

DISSERTATION

GAMMA, BETA, AND ALPHA CHANGE IN INDIVIDUALS
FOLLOWING A DEVELOPMENTAL ASSESSMENT CENTER

Submitted by

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In partial fulfillment of the requirements

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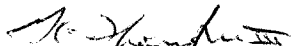
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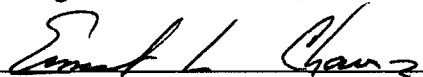
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DISSERTATION ABSTRACT

GAMMA, BETA, AND ALPHA CHANGE IN INDIVIDUALS
FOLLOWING A DEVELOPMENTAL ASSESSMENT CENTER

Despite widespread application of the assessment center method to diagnosis and development, little is known about how participants' understanding of the dimensions tapped by the process is affected following their participation. Using the method outlined by Terborg, Maxwell, and Howard (1980) to measure alpha, beta, and gamma change (Golembiewski, Billingsley, & Yeager, 1976), the presence of each of these three conceptually distinct types of change was assessed for mid-level managers following participation in a developmental assessment center. In addition, the role of trait goal orientation was hypothesized as a potential correlate of change type.

The results lend support to a tripartite conception of change, in that participants differentially exhibited gamma, beta, and alpha change in each of the six dimensions assessed by the center. Further, the tripartite model was found to yield substantially different conclusions than the traditional (i.e., pre versus post) measurement of change with respect to both the frequency and nature of the changes observed. Consistent with predictions, the current findings also suggest that learning orientation may be associated with beta change and performance goal orientation may be associated with alpha change. Additional supplemental analyses revealed that emotional stability, and to a lesser extent,

general cognitive ability, may also be associated with the nature of the change observed.

The implications of this study for both developmental assessment centers and the measurement of individual-level change are discussed.

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CHAPTER I

INTRODUCTION

Managerial researchers and practitioners have long recognized the value of assessment centers. Though traditionally utilized for selection and promotion decisions, the assessment center method is increasingly being applied to other human resource functions, most notably in the areas of employee diagnosis and development (Ballantyne & Povah, 1995; Iles, Robertson, & Rout, 1989; Lee & Beard, 1994). A 1997 survey of 215 organizations which used assessment centers revealed that slightly over half of these organizations (51.2%) utilized assessment center data for development planning purposes, with 39.2% of the respondents indicating development activities as a key reason for initially developing the assessment center (Spsychalski, Quinones, Gaugler, & Pohley, 1997). It is likely that these numbers are even greater today. The empirical investigation of developmental assessment centers, however, is still in its infancy, and the research conducted to date does not match the speed with which developmental assessment centers are being applied in practice. Although a critical goal of developmental assessment centers is to facilitate a better understanding of key performance attributes, surprisingly little is known about the actual impact of the process on participant cognitions, including individual differences in participants' responses to assessment, feedback, and developmental recommendations. The goal of this study, therefore, is to investigate the effects of participation in a developmental assessment

center on individuals' understanding of the assessed constructs and explore the potential role of motivation in affecting these outcomes.

Developmental Assessment Centers: The State of the Field

The growing popularity of developmental assessment centers can be attributed, in part, to current trends in the nature of work and careers. The work environment is becoming increasingly dynamic, resulting in jobs with rapidly changing skill requirements and a need for adaptability and flexibility among workers (Arnold, 1997; Pulakos, Arad, Donovan, & Plamondon, 2000), and many organizations are coming to perceive the assessment and development of employee competencies as having strategic value (Tillema, 1998). Organizational structures have also become both leaner and flatter, often leading to the broadening of job tasks and personal accountability but allowing fewer opportunities for promotion (Arnold, 1997). Thus, there is a need for activities that will enable employees to become more effective within the context of their current position. Consistent with these trends, a greater emphasis has been placed on employee empowerment, and organizations are encouraging individuals to take personal responsibility for their own growth and improvement (Ballantyne & Povah, 1995; Howard, 1995).

As assessment centers provide a wealth of data regarding participants' relative strengths and weaknesses with respect to job- and organizationally-relevant attributes, the application of the method to developmental purposes certainly has intuitive appeal (Ballantyne & Povah, 1995; Howard, 1997). It has been suggested that participation in the assessment process can facilitate self-insight (Byham, 1971), learning (Byham, 1971; Dodd, 1977), and behavioral change (Jones & Whitmore, 1995). Further, existing

research indicates assessment centers used for decision making purposes have demonstrated validity in predicting performance (Gaugler, Rosenthal, Thornton, & Bentson, 1987), are face valid (e.g., Howard, 1997), and are typically perceived favorably by participants, assessors, and organizations (e.g., Dodd, 1977; Dulewicz, 1991; Thornton, 1992).

Despite current enthusiasm among practitioners, there is little empirical evidence which directly supports the utility of developmental assessment centers. To a great degree, expectations are based instead on a series of assumptions drawn from research conducted within the context of their more traditional counterparts (Ballantyne & Povah, 1995; Carrick & Williams, 1999). Moreover, the ease with which assessment centers can be modified to meet varying needs of the organization and its employees (Howard, 1997) has likely contributed to a perception that a traditional assessment center can readily be used for developmental purposes, evidenced in the growing number of “hybrid” centers with the dual purpose of assessment and development (Carrick & Williams, 1999). However, there are certain common practices as well as critical variations in both purpose and content which serve to distinguish assessment centers used for developmental purposes from those used for more traditional purposes (Ballantyne & Povah, 1995; Joiner, 2002; Thornton, 1992). For example, developmental assessment centers are focused on facilitating long-term improvements rather than meeting the short-term needs of the organization (Boehm & Hoyle, 1977). The competencies considered for evaluation within a developmental assessment center must therefore be carefully chosen to ensure that they are skills or attributes that are conceptually distinguishable and can be developed or improved upon by the participant (Ballantyne & Povah, 1995; Thornton,

1992; Thornton & Rogers, 2001). Further, greater emphasis is placed on the provision of high quality behavioral feedback, opportunity for practice, and longer-term developmental planning rather than the accuracy of ratings and personnel decision making (Joiner, 2002; Kudisch, Ladd & Dobbins, 1997; Thornton, 1992). In light of these differences, a clear need arises for research that directly examines critical characteristics and key assumptions of developmental assessment centers within the appropriate context. The current study seeks to address one of the more fundamental assumptions of developmental assessment centers: that participation in the process will facilitate a change in individuals' understanding of evaluated constructs. Further, the study investigates how motivational tendencies to pursue learning- or performance-oriented goals might affect the nature of change that occurs.

Developmental Assessment Centers as a Means to Elicit Change

Developmental assessment centers are often touted as an effective tool to help individuals strengthen relevant skills and competencies and ultimately improve their performance. Implicit in this argument is the fundamental assumption that an effective developmental assessment center will facilitate a change in participants, such as an increased self-awareness with respect to the relevant attributes or dimensions being assessed (Van Velsor, Taylor, & Leslie, 1993). Although there is evidence suggesting participants do at least perceive the process as having the capacity to facilitate self-development and insight (Arnold, 2002; Kraut, 1972), few studies have directly addressed the validity of this contention. Schmitt, Ford, and Stults (1986) observed significant changes in participant self-ratings of ability taken prior to and following participation in an assessment center on five of eight assessed dimensions, which

suggests the process may indeed affect self-perceptions. Fletcher and his colleagues (Fletcher & Kerslake, 1992; Halman & Fletcher 2000) investigated changes in self-assessment accuracy by correlating participant self-ratings of performance with the ratings made by assessors. Fletcher & Kerslake (1992) found no relationship between assessor and participant ratings made prior to participation in an assessment center; however, assessor and participant ratings were correlated for four of the seven assessed dimensions for self-ratings taken immediately following the process, and for two of seven dimensions for self-ratings made 6 months later after feedback had been received. They also found that participants who performed well in the assessment center showed greater self-assessment accuracy post-participation than did participants classified as “unsuccessful” in the process. In a similar study, Halman and Fletcher (2000) observed congruence between assessor and pre-participation self-ratings for only two of ten dimensions for self-ratings made prior to a developmental assessment center, but for six of ten dimensions following participation in the process and receipt of feedback.

The results of these studies, while informative, provide only limited insight. Only one study (Halman & Fletcher, 2000) was conducted within the context of what could be considered a “true” developmental assessment center. The assessment center used in the Schmitt et al. (1986) study was designed for selection purposes, and candidates had received no feedback regarding their performance at the time post-participation ratings were made. Although Fletcher and Kerslake (1992) conducted their study on an assessment center that incorporated the provision of feedback to candidates, the feedback typically was not provided until at least 4 weeks following the assessment center. More importantly, the process still involved an element of selection in that ratings were used to

facilitate the identification of management potential. As the context of the assessment center may affect elements such as participant behavior during the process, feedback receptiveness, motivation, and later developmental activities (Arnold, 1997), it cannot be presumed that the same types of changes will be observed in participants regardless of the primary purpose assessment center.

Further, each study described above defined or measured change in participants as a function of the scores provided by assessors. The impact of the process on self-perceptions was analyzed by Schmitt et al. (1986) by entering pre-assessment self-ratings and assessor ratings, respectively, into a regression equation to predict post-assessment self-ratings. Change was inferred by examining partial correlations and beta weights associated with the ratings given by assessors for each exercise. Thus, the observed changes self-ratings of ability were rooted in performance rather than participation per se. Fletcher and Kerslake (1992) and Halman and Fletcher (2000) examined changes in the extent of agreement between ratings made by participants and assessors, interpreting higher correlations as indicative of increased accuracy in participant self-perceptions, or self-awareness. Although congruence between participants and assessors may have implications for feedback acceptance (Meyer, 1980) and the motivation to engage in subsequent developmental activities (Noe & Steffy, 1987), it reveals little about the impact of the process on the participants themselves.

The dearth of research investigating developmental assessment centers as a means to effect changes in participant self-assessments is surprising, particularly given that they seem to be an ideal setting for the formation and testing of such hypotheses (Heneman, 1980). There is a clear need for research that investigates whether participation in a

developmental assessment center alters participants' awareness or understanding of the actual constructs being assessed, independently of the ratings provided by assessors. Such insight reflects cognitive change at the individual level, and Golembiewski, Billingsley, and Yeager (1976) argue that it may manifest itself in multiple ways. An observed change in self-ratings may be reflective not only of a perceived change in proficiency, but of a new understanding of the meaning of the assessed dimensions, and each of type of change should be considered in order to have a better understanding of how individuals respond to a given intervention. The measurement of these changes, however, is difficult, and perhaps as a result, the concept has received little attention in published research. This is unfortunate, as consideration of different types of change can facilitate a better and more accurate understanding of how individuals respond to developmental assessment centers. The current study therefore adopts Golembiewski et al.'s model of defining and understanding change, applying it at the level of the individual, to describe the impact of developmental assessment centers on participants. The following sections describe this model in greater detail as well as a method for the measurement of alpha, beta, and gamma change at the individual-level.

The Tripartite Model as a Framework for Understanding Change

Golembiewski, Billingsley, & Yeager (1976) distinguish among three types of change that might occur as a function of an intervention. The first is *alpha change*, or changes in the level of a given variable or construct along a constantly calibrated instrument. Alpha changes are the most commonly recognized and studied. Most often, its assessment conforms to an experimental design where a measure of some criterion, such as a self-assessment of one's performance, is taken before and after a given

procedure or intervention, and change is assessed by calculating an index of change, such as a mean shift (e.g., Vandenberg & Self, 1993). Such changes reflect a true or real movement from one level of a constantly defined construct to another given a constantly calibrated instrument. In other words, it reflects a change within a fixed system – such as an actual improvement in one’s level of proficiency. By contrast, *beta change* involves the respondent’s subjective recalibration of the intervals comprising the measurement continuum, though the conceptual definition of the construct itself remains the same. Essentially, beta change reflects differences in how the rating scale is interpreted by an individual across administrations – the intervals between measurement anchors may expand or contract such that a statistically significant change in rating does not necessarily reflect an observable change in state, nor would a change in state necessarily be reflected in a change in ratings (e.g., Millsap & Hartog, 1988; Vandenberg & Self, 1993). To illustrate, an individual may perceive a self-rating of 2 on a 5-point scale following participation in a developmental assessment center in the same manner that he or she interpreted a rating of 3 on the same scale prior to the process (Vandenberg & Self, 1993). In other words, the participant learns that what he or she initially believed was “average” performance actually reflects performance slightly below that desired from the typical employee. In this case, a simple interpretation of difference scores would have indicated a negative impact of the intervention (i.e. the participant’s self-rating changed from 3 to 2). Closer inspection, however, might reveal that the individual actually had a different and perhaps more realistic perspective regarding the assessed construct after participating in the process. This suggests a more positive interpretation of the intervention (Golembiewski et al., 1976). The third type of change, *gamma change*,

reflects the reconceptualization of the construct itself, a fundamental change in its meaning, following some form of intervention. Here, change reflects a new understanding or perspective regarding a given construct – a shift from one psychological state to another. In the case of gamma change, there exists no constancy of the construct itself, rendering the simple interpretation of difference scores essentially meaningless.

In the decade following Golembiewski et al.'s (1976) introduction of the tripartite model of change, there was a small flurry of research dealing with issues related to its understanding and measurement. Some initial responses to the model were ones of avoidance and control, in that they tended to treat beta and gamma changes as errors: potential contaminants of change measurement that complicated the accurate interpretation of difference scores. Lindell and Drexler (1979), for example, argued that both response scale recalibration (beta change) and changes in construct meaning (gamma change) could be avoided through the development and use of psychometrically sound scales, particularly the use of multiple item scales and behavioral anchors at scale endpoints. By and large, however, a review of the literature in the area indicates both general acceptance and empirical support for the validity of the concept (Golembiewski, 1989, 1997; Tennis, 1989). Further, the model has some rather important implications for the understanding of developmental assessment centers. By considering multiple types of change, it becomes possible to better identify the specific effects of the process on participants, thus facilitating a more accurate conception of how the process operates. Further, the model allows for a more thorough and precise evaluation of the effectiveness of a given developmental assessment center. In many developmental activities, scale recalibration (beta change) or changes in construct understanding (gamma change) may

actually reflect legitimate goals of the process (Armenakis, Buckley, & Bedeian, 1986; Golembiewski et al., 1976). In such cases, the investigation of gamma, beta, and alpha change may allow for a more precise evaluation of the effectiveness of the process.

