felt Age, expectations regarding age, age stereotypes, AARC-Gains, and AARC-Losses) showed significant and meaningful improvements after adults' participation in the intervention. However, AARC-Losses exhibited a longer period of time until improvements were seen. Specifically, AARC-Losses did not show improvement until Week 12 of the program, whereas other measures of subjective aging showed more immediate improvements at Week 4. This finding is not entirely surprising, as AARC captures behavior-specific perceived age-related losses that may not be quickly reversible. For instance, AARC-Losses items such as, "I am slower in my thinking" and "I have less energy"

(Appendix 1) reflect changes that are known from the research to be age-related (e.g., slower processing speed and decreased stamina), and also a common experience of many aging individuals. Although there is evidence that such types of functioning may be improved with engagement in physical activity, it likely takes longer than 4 weeks to see a noticeable change and to convince participants of the plasticity of their own behavior. Such a possibility would be one explanation for the improvement of AARC-Losses seen at Week 12, but not at Week 4.

The Modifiability of AARC as it Relates to Health Promotion

Chapter 4 added to the existing literature by developing and evaluating Aging^{Plus}, a community-based intervention program for middle-aged and older adults to mitigate the detrimental impacts of negative views of subjective aging. Based on the availability of evidence, control beliefs and health behaviors (namely physical activity promotion) were therefore identified as psychological mechanisms to target via behavioral intervention in order to promote healthy aging. The intervention program was efficacious in promoting positive views of aging and higher control beliefs, and these changes were accompanied by an increase in physical activity. Although the study yielded evidence that each of these aspects improved, the feasibility study did not yet allow for an empirical test of the causal pathways from a conceptual or statistical standpoint. Therefore, building on this initial feasibility study, future research employing a randomized controlled design will focus on the testing of causal mechanisms to further elucidate the associations between changes in views of subjective aging and changes in a relevant outcome variable such as physical activity.

Evidence supporting the modifiability of AARC can be interpreted within a theoretical framework considering lifespan tenets of agency and developmental plasticity (Brandtstädter, 1999). Agency refers to the innate tendency of individuals to take an active role in shaping and

influencing their own development. That is, humans select environments and experiences in their lives, and these influences play a role in shaping all aspects of their adult development, such as their health, their social relationships, and their daily activities. Plasticity is a closely related term, which refers to the ability for the course of development to be shaped by behavioral or environmental forces (Baltes, 1987). The life-span framework operates within the assumption that human development is never completely set in stone but can, in many instances, be modified and optimized. There are certainly upper limits on the extent to which development can be shaped, however research continues to push these limits that were at one time thought to be relatively set. To illustrate, recent research refutes the long-held assumption that the generation of new neurons was impossible, and it is now widely accepted that new neurons can be generated as a result of lifestyle behaviors, including sustained aerobic exercise (Erickson et al., 2011). Not only is neurogenesis now known to be possible, but it has been documented specifically to occur within the hippocampus, an area of the brain that is critically important for memory and learning. Such a finding suggests exciting possibilities for improving cognitive function in later life through the use of behavioral strategies such as a physically active lifestyle. This is just one example of expanding knowledge on the topic of developmental plasticity that can be exploited for the purpose of optimizing development throughout the adult years.

Aging*Plus* represents one attempt at designing a behavioral intervention to promote healthy aging which draws on assumptions of agency and plasticity, and is consistent with recent calls for motivation-based programs from leaders in the field (Nielsen & Reiss, 2012). In the program, individuals learn about the potential for the plasticity throughout adult development, and are supported in their efforts to take a greater agentic role in shaping their own healthy

aging. As demonstrated in Chapter 4, Aging^{Plus} shows promise with regard to motivating and empowering adults to have a greater chance of entering later life in good health.

The Differential Role of Positive and Negative AARC

In contrast to the majority of subjective aging research, which has investigated positive and negative subjective aging as two ends of the same spectrum, the present studies examined positive and negative AARC as qualitatively different elements of subjective aging, permitting a couple of primary conclusions. First, there was an overall pattern of findings showing that AARC-Losses exhibited relatively stronger associations with developmental outcomes compared to AARC-Gains. Such a pattern was present in both Chapters 2 and 3. This finding is consistent with research that has examined the effect of implicit age stereotypes. For instance, in a meta-analysis, Meisner (2012) found that the priming of negative age stereotypes exerted an almost three times stronger effect on behavioral performance than did the priming of positive age stereotypes. One plausible explanation for the primacy of negative versus positive subjective aging is that negative behavioral experiences are more memorable (Hummert, 2011) and have more of a lasting impact on individuals' lives (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Because negative attitudes toward aging are so prevalent throughout our society and have become a normative way of thinking (Lindland et al., 2015), it is likely that it is primarily the negative markers upon which individuals rely for evaluating their own subjective aging experiences.

A second conclusion regarding the issue of valence is that positive and negative subjective aging appear to be differentially related to outcomes, especially to physical health outcomes. As shown in Chapter 3, both AARC-Gains and AARC-Losses predicted functional health, although AARC-Losses was a significantly stronger predictor relative to AARC-Gains (β

= -.37 vs. β = .08, respectively). Interestingly, though, AARC-Losses and AARC-Gains were quite similar in their relative predictive associations for satisfaction with life (β = -.28 and β = .24, respectively). This pattern of findings suggests that both positive and negative AARC are instrumental in both physical and mental health, but likely to different degrees. There are, to date, few other studies that have measured self-reported positive and negative subjective aging simultaneously. One exception is the use of the AgeCog scales (Steverink et al., 2001) to examine positive and negative subjective aging separately. Early correlational data showed that the physical loss scale had a relatively stronger association with measures of physical health (r = -.34) compared to the "ongoing development" (r = .12) dimension that represents positive subjective aging. However, the AgeCog scales measure only negative physical changes and only positive social changes. In comparison, AARC allows for the assessment of positive and negative perceived experiences across five behavioral domains. Therefore, the ability of the AARC questionnaire to differentiate between positive and negative subjective aging regardless of domain is a major strength. Future research is needed to further explore the differential role of valence-specific subjective aging. Such endeavors will help to answer questions of whether it is the promotion of positive subjective aging or the reduction of negative subjective aging that might be associated with the largest benefits to health and well-being, or whether both should be targeted simultaneously.

From a theoretical standpoint, the separate assessment of AARC-Gains and AARC-Losses is consistent with a life-span developmental approach (Baltes, 1987). Although gains tend to outweigh losses in childhood, adolescence and early adulthood, the balance begins to change in late midlife and early old age, when loss experiences are likely to increase. In later life, then, the experience of losses is likely to outnumber gain experiences. This shifting pattern is shaped

by influences from many life domains and represents increasing losses in physical function, social partners and social roles, for example. Supporting the theoretical basis, empirical evidence also supports a gain-loss orientation of studying adult development. For instance, research shows that adults of all ages have normative expectations about the gains and losses they will encounter throughout their adult lives, and most individuals, regardless of age, expect more losses and fewer gains in the later years (Heckhausen & Baltes, 1991). Furthermore, the simultaneous experience of gains and losses that is common in later life parallels the increasing complexity of emotional experiences that occur with increasing age (Carstensen, et al., 2011). Therefore, that the new AARC questionnaire captures subjective aging from a gains-losses perspective is consistent with theoretical and empirical approaches to the study of adult development and aging.

