It's Complicated:

An Examination of Emotional Complexity and the Influence of Stress

by

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ABSTRACT

Objective: The present study sought to 1) examine the measurement of emotional complexity (EC) by examining the associations among different indicators of EC (i.e., covariation between positive affect and negative affect; overall, negative, and positive granularity; overall, negative, and positive differentiation) derived from the same data set and identifying a latent factor structure; and 2) evaluate the predictive ability of EC on psychological distress, emotional well-being, and physical functioning while accounting for stressful contexts. The utility of assessing emotion diversity (ED) as another aspect of EC was also explored.

Methods: 191 middle-aged adults from a community-based study on resilience were asked to complete 30 daily diaries assessing positive and negative affect. At least 6 months later, participants completed a phone interview that assessed distress (i.e., depressive and anxiety symptoms), well-being (i.e., WHO-5 well-being, vitality, social functioning), physical functioning, and perceived stress.

Results: A three-factor solution with latent factors representing overall, negative, and positive EC was identified. Overall EC significantly predicted enhanced physical functioning, but was not associated with distress or well-being. Contrary to study hypotheses, positive and negative EC were not associated with future distress, well-being, or physical functioning, though a trend toward improved physical functioning was noted for positive EC. In contrast, positive and negative ED were both associated with less distress, and better well-being and physical functioning. Overall ED was unexpectedly related to worse outcomes (i.e., more distress, less well-being, decreased physical

functioning). Stress did not moderate the relationship between emotional complexity and the outcome variables.

Conclusions: Different indicators of EC represent distinct aspects of emotional experience. Partial support of the hypotheses found. Physical functioning was the only outcome influenced by EC. The inclusion of stress did not change the results. The discrepancy between the findings and those in the literature may be related to reliability of EC indicators and absence of contextual factors. Further exploration of ED revealed a potentially important construct of emotional experience that is deserving of further inquiry.

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Emotions are an important part of daily life. They infuse our thoughts, motivate us to behave in specific ways, and provide information to help interpret our experiences. Research on discrete emotions and the influence of valence, intensity, and other aspects of emotion have shed considerable light on how emotions serve adaptive functions. However, it is also true that we can experience complex emotional states. For instance, the birth of child might inspire fear, anxiety, excitement, and happiness simultaneously. Having the capacity to describe experiences in more detail than descriptors of "good" and "bad" also conveys emotional complexity. These differentiated emotional experiences are generally thought to be associated with adaptive socioemotional and physical functioning. However, the presence of contradictory findings in the research literature suggest differences in measurement and context may be obscuring the true relationships between emotional complexity and functioning on social, emotional, and physical levels.

What is Emotional Complexity?

The capacity to have complex emotional experiences has been described in a multitude of ways. Some researchers define emotional complexity as the basic capacity to discriminate between pleasant and unpleasant emotional states (Ong & Bergeman, 2004), while others add that emotionally complex individuals experience different emotions simultaneously, differentiate between their own emotions with clarity, distinguish between their own emotions and others' emotions, and are able to express and verbalize these varied emotional states (Grühn, Lumley, Diehl, and Labouvie-Vief, 2013). Kang and Shaver (2004) describe emotional complexity as primarily representing two

correlated aspects: a broad range of emotional experience and the tendency to distinguish between subtle categories of emotion. These definitions portray emotional complexity as encompassing both breadth and specificity of one's own emotional experience. Though there is a lack of unifying nomenclature to describe emotional complexity and its different facets, the method by which emotional complexity is measured provides some information about the constructs being tapped. Three distinct approaches to assess emotional complexity with time-based indicators appear in the literature: those identifying a) co-occurring affects or emotion blends, b) affect differentiation, and c) emotional granularity.

Co-occurring affects, emotion blends, and mixed emotions. Co-occurring affects, emotion blends, or mixed emotions describe the affinity for emotional experience to contain blends or overlaps between positive and negative emotions (Carstensen, Pasupathi, Mayer, & Nesselrode, 2000; Ong & Bergeman, 2004). Studies examining co-occurring emotions generally measure this facet of emotional complexity using experience sampling methodology, capturing several ratings of both positive and negative emotions over time for each individual in a sample (Lindquist & Barrett, 2008). An intra-individual correlation between positive affect and negative affect provides an index of covariation that represents the extent of overlap between positive and negative emotions (i.e., PA-NA covariation). Correlations can range from -1 to 1, with more strongly negative correlations representing less overlap between positive affect and negative affect, and thus less emotional complexity. Conversely, a positive correlation represents more covariation, or greater overlap among positive and negative emotion, and thus greater emotional complexity. Alternate approaches such as counting the number of

occasions in which both positive and negative emotion words appear together in a narrative have also been used to assess for co-occurring emotions (Adler & Hershfield, 2012).