Assessing Gamma, Beta, and Alpha Change

Factor analytic techniques. Various methods have been proposed for operationalizing and identifying alpha, beta, and gamma change given self-report scores on pre- and post- intervention measures. Several of the proposed methods involve factor analytic techniques, whereby gamma change is inferred by examining changes in the number or structure of factors from Time 1 to Time 2 (e.g., Golembiewski et al., 1976; Schmitt, 1982; see also Millsap & Hartog, 1988; Schaubroeck & Green, 1989; Zmud & Armenakis, 1978) and beta change is assessed by examining changes in factor loadings (Schmitt, 1982) or in the variances of the construct (Schaubroeck & Green, 1989) from Time 1 to Time 2. If neither gamma nor beta changes are present, alpha change can last be assessed using the more “traditional” statistical means, such as analysis of variance or *t*-tests (Vandenberg & Self, 1993). The application of these methods has shown some promise in identifying the potential presence of gamma and beta change and demonstrating the effect that concept reconceptualization or scale recalibration might have on the interpretation of alpha change (e.g., Millsap & Hartog, 1988; Rice & Contractor, 1990; Schaubroeck & Green, 1989; Vandenberg & Self, 1993).

However, there are two key considerations associated with the use of such techniques which may render them problematic for many practical purposes. First, factor analytic methods require a large sample size in order to obtain reliability – researchers have recommended that the sample size exceed 600 (Schaubroeck & Green, 1989;

Vandenberg & Self, 1993). In many studies, particularly those in applied settings, the availability of a relatively small sample makes the use of these methods inappropriate (Terborg, Howard, & Maxwell, 1980). Further, when sample size is sufficiently large, many goodness of fit tests can indicate statistical significance when no practical significance exists (Millsap & Hartog, 1988) leading to erroneous conclusions.

Second, these methods involve comparison of means and factor structure at the level of the group, overlooking potentially relevant information which might be gleaned from examining change at the individual level. In any given self-assessment taken prior to and following an intervention, it can be expected that, at the very least, there will be variations in the magnitude of change reported across individuals. Thus, a large amount of change exhibited by only a few individuals following a given developmental effort may be taken as evidence that the intervention had a group effect. The matter is further complicated when individual differences in the *types* of change is taken into account – some individuals may exhibit gamma change, while others show beta, alpha, or no change at all. Alpha and beta change occurring in a subset of individuals, for example, might translate into changes in factor structure when the data are aggregated, leading to the conclusion that gamma change had occurred when in fact it had not (Lindell & Drexler 1979, 1980). Perhaps more relevantly, however, individual-level change should be examined because it allows for a more precise investigation of change (Terborg et al., 1980). Researchers might find it useful to know for which individuals a certain type of change occurred following a given intervention, as might be the case when managers at different organizational levels or with varying years of experience participate in a developmental assessment center. Further, by examining such differential effects, a

developmental intervention might be better evaluated and tailored to meet the needs of each participant (e.g., Terborg et al., 1980). In the case of developmental assessment centers, then, it seems more relevant to assess change at the level of the individual.

Profile comparisons using “Then” ratings. Terborg, Howard, and Maxwell (1980), drawing from research by Howard and colleagues (Howard & Dailey, 1979; Howard, Schmeck, & Bray, 1979) explicitly addressed the problems discussed above by proposing an alternative method of assessing gamma, beta, and alpha change that can readily be used with small sample sizes and allows for analysis at the individual level. Their method involves the use of “Then” ratings, retrospective self-report measures taken at the same time as the post-intervention measures which require respondents to report how they perceived themselves with respect to a given dimension *prior to the intervention* (i.e., before their participation in the developmental assessment center). The three measures are then examined for each individual via profile analysis, whereby pairs of profiles are compared with respect to their levels (means), shapes (correlations), or dispersions (standard deviations). Specific variations or patterns of responses observed across these scales can then be interpreted as evidence for the various types of change.

The logic and use of this method can be illustrated by describing the assessment of beta and alpha change with respect to a construct measured by a unidimensional, multiple-item scale. If an intervention, such as participation in a developmental assessment center, led to an individual’s recalibration of this scale, such change would be reflected as a difference in the levels of the profile – the mean scores for the scales taken prior to and following participation would differ. That is, the individual would shift his or her responses up or down along the scale while maintaining the overall response

pattern. A simple comparison of Pre and Post measures might mask the presence of beta change, because it involves the comparison of self-ratings taken prior to the intervention with self-ratings made following the intervention, thus also potentially reflecting true change (alpha change). Then ratings, however, ask the participant to report his or her performance prior to their participation, theoretically partialling out the effect of alpha change that might occur as a result of the intervention. Thus, beta change can theoretically be assessed by comparing the mean scores of Pre and Then measures, with a difference between the two indicating scale recalibration has occurred for the individual. In the case of alpha change, again, Pre and Post comparison may result in erroneous conclusions, as the two measures may reflect a combination of beta and alpha change. However, because the Post and Then ratings are taken in close proximity to each other, they should be made according to a common metric, and thus be unaffected by scale recalibration or beta change (Terborg et al., 1980). Thus, alpha change can be assessed by comparing the mean scores of Post and Then measures, with a difference interpreted as indicative of behavioral change occurring following the intervention.

The evaluation of the presence of gamma change, while slightly more complex, is based on a similar logic and involves the examination of the shapes (correlations) and dispersions (standard deviations) of the profiles, which is done by analyzing pairs of the three ratings. In the case of gamma change, the construct is perceived differently by the individual at Time 2 than it was at Time 1. Thus, the correlation between items on the Then and Post measures, both taken at Time 2, should be higher than the correlation of the items of both Pre and Then ratings and Pre and Post ratings. Similarly, the presence of gamma change could also be inferred by comparing the item standard deviations

across the three profiles. Specifically, gamma change is inferred if the standard deviations of the Post and Then profiles are similar to each other, but each is different from that of the Pre profile.

The Terborg et al. (1980) method of conceptualizing and measuring gamma, beta, and alpha change has been applied to the investigation of change with some degree of success. In an investigation of the nature and type of change in individuals following their participation in an assertiveness training program, Birkenbach (1986) demonstrated the utility of the technique to identify change in individuals that would not have been detected through traditional means. One-third of his participants who exhibited no change on the basis of Pre and Post comparisons, for example, exhibited scale recalibration (beta change) when Pre and Then measures were compared, providing evidence that the method enabled a more in-depth understanding of the program's effect on participants. Similar results were obtained by Rogers and Thornton (2003), who used this method to examine change in students as a result of a course project designed to facilitate a better understanding of key educational objectives. Randolph and Elloy (1989) compared the Terborg et al. procedure to the statistical method proposed by Golembiewski et al. (1976), reporting that despite some differences, the two methods yielded rather similar conclusions. In a similar vein, Schmitt, Pulakos, & Lieblein (1984) found that the method yielded conclusions at the group level in line with the factor analysis methodology used by Schmitt (1982), and argued that either could be used in assessing change, depending on the nature of the study and goals of the researcher.

However, the use of Then ratings naturally raises some concern regarding their actual accuracy and utility in drawing conclusions about the presence of gamma, beta,

and alpha change. Comparison of Then and Post ratings, for example, often yields substantially different conclusions than traditional Pre and Post comparisons (Birkenbach, 1986). Yet several studies provide evidence that Then and Post comparisons yield the more accurate estimate of change, in that they are better aligned with objective, external criteria, such as ratings made by independent judges and performance tasks (Hoogstraten, 1982, 1985; Howard & Dailey, 1979; Howard et al., 1979; Pratt, McGuigan, & Katzev, 2000). Further, Then ratings appear to be unaffected by response biases such as social desirability or acquiescence due to collecting Post and Then measures in close proximity, nor do they seem affected by systematic memory distortion or biases from the recall of pre-intervention levels (Bray & Howard, 1980).

The Role of Goal Orientation in Predicting Change Type

Recognizing that individuals may differentially exhibit alpha, beta, and gamma change as a function of a given developmental intervention, the question arises as to whether individual-difference variables may play a role in predicting the type of change that occurs. Both gamma and beta changes reflect a new and deeper understanding of a given construct, thus, it would seem more likely to observe these changes among individuals who are motivated to learn and develop. The current study explored this possibility by examining the role of trait goal orientation as a correlate of the type of change observed.

The concept of goal orientation emerged from theory and research by Nicholls (1984) and Dweck and colleagues (Dweck & Elliot, 1983; Dweck & Leggett, 1988), who postulated that individuals hold dispositional tendencies toward goal preferences in achievement related settings. These researchers identified two broad classes of goal

orientations: (a) a learning goal orientation, characterized by the desire to increase one's competence and acquire or develop one's skill and ability through mastering a challenging task, and (b) a performance goal orientation, associated with a focus on demonstrating one's competence and ability by gaining favorable evaluations and avoiding unfavorable ones. The type of goal held is believed to affect how individuals interpret and respond to various tasks, predisposing the individual toward cognitive strategies and behaviors which serve to facilitate the attainment of learning- or performance-relevant goals. Research indicates that the two orientations are separate constructs, rather than opposing ends on a single trait continuum, thus individuals may exhibit aspects related to each type of orientation (Button, Matthieu, & Zajac, 1996).

A growing body of theory and research highlights the potential practical implications of goal orientation for development activities, with more advantageous results typically associated with a learning goal orientation. For example, each goal orientation has been associated with differing perceptions of effort expenditure (Ames, 1992; Ames & Archer, 1988). As a learning goal orientation involves a concern for an increase in competence, individuals who hold this orientation are more likely to perceive effort as a means to facilitate not only task success, but the further strengthening of relevant skills and abilities. Conversely, within the context of a performance goal orientation, effort is viewed as indicative of a lack of ability, in that those who possess the requisite skill should not need to put forth a great deal of effort to successfully perform a task. In addition, individuals who adopt learning goals seem more likely than those who adopt performance goals to utilize task-related strategies which facilitate understanding of material (Nolen, 1988; Nolen & Haladyna, 1990), employ effective

goal-setting and self-regulation tactics (Ames & Archer, 1988; Miller, Beherens, Green, & Newman, 1993; VandeWalle, Brown, Cron, & Slocum, 1999), and persevere when faced with challenges (Dweck & Leggett, 1988). Further, learning goal orientation has also been positively linked with feedback seeking behavior (Tuckey, Brewer, & Williamson, 2002; VandeWalle & Cummings, 1997; VandeWalle, Ganesan, Challagalla, & Brown, 2000) solicitation of help (Middleton & Midgely, 1997; Ryan & Pintrich, 1997), and transfer of training (Ford, Smith, Weissbein, Gully, & Salas, 1998).

It has been suggested that those who are motivated to learn from their participation in an assessment center may be more likely to benefit from the process (Boehm, 1985), and there is some evidence suggesting that goal orientation may impact assessment center performance. Fletcher (1991) examined achievement-related variables in assessment center participants, including the variables of mastery and competitiveness, which are conceptually related to learning and performance goal orientation, respectively. Though both variables were positively and significantly related to assessment center performance, mastery showed a higher correlation than did competitiveness. Further, successful candidates showed higher levels of mastery and lower levels of competitiveness prior to their participation in the assessment center than did unsuccessful candidates.

Within the context of developmental assessment centers, then, participants who hold a learning goal orientation may very well respond to the process differently than their performance oriented counterparts. Of primary interest in the current study is the potential relationship between learning goal orientation and the presence of gamma or beta change. Because individuals who hold a learning goal orientation tend to exhibit

many of the characteristics associated with personal growth and development, including beliefs that ability can be strengthened, the willingness to expend effort to do so, and cognitive and behavioral tendencies that facilitate the learning process, it might be expected that these individuals are more likely than those with a performance orientation to change their understanding of the assessed constructs. In other words, individuals who hold a learning goal orientation may be more likely to exhibit beta or gamma change following their participation in a developmental assessment center. Performance oriented individuals, in contrast, should be less likely to exhibit these changes, as their primary aim is to demonstrate their competence or show a visible improvement with respect to a given dimension or construct. Thus, even if these individuals understand that the process will not be used for selection decisions or to otherwise classify participants, they may try to avoid making mistakes, even at the expense of a deeper level of learning, so that they can convey a positive image. For this reason, individuals strong in performance orientation may show a tendency to exhibit alpha change. The current study examined this possibility by correlating learning and performance goal orientation with the type of change observed across participants. It was hypothesized that learning goal orientation would exhibit higher correlations with the presence of gamma and beta change than would performance goal orientation. Performance goal orientation, in contrast, was expected to show a higher correlation with the presence of alpha change.

Summary of the Goals of the Study

The primary purpose of this study was to assess whether participants in a developmental assessment center change their understanding of the assessed constructs following their participation in the process. To do so, Golembiewski et al.'s (1976)

tripartite model of change was applied, which allowed not only for the investigation of *if* change occurred, but for the specification of *what type* of change (alpha, beta, or gamma) was observed. Because development is essentially an individualized process, the study focused on individual-level change, enabling a more precise investigation of change as well as the possible illustration of how a single developmental assessment center might have differential effects on participants. In addition, the role of goal orientation as a correlate of change type was explored, with learning goal orientation hypothesized to be related to the presence of gamma and beta changes and performance orientation hypothesized to correlate with the presence of alpha change.

CHAPTER II

METHOD

Overview

The data in this study were collected as part of a large-scale effort involving the creation, implementation, and empirical investigation of a managerial developmental assessment center. Located on the campus of a large Midwestern university, the center was designed to provide mid-level supervisors and managers with the opportunity to develop relevant managerial competencies. It was open to companies in both the private and public sector, and was offered at no charge to participating organizations. A key feature of the center was the fact that it was external to participants' organizations, thus allowing assessment and development to occur in a penalty-free environment. None of the information collected through the center was used for personnel decision making, and the feedback provided to participants was completely confidential.

As part of the process, participants were asked to complete a variety of self-report measures and questionnaires approximately one week prior to and one month following their participation. They were informed that this information was being collected for research purposes only and were assured that their responses would not be used by assessors or shared with any member of their organization.