What might be some implications of the qualitatively different findings between positive and negative AARC? It might be that positive subjective aging serves a protective role in middle age and later life. To be clear, it is important to note that positive subjective aging does not mean denying or ignoring negative experiences that are more likely to occur with increasing age, such as declining health, the loss of a spouse, or loss of prominent social roles. Rather, positive subjective aging means that individuals perceive growing older as holding new opportunities and new experiences, for the potential of growth and gains in at least some aspects of life, perhaps in strengthening relationships with friends and family members, for learning and experiencing new things, for sharing knowledge and experience with others. Longitudinal evidence supports this possibility so far, as individuals' scores on the AgeCog ongoing development subscale have been shown to be associated with higher life satisfaction in the face of serious health problems (Wurm et al., 2008). In a similar vein, additional data not included in this dissertation (Brothers,

Gabrian, Wahl & Diehl, in press) provide evidence for the moderating role of AARC-Gains for the ability to preserve psychological well-being in later life. In particular, with increasing age, the natural tendency to perceive time as becoming limited and running out tends to be associated with decreased psychological well-being (Hoppman, Infurna, Ram & Gerstorf, 2015). However, we were able to show a buffering effect of AARC-Gains such that when individuals reported more perceived age-related gains, the detrimental effects of a limited future time perspective on psychological well-being was significantly attenuated (Brothers et al., in press). Interestingly, we found no corresponding effect in which AARC-Losses exacerbated the effect of a limited future time perspective on low psychological well-being. Thus, this study illustrates emerging evidence for the differential role that AARC-Gains and AARC-Losses may play in adult development.

Considering the Role of Chronological Age as it Relates to AARC

To what extent subjective aging and chronological aging are related has been of interest in the literature because of the presumed closeness of these variables. Although chronological age is moderately associated with various indicators of subjective aging (e.g., Kleinspehn-Ammerlan et al., 2008), the empirical overlap nonetheless leaves much of the variance to be accounted for by other factors, and the increasing heterogeneity in aging trajectories means that chronological age becomes less accurate in predicting developmental outcomes. As a result, the first subjective aging constructs were articulated in an attempt to provide greater predictive and explanatory power than simply time since birth (Kastenbaum et al., 1972). Evidence from this line of research confirms that subjective evaluations of age often are more powerful in predicting health and longevity-related outcomes in later life than individuals' chronological age (Kotter-Grühn et al., 2009; Markides & Pappas, 1982).

Therefore, although the primary focus of this dissertation was on the measurement, conceptual status and predictive role of subjective aging constructs, the manuscripts presented here also examined the role and status of chronological age. Using a moderated mediation model, Chapter 3 found that, with increasing age, AARC-Gains had a stronger beneficial effect on health, and AARC-Losses had a stronger detrimental effect on health. However, in Chapter 4, there was no evidence for a differential role of age with regard to the effects of the intervention program. That is, participants throughout the entire range of ages represented (53 – 82 years) experienced similar effects of the program on views on aging, control beliefs, and physical activity levels. The findings, at first glance, may seem to contradict one another. However, with further consideration, these findings may be easily reconciled. Although perceived negative age-related experiences of aging appear to become a stronger risk factor for poor health in later life, it was also found that perceived positive age-related experiences in later life were associated with beneficial effects on functional health. Furthermore, that positive views of subjective aging were modifiable among individuals of all ages is also quite encouraging. That there were no age differences with regard to the efficacy of Aging^{Plus} suggests that it is never too late to intervene to promote more positive views on aging, and that efforts to promote positive subjective aging should be directed toward adults of all ages.

The findings regarding chronological age showed the importance of promoting positive subjective aging at all ages. However, there is nonetheless good reason to believe that the years from approximately age 40 - 60 represent a key developmental period during which individuals' subjective aging experiences are shaped in crucial ways. Most commonly, the general public views the fourth and fifth decade of life as "over the hill," and generally out of a person's control (Lindland et al., 2015). Many individuals even expect a midlife crisis, although little research

supports this notion (Wethington, 2000). In contrast to these popular and negative views of aging, there is accumulating evidence suggesting that individuals and societies alike will benefit from adopting a view that the midlife years (roughly age 40 – 60) represent a unique window of opportunity for influencing later life development for several reasons. One reason is that age and aging become particularly relevant to individuals' self and identity in midlife (Levy, 2009). This part of the life span is a time in which individuals are working to make sense of age-related experiences which later become adopted into their aging identity, and it therefore represents a period during which views on aging are potentially most malleable. A second reason is although middle-aged adults commonly have multiple responsibilities in terms of work and family, their levels of functioning have not yet been affected by major normative declines. Third, middle-aged adults are expected to have a longer time period in which to counteract the potential negative physical and cognitive declines that become more normative in later adulthood. Taken together, these assumptions suggest that midlife is a period in which subjective aging can be shaped, and more optimal aging trajectories can be set in motion—if individuals are inclined to engage in the right behaviors.

Although the importance of considering midlife as a specific developmental period has been championed by Lachman and others for over a decade (e.g., Lachman, 2001; Lachman, 2015; Whitbourne & Willis, 2006), there is still a relative scarcity of research attention to midlife as a unique developmental period. Only about one-third of articles in the top journals in adult development and aging (e.g. the Journals of Gerontology, Series B: Psychological Sciences) included middle-aged participants, and only about 1% focused exclusively on middle-aged participants (Lachman, 2015). Certainly more work is needed to explore the possibilities of

midlife as a crucial period of development for the promotion of more positive views of aging, with the ultimate goal of preserving health and well-being well into late life.

Practical Implications

Consistent evidence emerged across the three studies to indicate that adults' positive self-perceptions of aging, as operationalized via the AARC-Gains scale, were associated with better health and well-being, and negative self-perceptions of aging, as operationalized via the AARC-Losses scale, with poorer health and well-being. Taken together, one implication of this work points to the importance of maximizing gain experiences and minimizing loss experiences throughout adulthood. There are a multitude of ways and domains in which this can be achieved through programming and the development of opportunity structures which foster gain-related experiences in later life. Aging*Plus* represents just one avenue to help individuals become more aware of positive age-related changes they may not have otherwise have paid attention to. Additionally, the program aims to illuminate the benefits of perceiving the upcoming years as a time for opportunity and growth. It is also necessary to promote a shift in societal and cultural attitudes regarding what it means to grow older. Increasing opportunities for meaningful work, engagement in families and societies, and valued social roles will help to change the way older adults are perceived. Not only would such opportunities support individuals' desire to be generative (Erikson, 1982), but it would also provide them with the opportunity to show that they can fill social roles in a constructive and productive way. Fostering volunteer and civic engagement opportunities within neighborhoods and communities is essential to promote a sense of purpose and engagement among older adults, and for making good use of years of accumulated experiences. One exemplary program to this effect is Experience Corps (Morrow-Howell, Lee, McCrary & McBride, 2014), which matches older adult volunteers with

neighborhood schools and consistently shows beneficial effects for older adults and youth alike (Rebok et al., 2014), including effects on cognitive functioning and brain health. In the workplace, creating training and development programs for employees of all ages and experience levels is essential for helping them to stay engaged and productive. Empirical evidence supports the idea of creating productive opportunities for older adults, as countries which have a higher percentage of older workers also have more positive attitudes about aging (Löckenhoff et al., 2009). Bernice Neugarten, one of the pioneers of social gerontology, advocated for the inclusion of older adults within societal structures for her entire career (e.g., Neugarten, B., 1979; Neugarten, D., 1996), although there is still plenty of room for improvement in today's societies.

Conclusions

This dissertation presented evidence for the utility of AARC as a new subjective aging construct. AARC is unique for several reasons, given its multidimensional, valence-based approach to capturing the actual behavioral experiences that make people aware of their age and of becoming older. As expected, AARC-Gains and AARC-Losses showed meaningful associations with a variety of health and well-being measures that were selected to represent important aspects of successful aging (e.g., Rowe & Kahn, 2015).

The research presented in this dissertation makes three primary contributions to the literature. First, it reported the establishment of a psychometrically sound measurement tool of AARC, which is now available to use in future research efforts as a way to assess positive and negative subjective aging in a way previously not possible. Second, it showed that AARC represents conceptually and empirically unique information about individuals' subjective aging experiences compared to existing subjective aging measures. Finally, it included the development and evaluation of a behavioral intervention to modify AARC. Such a translational

research approach represents a prime area for new research attention. As Schaie (2016) recently remarked, the outlook of aging research must focus on the "mechanisms which lead to slower rates of normal decline in successive cohorts and the retention of a higher level of function in greater proportions of the older population" (p. 10). The role of attitudinal and behavioral mechanisms, which was the focus of this dissertation, has so far been an underutilized approach that has the potential to improve the course of aging for individuals and societies alike (Nielsen & Reiss, 2012).