Affective differentiation. The second category of emotional complexity is affective differentiation. Affective differentiation is a term that is used often—and inconsistently—in the emotional complexity literature. In this paper it is be defined as the range of distinct emotional experiences assessed by computing component scores based on a principal components analysis of each individual's affective reports over time. Instead of calculating a principal components analysis for a set of variables measured from different persons on one occasion, an index of affective differentiation is created by completing a principal components analysis for a set of emotion variables over several occasions—daily, for example, in the case of daily diaries—for one individual (Grühn et al., 2013). This method requires a measure that contains a large number of affect words like the Positive Affect and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) to adequately carry out the statistical analyses. Termed the P-technique (Cattell, Cattell, & Rhymer, 1947), this index provides a component score that represents the number of distinct affective dimensions experienced by an individual. A larger number of components or factors reflects more distinct emotion states, implying a more differentiated emotional experience and greater emotional complexity (Ong & Bergeman, 2004). While computing component scores is the predominant method to assess for affective differentiation, some investigators utilize other methods to measure the range of emotional experience, such as counting the number of discrete emotions reported in a narrative (e.g., Chipperfield, Perry, & Weiner, 2003).

Emotional granularity. The third category of emotional complexity is granularity. Emotion granularity refers to the ability to describe emotion with precision and specificity (Barrett, 1998). Emotional granularity has also been called "poignancy" by some researchers (e.g., Carstensen et al., 2000). Individuals high in granularity describe emotions as discrete and differentiated whereas individuals low in granularity describe emotional experience in broad or global terms (Lindquist & Barrett, 2008). For instance, an individual who uses words like "happy," "sad," "elated," and "angry," to represent distinct emotional experiences will demonstrate greater emotional granularity than someone who uses emotion descriptors in an imprecise manner to represent global affective states (e.g. pleasant versus unpleasant; Lindquist & Barrett, 2008).

An emotional granularity index is created by calculating an intraclass correlation (ICC) across emotion items obtained over time with multiple observations per person. ICCs can be calculated across all emotions to create an overall index of emotional granularity, or separately by valence to create indices of positive and negative granularity (Tugade, Fredrickson, & Barrett, 2004). Greater granularity is associated with more complexity.

Another construct that is conceptually similar to emotional granularity is mood clarity. The concept of mood clarity arose out of Salovey and colleagues' (1995) research on meta-mood, which is defined as the tendency to pay attention to one's own moods and emotions, and the capacity to discriminate among and regulate emotions. Mood clarity refers to the ability to understand one's moods and is measured by administering the self-report Mood Clarity subscale of Salovey and colleagues' (1995) Trait Meta-Mood scales. Representative items from the Mood Clarity subscale include, "I usually know my

feelings about a matter" and "I almost always know exactly how I am feeling." This construct differs from emotional granularity in that it requires metaknowledge of one's own affective experience and it does not specifically refer to discrimination of emotional states. The relationship between emotional granularity and mood clarity has not been investigated thoroughly though there is some evidence to suggest they are not related (Boden, Thompson, Dizén, Berenbaum, & Baker, 2013). These similarities are enough to warrant its inclusion as a measure of emotional complexity.

Comparison of metrics. Indices of PA-NA covariation, differentiation, and granularity all appear to measure some aspect of emotional complexity, but to what extent are they tapping into the same construct? That is, how much redundancy is there between these measures of emotional complexity? The data are limited, but some conclusions can be drawn from studies that have examined multiple metrics of emotional complexity. In a study of emotional experience across the adult lifespan, Carstensen and colleagues (2000) found a modest positive correlation between overall differentiation and PA-NA scores ($r = .23$, $p < .01$). Ong and Bergeman (2004)'s study of emotional complexity in older adults found a similar association between PA-NA covariation and overall differentiation indices ($r = .26$, $p < .05$) consistent with Carstensen and colleagues' findings. Kang and Shaver (2004) found that the emotional granularity and affect differentiation subscales of the Range and Differentiation of Emotional Experience Scale (RDEES), a self-report instrument that assesses emotional complexity, were modestly correlated, $r = .31$ to $.47$ in three samples of 400 undergraduate students. These studies suggest the different metrics represent independent, but related constructs.