Participants

One hundred mid-level supervisors and managers from eleven private and public sector organizations participated in the center between October 2003 and April 2004.

Individuals who failed to provide complete and usable data both prior to and following their participation in the process had to be excluded from analysis. This resulted in a total sample size of 28 individuals representing 6 organizations (4 private sector, 2 public sector). A variety of industries were represented, including county- and state-level services, research and engineering, industrial technology, customer management, and financial services. Participants were primarily male (61%) and white (93%), and the average age of participants was 37.54 years ($SD = 7.12$ years). The majority of participants (93%) held at least a college undergraduate degree, and 75% reported they held a position in middle management. Participants had been in the workforce on the average of 15.62 years ($SD = 8.19$). The mean tenure at the participants' current company was 5.97 years ($SD = 5.10$ years) and the mean tenure on their current job was 3.81 years ($SD = 4.80$).

Preliminary analyses were conducted to examine whether differences existed between participants who were included versus excluded in the current study. Although differences were observed with respect to age (M included = 37.54, $SD = 7.12$; M excluded 42.71; $SD = 8.01$), $t(98) = -2.99$, $p = .003$ and cognitive ability as measured by the Wonderlic Personnel Test (M included = 30.39 $SD = 5.36$; M excluded = 27.71, $SD = 5.31$), $t(98) = 2.27$, $p = .026$, additional examination also revealed variations in these variables as a function of the organization with which the participant was affiliated. Further, the three organizations with the greatest number of participants in the developmental assessment center (58% of the total sample) also exhibited the lowest collective response rate (16%) with respect to providing full and complete data. This implies that the primary differentiator between participants who were included or

excluded in the current study was the employing organization rather than systematic characteristics of responders versus non-responders.

Developmental Assessment Center

The developmental assessment center used in this study was conducted approximately four times per month, accommodating up to 6 participants at a time. The center lasted 1 day and consisted of two blocks of three exercises. Each block was set within the context of a fictitious company in which participants were to assume a managerial role, with the three exercises comprising the block depicting specific scenarios within the company that required the participant to take some form of action. Participants were assessed along six primary dimensions representing a variety of managerial performance areas, with each dimension evaluated twice in each block of exercises. They received verbal feedback from the assessors on their performance with respect to the assessed dimensions following each block of exercise.

The dimensions on which participants were assessed were drawn from a list of 16 primary dimensions identified by prior research as both important to managerial performance and amenable to development by participants (Rupp, Gibbons, Runnels, Anderson, & Thornton, 2003). The subset of dimensions included in the developmental assessment center were selected based on their relative importance and ease of development as reported in Rupp et al. (2003) and consideration of how readily they could be elicited and accurately evaluated through a simulation exercise. These dimensions were information seeking, problem solving, planning and organizing, conflict management/resolution, leadership, and oral communication. Dimension definitions are

provided in Table 1. Care was taken to ensure the dimensions were behaviorally-defined and sufficiently distinguishable from one another.

Table 1
Developmental Assessment Center Dimensions and Definitions

Dimension	Definition
Information seeking	Actively seeks information from multiple sources; identifies and finds relevant and essential information needed to solve a problem; organizes data into meaningful patterns; gathers data; effectively analyzes and uses data and information.
Problem solving	After gathering pertinent information, identifies problems and uses analysis to perceive logical relationships among problems or issues; develops and evaluates courses of action to determine costs and benefits of each; makes timely and logical decisions; evaluates the outcomes of a problem solution.
Planning and organizing	Effectively schedules own work and time, by handling multiple demands; establishes a system for monitoring tasks, activities, or responsibilities of self or others to assure accomplishment of specific objectives; determines priorities and allocates time and resources effectively by recognizing time limitations; makes effective short-and long-term plans; handles administrative detail.
Conflict management/resolution	Recognizes and openly addresses conflict appropriately; Arrives at constructive solutions while maintaining positive working relationships.
Leadership	Guides, directs, and motivates others toward important and challenging work in line with their interests and abilities as well as the needs of the organization; Gives regular, specific and constructive feedback to others in relation to their personal goals; Commands attention and respect; Promotes positive change by setting goals and priorities that are in line with the common vision of the organization.
Oral communication	Expresses thoughts verbally and nonverbally in a clear, concise, and straightforward manner that is appropriate for the target audience whether in a group or individual situation.

Note. Dimension definitions derived from Rupp, Gibbons, Runnels, Anderson, & Thornton (2003).

The exercises in the center were developed by a team of researchers experienced in assessment center methodology. Exercises for both blocks were similar in structure, consisting of a leaderless group discussion, a written case study and oral presentation, and an interview simulation. Additionally, each exercise evaluated the same four dimensions in both blocks. The specific dimensions assessed by each exercise are

presented in Table 2. In the group discussion exercise, participants received information about a specific problem or situation within the organization, and worked together to generate recommendations for its resolution. Final decisions made by the group were to be supported by each member. The written case study and presentation required each participant to study printed materials describing an issue within the company, compose a written plan of action for addressing the issue, and present this plan orally to the assessor, who adopted the role of an administrative figure within the organization. For the interview simulation, each participant was given the task of addressing an issue involving one or two subordinates in a face-to-face meeting. In this exercise, trained individuals not serving as assessors played the role of the employees.

Table 2
Dimensions by Exercise Matrix

Dimensions	Exercises		
	Group discussion	Case study/ presentation	Interview simulation
Information seeking		X	X
Problem solving	X	X	
Oral communication	X	X	
Planning and organizing		X	X
Leadership	X		X
Conflict management/resolution	X		X

Note. The same dimensions were assessed by each exercise for both blocks.

Six assessors were present at each administration. Each participant was observed by three assessors in each block, with one assessor observing one participant in each exercise. To ensure an accurate assessment of participants' improvement in performance during the center, the same group of three assessors observed the same 3 participants for both blocks of exercises. Each participant was also assigned a "primary assessor," who was responsible for providing individualized feedback following each block of exercises. Assessors were local human resource professionals and graduate students in human

resource management and industrial/organizational psychology. Each participated in multiple administrations of the center, with many serving as an assessor approximately twice per month. All assessors were required to complete a 4-week training and certification program, which included experiencing the process as a participant, 1.5 days of formal classroom instruction and practice, a series of exercises and paper-and-pencil tests, observation of an experienced assessor, and supervised assessment and feedback. Periodic updates and refresher meetings were held as needed during the course of the center administrations.

During each exercise, assessors took detailed notes about both the positive and negative behaviors exhibited by the participant which reflected the relevant dimensions assessed by the exercise. Immediately following the exercise, assessors rated each dimension along a 7-point behaviorally anchored rating scale (1 = Needs Improvement, 7 = Highly Proficient), noting specific behavioral observations supporting the assigned ratings. These ratings were used to facilitate the evaluation of the participant's relative level of proficiency with respect to each dimension. They were not provided to the participants or any member of the organization in which they were employed.

Following the completion of each block of exercises, the assessors participated in an integration session to prepare the feedback to be presented to each participant. These meetings were conducted simultaneously in two groups of three assessors, such that each group discussed only the performance of the 3 participants they observed in the preceding block. The integration process was facilitated by the center coordinator, who compiled the behavioral observation and ratings forms received from the three assessors into complete packets specific to each participant. Each assessor individually reviewed the

packet for his or her primary participant to develop a preliminary plan for feedback, requesting clarification from the other assessors as necessary. The assessor then discussed this feedback plan with the other assessors, who provided further explanation of their evaluation of the participant, additional insights or behavioral examples they had observed, and other information to be included in the feedback. Once all assessors were in agreement about the feedback to be delivered to each participant, the participant's primary assessor prepared a final, comprehensive feedback report. During this time, participants evaluated their own performance with respect to each dimension.

Each participant then met privately with his or her primary assessor to receive verbal feedback on their performance. The assessor addressed all six of the assessed dimensions with the participant, citing specific behavioral examples of effective and ineffective performance in each. Particular emphasis was placed on those dimensions in which less effective behaviors predominated. Participants were also given the opportunity to share and discuss their own perceptions of how they performed with respect to each dimension and to compare these perceptions with the assessors' observations. The participant and assessor then identified goals and activities that could facilitate improvement with respect to their identified developmental needs and created a concrete plan of action for development. In the first feedback session, these efforts were directed toward immediate improvement, focusing on how the participant could enhance his or her performance in the second block of exercises. In the second feedback session, the emphasis was shifted toward the identification of how the participant could apply what had been learned through the center toward efforts to improve his or her actual job performance with respect to the assessed dimensions. Assessors worked with participants

to create a specific developmental plan, emphasizing activities the participant could begin relatively quickly once he or she returned to the job. In the week following the completion of the center, participants were mailed a written summary of their preliminary development plan. Monthly follow-up meetings were held to track participants' progress, re-assess goals, and provide additional recommendations.

Measures

Self assessment inventory. Forty-eight behaviorally-based self-assessment items reflecting the six primary dimensions were constructed for this study on the basis of the dimension definitions. The number of items assessing each dimension initially ranged from 6 for information seeking to 11 for leadership. For each item, participants were asked to rate their proficiency along a scale ranging from 1 ("I do this extremely poorly") to 7 ("I do this extremely well"). Participants completed this measure within one week prior to (Pre) and approximately one month following (Post) the center. For both the Pre and Post self-assessment measures, participants were asked to select their responses according to how they perceived their *current level* of performance. As part of the second administration, participants were also asked to complete provide retrospective (Then) ratings for each item, which were to reflect where they believed they stood with respect to each item *prior to* the center. Specifically, participants were instructed to think back to their performance before their participation in the developmental assessment center and make their ratings according to how they perceived themselves at that time.

As the Terborg et al. (1980) method assumes that the items comprising each scale tap a unidimensional construct, the internal consistency of each dimension was examined using the responses from the first administration of the self-assessment inventory (the Pre

measure). Inter-item and item-total correlations were also examined to determine if any items should be deleted from each of the scales. These analyses led to the deletion of four items in the leadership scale, three items in the planning and organizing scale, two items each in the problem solving and oral communication scales, and one item in the conflict management/resolution scale. Each of the six revised scales showed respectable levels of internal consistency, with coefficient alphas ranging from .87 for problem solving to .91 for planning and organizing. The unidimensionality of the revised scales was further confirmed by examining the internal consistency and item-level statistics of both the Post and Then measures, with all six scales still demonstrating respectable inter-item and item-total correlations as well as high levels of internal consistency. The final list of items classified by dimension is presented in Appendix A.

Goal orientation. Learning and performance goal orientation were assessed using 8-item scales developed by Button et al. (1996). Responses were made using a 7-point scale with anchors ranging from “Strongly Disagree” (1) to “Strongly Agree” (7). The two scales of learning and performance goal orientation demonstrated coefficient alphas of .78 and .75, respectively, in the present study. Participants completed the goal orientation measure at the same time as the first administration of the self-assessment inventory.

Analytical Procedure for Assessing Gamma, Beta, and Alpha Change

The analytical procedure to assess for the presence of gamma, beta, and alpha change followed the methods outlined by Terborg et al. (1980) whereby pair-wise comparisons of Pre, Post, and Then ratings are made for each individual’s responses to each scale. Under this procedure, each item comprising the scale is treated as a separate

observation, allowing the presence of gamma, beta, and alpha change to be assessed independently for each person with respect to each of the six dimensions.

Gamma change. Gamma change was assessed using two methods – the comparison of profile shapes (correlations) and dispersions (standard deviations). Using the first method, correlations between the total scores for each scale are calculated for each participant's Pre and Post measures, Pre and Then measures, and Post and Then measures. Gamma change for a participant can be inferred for a given dimension if the correlation between Post and Then measures is substantially greater in magnitude than the correlations between both the Pre and Post measures and Pre and Then measures. Terborg et al. (1980) stress that the absolute magnitude of the difference between correlations needed for a conclusion of gamma change is difficult to specify, so reasonable judgment must be used in interpretation.

In the current study, William's *t*-tests for the difference between dependent correlations were calculated for each comparison to provide a rough index of the dissimilarity of the correlations. However, given that the number of observations (items) on which each test was based did not exceed the recommended sample size of 20 for conducting this test (Chen & Popovich, 2002) the resulting statistic was interpreted descriptively. Further, the presence of gamma change is indicated primarily by differences in the magnitude of the correlations (Terborg, et al., 1980), whereas the obtained *t*-values reflect differences in both magnitude and direction. For these reasons, three criteria were examined in making a conclusion of gamma change: (1) the magnitude of the obtained *t*-value, (i.e., whether it was .50 or greater), (2) the magnitude of the correlations between the Pre, Post, and Then measures (i.e., whether the absolute

value of the correlation between Post and Then measures was at least 50% greater than that of the highest of the Pre and Then and Pre and Post measures), and (3) the statistical significance of the correlation between Post and Then measures (i.e., if this correlation was statistically significant while the correlations between both the Pre and Then and Pre and Post measures were not). In general, gamma change was concluded when at least two of the three criteria were satisfied. However, all decisions were considered on a case-by-case basis, and exceptions to these criteria were made when there was reasonable evidence to do so.

The second method for inferring gamma change involves the comparison of the profile dispersions, or standard deviations, of Pre, Post, and Then scores (Terborg et al., 1980). Evidence for gamma change exists if the standard deviations of Post and Then scores do not substantially differ from each other, but each is different from the standard deviation of Pre scores. In the current study, the differences between the three standard deviations were evaluated using *t*-tests for dependent variances (Kirk, 1999). However, because these tests are based on responses made by the same individual, the assumption of independence of observations is violated (Terborg et al., 1980). Thus, as with the first method of evaluating gamma change, the results of the analyses were interpreted descriptively. Specifically, conclusions were made by examining the absolute value of the *t*-statistics and the relative differences of the three standard deviations. As a rule of thumb, gamma change was inferred when either (1) the *t*-value comparing the standard deviations of the Post and Then measure was small in magnitude ($t < .50$) and substantially different from either of the *t*-values comparing the standard deviations of the Pre and Post and Pre and Then measures, or (2) the standard deviations of the Post and

Then measures differed by one quarter of a standard deviation or greater from that of the Pre measure.

Terborg et al. (1980) noted the evidence of gamma change is strongest when the two methods described above converge (i.e., when differences in both profile shapes and profile dispersions are observed). In the current study, a final judgment of the existence of gamma change was made using this more conservative criterion.