REFERENCES

Agrigoroaei, S., Polito, M., Lee, A., Kranz-Graham, E., Seeman, T., & Lachman, M. E. (2013). Cortisol response to challenge involving low controllability: The role of control beliefs and age. *Biological Psychology, 93,* 138-142. doi: 10.1016/j.biopsycho.2013.01.003

Aldwin, C. M., Spiro, A., & Park, C. L. (2006). Health, behavior, and optimal aging: A life span developmental perspective. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (6th ed., pp. 85-104). New York, NY: Elsevier.

Allen, P. M., Mejía, S. T., & Hooker, K. (2015). Personality, self-perceptions, and daily variability in perceived usefulness among older adults. *Psychology and Aging, 30,* 534-543. doi:10.1037/pag0000039

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103,* 411-423.

Andresen, E. M., Malmgren, J. A., Carter, W. B., & Patrick, D. L. (1994). Screening for depression in well older adults: Evaluation of a short form of the CES-D. *American Journal of Preventive Medicine, 10,* 77-84.

Baltes, M. M., & Baltes, P. B. (Eds.). (1986). *The psychology of control and aging.* Hillsdale, NJ: Erlbaum.

Baltes, P. B. (1987). Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology, 23,* 611-626. doi:00I2-l649/87

Baltes, P., Lindenberger, U., & Staudinger, U. M. (2006). Lifespan theory in developmental psychology. In R. M. Lerner (Ed.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (pp. 569-644). New York, NY: Wiley.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York, NY: W. H. Freeman and Company.

Barak, B. (2009). Age identity: A cross-cultural global approach. *International Journal of Behavioral Development, 33,* 2-11. doi: 10.1177/0165025408099485

Barrett, A. E. (2003). Socioeconomic status and age identity: The role of dimensions of health in the subjective construction of age. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 58,* S101-S109. doi: 10.1093/geronb/58.2.S101

Barrett, A. E. (2005). Gendered experiences in midlife: Implications for age identity. *Journal of Aging Studies, 19,* 163-183. doi:10.1016/j.jaging.2004.05.002

Barrett, A. E., & Montepare, J. M. (2015). "It's about time" Applying life span and life course perspectives to the study of subjective age. In M. Diehl & H.-W. Wahl (Eds.), *Annual Review of Gerontology and Geriatrics: Vol. 35. Research on subjective aging: New developments and future directions* (pp. 55-77). New York, NY: Springer Publishing. doi: 10.1891/0198-8794.35.55

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology, 5,* 323 – 370. doi: 1089-2680/01

Boehmer, S. (2007). Relationships between felt age and perceived disability, satisfaction with recovery, self-efficacy beliefs and coping strategies. *Journal of Health Psychology, 12,* 895-906. doi:10.1177/1359105307082453

Brandtstädter, J. (1999). The self in action and development: Cultural, biosocial, and ontogenetic bases of intentional self-development. In J. Brandtstädter & R. M. Lerner (Eds.), *Action and self-development: Theory and research through the life span* (pp. 37-65). Thousand Oaks, CA: Sage.

Brothers, A., Gabrian, M., Wahl, H.-W., & Diehl, M. (In press). Future time perspective and awareness of age-related change: Examining their role in predicting psychological well-being. *Psychology and Aging.*

Brothers, A., Miche, M., Wahl, H.-W., & Diehl, M. (2015). Examination of associations among three distinct subjective aging constructs and their relevance for predicting developmental correlates. *The Journals of Gerontology, Series B: Psychological Sciences,* Advance access publication October 1, 2015. doi:10.1093/geronb/gbv085

Bryant, C., Bei, B., Gilson, K., Komiti, A., Jackson, H., & Judd, F. (2012). The relationship between attitudes to aging and physical and mental health in older adults. *International Psychogeriatrics, 24,* 1674-1683. doi: 10.1017/S1041610212000774

Bullinger, M., & Kirchberger, I. (1998). *SF-36, Fragebogen zum Gesundheitszustand [SF-36-Questionnaire on health status]*. Göttingen, Germany: Hogrefe.

Byrne, B. M. (2012). *Structural equation modeling with Mplus.* New York, NY: Routledge.

Carstensen, L. L. (2006). The influence of a sense of time on human development. *Science, 312,* 1913-1915. doi:10.1126/science.1127488

Carstensen, L. L., Turan, B., Scheibe, S., Ram, N., Ersner-Hershfield, H., Samanez-Larkin, G. R., . . . Nesselroade, J. R. (2011). Emotional experience improves with age: Evidence based on over 10 years of experience sampling. *Psychology and Aging, 26,* 21-33. doi:10.1037/a0021285

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Diehl, M., & Brothers, A. (In press). Self-theories of the aging person. In N. Pachana (Series Ed.), B. G. Knight, & H.-W. Wahl (Vol. Eds.), *Encyclopedia of Geropsychology: Vol. 1. Introduction and Historical Perspectives.* New York, NY: Springer.

Diehl, M. K., Brothers, A. F., Wettstein, M., Miche, M., & Wahl, H. (2013). Measuring awareness of age-related change: Findings from a study in the U.S. and Germany. *The Gerontologist (Conference Proceedings from the Annual Scientific Meeting of the Gerontological Society of America), 53*, 532.

Diehl, M., Chui, H., Hay, E. L., Lumley, M. A., Grühn, D., & Labouvie-Vief, G. (2014). Change in coping and defense mechanisms across adulthood: Longitudinal findings in a European American sample. *Developmental Psychology, 50,* 634-648. doi:10.1037/a0033619

Diehl, M., & Hay, E. L. (2010). Risk and resilience factors in coping with daily stress in adulthood: the role of age, self-concept incoherence, and personal control. *Developmental Psychology, 46,* 1132-1146. doi:10.1037/a0019937

Diehl, M., & Wahl, H. (2010). Awareness of age-related change: examination of a (mostly) unexplored concept. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 65B,* 340-350. doi: 10.1093/geronb/gbp110

Diehl, M., Wahl, H. W., Barrett, A. E., Brothers, A. F., Miche, M., Montepare, J. M., . . . Wurm, S. (2014). Awareness of aging: Theoretical considerations on an emerging concept. *Developmental Review, 34,* 93-113. doi: 10.1016/J.Dr.2014.01.001

Diehl, M., Wahl, H.-W., Brothers, A., & Miche, M. (2015). Subjective aging and awareness of aging: Toward a new understanding of the aging self. In M. Diehl & H.-W. Wahl (Eds.),

Annual Review of Gerontology and Geriatrics: Vol. 35. Research on subjective aging: New developments and future directions (pp. 1-28). New York, NY: Springer Publishing. doi: 10.1891/0198-8794.35.1

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49,* 71-75. doi: 10.1207/s15327752jpa4901_13

Diener, E., Inglehart, R., & Tay, L. (2013). Theory and validity of life satisfaction scales. *Social Indicators Research, 112,* 497-527. doi:10.1007/s11205-012-0076-y

Dörner, J., Mickler, C., & Staudinger, U. M. (2005). Self-development at midlife. Lifespan perspectives on adjustment and growth. In S. L. Willis & M. Martin (Eds.), *Middle adulthood: A lifespan perspective* (pp. 243-276). Thousand Oaks, CA: Sage.

Eagly, A. H., & Chaiken, S. (1998). Attitude structure and function. In D. Gilbert, S.Fiske & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., Vol. 1, pp. 269-322). New York, NY: McGraw-Hill.