There has been one notable exception to the lack of work in this area: Grühn and colleagues (2013) determined the extent to which indicators of covariation, differentiation, granularity, and variability[1] are related. Grühn and colleagues (2013) captured emotional complexity in nine distinct metrics—a covariation index, two differentiation indices[2], three granularity indices—overall, positive, and negative—and three variability indices—overall, positive, and negative. Exploratory factor analyses of these indices yielded a four-factor solution with latent factors that representing overall fluctuation (i.e., the number of discrete emotional states experienced), positive differentiation (i.e., the occurrence of distinct positive emotional states), negative differentiation (i.e., the occurrence of distinct negative emotional states), and positive and negative affect covariation. These four latent factors were uncorrelated, but the existence of cross-loadings suggested some overlap among the different indices (Grühn et al., 2013). Grühn and colleagues (2013) concluded that these four latent factors represented distinct, independent aspects of emotional complexity.

Grühn and colleagues' (2013) close examination of emotional complexity has important implications. First, examinations of emotional complexity in the research literature lack uniformity in definition, replicability, and agreement across studies. Secondly, emotional complexity can be thought of as a broad construct with the different indicators representing different aspects of complexity (Kang & Shaver, 2004). Given the statistical independence between constructs we may assume that individuals can be high in one aspect and low in another, producing innumerable ways in which an individual may be emotionally complex.

Emotion diversity. Emotion diversity, or "emodiversity" is yet another conceptualization of emotional experience that has recently emerged in emotion research. The concept of emotion diversity has been borrowed from the natural sciences' conceptualization of biodiversity, here defined as the variety and relative abundance of different types of organisms within an ecosystem (Quoidbach, Gruber, Mikolajczak, Kogan, Kotsou, & Norton, 2014). Emotion diversity refers to the range and relative abundance of emotional experience. It is operationalized by adapting the Shannon biodiversity index (Shannon, 1948), which reflects both "richness" (quantity of specific emotions) and "evenness" (proportion of specific emotion experienced relative to all other specific emotions; Quoidbach et al., 2014).

In contrast to the indicators of emotional complexity described above—which are predicated on valence-based theories of emotion and focus on the unique contributions of global, positive, and negative affective states—emotion diversity draws upon functionalist theories of emotion, and is derived from the relative amount and number of discrete emotions experienced (Quoidbach et al. 2014; Benson et al., 2015). For example, an individual who experiences several discrete emotions at high frequency would be considered as having rich emotion diversity. There is evidence in the literature that discrete emotional states serve specific functions and provide adaptive value over global states (e.g., Barrett, Gross, Christensen, & Benvenuto, 2001; Barrett & Campos, 1987). Having many discrete emotional experiences (i.e., greater emotion diversity) may be associated with a wider array of specific strategies associated with affective states, which may consequently confer benefits in well-being, mental health, and physical health. One published study that has examined this construct demonstrated that global, positive, and

negative emotion diversity were associated with less depression and better physical health (e.g., less visits to the physician, lower hospital-related costs), even after accounting for mean levels of positive and negative emotion (Quoidbach et al., 2014). These results suggest further examination of this construct is needed, particularly in relation to other measures of emotional complexity.

Emotional Complexity is Good…or is It?

Different aspects of emotional complexity have been associated with more effective emotion regulation and adaptive coping. Carstensen and colleagues (2000) suggest that affective differentiation is an indication of adaptive emotion regulation, given its associations with greater emotional control, lessened neuroticism and decreased negative affect. Negative, but not positive, emotional granularity is associated with a wider range of emotion regulation strategies, especially for those individuals who experience emotions more intensely (Barrett et al., 2001). Greater positive granularity has been associated with increased behavioral disengagement and mental disengagement coping strategies, suggesting that individuals that demonstrate high positive granularity are more likely to pause before attempting coping efforts and are less likely to be self-distracted (Tugade et al., 2004). Better identification of positive emotion appears to facilitate psychological flexibility and self-regulation (Tugade et al., 2004; Kashdan, Ferssizidis, Collins, & Muraven, 2010).

Given that there is evidence that suggests that emotional complexity is associated with adaptive self-regulation, it is reasonable to assume that the use of adaptive coping may lend itself to better mental health and psychological well-being. Emotional complexity appears to be associated with better mental health and less psychopathology.

Mood clarity is related to less depression (Rude & McCarthy, 2003), lower social anxiety, greater self-esteem (Salovey, Stroud, Woolery, & Epel, 2002), and less mood lability (Salovey et al., 1995). Individuals with major depressive disorder demonstrate decreased negative granularity compared to their healthy counterparts (Demiralp et al., 2012). High mood clarity coupled with a frequent cognitive appraisal style is related to greater positive affect and less severe PTSD symptomatology after controlling for positive affect and attention to emotions (Boden, Bonn-Miller, Kashdan, Alvarez, & Gross, 2012). In a study of aggression, individuals with higher emotional granularity reported less daily aggressive tendencies and less daily aggression in response to being provoked (Pond et al., 2012). Carstensen and colleagues (2011) posit that mixed emotional states may serve to blunt extreme emotional highs and lows, reducing the likelihood of emotional lability while increasing emotional stability, which in turn contributes to less psychological distress. Though the findings above provide evidence to suggest emotional complexity is associated with less psychopathology, there have also been studies that do not find support for this association. For example, in study of emotional experience across the adult lifespan, investigators found that affective differentiation was not associated with mental health in a community sample of 184 adults ranging in age from 18 to 94 (Carstensen et al., 2000).