Beta and alpha change. If no evidence existed to suggest the presence of gamma change, the presence of beta and alpha change, respectively, was then evaluated for each individual. As previously discussed, the occurrence of beta and alpha change can be evaluated by comparing profile levels (means) of Pre, Post, and Then measure for each individual. To test for the presence of beta change, dependent *t*-tests, where *n* was based on the number of items comprising the scale, were calculated to compare Pre and Then scores for each individual across the three scales (Terborg et al., 1980). Alpha change was similarly assessed using dependent *t*-tests of the difference between means on Post and Then measures. In both cases, the resulting statistic was used as a descriptive index of change rather than interpreted inferentially due to the lack of independence of observations. To facilitate a final conclusion of the presence of beta, alpha, or no change for each individual, the resultant *t*-statistics and the actual differences in the mean scores of each scale were examined. In addition, the presence of beta and alpha changes were assessed concurrently, so that comparative judgments could be made as to whether the evidence was stronger for one type of change versus another (Terborg et al., 1980).

CHAPTER III

RESULTS

Table 3 presents the nature and frequency of the changes observed across the six assessed dimensions, with the analyses for each type of change presented in greater detail below. Within each dimension, it appears that more than half the participants experienced some form of change. With the exception of the dimension of conflict management, change most frequently took the form of a reconceptualization of the construct (gamma change) or scale recalibration (beta change) rather than a simple change in state or perceived proficiency (alpha change). Further, some participants exhibited both beta and alpha change concurrently, indicating that they not only recalibrated the scale on which their self-evaluations were made, but assessed their past and current levels of proficiency along this adjusted scale. The analyses for each type of change are presented in greater detail below.

Table 3
Summary of the Occurrence of Gamma, Beta, and Alpha Changes

Construct	Number (Percent) of Individuals Exhibiting Change				
	Gamma	Beta Only	Alpha Only	Beta and Alpha	No Change
Information Seeking ^a	6 (33%)	3 (17%)	1 (6%)	3 (17%)	5 (28%)
Problem Solving ^b	5 (31%)	2 (13%)	2 (13%)	1 (6%)	6 (38%)
Planning and Organizing ^c	5 (25%)	7 (35%)	0 (0%)	2 (10%)	6 (30%)
Oral Communication ^c	1 (5%)	7 (35%)	3 (15%)	4 (20%)	5 (25%)
Leadership ^d	2 (10%)	9 (43%)	1 (5%)	8 (38%)	1 (5%)
Conflict Management ^a	1 (6%)	5 (28%)	7 (39%)	2 (11%)	3 (17%)

^an=18. ^bn=16. ^cn=20. ^dn=21.

Assessment of Gamma Change

As previously mentioned, the presence of gamma change was evaluated using two methods: a comparison of profile shapes (correlations) and dispersions (standard deviations), with the resultant statistic interpreted descriptively rather than inferentially using the criteria outlined above. The results obtained for these analyses across the six dimensions are summarized in Table 4, with person-by-person results for each dimension presented in Appendices B through G. Due to a lack of variance in the Pre, Post, and/or Then measures, which made it impossible to calculate correlations or compare standard deviations, data for some individuals had to be omitted within each dimension. One individual exhibited this lack of variance in scores across all six dimensions, thus these data were deemed unusable and excluded from all subsequent analyses. This yielded a final total sample size of 27, with the number of participants included for each dimension ranging from 16 for problem solving to 21 for leadership.

Table 4
Summary of Results for the Assessment of Gamma Change

Construct	Number (Percent) of Individuals Exhibiting Gamma Change		
	Profile Shapes (Correlations)	Profile Dispersions (Standard Deviations)	Both Methods
Information Seeking ^a	10 (56%)	8 (44%)	6 (33%)
Problem Solving ^b	7 (44%)	6 (38%)	5 (31%)
Planning and Organizing ^c	10 (50%)	5 (25%)	5 (25%)
Oral Communication ^c	7 (35%)	4 (20%)	1 (5%)
Leadership ^d	9 (43%)	5 (24%)	2 (10%)
Conflict Management ^a	5 (28%)	4 (22%)	1 (6%)

^an=18. ^bn=16. ^cn=20. ^dn=21.

As can be seen in Table 4, the use of either approach alone suggests the presence of gamma change for at least 20% of participants with respect to each of the six dimensions. Comparison of profile dispersions was found to yield fewer conclusions of gamma change than comparison of profile shapes, a finding consistent with prior studies

that have utilized the Terborg et al. (1980) method (Porras & Singh, 1986; Randolph & Elloy, 1989; Rogers & Thornton, 2003). In accordance with the suggestions of Terborg et al., an overall conclusion of gamma change was made only for those individuals for whom both methods indicated its presence. Using this more conservative standard, gamma change was inferred for fewer participants across dimensions, ranging from 5% for oral communication to 33% for information seeking. The relatively low level of convergence obtained between the two methods of assessing gamma change was not surprising, and, again, is in line with previous research (Birkenbach, 1986; Porras & Singh, 1986; Randolph & Elloy, 1989; Rogers & Thornton, 2003).

Assessment of Beta and Alpha Change

As the presence of gamma change renders un-interpretable the assessment of change through the comparison of mean scores (Golembiewski et al., 1976), beta and alpha change were assessed only for those individuals for whom a conclusion of gamma change was not made. In accordance with the recommendations of Terborg et al. (1980), beta and alpha change were assessed through comparison of profile levels (mean scores) of the Pre, Post, and Then measures for each individual for each of the six dimensions using the method described above. A difference between the mean scores of the Pre and Then measures was interpreted as evidence of beta change, while alpha change was inferred when a difference between the mean scores of the Post and Then measures was observed. As in the case of gamma change, conclusions were made on a judgmental basis (i.e., descriptive interpretation of the *t*-values, examination of the actual differences in the mean scores, and concurrent evaluation of beta and alpha change). The results of these analyses for each dimension are presented in Appendices H through M.

Using this method, the frequency of individuals exhibiting only beta change ranged from 3 individuals for the dimension of information seeking to 9 individuals for the dimension of leadership (see Table 3). In general, beta change occurred with greater frequency than did alpha change, which was observed for 3 or fewer participants across all dimensions except conflict management. Finally, some individuals appeared to have experienced both beta and alpha change, indicating that they not only recalibrated the scale on which their self-evaluations were made, but assessed their prior and current levels of proficiency along this adjusted scale.

Comparison with Traditional Change Assessment

The rightmost columns in the tables presented in Appendices H through M present the resulting *t*-statistic for the traditional Pre to Post assessment of change for each individual. Comparison of these results with those obtained using the retrospective Then measures and Terborg et al.'s (1980) method for assessing change indicates that substantially different conclusions would have been drawn had change been assessed through traditional means. Across dimensions, traditional Pre and Post comparisons made using the same judgmental basis of comparing mean scores and *t*-statistics underestimated the frequency of change occurring in participants. This rate of underestimation was 25% or greater for all dimensions except oral communication, which showed a 5% underestimation. Further, the typical pattern observed in the present study was that of the Terborg et al. method suggesting change for an individual when a conclusion of no change would have been reached by the traditional method. Thus, it appears that Pre and Post comparisons alone may fail to detect the presence of change when it, in fact, exists.

Even more striking is the fact that in many cases, Pre and Post comparisons alone might have led to erroneous conclusions, as they often masked the true nature of change occurring among participants. A common misconception found in the present study was a Pre to Post indication of a change in proficiency (alpha change) when in fact the change reflected scale recalibration (beta change). To illustrate, consider the results obtained for participant 18 with respect to the dimension of planning and organizing (Appendix J). Traditional Pre to Post comparison indicates a significant improvement (M Pre = 4.40, SD = .55; M Post = 5.80, SD = .45), $t(4) = 5.72$, $p = .005$. Comparison of Post and Then scores, however, indicate that when ratings were made using a common metric, thus controlling for beta change reflected in the Pre and Then comparison (Birkenbach, 1986), the individual in fact perceived very little actual change in proficiency (alpha change) with respect to this dimension (M Then = 5.40, SD = .89; M Post = 5.80, SD = .45), $t(4) = 0.78$, ns . Here, failure to detect beta change resulted in an overestimation of the actual improvements in proficiency perceived by the participant. An even more troublesome pattern that emerged as a result of the failure to take beta change into account was a tendency for a Pre to Post comparison to suggest a *decrease* in proficiency when, in fact, the change observed in the participant would be more accurately categorized as reflecting scale recalibration. The results obtained for participant 9 on the dimension of information seeking (Appendix H) is an example: although traditional comparison suggests a decrease with respect to this dimension (M Pre = 6.33, SD = .52; M Post = 5.67, SD = .52), $t(5) = -3.16$, $p = .025$, when controlling for beta change it appears this individual actually showed no perceived change in proficiency (alpha change) on the basis of Then and Post comparisons (M Then = 5.67, SD = .52; M Post = 5.67, SD = .52),

$t(5) = 0.00, ns$. The traditional method would also have been ineffective in detecting the presence of gamma change: for the majority of individuals who showed evidence of gamma change, Pre to Post comparisons suggested no change occurred. In fact, averaging across all six dimensions, the conclusions reached by traditional comparison would have agreed with those made by using the Terborg et al. (1980) method in approximately 28% of the cases. The vast majority of this agreement was in the form of neither method detecting the presence of change.

Correlations between Goal Orientation and Change

To examine the efficacy of goal orientation in predicting the occurrence of gamma, beta, and alpha change, a series of point biserial correlations were calculated for the two dimensions of learning and performance goal orientation with the presence (coded as 1) or absence (coded as 0) of each type of change exhibited by participants. As the primary concern in these analyses was whether goal orientation showed a general relationship to each type of change, and given relatively small number of individuals exhibiting each type of change within each dimension, data were collapsed across the six dimensions such that an individual was coded as having exhibited gamma, beta, or alpha change if that type of change was observed for the participant with respect to any of the six constructs.

The resulting correlation coefficients are presented in Table 5. As expected, learning goal orientation was found to exhibit a significant, positive relationship with beta change; however, no relationship between learning goal orientation and gamma change was observed. Also consistent with prediction, performance goal orientation

showed a reliable positive relationship with the presence of alpha change. These results are particularly encouraging considering the small sample size of the current study.

Table 5
Intercorrelations among Goal Orientation and Type of Change

Variable	Mean	SD	1	2	3	4	5
1. Learning goal orientation	48.00	3.62	--				
2. Performance goal orientation	38.74	6.81	.36	--			
3. Gamma change ^a	--	--	.06	-.23	--		
4. Beta change ^b	--	--	.40*	.11	.05	--	
5. Alpha change ^c	--	--	.13	.38*	-.30	-.03	--

^a Observed for 11 of 27 individuals. ^b Observed for 24 of 27 individuals. ^c Observed for 17 of 27 individuals.
* $p < .05$.

Although no relationship was observed between gamma change and learning goal orientation, it is worth noting that there did appear to be a non-significant tendency for individuals who were lower on performance goal orientation to exhibit this type of change, a trend which is conceptually consistent with prediction. Additional analyses using dependent t -tests confirmed this tendency, revealing that those individuals for whom gamma change was observed showed lower levels of performance goal orientation ($M = 36.92$, $SD = 9.02$) than learning goal orientation ($M = 48.27$, $SD = 3.52$), $t_{(10)} = -4.99$, $p < .01$.

Supplemental Analyses

Given the unexpectedly small sample size in the current study, additional supplemental analyses not originally proposed for investigation were conducted to further explore potential individual differences that might relate to the presence of gamma, beta, and alpha change. These additional variables were collected as part of the larger developmental assessment center study, and included readiness to develop, cognitive ability, and personality characteristics. All three measures were completed by participants on the day of their participation, prior to beginning the assessment center exercises.

Readiness to develop was assessed using a 19-item scale developed by Walter (2004). This scale was intended to measure attitudes, beliefs, and actions toward developmental activities, including awareness of one's developmental needs, seeking out developmental opportunities, and demonstrating behaviors consistent with personal development and growth. Sample items included, "I take advantage of opportunities to better myself," "I regularly evaluate my development goals," and "I actively search for ways to advance myself." Responses were made using a 5-point scale with anchors ranging from "not like me" (1) to "a great deal like me" (5). The scale demonstrated a coefficient alpha of .85 in the present study. Additionally, the scale showed a correlation of .57 ($p < .01$) with learning goal orientation and .37 (*ns*) with performance goal orientation, suggesting some conceptual similarity between the constructs.

Cognitive ability was assessed using the Wonderlic Personnel Test (WPT), a 12-minute timed test consisting of 50 progressively difficult items designed to assess verbal, quantitative, and spatial ability. It has a reported correlation of .92 with the full scale IQ score of the WAIS-R, and test-retest reliabilities range from .82 to .94 (Wonderlic, 2000). The mean score for the present study was 30.30 ($SD = 5.44$).

The Abridged Big Five-Dimensional Circumplex scales from the International Personality Item Pool (AB5C-IPIP; Goldberg, 1999; Hofstee, De Raad, & Goldberg, 1992) were used to assess the "Big Five" personality characteristics of extraversion, agreeableness, conscientiousness, openness to experience, and intellect (emotional stability). Participants were instructed to indicate how well a series of trait-related statements described them using a 5-point scale ranging from "very inaccurate" (1) to "very accurate" (5). Dimension scales were comprised of 10 to 13 items and

demonstrated internal consistency-reliabilities ranging from .60 for openness to experience to .88 for extraversion in the present study.

The results of these analyses are presented in Table 6. Readiness to develop showed no reliable relationships with gamma, beta, or alpha change, which is somewhat inconsistent with what might be expected given the relationship between this scale and learning goal orientation reported above. Cognitive ability also showed no correlation with change type; however, there does appear to be a slight tendency for gamma change to be associated with higher scores on cognitive ability. Given that gamma change was observed for only 11 participants in the current study, there is a possibility that the correlation obtained here may have been attenuated due to small sample size. Finally, of the five personality factors assessed, only emotional stability showed a significant relationship with change type. Specifically, individuals who exhibited alpha change showed lower levels of emotional stability (i.e., they were more likely to report they were anxious, depressed, or prone to frequent mood swings).