Eibach, R. P., Mock, S. E., & Courtney, E. A. (2010). Having a "senior moment": Induced aging phenomenology, subjective age, and susceptibility to ageist stereotypes. *Journal of Experimental Social Psychology, 46,* 643-649. doi:10.1016/j.jesp.2010.03.002

Erickson, K. I., Voss, M. W., Prakash, R. S., Basak, C., Szabo, A., Chaddock, L., . . . Kramer, A. F. (2011). Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences, 108,* 3017-3022. doi:10.1073/pnas.1015950108

Erikson, E. H. (1982). *The life cycle completed*. New York, NY: Norton.

Fiske, S. T., & Taylor, S. (1991). *Social cognition* (2nd ed.). New York, NY: McGraw-Hill.

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2011). Intervention effects of exercise self-regulation on physical exercise and eating fruits and vegetables: A longitudinal study in orthopedic and cardiac rehabilitation. *Preventive Medicine, 53,* 182-187. doi:10.1016/j.ypmed.2011.06.019

Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., Gottdiener, J., . . . McBurnie, M. A. (2001). Frailty in older adults: evidence for a phenotype. *The Journals of Gerontology, Series A: Medical Sciences, 56,* M146-156. doi: 10.1093/gerona/56.3.M146

Gerstorf, D., Röcke, C., & Lachman, M. E. (2011). Antecedent-consequent relations of perceived control to health and social support: Longitudinal evidence for between-domain associations across adulthood. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 66,* 61-71. doi: 10.1093/geronb/gbq077

Goodwin, J. S., Black, S. A., & Satish, S. (1999). Aging versus disease: The opinions of older black, hispanic, and non-hispanic white Americans about the causes and treatment of common medical conditions. *Journal of the American Geriatrics Society, 47,* 973-979. doi: 10.1111/j.1532-5415.1999.tb01293.x

Harvey, J. A., Chastin, S. F., & Skelton, D. A. (2013). Prevalence of sedentary behavior in older adults: A systematic review. *International Journal of Environmental Research and Public Health, 10,* 6645-6651. doi:10.3390/ijerph10126645

Hausdorff, J. M., Levy, B. R., & Wei, J. Y. (1999). The power of ageism on physical function of older persons: Reversibility of age-related gait changes. *Journal of the American Geriatrics Society, 47,* 1346-1349. doi: 10.1111/j.1532-5415.1999.tb07437.x

Hayes, A. F. (2012). *SPSS MEDIATE macro syntax reference.* Retrieved from http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* New York, NY: Guilford.

Healthy People 2020. (2014). *Physical activity.* Retrieved from http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=33

Heckhausen, J., & Baltes, P. B. (1991). Perceived controllability of expected psychological change across adulthood and old-age. *The Journals of Gerontology, Series B: Psychological Sciences, 46,* P165-P173. doi: 10.1093/geronj/46.4.P165

Hess, T. M., Auman, C., Colcombe, S. J., & Rahhal, T. A. (2003). The impact of stereotype threat on age differences in memory performance. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 58B,* P3-P11. doi:10.1093/geronb/58.1.P3

Hoppmann, C. A., Infurna, F. J., Ram, N., & Gerstorf, D. (2015). Associations among individuals' perceptions of future time, individual resources, and subjective well-being in old age. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences,* Advance access publication October 5, 2015, 1-12. doi:10.1093/geronb/gbv063

Hubley, A. M., & Russell, L. B. (2009). Prediction of subjective age, desired age, and age satisfaction in older adults: Do some health dimensions contribute more than others? *International Journal of Behavioral Development, 33,* 12-21. doi: 10.1177/0165025408099486

Hummert, M. L. (2011). Age stereotypes and aging. In K. W. Schaie & S. L. Willis (Eds.), *Handbook of the psychology of aging* (7th ed., pp. 249-262). San Diego, CA: Academic Press. doi: 10.1016/b978-0-12-380882-0.00016-4

Ip, E. H., Church, T., Marshall, S. A., Zhang, Q., Marsh, A. P., Guralnik, J., ... Rejeski, W. J. (2013). Physical activity increases gains in and prevents loss of physical function: Results

from the Lifestyle Interventions and Independence for Elders pilot study. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences, 68A,* 426-432. doi:10.1093/gerona/gls186

Kastenbaum, R., Derbin, V., Sabatini, P., & Artt, S. (1972). "The ages of me": Toward personal and interpersonal definitions of functional aging. *Aging and Human Development, 3,* 197-211.

King, A. C. (2001). Interventions to promote physical activity by older adults. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences, 56,* 36-46. doi: 10.1093/gerona/56.suppl_2.36

Kleinspehn-Ammerlahn, A., Kotter-Grühn, D., & Smith, J. (2008). Self-perceptions of aging: Do subjective age and satisfaction with aging change during old age? *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 63,* P377-P385. doi: 10.1093/geronb/63.6.P377

Klusmann, V., Evers, A., Schwarzer, R., & Heuser, I. (2012). Views on aging and emotional benefits of physical activity: Effects of an exercise intervention in older women. *Psychology of Sport and Exercise, 13,* 236-242. doi: 10.1016/j.psychsport.2011.11.001

Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., . . . Lancet Physical Activity Series Working Group. (2012). The pandemic of physical inactivity: global action for public health. *Lancet, 380,* 294-305. doi:10.1016/S0140-6736(12)60898-8

Kornadt, A. E., & Rothermund, K. (2011). Contexts of aging: Assessing evaluative age stereotypes in different life domains. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 66,* 547-556. doi:10.1093/geronb/gbr036

Kornadt, A. E., & Rothermund, K. (2012). Internalization of age stereotypes into the self-concept via future self-views: A general model and domain-specific differences. *Psychology and Aging, 27,* 164-172. doi: 10.1037/a0025110

Kotter-Grühn, D. (2013). Positive self-perceptions of aging: The role of health, self-regulation, and attitudes toward aging. *The Gerontologist, 53,* 512-512.

Kötter- Grühn, D. (2015). Changing negative views of aging: Implications for intervention and translational research. In M. Diehl & H.-W. Wahl (Eds.), *Annual Review of Gerontology and Geriatrics: Vol. 35. Research on subjective aging: New developments and future directions* (pp. 167-186). New York, NY: Springer Publishing. doi: 10.1891/0198-8794.35.167

Kotter-Grühn, D., Kleinspehn-Ammerlahn, A., Gerstorf, D., & Smith, J. (2009). Self-perceptions of aging predict mortality and change with approaching death: 16-year longitudinal results from the Berlin Aging Study. *Psychology and Aging, 24,* 654-667. doi:10.1037/a0016510

Kotter-Grühn, D., Neupert, S. D., & Stephan, Y. (2015). Feeling old today? Daily health, stressors, and affect explain day-to-day variability in subjective age. *Psychology & Health, 30,* 1470-1485. doi:10.1080/08870446.2015.1061130

Lachman, M. E. (Ed.) (2001). *Handbook of midlife development.* New York, NY: Wiley.

Lachman, M. E. (1986). Locus of control in aging research: A case for multidimensional and domain-specific assessment. *Psychology and Aging, 1,* 34-40.

Lachman, M. E. (2006). Perceived control over aging-related declines: Adaptive beliefs and behaviors. *Current Directions in Psychological Science, 15,* 282-286. doi:10.1111/j.1467-8721.2006.00453.x

Lachman, M. E. (2015). Mind the gap in the middle: A call to study midlife. *Research in Human Development, 12,* 327-334. doi:10.1080/15427609.2015.1068048

Lachman, M. E., & Agrigoroaei, S. (2010). Promoting functional health in midlife and old age: Long-term protective effects of control beliefs, social support, and physical exercise. *Plos One, 5,* 1-9. doi: 10.1371/journal.pone.0013297

Lachman, M. E., Neupert, S. D., & Agrigoroaei, S. (2011). The relevance of control beliefs for health and aging. In K. W. Schaie & S. L. Willis (Eds.), *Handbook of the psychology of aging* (7th ed., pp. 175-190). San Diego, CA: Academic Press.