In addition to its association with better mental health, some aspects of emotional complexity are related to enhanced well-being. Ong and Bergeman (2004) found that greater affective differentiation and co-occurrence of positive and negative emotions was associated with more trait resilience, less perceived stress, and less neuroticism in a daily diary study of 40 older adults. Adler and Hershfield (2012) found that mixed emotional

experience in the form of narratives that contained both happiness and sadness predicted hedonic well-being (e.g., life satisfaction, presence of positive affect) over and above the independent effects of happiness, sadness, and neuroticism in a sample of adults undergoing psychotherapy. The data on emotional complexity's association with eudaimonic outcomes (e.g., self-actualization, vitality) is less clear. Mood clarity was found to predict greater life satisfaction after controlling for positive affect and negative affect in a sample of adults (Palmer, Donaldson, & Stough, 2002), but affective differentiation and co-occurring affects were not significantly associated with health or life satisfaction in some prior studies that utilized experience sampling methodology (e.g., Ong & Bergeman, 2004).

In addition to its associations with better mental health and psychological well-being, emotional complexity has also been associated with better physical health. In a study of adults aged 18 to 94, higher levels of mixed emotions were significantly associated with fewer physical health symptoms (e.g., hard of hearing, joint pain, loss of bladder control), controlling for the independent effects of positive emotions, negative emotions, and age (Hershfield, Scheiber, Sims, & Carstensen, 2013). Furthermore, increases in mixed emotions over time predicted lessened decline in health (Hershfield et al., 2013), suggesting that mixed emotional experience is not only associated with better physical health, but it may serve as a protective mechanism against worsening health. Larsen's co-activation model of emotional experience posits that experiencing positive emotions concurrently with negative emotions may "detoxify them," reframe negative emotional experience into meaningful experiences (e.g., meaning-making), and consequently lead to enhanced psychological well-being (Larsen, Hemenover, Norris, &

Cacioppo, 2003). In contrast, greater differentiation of negative emotions was associated with a greater number of chronic health conditions in a study of older adults ages 72 to 99 years (Chipperfield et al., 2003).

Emotional complexity may also have social implications. People who are more attuned to their own emotional experience might also be more likely to recognize and understand others' feelings. Thus, emotional granularity—that is, the capacity to differentiate between the subtle nuances of distinct emotion states—may be a necessary condition for emotional intelligence (i.e., the capacity to navigate social environments; Kang & Shaver, 2004). Studies examining alexithymia—a condition associated with having difficulty identifying and describing emotions—support this idea, as individuals with alexithymia report having fewer close relationships and less social support than individuals who do not have alexithymia (Lumley, Stettner, & Wehmer, 1996). Individuals reporting greater differentiation of emotions demonstrate increased empathy toward others and greater interpersonal adaptability compared to their less differentiated counterparts in both self- and peer-reports (Kang & Shaver, 2004). Similarly, differentiation of positive emotions has been associated with perceived social support in at least one study (e.g., Chipperfield et al., 2003). Tugade and colleagues (2004) theorize that individuals high in positive granularity cultivate positive emotions not only in themselves, but also elicit positive emotions in other individuals close to them, which serves to cultivate and strengthen a supportive social network that in turn helps in the coping process when individuals are under stress.

While most of the findings in the literature provide evidence that suggests emotional complexity is generally associated with positive outcomes, conflicting findings

exist. For example, Grühn and colleagues (2013) found that most indicators of emotional complexity were associated with a maladaptive profile in which overall differentiation was associated with more depressive symptoms, less life satisfaction, and less self-acceptance; and positive granularity was associated with less personal growth (Grühn et al., 2013).

Conclusions from this literature ought to be made with care, as context from study to study varies greatly. Differences in measurement may contribute to the conflicting findings. As previously discussed, different aspects of emotional complexity are likely to be associated with outcomes in different domains. Negative differentiation, for example, has been associated with a wider repertoire of emotion regulation strategies (Barrett al., 2001), and yet it has also been associated with poorer health in old age (Chipperfield et al., 2003). Differences in sample characteristics also make it difficult to compare one study to the next, as findings from one study may not generalize to another.