Table 6
Intercorrelations among Supplemental Variables and Type of Change

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10
1. Readiness to develop	3.69	.50	--									
2. Cognitive ability	30.30	5.44	.01	--								
3. Extraversion	3.18	.80	.72**	-.05	--							
4. Agreeableness	4.36	.45	.12	-.38*	.30	--						
5. Conscientiousness	4.03	.49	.07	-.32	-.01	.18	--					
6. Emotional stability	3.79	.70	.03	.15	-.10	.03	.03	--				
7. Intellect	3.89	.39	.30	.10	.03	.09	-.07	.54**	--			
8. Gamma Change ^a	--	--	-.10	.21	.08	.08	.01	-.05	-.06	--		
9. Beta Change ^b	--	--	-.07	-.07	.10	.23	-.02	-.28	-.16	.05	--	
10. Alpha Change ^c	--	--	-.04	-.07	-.12	-.08	-.20	-.41*	.01	-.30	-.03	--

^a Observed for 11 of 27 individuals. ^b Observed for 24 of 27 individuals. ^c Observed for 17 of 27 individuals.
* $p < .05$. ** $p < .01$.

CHAPTER IV

DISCUSSION

Despite the increasing application of the assessment center method toward individual growth and development, there is a dearth of research in this area, and little is known about how participants' understanding of the dimensions tapped by the process is affected as a result of their participation in the process. The goal of this study was to explore this issue by applying Golembiewski et al.'s (1976) tripartite model of change to assess the presence of alpha, beta, and gamma change in individuals following their participation in a developmental assessment center. Using Terborg et al.'s (1980) method for investigating change, where pre, post, and retrospective "then" ratings were systematically compared for each participant, evidence for all three types of change was obtained across all six of the dimensions assessed by the developmental assessment center. Given the relatively large proportion of individuals who exhibited gamma or beta change, the current study lends some initial credibility to a crucial assumption of developmental assessment centers: that they may be an effective means of facilitating new, cognitive-level insight regarding the dimensions on which they are assessed.

Support for the Tripartite Model of Change

These results lend both theoretical and empirical support to Golembiewski et al.'s (1976) tripartite model of change, and provide additional evidence for Terborg et al.'s (1980) argument that the simple comparison of Pre and Post self-report measures, though

widely used, can lead to inaccurate or incomplete conclusions. Across constructs, evidence for each of the three types of change was exhibited by participants; however, substantially different conclusions would have been drawn, and the frequency of change actually underestimated, had change been inferred on the basis of obtained differences in Pre and Post measures. These findings are consistent with prior research in this area (e.g., Birkenbach, 1985, Rogers & Thornton, 2003) thus strengthening the argument that when self-report measures of change are of primary research interest, it would be prudent to assess for, or at least consider, the possibility of gamma and beta change in addition to alpha change.

In the current study, evidence for all three types of change were observed in all six of the assessed dimensions, though it does appear that perhaps some dimensions may lend themselves more readily to certain types of change than others. For the dimensions of information seeking and problem solving, for example, participants more frequently demonstrated gamma change than they did beta or alpha change. Perhaps these dimensions have a relatively higher level of conceptual complexity than others, or are comprised of multiple elements which must be integrated to achieve optimal levels of proficiency, factors which might contribute to greater opportunities to experience a higher-level change. Conversely, dimensions such as oral communication and conflict management may have been defined in the developmental assessment center in a more straightforward, succinct manner, with assessors implicitly or explicitly prescribing behaviors representative of high levels of proficiency. For these dimensions, then, participants appeared more likely to demonstrate beta or alpha change. Further research

is necessary to provide a more comprehensive understanding of the interaction between dimension complexity and change.

Practically, an understanding and recognition of multiple types of change can be useful, particularly within the context of activities and programs designed to facilitate growth and improvement. Although the developmental assessment center examined in the current study was not explicitly designed to evoke a particular type of change per se, many developmental efforts do have the implicit or explicit goal of providing participants with new insights regarding the various competencies targeted by the intervention (i.e., beta or gamma change). Examining the type of change occurring in participants as a result of these efforts allows for the examination of whether the intervention had its intended effect and, consequently, a more precise evaluation of the effectiveness of the intervention. It has been argued that the primary purpose of evaluating a given training or development program should be to ascertain whether the intended outcomes of the process have been achieved (Shuell, 1986), and that evaluation efforts are most constructive when the outcome criteria are conceptually tied to the objectives of the process (Kraiger, Ford, & Salas, 1993). In the case of developmental assessment centers, then, the application of the tripartite model of change allows for the evaluation of the center's effectiveness with respect to its specific goals, be it a change in proficiency (alpha change), a change in self-awareness (beta change) or a fundamental change in understanding (gamma change). This is an improvement from existing research seeking to investigate the utility of developmental assessment centers, which has focused on outcome criteria such as participant perceptions of and reactions to the process (e.g., Arnold, 2002; Harris, Paese, & Greising, 1999; Iles, Robertson, & Rout, 1989; Kerr &

Davenport, 1989), the immediate and long-term impact on work-related attitudes and other affective and psychological variables (e.g., Fletcher, 1991; Francis-Smythe & Smith, 1997; Iles, Robertson, & Rout, 1989), and concrete outcomes such as post-participation performance ratings (Engelbrecht & Fischer, 1995) and subsequent participant developmental activity and career advancement (Jones & Whitmore, 1995). Consideration of gamma, beta, and alpha change is also consistent with models of training evaluation such as that proposed by Kraiger et al. (1993) which propose that multiple potential levels of cognitive outcomes, such as knowledge structure and complexity, should be considered when assessing training effectiveness.

Implications for the Investigation of Individual-level Change

Further, the current study underscores the importance of examining change at the level of the individual. Gamma, beta, and alpha change occurred differentially across participants both within and across constructs, indicating that individuals had varied reactions to their participation in this developmental assessment center which might not have been detected had the data been aggregated. Consideration of these differential effects may prove useful in tailoring feedback and subsequent developmental activities to better meet the needs of participants, a key component in ensuring the overall effectiveness of the development program (Thornton, 1992). Bringing up the nature of change that occurred for participants during feedback and follow-up meetings with assessors or managers can serve as a good springboard for discussion, perhaps facilitating even further change. If alpha change is observed in an individual, it may suggest that participation in the process has led to changes in his or her proficiency, and future developmental efforts can be targeted toward allowing this person to continue to

strengthen his or her skills in this area. On the other hand, if an individual gains a new or richer understanding of a construct (gamma change) he or she could be directed toward activities that better reflect this new perspective. Similarly, individual-level analyses may further ensure the process is effective in meeting its goals. For example, if the primary goal of a training or development program is gamma change, yet some individuals do not exhibit such change, modifications to the intervention can be made or subsequent activities employed as needed to ensure both the specific needs of each participant and the overall aim of the intervention are met.

Correlates of Change

While the vast majority of studies investigating alpha, beta, and gamma change focus on methodology, this study had a secondary aim of examining individual-level difference variables as a potential correlate of change, specifically one's orientation toward learning- or performance-related goals in predicting the type of change observed. The results obtained do indeed suggest some relevance to this line of research. Consistent with prediction, learning goal orientation showed a reliable, positive relationship with beta change, while performance goal orientation demonstrated a positive correlation with alpha change. Although the hypothesized relationship between learning goal orientation and gamma change was not observed, there did appear to be a tendency for individuals who exhibited gamma change to show lower levels of performance goal orientation. Supplemental post-hoc analyses using additional individual-difference variables revealed that one's level of emotional stability might also relate to change type, such that individuals lower in this trait may be more likely to exhibit alpha change. A possible explanation for this observation might be that

individuals who are more easily prone to stress or becoming upset may strive to avoid taking on challenges that might elicit further stress or frustration, such as those that might be associated with a deepening of one's understanding (gamma or beta change). Future studies should continue to explore the role of individual difference variables in predicting change. By doing so, research in the area can move beyond assessment and measurement toward the development of a theory of change.

Limitations of the Terborg et al. Method

In the current study, the Terborg et al. (1980) method was utilized to assess for the presence of alpha, beta, and gamma change, and some aspects of this process warrant additional consideration. A somewhat concerning observation in the present study was the presence of a few unreasonably large t -values when profile shapes (correlations) were compared. For example, consider the Post/Then and Pre/Then correlations obtained for participant 5 in the dimension of information seeking (.92 and 1.00, respectively). While it is clear these correlations are not substantially different, the resultant t -value was -10.15. Although this reflects a statistical artifact driven by the computational process, it is potentially problematic, and underscores the importance of interpreting the resulting statistic descriptively when making a final conclusion of change. In the current study, however, the obtained t -value was only one of three a priori criteria established for making a final conclusion of gamma change (the other two being the absolute size and statistical significance of the correlations); thus, it is not likely that this unexpected phenomenon artificially inflated the likelihood of an erroneous conclusion of gamma change on the basis of profile shapes. Nevertheless, in light of these results, the resultant t -values were given less weight than were the other criteria in making a final decision.

Additionally, and consistent with prior research (Birkenbach, 1986; Randolph & Elloy, 1989; Rogers & Thornton, 2003), the comparison of profile shapes and dispersions to evaluate gamma change yielded inconsistent results, evidenced by the fewer number of conclusions of gamma change using the criteria of the convergence of the two methods. As Birkenbach (1986) notes, some degree of convergent validity between these two methods should be expected if each reflects the reconceptualization of a construct. Randolph and Elloy (1989) suggest a possible explanation for such inconsistent conclusions is the potential effect of common method bias, which would manifest itself in high correlations between Post and Then ratings. Although this may have occurred for some cases in the current study, the range of Post/Then correlations is quite wide, and relatively few equal 1.0. Further, if such bias were present, it is likely that the variability of both the Post and Then measures would also be similar – thus, a greater level of convergence between the two methods might be expected. Another possibility for the disparate conclusions is the fact that the sizes of the standard deviations of the Post and Then measures affect the probability of obtaining a high correlation between the two measures (Birkenbach, 1986). If this were the case, however, the method of comparing profile dispersions would be expected to result in a greater number of conclusions of gamma change than would the comparison of profile shapes. The current results, however, indicate the opposite pattern. Clearly, further consideration of the two methods for investigating gamma change is warranted. In the interim, researchers employing the Terborg et al. (1980) method would be well advised to infer the presence of gamma change only when the methods converge with respect to such a conclusion.

In addition to the issues raised by the use of the methods proposed for assessing gamma change, several other concerns with respect to the Terborg et al. (1980) method warrant mentioning. Most relevantly, the approach relies on the descriptive use of inferential tests and the distinction between statistical and practical significance. Clearly, the use of inferential tests would be desirable, but until they can be modified to allow for the violation of the assumptions of the test statistics, they cannot be used with confidence (Terborg et al., 1980). Terborg et al. offer little guidance in the interpretation of results, and are “willing to trust the researcher with interpretation,” (p. 115) noting only that the results should be presented openly and reasonable judgment employed by the researcher in drawing conclusions. Other researchers who have utilized this method have added little to the development of interpretive guidelines, and the rules of thumb employed here were unique to the current study. The development of clearer guidelines for the interpretation of results would therefore be desirable. Further, the Terborg et al. method is quite tedious, and several calculations must be performed for each individual. Because the method requires unidimensionality of constructs, careful scale revision is a prerequisite for analysis, and independent calculations must be performed for each individual with respect to each dimension assessed. Finally, the method has been criticized in that it requires the use of an additional measure, Then ratings, which serves to lengthen data collection process (Schmitt, 1982; Schmitt et al., 1984).

Despite these concerns, however, the results of this study add to existing research (Birkenbach, 1986; Randolph & Elloy, 1989) indicating that the Terborg et al. (1980) method does appear to be a viable means for evaluating gamma, beta, and alpha change. Further, it offers two key advantages that make it appealing for use in many research and

applied efforts. Presently, it is the only method that allows for the assessment of change at the level of the individual, which, as was the case in the current study, allows change to be assessed independently across participants. As previously discussed, this holds practical implications for both the evaluation of the change intervention and the more effective design of activities to best meet the needs of participants. Further, unlike factor analytic techniques, the method can be used with small samples, which are typically the norm in applied settings.

Limitations of the Current Study

Aside from the practical concerns raised by the use of the Terborg et al. (1980) method for assessing change, there are certain limitations of the present study that must be addressed. First, the assumption must be made that participation in the developmental assessment center, rather than other intervening factors, was directly linked to the observed changes. To have confidence in this assumption requires the use of a control group, and none was available for use in the current study. However, the primary concern in the present research was not the evaluation of the general effectiveness of a specific intervention per se, but to explore how a given task differentially affected participants. Further, in many applied settings, the luxury of a comparison group is simply not available (Randolph & Elloy, 1989). Nevertheless, evidence which explicitly connects gamma, beta, and alpha change with the task designed to target the relevant competencies would have been desirable.

Secondly, a large number of participants had to be removed from analysis in the current study due to a lack of variability in responses. Because analyses were conducted at the level of the individual, a decrease in sample size did not affect the statistical

computations performed when evaluating change type. However, it does raise concern as to the presence of potential response biases in the sample. Had there been more variability within participants, perhaps more compelling evidence of gamma, beta, and alpha change could have been inferred.

Considerably more work is necessary in order to arrive at a more complete understanding of the tripartite model of change, yet the area has received little focus, particularly in recent years. As Tennis (1989) notes, this inactivity may be due, in part, to the complexity associated with operationalizing and statistically testing the concept. Although many of the studies that have directly examined alpha, beta, and gamma change represent attempts to design and test alternative methods by which each type of change can be assessed, there remains a lack of consensus with respect to a universal method of measuring higher-order change. Thus, many researchers and practitioners may find it easier to downplay or avoid the issue altogether. Further complicating the matter is the fact that the field is still lacking a means by which the direction of gamma change can be inferred – current methods, including Terborg et al.'s (1980), only allow for an estimation of the size of the change (Golembiewski, 1997). This is an issue which must be addressed if gamma change is to be fully understood.