Laidlaw, K., Power, M. J., & Schmidt, S. (2007). The attitudes to ageing questionnaire (aaq): Development and psychometric properties. *International Journal of Geriatric Psychiatry, 22,* 367-379. doi:10.1002/gps.1683

Lawton, P. (1975). The Philadelphia Geriatric Center Morale Scale: A revision. *Journal of Gerontology, 30,* 85-89. doi: 10.1093/geronj/30.1.85 .

Lee, I. A., & Preacher, K. J. (2013). *Calculation for the test of the difference between two dependent correlations with one variable in common* [Computer software]. Available from http://quantpsy.org.

Leventhal, E. A., & Prohaska, T. R. (1986). Age, symptom interpretation, and health behavior. *Journal of the American Geriatrics Society, 34,* 185-191.

Levy, B. R. (1996). Improving memory in old age through implicit self-stereotyping. *Journal of Personality and Social Psychology, 71,* 1092-1107.

Levy, B. R. (2000). Handwriting as a reflection of aging self-stereotypes. *Journal of Geriatric Psychiatry, 33,* 81-94.

Levy, B. R. (2003). Mind matters: Cognitive and physical effects of aging self-stereotypes. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 58B,* P203-P211. doi: 10.1093/geronb/58.4P203

Levy, B. R. (2009). Stereotype embodiment: A psychosocial approach to aging. *Current Directions in Psychological Science, 18,* 332-336. doi: 10.1111/j.1467-8721.2009.01662.x

Levy, B., Ashman, O., & Dror, I. (1999). To be or not to be: The effects of aging stereotypes on the will to live. *Omega: Journal of Death and Dying, 40,* 409-420. doi:10.2190/y2ge-bvyq-nf0e-83vr

Levy, B. R., Ferrucci, L., Zonderman, A. B., Slade, M. D., Troncoso, J., & Resnick, S. M. (2016). A culture–brain link: Negative age stereotypes predict Alzheimer's disease biomarkers. *Psychology and Aging, 31,* 82-88. doi:10.1037/pag0000062

Levy, B. R., Hausdorff, J. M., Hencke, R., & Wei, J. Y. (2000). Reducing cardiovascular stress with positive self-stereotypes of aging. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 55B,* P205-P213. doi: 10.1093/geronb/55.4.P205

Levy, B. R., & Leifheit-Limson, E. (2009). The stereotype-matching effect: Greater influence on functioning when age stereotypes correspond to outcomes. *Psychology and Aging, 24,* 230-233. doi: 10.1037/a0014563

Levy, B. R., & Myers, L. M. (2004). Preventive health behaviors influenced by self-perceptions of aging. *Preventive Medicine, 39,* 625-629. doi:10.1016/j.ypmed.2004.02.029

Levy, B. R., Ryall, A. L., Pilver, C. E., Sheridan, P. L., Wei, J. Y., & Hausdorff, J. M. (2008). Influence of African American elders' age stereotypes on their cardiovascular response to stress. *Anxiety Stress and Coping, 21,* 85-93.

Levy, B. R., Slade, M. D., Chung, K., & Gill, T. M. (2015). Resiliency over time of elders' age stereotypes after encountering stressful events. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 70,* 886-890. doi:10.1093/geronb/gbu082

Levy, B. R., Slade, M. D., & Kasl, S. V. (2002). Longitudinal benefit of positive self-perceptions of aging on functional health. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences, 57B,* P409-P417. doi:10.1093/geronb/57.5.P409

Levy, B. R., Slade, M. D., Kunkel, S. R., & Kasl, S. V. (2002). Longevity increased by positive self-perceptions of aging. *Journal of Personality and Social Psychology, 83,* 261-270. doi:10.1037//0022-3514.83.2.261

Levy, B. R., Slade, M. D., Murphy, T. E., & Gill, T. M. (2012). Association between positive age stereotypes and recovery from disability in older persons. *JAMA: The Journal of The American Medical Association, 308,* 1972-1973. doi:10.1001/jama.2012.14541

Levy, B. R., Zonderman, A. B., Slade, M. D., & Ferrucci, L. (2009). Age stereotypes held earlier in life predict cardiovascular events in later life. *Psychological Science, 20,* 296-298. doi:10.1111/j.1467-9280.2009.02298.x

Liang, J., & Bollen, K. A. (1983). The structure of the Philadelphia Geriatric Center Morale Scale - a reinterpretation. *Journals of Gerontology, 38,* 181-189. doi: 10.1093/geronj/38.2.181

Lindland, E., Fond, M., Haydon, A., & Kendall-Taylor, N. (2015). *Gauging aging: Mapping the gaps between expert and public understandings of aging in America.* Retrieved from FrameWorksInstitute.org

Löckenhoff, C. E., De Fruyt, F., Terracciano, A., McCrae, R. R., De Bolle, M., Costa, P. T., Jr., . . . Yik, M. (2009). Perceptions of aging across 26 cultures and their culture-level associates. *Psychology and Aging, 24,* 941-954. doi: 2048/10.1037/a0016901

Lowsky, D. J., Olshansky, S. J., Bhattacharya, J., & Goldman, D. P. (2014). Heterogeneity in healthy aging. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences, 69,* 640-649. doi:10.1093/gerona/glt162

Markides, K. S. & Ray, L. A. (1988). Change in subjective age among the elderly: An eight-year longitudinal study. *Comprehensive Gerontology. Section B, Behavioural, Social, and Applied Sciences, 2,* 11-15.

Markides, K. S., & Pappas, C. (1982). Subjective age, health, and survivorship in old age. *Research on Aging, 4,* 87-96. doi: 10.1177/016402758241004

Meisner, B. A. (2012). A meta-analysis of positive and negative age stereotype priming effects on behavior among older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 67,* 13-17. doi: 10.1093/geronb/gbr062

Meisner, B. A., Weir, P. L., & Baker, J. (2013). The relationship between aging expectations and various modes of physical activity among aging adults. *Psychology of Sport and Exercise, 14,* 569-576. doi: http://dx.doi.org/10.1016/j.psychsport.2013.02.007

Miche, M., Brothers, A., Diehl, M., & Wahl, H.-W. (2015). The role of subjective aging within the changing ecologies of aging. In M. Diehl & H.-W. Wahl (Eds.), *Annual Review of Gerontology and Geriatrics: Vol. 35. Research on subjective aging: New developments and future directions* (pp. 211-245). New York, NY: Springer Publishing. doi: 10.1891/0198-8794.35.211

Miche, M., Elsässer, V. C., Schilling, O. K., & Wahl, H. W. (2014). Attitude toward own aging in midlife and early old age over a 12-year period: Examination of measurement equivalence and developmental trajectories. *Psychology and Aging, 29,* 588-600. doi:10.1037/a0037259

Miche, M., Wahl, H. W., Diehl, M., Oswald, F., Kaspar, R., & Kolb, M. (2014). Natural occurrence of subjective aging experiences in community-dwelling older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 69,* 174-187. doi: 10.1093/geronb/gbs164

Mock, S. E., & Eibach, R. P. (2011). Aging attitudes moderate the effect of subjective age on psychological well-being: Evidence from a 10-year longitudinal study. *Psychology and Aging, 26,* 979-986. doi: 10.1037/a0023877

Montepare, J. M. (2009). Subjective age: Toward a guiding lifespan framework. *International Journal of Behavioral Development, 33,* 42-46. doi:10.1177/0165025408095551

Moor, C., Zimprich, D., Schmitt, M., & Kliegel, M. (2006). Personality, aging self-perceptions, and subjective health: A mediation model. *The International Journal of Aging and Human Development, 63,* 241-257. doi: 10.2190/AKRY-UM4K-PB1V-PBHF

Morrow-Howell, N., Lee, Y. S., McCrary, S., & McBride, A. (2014). Volunteering as a pathway to productive and social engagement among older adults. *Health Education & Behavior, 41,* 84S-90S. doi:10.1177/1090198114540463

Moser, C., Spagnoli, J., & Santos-Eggimann, B. (2011). Self-perception of aging and vulnerability to adverse outcomes at the age of 65–70 years. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 66,* 675-680. doi: 10.1093/geronb/gbr052

Murphy, S. L. (2009). Review of physical activity measurement using accelerometers in older adults: Considerations for research design and conduct. *Preventive Medicine, 48,* 108-114. doi:10.1016/j.ypmed.2008.12.001

Nejat, E. J., Polotsky, A. J., & Pal, L. (2010). Predictors of chronic disease at midlife and beyond: The health risks of obesity. *Maturitas, 65,* 106-111. doi:10.1016/j.maturitas.2009.09.006

Neugarten, B. L. (1968). The awareness of middle age. In B. L. Neugarten (Ed.), *Middle age and aging* (pp. 93-98). Chicago, IL: University of Chicago Press.