The Influence of Emotional Complexity on Stress

The presence of stress is another important contextual factor that may help explain the presence of conflicting findings in the research literature. The benefits of emotional complexity may be most apparent when stress is high (Barrett et al., 2001). For example, all individuals, regardless of whether they tend to be emotionally complex or not, may report relatively low levels of distress when stress is low. However, when stress is high, individuals who tend to be more emotionally complex may report less distress compared to individuals who tend to report less emotional complexity on average. Individuals who are able to maintain emotional complexity under stressful circumstances

are likely to benefit from enhanced emotion regulation and flexible coping associated with complex emotional experiences (Carstensen et al., 2000).

Thus, accounting for the level of stress experienced during the period of time emotion is assessed is crucial to determining the extent to which one is emotionally complex. Without taking stress into account, an individual with low emotional complexity might otherwise look identical to an individual with high emotional complexity. An individual low in emotional complexity may who experiences little stress may report similar levels of distress compared to an individual high in emotional complexity who is under stressful circumstances.

The negative and opposing findings in the literature may thus be explained in terms of stress. It is possible that the findings that suggest emotional complexity is not associated—or even negatively associated—with positive outcomes may have assessed emotional complexity under less stressful circumstances.

The Present Study

The failure to use indicators of emotional complexity in a consistent manner, and the absence of stress as an influence on psychological outcomes present major limitations in the research literature. The present study addresses these limitations by first utilizing a measurement approach to examine the associations among the different indicators of emotional complexity and clarifying the nature of any underlying construct(s), and second, determining the extent to which these measures together predict psychological distress, emotional well-being, and physical functioning. Additionally, perceived stress was included to account for the influence of stressful contexts on distress, well-being, and

physical functioning, so that the effects of emotional complexity indicators on these outcomes could be adequately modeled.

The first aim of the study was to gain clarity about emotional complexity as a construct. The relationships among the time-based indicators of emotional complexity (i.e., overall differentiation, positive differentiation, negative differentiation, overall granularity, positive granularity, negative granularity, and covariation between positive affect and negative affect) were examined in correlation analyses. Overall or global indicators of emotional complexity were expected to be highly correlated with positive and negative valenced emotional complexity indicators of the same type (e.g., overall granularity and positive granularity; overall differentiation and negative differentiation) because of the redundancy inherent in the construction of the indicators. Emotional complexity indicators of the same valence (i.e., positive differentiation and positive granularity; negative differentiation and negative granularity) were also expected to be positively correlated. The exploratory and confirmatory factor analyses were expected to replicate Grühn and colleagues' (2013) findings and yield three latent factors representing positive emotional complexity (positive differentiation, positive granularity), negative emotional complexity (negative differentiation, negative granularity), and PA-NA covariation. Overall differentiation and overall granularity were expected to cross-load across the other three factors.

There is a long tradition of examining negative outcomes, such as depressive symptoms, as indicators of mental health, but there is also ample support that positive aspects of well-being, such as vitality, provide additional information about psychological functioning above and beyond examining negative outcomes alone (e.g.,

Zautra, Affleck, Tennen, Reich, & Davis, 2005). These aspects of psychological functioning represent related, but independent constructs. It was expected that the outcome variables would cluster together in the same fashion and form two factors representing psychological functioning and one representing physical functioning. Previous work in this particular sample yielded a latent factor structure with three factors representing overall distress, well-being, and physical functioning (Yeung, Arewasikporn, & Zautra, 2012). A similar latent factor structure was expected to be identified, with anxiety and depressive symptoms loading on a latent factor representing psychological distress; vitality, well-being, and social functioning loading on a latent factor representing general well-being; and a factor representing physical functioning.

The second aim of the study was to evaluate the extent to which the emotional complexity latent factors—comprised of the seven individual indicators—predict psychological distress, emotional well-being, and physical functioning simultaneously. It was predicted that emotional complexity would be associated with a more adaptive profile, individuals demonstrating more emotional complexity reporting less distress, more well-being, and better physical functioning compared to individuals reporting less emotional complexity. Demographic differences—that is, age, gender, race, ethnicity, marital status, and employment status—in emotional complexity were also explored.

The third aim of the study examined the role of stress on these relationships. It was hypothesized that stress moderates the effects of emotional complexity on distress, well-being, and physical functioning. It is thought that emotional complexity confers benefits in terms of flexibility of coping strategies, which then leads to better outcomes. Under conditions of high stress individuals who report high levels of emotional

complexity would thus report less distress, more well-being, and better physical functioning compared to individuals who reported less emotional complexity. Under conditions of low stress all individuals—regardless of how emotionally complex they are—would report relatively low levels of distress, more well-being, and better physical functioning.