Conclusion

Despite these limitations, this study contributes to the better understanding of both developmental assessment centers and the concept of change, and may essentially be viewed not only as an evaluation of developmental assessment centers, but as a demonstration of the utility of the tripartite model. With respect to the former, the study reflects an important step toward a better understanding of the impact of developmental

assessment centers on participants, and gives credence to the fundamental, yet often untested, assumption that participation in the process facilitates a change in participants' understanding of the assessed dimensions. Although further research is necessary, the results of the present research are promising, and it is hoped that future studies will continue to directly examine developmental assessment centers in their own right. Further, the study demonstrates the utility of the tripartite model of change as a potentially more meaningful and useful means to understand and interpret change, and represents a first step toward a more thorough understanding of factors that might contribute to the understanding of why individuals might exhibit differing levels of change. Though the current study utilized developmental assessment centers as the context for the study of change, the tripartite model is applicable to *any* effort which might facilitate a change in individuals, which may serve not only to impact their self-ratings, but their frame of reference for evaluating and assessing others. Thus, it is hoped that additional research will continue to employ this model, applying it to other settings, to advance the understanding and assessment of change.

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APPENDIX A

Self Assessment Inventory Items Grouped by Dimension

Information Seeking ($\alpha = .88$)

Utilize multiple sources in order to find pertinent information regarding a situation, task, or issue.

Seek out information from sources not at your immediate disposal

Find all relevant information in order to deal with a given situation or task.

Identify what types of information are more versus less useful for dealing with a given situation or task.

Organize information regarding a situation or task into patterns that are usable and meaningful.

Connect different pieces of information in order to understand or deal with a situation or task

Problem Solving ($\alpha = .87$)

Perceive logical relationships between problems or issues.

Develop alternative courses of action for dealing with a problem.

Consider both costs and benefits of alternative courses of action for dealing with a problem.

Evaluate the outcomes of a proposed solution to a problem.

Make logical decisions

Planning and Organizing ($\alpha = .91$)

Manage the time you have available in a way that allows you address tasks, situations, or issues in an effective manner.

Allocate the resources you have available in a way which allows tasks to be completed effectively.

Organize multiple tasks in a way that allows timely completion of each.

Establish and use a system for monitoring your own tasks and activities to ensure specific objectives are accomplished.

Set reasonable short-term goals

APPENDIX A
(continued)

Oral Communication ($\alpha = .88$)

- Express your thoughts verbally.
- Speak with an appropriate pitch and tone of voice.
- Speak with an appropriate volume.
- Verbally convey a message in a way that is straightforward.
- Verbally convey a message in a way that is concise.
- Speak in a manner that matches the communication style of your audience.
- Effectively communicate verbally with a group.

Leadership ($\alpha = .88$)

- Motivate others.
- Give regular feedback to subordinates and other individuals.
- Give specific feedback to subordinates and other individuals.
- Set goals and priorities for yourself that are in line with the needs of the organization.
- Set goals and priorities for others that are in line with the needs of the organization.
- Balance the work and tasks you assign to others with their interests and abilities.
- Command attention from others.

Conflict Management/Resolution ($\alpha = .90$)

- Deal with conflict between yourself and others effectively.
- Deal with conflict between two parties effectively.
- Address conflict situations openly.
- Address conflict in an appropriate manner.
- Arrive at constructive solutions to conflict situations.
- Deal with conflict situations while maintaining positive working relationships with others.

Appendix B

Assessment of Gamma Change for the Dimension of Information Seeking

Participant	Correlations			Standard Deviations								
	(1) Post/Then	(2) Pre/Then	(3) Pre/Post	t(1)(2)	t(1)(3)	(1) Pre	(2) Post	(3) Then	t(2)(3)	t(1)(3)	t(1)(2)	
1	0.97**	0.25	0.32	3.31*	2.65* ^b	0.63	0.98	1.26	-1.94	-1.55	-0.96	
2	1.00**	0.79	0.79	7.31**	7.31** ^b	0.82	0.52	0.52	0.00	1.55	1.55 ^c	X
3	0.17	0.32	0.54	-0.28	-0.65	0.41	0.75	0.52	0.78	-0.50	-1.55	
4	0.00	0.33	-0.58	-0.35	1.09	0.55	0.63	0.55	0.29	0.00	-0.35	
5 ^a	---	---	---	---	---	0.00	0.00	0.00	---	---	---	
6	0.88*	0.58	0.61	1.18	1.06 ^b	0.98	0.84	0.82	0.10	0.46	0.41 ^c	X
7	1.00**	0.00	0.00	4.47*	4.47* ^b	0.55	0.52	0.52	0.00	0.12	0.12	
8 ^a	---	0.63	---	---	---	0.41	0.00	0.52	---	---	---	
9	1.00**	0.50	0.50	5.16**	5.16** ^b	0.52	0.52	0.52	0.00	0.00	0.00	
10	1.00**	-0.08	-0.08	4.49*	4.49* ^b	0.98	0.41	0.41	0.00	2.00	2.00 ^c	X
11 ^a	---	---	0.87*	---	---	0.89	0.52	0.00	---	---	---	
12	0.71	0.71	0.33	0.00	1.26	0.55	0.55	0.52	0.17	0.17	0.00	
13	0.77	0.05	-0.29	1.16	2.35 ^b	0.75	0.75	0.98	-0.84	-0.54	0.00	
14 ^a	---	0.32	---	---	---	0.52	0.00	0.41	---	---	---	
15 ^a	---	0.63	---	---	---	0.52	0.00	0.41	---	---	---	
16 ^a	---	---	---	---	---	0.55	0.00	0.00	---	---	---	
17	0.34	-0.63	0.08	1.84	0.28	1.14	0.52	0.75	-0.82	1.10	1.76	
18	0.24	0.00	0.00	0.31	0.31	0.63	0.75	0.55	0.67	0.29	-0.35	
19 ^a	---	---	0.32	---	---	0.52	0.41	0.00	---	---	---	
20 ^a	---	---	---	---	---	0.75	0.00	0.00	---	---	---	
21	1.00**	0.20	0.20	4.56**	4.56** ^b	0.82	0.41	0.41	0.00	1.53	1.53 ^c	X
22	-0.32	0.37	0.70	-3.31*	-4.36*	1.05	0.41	0.52	-0.50	1.66	3.06* ^c	
23 ^a	---	---	---	---	---	0.41	0.00	0.00	---	---	---	
24	0.63	1.00**	0.63	-5.77**	0.00	0.41	0.52	0.41	0.61	0.00	-0.61	
25	0.71	-0.45	-0.32	1.82	1.41 ^b	0.82	0.52	0.55	-0.17	0.92	1.00 ^c	X
26	0.32	0.00	0.43	0.55	-0.16	0.89	0.52	0.41	0.50	1.73	1.28 ^c	
27	1.00**	0.34	0.34	4.76**	4.76** ^b	0.52	0.75	0.75	0.00	-0.82	-0.82 ^c	X

Note. Xs in the right margin indicate those individuals for whom both methods indicate gamma change.
^a Individual was omitted from analysis due to zero variance on the Pre, Post, and/or Then measures. ^b Indicates gamma change according to comparison of profile shapes (i.e., Post/Then correlation is greater than Pre/Then and Pre/Post correlations). ^c Indicates gamma change according to comparison of profile dispersions (i.e., Post and Then standard deviations are not different from each other, but each differs from the Pre standard deviation).
 * $p < .05$. ** $p < .01$.

Appendix C

Assessment of Gamma Change for the Dimension of Problem Solving

Participant	Correlations			Standard Deviations								
	(1)	(2)	(3)	t(1)(2)	t(1)(3)	(1)	(2)	(3)	t(2)(3)	t(1)(3)	t(1)(2)	
	Post/Then	Pre/Then	Pre/Post			Pre	Post	Then				
1	0.92*	0.47	0.33	1.35	2.03 ^b	0.84	0.55	0.89	-2.24	-0.13	0.80	
2 ^a	---	0.25	---	---	---	0.45	0.00	0.45	---	---	---	
3	-0.25	-0.25	-0.25	0.00	0.00	0.45	0.45	0.45	0.00	0.00	0.00	
4	0.38	0.79	0.40	-0.85	-0.05	0.71	0.89	0.45	1.40	1.34	-0.45	
5	0.79	1.00**	0.79	-6.54*	0.00	0.45	0.71	0.45	1.34	0.00	-1.34	
6	0.76	0.61	0.80	0.53	-0.12	0.89	0.84	0.55	1.17	1.12	0.19	
7	0.61	0.61	1.00**	0.00	-5.06*	0.45	0.45	0.55	-0.45	-0.45	0.00	
8 ^a	---	0.61	---	---	---	0.45	0.00	0.55	---	---	---	
9 ^a	---	-0.61	---	---	---	0.55	0.00	0.45	---	---	---	
10	1.00**	0.00	0.00	4.00*	4.00 ^b	0.71	0.55	0.55	0.00	0.45	0.45 ^c	X
11	0.85	1.00**	0.85	-7.48**	0.00	0.71	0.84	0.71	0.55	0.00	-0.55	
12 ^a	1.00**	---	---	---	---	0.00	0.45	0.45	---	---	---	
13	0.22	0.00	0.00	0.22	0.22	0.71	0.84	0.55	0.77	0.45	-0.29	
14 ^a	---	---	0.25	---	---	0.45	0.45	0.00	---	---	---	
15 ^a	---	0.61	---	---	---	0.55	0.00	0.45	---	---	---	
16	1.00**	0.61	0.61	5.06*	5.06 ^b	0.45	0.55	0.55	0.00	-0.45	-0.45 ^c	X
17 ^a	---	---	0.87	---	---	0.55	0.84	0.00	---	---	---	
18 ^a	---	---	---	---	---	0.00	0.55	0.00	---	---	---	
19 ^a	---	0.65	---	---	---	0.71	0.00	0.55	---	---	---	
20 ^a	---	---	0.79	---	---	0.71	0.45	0.00	---	---	---	
21	1.00**	-0.15	-0.15	4.04*	4.04 ^b	0.45	1.52	1.52	0.00	-2.71	-2.71 ^c	X
22	1.00**	0.33	0.33	4.23*	4.23 ^b	0.84	0.55	0.55	0.00	0.80	0.80 ^c	X
23 ^a	---	---	---	---	---	0.00	0.45	0.00	---	---	---	
24	1.00**	-0.25	-0.25	4.13*	4.13 ^b	0.45	0.45	0.45	0.00	0.00	0.00	
25	1.00**	1.00**	1.00**	0.00	0.00	0.50	0.45	0.45	0.00	0.00	0.00	
26	0.06	0.41	-0.10	-0.36	0.22	0.55	0.89	0.89	0.00	-0.97	-0.89 ^c	
27	0.61	0.22	0.13	0.53	0.67 ^b	0.84	0.45	0.55	-0.45	0.77	1.17 ^c	X

Note. Xs in the right margin indicate those individuals for whom both methods indicate gamma change.
^a Individual was omitted from analysis due to zero variance on the Pre, Post, and/or Then measures. ^b Indicates gamma change according to comparison of profile shapes (i.e., Post/Then correlation is greater than Pre/Then and Pre/Post correlations). ^c Indicates gamma change according to comparison of profile dispersions (i.e., Post and Then standard deviations are not different from each other, but each differs from the Pre standard deviation).
 * $p < .05$. ** $p < .01$.

Appendix D

Assessment of Gamma Change for the Dimension of Planning and Organizing

Participant	Correlations			Standard Deviations							
	(1) Post/Then	(2) Pre/Then	(3) Pre/Post	t(1)(2)	t(1)(3)	(1) Pre	(2) Post	(3) Then	t(2)(3)	t(1)(3)	t(1)(2)
1	0.79	-0.42	0.13	4.23*	1.01 ^b	0.84	0.45	0.71	-1.34	0.32	1.17
2 ^a	---	---	---	---	---	0.84	0.00	0.00	---	---	---
3	0.42	-0.50	0.00	1.22	0.38	0.71	0.84	0.71	0.32	0.00	-0.29
4	0.61	-0.65	0.00	2.75	0.65	0.71	0.45	0.55	-0.45	0.59	0.82
5	0.92*	1.00**	0.92*	-10.15**	0.00	1.10	0.89	1.10	-0.90	0.00	0.90
6	1.00**	0.67	0.67	5.37*	5.37 ^b	0.55	0.55	0.55	0.00	0.00	0.00
7	1.00**	0.61	0.61	5.06*	5.06 ^b	0.55	0.45	0.45	0.00	0.45	0.45 ^c X
8	0.76	-0.54	-0.41	1.81	1.40 ^b	0.45	0.55	0.84	-1.17	-1.37	-0.39
9	1.00**	0.10	0.10	4.02*	4.02 ^b	1.10	0.45	0.45	0.00	1.78	1.78 ^c X
10	1.00**	0.37	0.37	4.31*	4.31 ^b	0.55	1.22	1.22	0.00	-1.67	-1.67 ^c X
11	0.85	0.42	0.64	1.36	0.57	0.84	0.84	0.71	0.55	0.32	0.00
12 ^a	---	---	---	---	---	0.00	0.00	0.00	---	---	---
13	1.00**	0.25	0.25	4.13*	4.13 ^b	0.89	0.89	0.89	0.00	0.00	0.00
14	0.00	0.65	0.17	-0.92	-0.29	0.55	0.55	0.71	-0.45	-0.59	0.00
15 ^a	---	---	---	---	---	0.00	0.00	0.00	---	---	---
16 ^a	---	---	---	---	---	0.45	0.00	0.00	---	---	---
17 ^a	---	0.87	---	---	---	0.55	0.00	0.84	---	---	---
18	-0.38	0.61	0.41	-3.23*	-2.75*	0.55	0.45	0.89	-1.40	-1.12	0.39
19	0.93*	0.73	0.78	1.17	0.84	1.14	0.89	1.14	-1.17	0.00	0.68
20	0.61	-0.25	0.61	27.20**	0.00	0.45	0.55	0.45	0.45	0.00	-0.45
21	0.65	0.92*	0.79	-1.59	-0.89	0.89	0.71	0.55	0.59	2.24	0.67
22	0.61	-0.37	0.00	1.41	0.66 ^b	1.22	0.45	0.55	-0.45	1.67	2.06 ^c X
23 ^a	---	---	---	---	---	0.71	0.00	0.00	---	---	---
24	1.00**	0.68	0.68	5.46*	5.46 ^b	1.14	0.84	0.84	0.00	0.74	0.74 ^c X
25 ^a	1.00**	---	---	---	---	0.00	0.55	0.55	---	---	---
26	0.79	-0.25	0.00	1.81	1.10 ^b	0.89	0.71	0.45	1.34	1.34	0.41
27	0.85	0.65	0.76	0.76	0.29	0.55	0.84	0.71	0.55	-0.59	-1.17

Note. Xs in the right margin indicate those individuals for whom both methods indicate gamma change.
^a Individual was omitted from analysis due to zero variance on the Pre, Post, and/or Then measures. ^b Indicates gamma change according to comparison of profile shapes (i.e., Post/Then correlation is greater than Pre/Then and Pre/Post correlations). ^c Indicates gamma change according to comparison of profile dispersions (i.e., Post and Then standard deviations are not different from each other, but each differs from the Pre standard deviation).
 * $p < .05$. ** $p < .01$.