Neugarten, B. L. (1979). Time, age, and the life cycle. *The American Journal of Psychiatry, 136,* 887-894.

Neugarten, D. A. (Ed.) (1996). *The meanings of age: Selected papers of Bernice L. Neugarten.* Chicago, IL: The University of Chicago Press.

Neupert, S. D., Lachman, M. E., & Whitbourne, S. B. (2009). Exercise self-efficacy and control beliefs: Effects on exercise behavior after an exercise intervention for older adults. *Journal of Aging and Physical Activity, 17,* 1-16.

Nielsen, L., & Reiss, D. (2012). *Motivation and aging: Toward the next generation of behavioral interventions.* (Background Paper: NIA- BBCSS Expert Meeting). Washington, DC: National Institutes of Health.

Nilsson, M., Sarvimäki, A., & Ekman, S.-L. (2000). Feeling old: Being in a phase of transition in later life. *Nursing Inquiry, 7,* 41-49. doi: 10.1046/j.1440-1800.2000.00049.x

Nunnally, J. C., & Berstein, I. H. (1994). *Psychometric Theory* (3rd ed.). New York, NY: McGraw-Hill.

Ory, M., Hoffman, M. K., Hawkins, M., Sanner, B., & Mockenhaupt, R. (2003). Challenging aging stereotypes: Strategies for creating a more active society. *American Journal of Preventive Medicine, 25,* 164-171. doi:10.1016/s0749-3797(03)00181-8

Pahor, M., Guralnik, J. M., Ambrosius, W. T., Blair, S., Bonds, D. E., Church, T. S., . . . LIFE Study Investigators. (2014). Effect of structured physical activity on prevention of major mobility disability in older adults The LIFE study randomized clinical trial. *JAMA: The Journal Of The American Medical Association, 311,* 2387-2396. doi:10.1001/jama.2014.5616

Powell, K. E., Paluch, A. E., & Blair, S. N. (2011). Physical activity for health: What kind? How much? How intense? On top of what? *Annual Review of Public Health, 32,* 349-365. doi:10.1146/annurev-publhealth-031210-101151

Preacher, K. J. (2015). Advances in mediation analysis: A survey and synthesis of new developments. *Annual Review of Psychology, 66,* 825-852. doi: 10.1146/annurev-psych-010814-015258

Rebok, G. W., Carlson, M. C., Frick, K. D., Giuriceo, K. D., Gruenewald, T. L., McGill, S., . . . Fried, L. P. (2014). The Experience Corps®: Intergenerational interventions to enhance wellbeing among retired people. In F. A. Huppert, C. L. Cooper, F. A. Huppert, & C. L. Cooper (Eds.), *Interventions and policies to enhance wellbeing* (Vol. VI, pp. 307-329). Oxford, UK: Wiley-Blackwell.

Robertson, D. A., King-Kallimanis, B. L., & Kenny, R. A. (2016). Negative perceptions of aging predict longitudinal decline in cognitive function. *Psychology and Aging, 31*, 71-81. doi:10.1037/pag0000061

Robertson, D. A., Savva, G. M., King-Kallimanis, B. L., & Kenny, R. A. (2015). Negative perceptions of aging and decline in walking speed: A self-fulfilling prophecy. *Plos One, 10.* doi: 10.1037/t10401-000

Rodin, J. (1986a). Health, control, and aging. In M. M. Baltes & P. B. Baltes (Eds.), *The psychology of control and aging* (pp. 139-165). Hillsdale, NJ: Erlbaum.

Rodin, J. (1986b). Aging and health: Effects of the sense of control. *Science, 233,* 1271-1276. doi:10.1126/science.3749877

Rothermund, K., & Brandstädter, J. (2003). Age stereotypes and self-views in later life: Evaluating rival assumptions. *International Journal of Behavioral Development, 27,* 549-554. doi:10.1080/01650250344000208

Rothman, A. J. (2006). Initiatives to motivate change: A review of theory and practice and their implications for older adults. In L. L. Carstensen & C. R. Hartel (Eds.), *When I'm 64 (pp. 121-144).* Washington, DC: National Academies Press.

Rowe, J. W., & Kahn, R. L. (1997). Successful aging. *The Gerontologist, 37,* 433-440. doi:10.1093/geront/37.4.433

Rowe, J. W., & Kahn, R. L. (2015). Successful aging 2.0: Conceptual expansions for the 21st century. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 70B,* 593-596. doi:10.1093/geronb/gbv025

Rubin, D. C., & Berntsen, D. (2006). People over forty feel 20% younger than their age: Subjective age across the lifespan. *Psychonomic Bulletin & Review, 13,* 776-780. doi: 2048/10.3758/BF03193996

Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2012a). The relationship between change in self-perceptions of aging and physical functioning in older adults. *Psychology and Aging, 27,* 750-760. doi:10.1037/a0027578

Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2012b). Change in health and self-perceptions of aging over 16 Years: The role of psychological resources. *Health Psychology, 31,* 423-432. doi:10.1037/a0027464

Sargent-Cox, K. A., Anstey, K. J., & Luszcz, M. A. (2014). Longitudinal change of self-perceptions of aging and mortality. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 69B,* 168-173. doi:10.1093/geronb/gbt005

Sarkisian, C. A., Prohaska, T. R., Davis, C., & Weiner, B. (2007). Pilot test of an attribution retraining intervention to raise walking levels in sedentary older adults. *Journal of the American Geriatrics Society, 55,* 1842-1846. doi:10.1111/j.1532-5415.2007.01427.x

Sarkisian, C. A., Steers, W. N., Hays, R. D., & Mangione, C. M. (2005). Development of the 12-item expectations regarding aging survey. *The Gerontologist, 45,* 240-248. doi: 10.1093/geront/45.2.240

Schaie, K. W. (2016). Theoretical perspectives for the psychology of aging in a lifespan context. In K. W. Schaie & S. L. Willis (Eds.) *Handbook of the psychology of aging* (8th ed., pp. 1-10). New York, NY: Academic Press.

Schrack, J. A., Zipunnikov, V., Goldsmith, J., Bai, J., Simonsick, E. M., Crainiceanu, C., & Ferrucci, L. (2014). Assessing the "physical cliff": Detailed quantification of age-related differences in daily patterns of physical activity. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences, 69,* 973-979. doi:10.1093/gerona/glt199

Schulz, K. F., Altman, D. G., Moher, D., & CONSORT Group. (2010). CONSORT 2010 statement: Updated guidelines for reporting parallel group randomized trials. *Journal of Clinical Epidemiology, 63,* 834-840. doi:10.1016/j.jclinepi. 2010.02

Schumacher, J., Klaiberg, A., & Brähler, E. (2003). *Diagnostische Verfahren zu Lebensqualität und Wohlbefinden [Diagnostic techniques for the assessment of well-being and quality of life]*. Göttingen, Germany: Hogrefe.

Schwarzer, R., & Jerusalem, M. (1995). Generalized self-efficacy scale. In J. Weinman, S. Wright, & M. Johnston (Eds.), *Measures in health psychology: A user's portfolio*. Windsor, UK: NFER-NELSON.