In addition to the planned analyses described above, indices of global, positive, and negative emotion diversity were examined as potential measures of emotional complexity. The emotion diversity indices were expected to positively correlate with the granularity indicators, as making fine-grained distinctions between distinct emotions may be a prerequisite to identifying the frequency by which they occur. It was predicted that emotion diversity would also be associated with an adaptive profile. Consistent with functionalist theory, it was expected that an increased number of discrete emotions (i.e., enhanced emotion diversity) would be associated with a greater number of coping strategies, which in turn translates into better outcomes. Thus, it was predicted that participants demonstrating increased emotion diversity would report less distress, more well-being, and better physical functioning than their less emotionally diverse counterparts. The same pattern of moderation effects described above was expected for the emotion diversity by stress interactions.

This paper is structured to first address planned analyses (i.e., examination of granularity, differentiation, and PA-NA covariation), then to examine the role of emotion diversity as a predictor of emotional and physical health, and finally to integrate findings in an effort to further develop our understanding of emotional complexity.

Method

Participants

One hundred ninety-one individuals were randomly selected from a larger community sample of 809 middle-aged adults living in Maricopa County, Arizona recruited for a community-based study of resilience. The sample was comprised of 107 women and 84 men between the ages of 40 and 65 (mean age = 53.5). Median income fell in the range of $50,000 to $65,000 and median level of education was completion of a college degree. The racial/ethnic composition of the participants is as follows: 79.2% non-Hispanic White, 14.6% Hispanic, 2.9% Black/African American, 2.9% Asian, 1.7% American Indian/Native American, and 13.3% bi- or multi-racial. Participants were allowed to endorse more than one race/ethnicity. 51.6% of the sample was married and 63% of the sample was employed at the time of study enrollment.

Procedure

Participants provided written consent upon study entry. Eight hundred and nine participants were recruited from 20 representative Census tracts in the Phoenix, Arizona metropolitan area. Participants were required to primarily reside in the Phoenix area and to be between the ages of 40 and 65. After providing consent, all participants were asked to complete a series of self-report questionnaires to obtain information about different aspects of their lives (e.g., demographics, neighborhood, social support, personality), a phone interview assessing physical health and mental health history, and a home visit in which biological samples and additional questionnaires (i.e., substance use, cultural attitudes) were obtained.

Participants were randomly selected at a ratio of 1 to 4 to complete a laboratory visit and daily diaries that assessed mood each night for 30 days. For the diary portion of the study participants were each loaned a portable tablet and trained by a research assistant to complete daily diaries for 30 consecutive days. Participants were asked to notify laboratory staff if any problem occurred with the tablet computer. In the event of malfunctioning equipment, a research assistant traveled to the participant's home to replace the equipment. The dates of the diary entries were verified with date-checking software in order to prevent participants from retrospectively entering information. Upon completion of 30 days of diaries, participants were debriefed and compensated for their efforts. The diary data were downloaded for analysis during a follow-up home visit. Participants were compensated $3 for each diary entry, for a maximum of $90 total for the diary portion of the study.

Participants were contacted a minimum of six months later for a follow-up telephone interview to evaluate psychological distress, subjective well-being, social functioning, and physical functioning. Time between completion of daily diaries and the follow-up phone assessment ranged from 6 months to 3 years, 10 months, with a mean of 15.9 months. Ratings of perceived stress were also obtained at follow-up. These ratings were selected as a contemporaneous measure of stress that described the level of stress experienced during the same time period. Research assistants interviewed the participants over the phone and recorded participants' responses in a secure, web-based survey system. Participants were compensated $30 for the follow-up phone assessment and the survey data were downloaded for analysis.

Measures

Diary measures.

Positive and negative affect. The PANAS (Watson et al., 1988) was used to measure positive affect and negative affect. Participants were given 10 positive and 10 negative mood adjectives and asked to rate how much they experienced each mood that day on a five point scale ranging from "very slightly/not at all" to "extremely." The internal consistency of the positive affect scale was excellent ($\alpha = 0.904$), and the internal consistency of the negative affect scale was good ($\alpha = 0.897$).

Follow-up measures.

Depressive symptoms. Six items from the Mental Health Inventory (MHI; Veit & Ware, 1983) and two items from the Short Form-36 Item Health Survey (SF-36; Ware & Sherbourne, 1992) were used to assess frequency of depressive symptomatology. A composite was created by taking the mean of the eight items. The internal consistency of this scale was excellent ($\alpha = 0.917$).

Anxiety symptoms. Four items from the MHI (Veit & Ware, 1983) and one item from the SF-36 (Ware & Sherbourne, 1992) were used to assess frequency of anxiety symptomatology. A composite was created by taking the mean of the five items. The internal consistency of this scale was good ($\alpha = 0.870$).