Appendix E

Assessment of Gamma Change for the Dimension of Oral Communication

Participant	Correlations			Standard Deviations							
	(1) Post/Then	(2) Pre/Then	(3) Pre/Post	t(1)(2)	t(1)(3)	(1) Pre	(2) Post	(3) Then	t(2)(3)	t(1)(3)	t(1)(2)
1	0.97**	-0.31	-0.33	3.94**	4.19** ^b	0.38	0.95	1.21	-2.20	-3.42*	-2.51*
2	0.47	-0.17	-0.35	0.87	1.29	0.53	0.38	0.53	-0.90	0.00	0.85
3	0.65	0.65	0.42	0.00	0.70	0.38	0.76	0.49	1.32	-0.76	-1.85
4	-0.55	0.73	-0.40	-2.42*	-0.48	0.49	0.49	0.53	-0.24	-0.30	0.00
5 ^a	---	1.00**	---	---	---	0.49	0.00	0.49	---	---	---
6	0.17	-0.06	0.47	0.45	-0.47	0.53	0.38	0.76	-1.70	-0.79	0.90
7	0.73	0.65	0.88**	0.52	-0.84	0.53	0.76	0.69	0.30	-0.76	-1.69 ^c
8	0.88**	0.32	0.68	4.97**	1.04 ^b	0.79	0.53	0.76	-1.69	0.09	1.21
9	0.40	0.42	0.42	-0.04	-0.04	0.58	0.69	0.69	0.00	-0.44	-0.44 ^c
10 ^a	1.00**	---	---	---	---	0.00	0.53	0.53	---	---	---
11	0.88**	-0.09	0.24	4.11**	1.72 ^b	0.69	1.00	0.38	5.38**	1.43	-0.87
12	0.65	0.35	0.55	0.79	0.24	0.53	0.49	0.38	0.76	0.85	0.24
13	-0.17	0.00	0.00	-0.24	-0.24	0.58	0.38	0.38	0.00	0.98	0.98 ^c
14 ^a	---	-0.59	---	---	---	0.49	0.00	0.58	---	---	---
15 ^a	---	---	---	---	---	0.00	0.00	0.00	---	---	---
16	0.73	-0.09	0.40	2.73*	0.72 ^b	0.49	0.49	0.53	-0.30	-0.20	0.00
17	-0.06	0.13	0.77*	-0.56	-1.93	0.76	0.53	0.76	-0.79	0.00	1.23
18	0.42	0.50	0.77*	-0.25	-1.05	0.53	0.76	0.90	-0.43	-1.40	-1.23
19	0.86*	0.85*	0.73	0.08	0.93	0.69	1.13	0.98	0.66	-1.50	-1.69
20 ^a	---	---	---	---	---	0.49	0.00	0.00	---	---	---
21	1.00**	0.20	0.20	5.00**	5.00** ^b	0.53	0.90	0.90	0.00	-1.24	-1.24 ^c
22	0.73	0.35	0.26	0.89	1.18 ^b	0.53	0.69	0.38	2.09	0.85	-0.60
23	0.85*	0.00	0.00	2.06	2.06 ^b	0.82	0.49	0.69	-1.50	0.38	1.20
24	1.00**	0.78*	0.78*	7.83**	7.83**	1.07	1.00	1.00	0.00	0.24	0.24
25 ^a	---	---	-0.47	---	---	0.53	0.38	0.00	---	---	---
26	0.35	-0.09	-0.71	0.51	2.21	0.49	0.76	0.53	0.85	-0.20	-1.43
27 ^a	0.76*	---	---	---	---	0.00	0.58	0.38	---	---	---

Note. Xs in the right margin indicate those individuals for whom both methods indicate gamma change.

^a Individual was omitted from analysis due to zero variance on the Pre, Post, and/or Then measures. ^b Indicates gamma change according to comparison of profile shapes (i.e., Post/Then correlation is greater than Pre/Then and Pre/Post correlations). ^c Indicates gamma change according to comparison of profile dispersions (i.e., Post and Then standard deviations are not different from each other, but each differs from the Pre standard deviation).

* $p < .05$. ** $p < .01$.

Appendix F

Assessment of Gamma Change for the Dimension of Leadership

Participant	Correlations			Standard Deviations								
	(1)	(2)	(3)	t(1)(2)	t(1)(3)	(1)	(2)	(3)	t(2)(3)	t(1)(3)	t(1)(2)	
	Post/Then	Pre/Then	Pre/Post			Pre	Post	Then				
1	0.88**	-0.31	-0.47	2.46*	3.60* ^b	0.53	0.76	1.00	-1.35	-1.57	-0.90	
2	-0.35	0.31	0.00	-1.07	-0.65	1.00	0.38	0.53	-0.85	1.57	2.54	
3	0.75	0.41	0.32	0.85	1.14 ^b	0.76	0.79	0.69	0.44	0.22	-0.09	
4	0.47	-0.26	0.73	36.86**	-0.64	0.69	0.76	0.53	0.90	0.60	-0.30	
5 ^a	---	---	---	---	---	0.00	0.53	0.00	---	---	---	
6	0.00	-0.50	0.00	0.81	0.00	0.58	0.49	0.58	-0.38	0.00	0.38	
7	0.76*	0.54	0.47	0.69	0.93 ^b	0.53	0.38	0.58	-1.51	-0.20	0.90	
8	-0.17	0.17	0.17	-0.54	-0.54	0.38	0.38	0.38	0.00	0.00	0.00	
9	1.00**	0.81*	0.81*	8.26**	8.26**	0.76	0.90	0.90	0.00	-0.66	-0.66 ^c	
10	1.00**	0.35	0.35	5.24**	5.24** ^b	1.27	0.90	0.90	0.00	0.85	0.85 ^c	X
11	0.87*	0.72	0.55	0.72	1.73	1.07	0.49	0.90	-2.93*	0.56	2.32	
12 ^a	---	---	---	---	---	0.00	0.38	0.00	---	---	---	
13 ^a	---	---	-0.65	---	---	0.49	0.38	0.00	---	---	---	
14	0.47	0.24	0.91**	1.39	-1.64	0.79	0.53	0.38	0.90	1.84	2.09	
15 ^a	---	---	---	---	---	0.00	0.00	0.00	---	---	---	
16	1.00**	0.26	0.26	5.07**	5.07** ^b	0.76	0.49	0.49	0.00	1.05	1.05 ^c	X
17	0.83*	0.26	0.52	2.18*	0.95 ^b	0.79	0.76	0.95	-0.92	-0.44	0.10	
18	-0.17	0.47	0.47	-1.62	-1.62	0.53	0.38	0.38	0.00	0.90	0.90 ^c	
19	0.23	0.40	0.73	-0.51	-1.32	0.69	0.76	0.69	0.21	0.00	-0.30	
20 ^a	---	---	---	---	---	0.76	0.00	0.00	---	---	---	
21 ^a	---	---	0.09	---	---	0.69	0.76	0.00	---	---	---	
22	0.75	0.58	0.44	0.51	1.02	0.95	0.69	0.69	0.00	0.90	0.81 ^c	
23	0.47	0.47	1.00**	0.00	-5.55**	0.53	0.53	0.38	0.90	0.90	0.00	
24	1.00**	0.68	0.68	6.71**	6.71** ^b	0.98	1.00	1.00	0.00	-0.07	-0.07	
25	1.00**	0.30	0.30	5.14**	5.14** ^b	0.49	0.49	0.49	0.00	0.00	0.00	
26	0.54	-0.07	0.00	1.02	0.86 ^b	0.90	0.82	0.76	0.20	0.39	0.22	
27	0.35	0.35	0.42	0.00	-0.12	1.13	0.76	0.53	0.85	1.97	1.03	

Note. Xs in the right margin indicate those individuals for whom both methods indicate gamma change.
^a Individual was omitted from analysis due to zero variance on the Pre, Post, and/or Then measures. ^b Indicates gamma change according to comparison of profile shapes (i.e., Post/Then correlation is greater than Pre/Then and Pre/Post correlations). ^c Indicates gamma change according to comparison of profile dispersions (i.e., Post and Then standard deviations are not different from each other, but each differs from the Pre standard deviation).
 * $p < .05$. ** $p < .01$.

Appendix G

Assessment of Gamma Change for the Dimension of Conflict Management/Resolution

Participant	Correlations			Standard Deviations								
	(1) Post/Then	(2) Pre/Then	(3) Pre/Post	t(1)(2)	t(1)(3)	(1) Pre	(2) Post	(3) Then	t(2)(3)	t(1)(3)	t(1)(2)	
1	0.79	0.85*	0.46	-0.31	2.26	0.52	0.84	1.21	-1.23	-3.68*	-1.13	
2 ^a	-0.63	---	---	---	---	0.00	0.41	0.52	---	---	---	
3	0.20	0.40	-0.40	-0.24	1.15	0.82	0.41	0.82	-1.53	0.00	1.64	
4	-0.32	0.71	-0.89*	-1.46	16.15**	1.10	0.41	0.52	-0.50	2.33	5.16** ^c	
5	0.58	1.00**	0.58	-5.48**	0.00	0.55	0.63	0.55	0.35	0.00	-0.35	
6 ^a	---	0.80	---	---	---	0.82	0.00	0.41	---	---	---	
7 ^a	---	1.00**	---	---	---	0.52	0.00	0.52	---	---	---	
8	0.63	0.71	0.45	-0.19	0.54	0.55	0.41	0.52	-0.61	0.17	0.67	
9	0.33	-0.45	0.45	1.92	-0.15	0.82	0.55	0.55	0.00	0.92	0.92 ^c	
10	1.00**	0.20	0.20	4.56**	4.56** ^b	0.41	0.41	0.41	0.00	0.00	0.00	
11	0.80	0.88*	0.55	-0.42	1.78	0.82	0.89	0.84	0.22	-0.10	-0.22	
12	1.00**	0.20	0.20	4.56**	4.56** ^b	0.41	0.41	0.41	0.00	0.00	0.00	
13 ^a	---	-0.78	---	---	---	0.63	0.00	0.41	---	---	---	
14 ^a	---	---	---	---	---	0.00	0.00	0.55	---	---	---	
15	0.71	0.45	0.32	0.56	0.90	0.41	0.52	0.55	-0.17	-0.67	-0.50	
16	1.00**	0.43	0.43	4.96**	4.96** ^b	0.52	0.89	0.89	0.00	-1.28	-1.28 ^c	
17	-0.34	-0.72	0.63	1.11	-1.13	1.14	0.75	0.52	0.82	2.53	1.10	
18	0.71	0.71	1.00**	0.00	-6.32**	0.52	0.52	0.55	-0.17	-0.17	0.00	
19	0.20	0.32	0.63	-0.25	-0.81	0.52	0.82	0.41	1.53	0.50	-1.22	
20 ^a	---	---	---	---	---	0.00	0.00	0.00	---	---	---	
21	0.50	-0.32	0.32	1.71	0.25	0.82	0.52	0.52	0.00	1.00	1.00 ^c	
22 ^a	---	---	-0.42	---	---	0.63	0.75	0.00	---	---	---	
23 ^a	---	---	0.63	---	---	0.52	0.41	0.00	---	---	---	
24	0.71	-0.33	0.00	2.01	1.02 ^b	0.55	0.52	0.55	-0.17	0.00	0.12	
25 ^a	1.00**	---	---	---	---	0.00	0.55	0.55	---	---	---	
26	-0.16	-0.61	-0.39	0.62	0.26	0.63	0.82	0.52	0.96	0.52	-0.56	
27	0.86*	0.32	0.11	1.30	2.17 ^b	0.41	0.75	0.52	1.50	-0.50	-1.31	

Note. Xs in the right margin indicate those individuals for whom both methods indicate gamma change.
^a Individual was omitted from analysis due to zero variance on the Pre, Post, and/or Then measures. ^b Indicates gamma change according to comparison of profile shapes (i.e., Post/Then correlation is greater than Pre/Then and Pre/Post correlations). ^c Indicates gamma change according to comparison of profile dispersions (i.e., Post and Then standard deviations are not different from each other, but each differs from the Pre standard deviation).
 * $p < .05$. ** $p < .01$.

Appendix H

Assessment of Beta and Alpha Change for the Dimension of Information Seeking

Participant	Mean Scale Scores			t(Then)(Pre)	t(Then)(Post)	t(Post)(Pre)
	Pre	Post	Then			
1	5.00	5.17	5.00	0.00	1.00	0.42
2 ^b	5.33	5.67	5.67	n/a	n/a	1.58 ^e
3	5.83	5.83	5.33	-2.24 ^c	1.46 ^d	0.00
4	3.50	5.00	4.50	3.87* ^c	1.46 ^d	3.50* ^e
5 ^a	6.00	6.00	6.00	---	---	---
6 ^b	6.17	6.50	6.67	n/a	n/a	1.00
7	6.50	6.67	6.67	0.54	0.00	0.54
8 ^a	5.83	6.00	5.67	---	---	---
9	6.33	5.67	5.67	-3.16* ^c	0.00	-3.16* ^e
10 ^b	5.83	5.83	5.83	n/a	n/a	0.00
11 ^a	5.00	5.33	5.00	---	---	---
12	6.50	6.50	6.33	-1.00	1.00	0.00
13	5.17	5.83	5.83	1.35 ^c	0.00	1.35 ^e
14 ^a	5.33	6.00	5.83	---	---	---
15 ^a	5.67	7.00	6.83	---	---	---
16 ^a	5.50	6.00	6.00	---	---	---
17	5.40	5.33	5.17	-0.25	0.54	0.00
18	5.00	6.17	5.50	1.46 ^c	2.00 ^d	2.91* ^e
19 ^a	6.67	6.17	6.00	---	---	---
20 ^a	5.17	6.00	6.00	---	---	---
21 ^b	5.33	4.83	4.83	n/a	n/a	-1.46 ^e
22	5.50	6.17	6.33	2.08 ^c	-0.54	2.00 ^e
23 ^a	6.17	6.00	6.00	---	---	---
24	5.83	5.67	5.83	0.00	-1.00	-1.00
25 ^b	5.67	5.67	5.50	n/a	n/a	0.00
26	4.00	4.33	3.83	-0.42	2.24 ^d	1.00
27 ^b	6.67	4.83	4.83	n/a	n/a	-5.97** ^e

Note: reported means are based on the full scale. Pair-wise deletions used in conducting *t*-tests.
^a Individual was omitted from analysis due to zero variance on the factor items. ^b Individual was omitted from analysis due to the presence of gamma change. ^c Indicates beta change. ^d Indicates alpha change.
^e Indicates change as assessed through traditional Pre/Post comparisons.
 p*<.05. *p*<.01.