Schwarzer, R., Lippke, S., & Luszczynska, A. (2011). Mechanisms of health behavior change in persons with chronic illness or disability: The Health Action Process Approach (HAPA). *Rehabilitation Psychology, 56,* 161-170. doi:10.1037/A0024509

Settersten, R. A., & Hagestad, G. O. (2015). Subjective aging and new complexities of the life course. In M. Diehl & H.-W. Wahl (Eds.), *Annual Review of Gerontology and Geriatrics: Vol. 35. Research on subjective aging: New developments and future directions* (pp. 29-53). New York, NY: Springer Publishing. doi: 10.1891/0198-8794.35.29

Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention-behaviour gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health, 20,* 143-160. doi: 10.1080/08870440512331317670

Spuling, S. M., Miche, M., Wurm, S., & Wahl, H.-W. (2013). Exploring the causal interplay of subjective age and health dimensions in the second half of life: A cross-lagged panel analysis. *Zeitschrift für Gesundheitspsychologie, 21,* 5-15. doi: 10.1026/0943-8149/a00084

Staudinger, U. M. (2015). Images of aging: Outside and inside perspectives. In M. Diehl & H.-W. Wahl (Eds.), *Annual Review of Gerontology and Geriatrics: Vol. 35. Research on subjective aging: New developments and future directions* (pp. 187-209). New York, NY: Springer Publishing. doi: 10.1891/0198-8794.35.187

Stephan, Y., Caudroit, J., Jaconelli, A., & Terracciano, A. (2014). Subjective age and cognitive functioning: A 10-year prospective study. *The American Journal of Geriatric Psychiatry, 22,* 1180-1187. doi:10.1016/j.jagp.2013.03.007

Stephan, Y., Chalabaev, A., Kotter-Grühn, D., & Jaconelli, A. (2013). "Feeling younger, being stronger": An experimental study of subjective age and physical functioning among older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 68,* 1-7. doi:10.1093/geronb/gbs037

Steverink, N., Westerhof, G. J., Bode, C., & Dittmann-Kohli, F. (2001). The personal experience of aging, individual resources, and subjective well-being. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 56,* P364-P373. doi: 10.1093/geronb/56.6.P364

Stewart, T. L., Chipperfield, J. G., Perry, R. P., & Weiner, B. (2011). Attributing illness to 'old age:' Consequences of a self-directed stereotype for health and mortality. *Psychology & Health, 27,* 889-897. doi:10.1080/08870446.2011.630735

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson.

Tennstedt, S., Howland, J., Lachman, M., Peterson, E., Kasten, L., & Jette, A. (1998). A randomized, controlled trial of a group intervention to reduce fear of falling and associated

activity restriction in older adults. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 53,* P384-P392. doi: 10.1093/geronb/53B.6.P384

Tian, Q., Studenski, S. A., Resnick, S. M., Davatzikos, C., & Ferrucci, L. (2016). Midlife and late-life cardiorespiratory fitness and brain volume changes in late adulthood: Results from the Baltimore Longitudinal Study of Aging. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences, 71,* 124-130. doi:10.1093/gerona/glv041

Timmer, E., Bode, C., & Dittmann-Kohli, F. (2003). Expectations of gains in the second half of life: A study of personal conceptions of enrichment in a lifespan perspective. *Ageing & Society, 23,* 3-24. doi:10.1017/S0144686X0200898X

Wahl, H.-W., Konieczny, C., & Diehl, M. (2013). Zum Erleben von altersbezogenen Veränderungen im Erwachsenenalter: Eine explorative Studie auf der Grundlage des Konzepts "Awareness of Age-Related Change (AARC)" [Experiencing age-related change in adulthood: An exploratory study of the concept of "Awareness of Age-Related Change (AARC)"]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie, 45,* 66-76.

Ware, J. E., Jr., Kosinski, M., Bjorner, J. B., Turner-Bowker, D. M., Gandek, B., & Maruish, M. E. (2007). *User's manual for the SF-36v2 Health Survey* (2nd ed.). Lincoln, RI: QualityMetric Incorporated.

Westerhof, G. J., & Barrett, A. E. (2005). Age identity and subjective well-being: A 'comparison of the United States and Germany. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 60,* S129-S136. doi: 10.1093/geronb/60.3.S129

Westerhof, G. J., Miche, M., Brothers, A. F., Barrett, A. E., Diehl, M., Montepare, J. M., . . . Wurm, S. (2014). The influence of subjective aging on health and longevity: A meta-analysis of longitudinal data. *Psychology and Aging, 29,* 793-802. doi: 10.1037/a0038016

Wethington, E. (2000). Expecting stress: Americans and the 'midlife crisis.' *Motivation and Emotion, 24,* 85-103. doi:10.1023/A:1005611230993

Whitbourne, S. K., & Willis, S. L. (Eds.). (2006). *The baby boomers grow up: Contemporary perspectives on midlife*. Mahwah, NJ: Erlbaum.

White House Conference on Aging. (2015). *Healthy aging policy brief.* Retrieved from http://www.whitehouseconferenceonaging.gov/blog/policy/post/healthy-aging-policy-brief.

Wolff, J. K., Warner, L. M., Ziegelmann, J. P., & Wurm, S. (2014). What do targeting positive views on ageing add to a physical activity intervention in older adults? Results from a randomised controlled trial. *Psychology & Health, 29*, 915-932. doi:10.1080/08870446.2014896464

Wurm, S., & Benyamini, Y. (2014). Optimism buffers the detrimental effect of negative self-perceptions of ageing on physical and mental health. *Psychology & Health, 29,* 832-848. doi:10.1080/08870446.2014.891737

Wurm, S., Tesch-Römer, C., & Tomasik, M. J. (2007). Longitudinal findings on aging-related cognitions, control beliefs, and health in later life. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 62,* P156-P164. doi: 10.1093/geronb/62.3.P156

Wurm, S., Tomasik, M. J., & Tesch-Römer, C. (2008). Serious health events and their impact on changes in subjective health and life satisfaction: the role of age and a positive view on ageing. *European Journal of Ageing, 5,* 117-127. doi: 10.1007/s10433-008-0077-5

Wurm, S., Tomasik, M. J., & Tesch-Römer, C. (2010). On the importance of a positive view on ageing for physical exercise among middle-aged and older adults: Cross-sectional and longitudinal findings. *Psychology & Health, 25,* 25-42. doi: 10.1080/08870440802311314

Wurm, S., Warner, L. M., Ziegelmann, J. P., Wolff, J. K., & Schüz, B. (2013). How do negative self-perceptions of aging become a self-fulfilling prophecy? *Psychology and Aging, 28,* 1088-1097. doi: 10.1037/a0032845

Wurm, S., Wolff, J. K., & Schüz, B. (2014). Primary care supply moderates the impact of diseases on self-perceptions of aging. *Psychology and Aging, 29,* 351-358. doi:10.1037/a0036248

APPENDIX 1.

AARC-50 Questionnaire Items by Domain and Valence

Domain	Valence	Item Text	Item #
Health and Physical Functioning	Positive	I pay more attention to my health.	5
		I pay more attention to eating healthy food.	25
		I take more time to focus on my physical shape.	29
		I pay more attention to regular physical exercise.	35
		I pay more attention to getting enough sleep.	43
	Negative	my ability to move around has gotten worse.	7
		I have less energy.	20
		my body needs rest more often.	22
		my physical ability is not what it used to be.	27
		I have more aches and pains in my body.	36
Cognitive Functioning	Positive	I have more experience and knowledge to evaluate things and people.	12
		I have more foresight.	21
		I gather more information before I make decisions.	33
		I have become wiser.	44
		I think things through more carefully.	49
	Negative	my mental capacity is declining.	3
		I am slower in my thinking.	9
		I have a harder time concentrating.	17
		learning new things takes more time and effort.	26
		I am more forgetful.	38

Domain	Valence	Item Text	Item #
Interpersonal Relations	Positive	others are treating me more respectfully.	1
		I appreciate relationships and people much more.	6
		my friendships and relationships have become stronger.	19
		I am more open toward other people.	39
		my family has become more important to me.	50
	Negative	people sometimes treat me as if I was not there.	11
		other people do things for me because they assume that I can't do them anymore.	30
		other people are more reserved toward me.	34
		I feel more dependent on the help of others.	42
		others are treating me with less patience.	45
Social-Cognitive and Social-Emotional Functioning	Positive	I recognize my own needs better.	10
		I have a better sense of what is important to me.	14
		I am more grateful for the things I have.	18
		I try to be more myself.	23
		I have grown in terms of my self-confidence.	41
	Negative	I am more anxious about the future.	4
		I think more about death and dying.	13
		I feel increasingly isolated from the world around me.	16
		I am sad more often.	24
		I find it harder to motivate myself.	47
Lifestyle and Engagement	Positive	I have more say in setting my daily routine.	8
		I enjoy life more consciously.	15
		I have more time for the things I enjoy.	31
		I enjoy many things more intensively.	37
		I have more freedom to live my days the way I want.	40
	Negative	I need more time for everything I do.	2

Domain	Valence	Item Text	Item #
		I don’t do as many things anymore.	28
		I feel less financially secure.	32
		I have to limit my activities.	46
		I am concerned what will happen once I can no longer do certain things.	48

APPENDIX 2.