Subjective well-being. The WHO-5 Well-being Index (WHO-5; Bonsignore, Barkow, Jessen, & Heun, 2001) is a five-item scale designed to measure feelings of well-being (e.g., "Has your daily life been filled with things that interest you?"). The internal consistency of this scale was also good ($\alpha = 0.899$).

Vitality. The four-item vitality subscale of the SF-36 (Ware & Sherbourne, 1992) was used to assess vitality. For example, participants were asked how much time they felt they had a lot of energy. The internal consistency of this scale was good ($\alpha = 0.852$).

Social functioning. Social functioning was measured with the two-item social functioning subscale of the SF-36 (Ware & Sherbourne, 1992). Participants were asked the extent to which their physical health and emotional problems interfered with social activities. The internal consistency of this scale was good ($\alpha = 0.871$).

Physical functioning. Physical functioning was measured with the physical functioning subscale of the SF-36 (Ware & Sherbourne, 1992). Participants were given a 10-item list of common physical activities, such as lifting or carrying activities, and asked whether their health limited these activities "a lot," "a little," or "not at all," in the past four weeks. The internal consistency of this scale was excellent ($\alpha = 0.920$).

Perceived stress. Participants were asked to rate how much they experienced stress in the past six months using a five point scale in the following domains: work, relations with spouse/partner, relations with family, neighborhood, finances, relations with friends, and physical and emotional health. A composite was created by taking the mean of the seven items.

Data Analytic Plan

Time-based indicators of emotional complexity. For each person a total of seven emotional complexity scores was computed in SPSS 22 (IBM Corp., 2013) from the diary data for the three categories of time-based indicators of emotional complexity: one covariation score, three differentiation scores (i.e., overall, positive, and negative), and three granularity scores (i.e., overall, positive, and negative).

The covariation score was computed by calculating the correlation between daily reports of positive affect and negative affect (Carstensen et al., 2000). The covariation score ranges from -1 to 1, with negative values conveying less complexity.

The differentiation scores were computed by performing a principal components analysis (PCA) for each individual's affective reports (Cattell et al., 1947). The differentiation score represents the number of principal components with eigenvalues greater than one. The overall differentiation score included all emotion items in the PCA, whereas the positive and negative differentiation scores only included positive and negative emotion items respectively. The greater the number of components, the more differentiated and emotionally complex the participant.

The granularity scores were computed by first calculating the intraclass correlation among the all emotion items for overall granularity, among positive emotion items only for positive granularity, and among negative emotion items only for negative granularity (Tugade et al., 2004). These values were then subtracted from 1 for ease of interpretation so that high values indicate weak relationships between emotion terms, which are suggestive of more granular and thus complex emotional experience.

Correlation analyses were conducted to examine the associations among the seven emotional complexity indicators.

There was significant missing data for the computed overall and negative differentiation indices ($N_{OVERALL\ DIFF.} = 36$, $N_{NEG.\ DIFF.} = 40$). It was discovered that for 81.2% of the participants there was not enough variability in negative affect to conduct the PCAs required to compute overall and negative differentiation scores. Mean negative affect scores ranged from 1 to 3.63, with 98.6% of the sample reporting mean levels of

negative affect less than 2 on a 5-point Likert scale (1=very slightly/not at all, 2=a little; M = 1.26; SD = 0.35; skew = 3.42). The implications of this low variability in negative emotion is further addressed in the discussion section.

Emotion diversity. Three emotion diversity indices were calculated (i.e., global, negative, and positive) using the following formula derived from Shannon's biodiversity index (Quoidbach et al., 2014):

$$\text{Emotion Diversity} = \sum_{i=1}^{S} (P_i \text{ X } \ln p_i)$$

where s is the total number of emotions experienced, and P_i is the proportion of s made up of ith emotions. Shannon's original biodiversity index uses binary coding to compute the number of species (here, emotions), s and i. Here we have modified the formula to use the full scale emotion rating to capture the degree of emotion experienced. The proportion of each emotion item was calculated by dividing the weighted frequency of each emotion item across days by the total frequency across all emotion variables (P_i), then multiplied by its natural log. The products were then summed and multiplied by -1. High values suggest greater diversity of emotional experience.

Exploratory and confirmatory factor analyses. Exploratory factor analyses of the 7 originally proposed emotional complexity variables were conducted with Mplus (Muthén & Muthén, 2012) to determine the nature of any underlying constructs representing distinct aspects of emotional complexity using maximum likelihood estimation with robust errors and geomin rotation. Traditional criteria were used to evaluate possible models (e.g., scree plots, eigenvalues greater than 1, factor loadings). The identified factor structure was then subjected to confirmatory factor analysis (CFA)

in which model fit was evaluated using standard fit indices (e.g., RMSEA<.08, CFI and TLI >.90, SRMR<.08). The same procedure was used to identify the latent factor structure of the outcome variables. Correlation analyses were conducted to explore associations among and between the emotional complexity and emotion diversity variables.