Appendix I

Assessment of Beta and Alpha Change for the Dimension of Problem Solving

Participant	Mean Scale Scores			t(Then)(Pre)	t(Then)(Post)	t(Post)(Pre)
	Pre	Post	Then			
1	4.80	5.60	5.40	1.50 ^c	1.00	2.14 ^e
2 ^a	4.80	6.00	5.20	---	---	---
3	5.80	5.80	4.80	-3.16* ^c	3.16* ^d	0.00
4	4.00	5.40	4.20	1.00	3.21* ^d	3.50* ^e
5	5.80	6.00	5.80	0.00	1.00	1.00
6	5.60	6.20	5.60	0.00	2.45 ^d	2.45 ^e
7	5.80	5.80	5.60	-1.00	1.00	0.00
8 ^a	5.80	6.00	5.60	---	---	---
9 ^a	6.40	6.00	5.80	---	---	---
10 ^b	6.00	5.40	5.40	n/a	n/a	-1.50
11	5.00	5.20	5.00	0.00	1.00	1.00
12 ^a	6.00	6.20	6.20	---	---	---
13	6.00	6.20	6.60	1.50 ^c	-1.00	0.41
14 ^a	5.20	5.80	6.00	---	---	---
15 ^a	5.60	7.00	6.80	---	---	---
16 ^b	6.20	6.40	6.40	n/a	n/a	1.00
17 ^a	5.40	5.20	5.00	---	---	---
18 ^a	5.00	6.40	6.00	---	---	---
19 ^a	6.00	6.00	6.40	---	---	---
20 ^a	5.00	6.20	6.00	---	---	---
21 ^b	5.20	4.40	4.40	n/a	n/a	-1.09
22 ^b	3.80	5.60	5.60	n/a	n/a	4.81** ^e
23 ^a	6.00	6.20	6.00	---	---	---
24	5.80	5.80	5.80	0.00	0.00	0.00
25	5.75	5.80	5.80	0.00	0.00	0.00
26	4.60	4.40	4.40	-0.54	0.00	-0.41
27 ^b	6.20	5.80	5.60	n/a	n/a	-1.00

Note: reported means are based on the full scale. Pair-wise deletions used in conducting *t*-tests.
^a Individual was omitted from analysis due to zero variance on the factor items. ^b Individual was omitted from analysis due to the presence of gamma change. ^c Indicates beta change. ^d Indicates alpha change.
^e Indicates change as assessed through traditional Pre/Post comparisons.
 p*<.05. *p*<.01.

Appendix J

Assessment of Beta and Alpha Change for the Dimension of Planning and Organizing

Participant	Mean Scale Scores			t(Then)(Pre)	t(Then)(Post)	t(Post)(Pre)
	Pre	Post	Then			
1	4.20	3.80	4.00	-0.34	-1.00	-1.00
2 ^a	3.80	5.00	5.00	---	---	---
3	5.00	4.20	4.00	-1.83 ^c	0.54	-1.63 ^e
4	4.00	4.80	4.60	1.18 ^c	1.00	2.14 ^e
5	5.20	5.40	5.20	0.00	1.00	1.00
6	4.40	4.60	4.60	1.00	0.00	1.00
7 ^b	6.60	6.80	6.80	n/a	n/a	1.00
8	5.80	5.60	5.20	-1.18 ^c	1.63 ^d	-0.54
9 ^b	4.80	5.20	5.20	n/a	n/a	0.78
10 ^b	6.40	6.00	6.00	n/a	n/a	-0.78
11	4.20	4.20	4.00	-0.54	1.00	0.00
12 ^a	6.00	6.00	6.00	---	---	---
13	6.40	6.60	6.60	0.41	0.00	0.41
14	3.40	4.40	4.00	2.45 ^c	1.00	3.16* ^e
15 ^a	6.00	7.00	7.00	---	---	---
16 ^a	5.80	6.00	6.00	---	---	---
17 ^a	6.40	6.00	5.20	---	---	---
18	4.40	5.80	5.40	3.16* ^c	0.78	5.72** ^c
19	5.60	4.60	4.40	-3.21* ^c	1.00	-3.16* ^e
20	4.80	5.60	5.80	3.16* ^c	-1.00	4.00* ^e
21	4.40	4.00	3.60	-4.00* ^c	1.63 ^c	-1.63 ^e
22 ^b	4.00	5.20	5.40	n/a	n/a	2.06
23 ^a	6.00	6.00	6.00	---	---	---
24 ^b	4.40	4.20	4.20	n/a	n/a	-0.54
25 ^a	5.00	5.60	5.60	---	---	---
26	4.60	5.00	4.80	0.41	1.00	0.78
27	6.60	5.20	5.00	-6.53** ^c	1.00	-5.72** ^c

Note: reported means are based on the full scale. Pair-wise deletions used in conducting *t*-tests.
^a Individual was omitted from analysis due to zero variance on the factor items. ^b Individual was omitted from analysis due to the presence of gamma change. ^c Indicates beta change. ^d Indicates alpha change.
^e Indicates change as assessed through traditional Pre/Post comparisons.
 p*<.05. *p*<.01.

Appendix K

Assessment of Beta and Alpha Change for the Dimension of Oral Communication

Participant	Mean Scale Scores			t(Then)(Pre)	t(Then)(Post)	t(Post)(Pre)
	Pre	Post	Then			
1	5.86	5.29	5.14	-1.37 ^c	1.00	-1.33 ^e
2	5.57	5.86	5.57	0.00	1.55 ^d	1.00
3	5.14	5.29	4.29	-6.00** ^c	4.58** ^d	0.55
4	3.71	4.71	4.57	6.00** ^c	0.42	3.24* ^e
5 ^a	5.71	6.00	5.71	---	---	---
6	5.57	5.86	5.29	-0.80	1.92 ^d	1.55 ^e
7	5.43	6.29	5.86	2.12 ^c	2.12 ^d	6.00** ^e
8	4.57	5.57	4.71	0.42	6.00** ^d	4.58** ^e
9	5.00	4.86	5.14	0.55	-1.00	-0.55
10 ^a	6.00	5.57	5.57	---	---	---
11	4.86	5.00	4.86	0.00	0.55	0.35
12	6.57	6.29	6.14	-2.12 ^c	1.00	-1.55 ^e
13	6.00	6.86	6.86	3.29* ^c	0.00	3.29* ^e
14 ^a	5.29	6.00	5.00	---	---	---
15 ^a	6.00	7.00	7.00	---	---	---
16	5.29	5.71	5.57	1.00	1.00	2.12 ^e
17	5.29	5.57	5.29	0.00	0.80	1.55 ^e
18	4.43	5.71	4.86	1.44 ^c	2.52 ^d	6.97** ^e
19	5.86	5.43	5.43	-2.12 ^c	0.00	-1.44 ^e
20 ^a	4.71	6.00	6.00	---	---	---
21 ^b	5.57	4.86	4.86	n/a	n/a	-1.99 ^e
22	5.57	5.86	6.14	2.83* ^c	-1.55 ^d	1.00
23	5.00	5.71	5.86	2.12 ^c	-1.00	1.99 ^e
24	5.14	5.00	5.00	-0.55	0.00	-0.55
25 ^a	4.57	5.14	5.00	---	---	---
26	4.71	3.71	3.43	-4.50** ^c	1.00	-2.29 ^e
27 ^a	5.00	5.00	4.86	---	---	---

Note: reported means are based on the full scale. Pair-wise deletions used in conducting *t*-tests. ^a Individual was omitted from analysis due to zero variance on the factor items. ^b Individual was omitted from analysis due to the presence of gamma change. ^c Indicates beta change. ^d Indicates alpha change. ^e Indicates change as assessed through traditional Pre/Post comparisons.
 p*<.05. *p*<.01.

Appendix L

Assessment of Beta and Alpha Change for the Dimension of Leadership

Participant	Mean Scale Scores			t(Then)(Pre)	t(Then)(Post)	t(Post)(Pre)
	Pre	Post	Then			
1	4.57	4.29	4.00	-1.19 ^c	1.55 ^d	-0.68
2	5.00	5.86	5.57	1.55 ^c	1.00	2.12 ^e
3	4.71	4.57	4.14	-1.92 ^c	2.12 ^d	-0.42
4	4.14	4.71	4.57	1.16 ^c	0.55	2.83** ^e
5 ^a	6.00	6.43	6.00	---	---	---
6	6.00	5.29	5.00	-2.65** ^c	1.00	-2.50** ^e
7	5.43	6.14	6.00	2.83** ^c	1.00	3.87** ^e
8	5.86	6.14	5.14	-3.87** ^c	4.58** ^d	1.55 ^e
9	4.71	5.14	5.14	2.12 ^c	0.00	2.12 ^e
10 ^b	5.57	5.14	5.14	n/a	0.00	-0.89
11	4.14	4.29	3.86	-1.00	2.12 ^d	0.42
12 ^a	6.00	6.14	6.00	---	---	---
13 ^a	6.29	6.86	7.00	---	---	---
14	4.57	5.43	5.14	1.92 ^c	1.55 ^d	6.00** ^e
15 ^a	6.00	7.00	7.00	---	---	---
16 ^b	5.29	5.71	5.71	n/a	n/a	1.44 ^e
17	5.57	5.29	4.71	-2.12** ^c	2.83** ^d	-1.00
18	4.43	5.14	4.14	-1.55 ^c	4.58** ^d	3.87** ^e
19	5.86	5.29	5.14	-2.50** ^c	0.42	-2.83** ^e
20 ^a	5.29	6.00	6.00	---	---	---
21 ^a	4.86	4.29	4.00	---	---	---
22	5.71	5.86	6.14	1.44 ^c	-1.55 ^d	0.42
23	6.43	6.48	6.14	-1.55 ^c	1.55 ^d	0.00
24	4.43	5.00	5.00	1.92 ^c	0.00	1.92 ^e
25	4.29	5.29	5.29	4.58** ^c	0.00	4.58** ^e
26	3.86	4.00	3.71	-0.31	1.00	0.31
27	6.57	5.71	5.43	-2.83** ^c	1.00	-2.12 ^e

Note: reported means are based on the full scale. Pair-wise deletions used in conducting *t*-tests. ^a Individual was omitted from analysis due to zero variance on the factor items. ^b Individual was omitted from analysis due to the presence of gamma change. ^c Indicates beta change. ^d Indicates alpha change. ^e Indicates change as assessed through traditional Pre/Post comparisons.
 p*<.05. *p*<.01.

Appendix M

Assessment of Beta and Alpha Change for the Dimension of Conflict Management

Participant	Mean Scale Scores			t(Then)(Pre)	t(Then)(Post)	t(Post)(Pre)
	Pre	Post	Then			
1	3.33	3.50	2.67	-2.00 ^c	2.71* ^d	0.54
2 ^a	5.00	5.83	5.33	---	---	---
3	5.33	5.83	5.33	0.00	1.46 ^d	1.17 ^e
4	4.00	4.83	4.67	2.00 ^c	0.54	1.39 ^e
5	5.50	6.00	5.50	0.00	2.24 ^d	2.24** ^e
6 ^a	5.33	6.00	5.83	---	---	---
7 ^a	5.67	6.00	5.67	---	---	---
8	5.50	5.83	5.67	1.00	1.00	1.58 ^e
9	4.33	4.50	4.50	0.35	0.00	0.54
10	5.83	5.17	5.17	-3.16* ^c	0.00	-3.16* ^e
11	3.67	4.00	3.50	-1.00	2.24 ^d	1.00
12	5.83	5.17	5.17	-3.16* ^c	0.00	-3.16* ^e
13 ^a	6.00	6.00	6.17	---	---	---
14 ^a	4.00	5.00	4.50	---	---	---
15	4.83	6.33	5.50	3.16* ^c	5.00** ^d	6.71** ^e
16 ^b	5.33	5.00	5.00	n/a	n/a	-1.00
17	5.40	4.83	5.33	0.00	-1.17 ^d	-1.50 ^e
18	4.33	5.33	4.50	1.00	5.00** ^d	0.00
19	5.33	4.33	3.83	-6.71** ^c	1.46	-3.87* ^e
20 ^a	5.00	6.00	6.00	---	---	---
21	4.33	4.67	4.33	0.00	1.58 ^d	1.00
22 ^a	6.00	5.83	6.00	---	---	---
23 ^a	5.67	5.83	6.00	---	---	---
24	5.50	5.33	5.50	0.00	-1.00	-0.54
25 ^a	5.00	5.50	5.50	---	---	---
26	4.00	4.33	3.67	-0.79	1.58 ^d	0.67
27	5.17	4.83	4.67	-2.24 ^c	1.00	-1.00

Note: reported means are based on the full scale. Pair-wise deletions used in conducting *t*-tests. ^a Individual was omitted from analysis due to zero variance on the factor items. ^b Individual was omitted from analysis due to the presence of gamma change. ^c Indicates beta change. ^d Indicates alpha change. ^e Indicates change as assessed through traditional Pre/Post comparisons.
 p*<.05. *p*<.01.