The AARC-50 Questionnaire and SPSS Scoring Syntax

AARC-50

INSTRUCTIONS: This questionnaire contains statements on how a person may feel about getting older. We are interested in how YOU feel about getting older and what you can tell us about your own experiences. We are mostly interested in whether certain experiences apply to you and to what extent you can relate to them given that you may have experienced them yourself as the years have passed.

Please read each statement carefully and answer in the following way:

Not at all				Very much
1	2	3	4	5
O	O	O	O	O

- If a statement very much reflects your own experience, then you would fill in the circle under the number "5", which stands for ***"Very much."***
- If a statement does not reflect your own experience at all, then you indicate that by filling in the circle under the number "1", which stands for ***"Not at all."***
- If a statement reflects your experiences more than "a little bit" but less than "quite a bit," then you should mark the circle under the number "3", which stands for ***"Moderately."***

There are no "right" or "wrong" answers to the statements on this questionnaire. We are simply interested in your own personal experiences and your honest opinion.

Please read each statement carefully and then answer as spontaneously as possible.

	With my increasing age, I realize that …	**Not at all** 1	**A little bit** 2	**Moder-ately** 3	**Quite a bit** 4	**Very much** 5
1	… others are treating me more respectfully.	O	O	O	O	O
2	…I need more time for everything I do.	O	O	O	O	O
3	…my mental capacity is declining.	O	O	O	O	O
4	…I am more anxious about the future.	O	O	O	O	O
5	…I pay more attention to my health.	O	O	O	O	O

	With my increasing age, I realize that …	Not at all 1	A little bit 2	Moder-ately 3	Quite a bit 4	Very much 5
6	…I appreciate relationships and people much more.	O	O	O	O	O
7	…my ability to move around has gotten worse.	O	O	O	O	O
8	…I have more say in setting my daily routine.	O	O	O	O	O
9	…I am slower in my thinking.	O	O	O	O	O
10	…I recognize my own needs better.	O	O	O	O	O
11	…people sometimes treat me as if I was not there.	O	O	O	O	O
12	…I have more experience and knowledge to evaluate things and people.	O	O	O	O	O
13	…I think more about death and dying.	O	O	O	O	O
14	…I have a better sense of what is important to me.	O	O	O	O	O
15	…I enjoy life more consciously.	O	O	O	O	O
16	…I feel increasingly isolated from the world around me.	O	O	O	O	O
17	…I have a harder time concentrating.	O	O	O	O	O
18	…I am more grateful for the things I have.	O	O	O	O	O
19	…my friendships and relationships have become stronger.	O	O	O	O	O
20	…I have less energy.	O	O	O	O	O
21	…I have more foresight.	O	O	O	O	O
22	…my body needs rest more often.	O	O	O	O	O
23	…I try to be more myself.	O	O	O	O	O
24	…I am sad more often.	O	O	O	O	O
25	…I pay more attention to eating healthy food.	O	O	O	O	O
26	…learning new things takes more time and effort.	O	O	O	O	O
27	…my physical ability is not what it used to be.	O	O	O	O	O
28	…I don’t do as many things anymore.	O	O	O	O	O
29	…I take more time to focus on my physical shape.	O	O	O	O	O

	With my increasing age, I realize that …	Not at all 1	A little bit 2	Moder-ately 3	Quite a bit 4	Very much 5
30	…other people do things for me because they assume that I can't do them anymore.	O	O	O	O	O
31	…I have more time for the things I enjoy.	O	O	O	O	O
32	…I feel less financially secure.	O	O	O	O	O
33	…I gather more information before I make decisions.	O	O	O	O	O
34	…other people are more reserved toward me.	O	O	O	O	O
35	…I pay more attention to regular physical exercise.	O	O	O	O	O
36	…I have more aches and pains in my body.	O	O	O	O	O
37	…I enjoy many things more intensively.	O	O	O	O	O
38	…I am more forgetful.	O	O	O	O	O
39	…I am more open toward other people.	O	O	O	O	O
40	…I have more freedom to live my days the way I want.	O	O	O	O	O
41	…I have grown in terms of my self-confidence.	O	O	O	O	O
42	…I feel more dependent on the help of others.	O	O	O	O	O
43	…I pay more attention to getting enough sleep.	O	O	O	O	O
44	…I have become wiser.	O	O	O	O	O
45	…others are treating me with less patience.	O	O	O	O	O
46	…I have to limit my activities.	O	O	O	O	O
47	…I find it harder to motivate myself.	O	O	O	O	O
48	…I am concerned what will happen once I can no longer do certain things.	O	O	O	O	O
49	…I think things through more carefully.	O	O	O	O	O
50	…my family has become more important to me.	O	O	O	O	O

AARC-50 SPSS Scoring Syntax.

Created by Brothers, A., Miche, M. Wahl, H.-W., Diehl, M. 2014.

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/* Notes: Use mean substitution for scales with less than 20% missing data.

COMPUTE PP= SUM.5(aarc5, aarc25,aarc29,aarc35,aarc43).
EXECUTE.

COMPUTE PN= SUM.5(aarc7, aarc20,aarc22,aarc27,aarc36).
EXECUTE.

COMPUTE CP= SUM.5(aarc12, aarc21,aarc33,aarc44,aarc49).
EXECUTE.

COMPUTE CN= SUM.5(aarc3, aarc9,aarc17,aarc26,aarc38).
EXECUTE.

COMPUTE IP= SUM.5(aarc1, aarc6,aarc19,aarc39,aarc50).
EXECUTE.

COMPUTE IN= SUM.5(aarc11, aarc30,aarc34,aarc42,aarc45).
EXECUTE.

COMPUTE SP0= SUM.5(aarc10, aarc14,aarc18,aarc23,aarc41).
EXECUTE.

COMPUTE SN= SUM.5(aarc4, aarc13,aarc16,aarc24,aarc47).
EXECUTE.

COMPUTE LP= SUM.5(aarc8, aarc15,aarc31,aarc37,aarc40).
EXECUTE.

COMPUTE LN= SUM.5(aarc2, aarc28,aarc32,aarc46,aarc48).
EXECUTE.

COMPUTE GAIN=SUM.25(aarc5, aarc25,aarc29,aarc35,aarc43,aarc12, aarc21,aarc33,aarc44,aarc49,aarc1,
aarc6,aarc19,aarc39,aarc50,aarc10,aarc14,aarc18,aarc23,aarc41,aarc8, aarc15,aarc31,aarc37,aarc40).
EXECUTE.

COMPUTE LOSS=SUM.25(aarc7, aarc20,aarc22,aarc27,aarc36,aarc3, aarc9,aarc17,aarc26,aarc38,aarc11,
aarc30,aarc34,aarc42,aarc45,aarc4, aarc13,aarc16,aarc24,aarc47,aarc2, aarc28,aarc32,aarc46,aarc48).
EXECUTE.
```