Demographic analyses. SPSS 22 (IBM Corp.) was used to examine demographic differences (i.e., age, gender, marital status, full-time employment, race, and ethnicity) in emotional complexity and emotion diversity. T-tests were used for all categorical demographic variables, except race. A chi-square test was utilized to discern differences between racial groups.

Structural equation modeling (SEM). Mplus software was used to model associations between each of the emotional complexity variables and the outcome variables from the follow-up phone interview data. Utilizing the identified factor structures above, the structural model examined the latent emotional complexity variables as predictors of the distress, well-being, and physical functioning. This multivariate approach was preferable to ordinary least squares regression because it allowed for the estimation of multiple pathways simultaneously, while accounting for measurement error and shared variance among the various indicators. The same approach was taken for the emotion diversity variables.

Moderation analyses. A modified version of the Klein and Moosbrugger (2000) approach was used to test interactions between the latent emotional complexity/diversity variables and the perceived stress measured variable. This approach allowed for simultaneous tests of main effects and latent variable interactions using maximum

likelihood estimation. Interactions were tested one at a time for each index of emotional complexity/diversity.

Results

Correlations

Table 1 displays correlations between the time-based emotional complexity and emotion diversity indicators. As expected, 7 of 9 within-metric correlations were statistically significant. Significant within-metric correlations were noted for granularity (*r*s(170-186) ranging from .203 to .887, *p*s < .01), overall differentiation ($r_{\text{OVERALL-NEGATIVE}}(36) = .432$, $R_{\text{OVERALL-POSITIVE}}(36) = .785$, *p*s < .01), and emotion diversity ($r_{\text{GLOBAL-NEGATIVE}}(182) = -.248$, $r_{\text{NEGATIVE-POSITIVE}}(182) = .185$, *p*s < .05). Four of 6 within-valence correlations were significant, $r_{\text{NEG. GRAN.-DIFF.}}(40) = .819$, $r_{\text{NEG. GRAN.-EMO. DIV.}}(162) = -.255$, $r_{\text{POS. GRAN.-DIFF.}}(156) = .876$, $r_{\text{POS. GRAN.-EMO. DIV.}}(178) = -.202$, *p*s < .05). Seven of 9 associations between granularity and differentiation indicators were highly correlated, with greater granularity associated with greater differentiation (*r*s(36-156) ranging from .570 to .883, *p*s < .001). PA-NA covariation was positively correlated with all granularity and differentiation indicators (*r*s(170-186) ranging from .127 to .477, *p*s < .10), with greater covariation associated with greater granularity and differentiation. The emotion diversity indicators were generally uncorrelated with the other emotional complexity variables, with the exception of positive emotion diversity, which was associated with less overall granularity, less positive granularity, and less PA-NA covariation.

Latent Factor Structure

Emotional complexity. One- through three-factor models were examined in EFA for the 7 time-based indices of emotional complexity. Of the two models that converged, the two-factor model with factors representing positive and overall emotional complexity (i.e., positive granularity, positive differentiation, overall granularity, overall differentiation, and PA-NA covariation) and negative emotional complexity (i.e., negative differentiation and negative granularity) appeared to fit the data better than the one-factor model based on factor loadings, scree plot, and number of eigenvalues over 1. Although the three-factor model did not converge in the EFA, the factor loadings for the variables in the overall and positive emotional complexity latent factor suggested model fit would be improved by separating this factor into overall (overall granularity, overall differentiation, PA-NA covariation) and positive emotional complexity (positive granularity, positive differentiation) latent factors, as originally hypothesized.

The three-factor model was subjected to CFA (SRMR = .061; see Figure 1), which yielded a model with some concerns. While the model converged and parameter estimates were provided, the presence of a negative residual and a standardized parameter estimate greater than 1 was suggestive of multicollinearity. Additionally, standard errors and several fit statistics could not be computed because of low covariance coverage.

Outcome variables. One- and two-factor models were examined in the EFA for the outcome variables. Physical functioning was removed from the analyses, as it loaded across factors. The scree plot and number of eigenvalues greater than 1 suggested that the two-factor solution with factors representing distress (i.e., anxiety symptoms and depressive symptoms) and overall well-being (i.e., well-being, vitality, social

functioning) fit the data better than the one-factor solution. The two-factor outcome model was then tested in CFA, which provided excellent fit to the data ($\chi^2(4) = 4.40$, $p = .354$; RMSEA = .026, CFI = .999; TLI = .998; SRMR = .015; see Figure 2).

Demographics

Table 2 displays the means, standard deviations, skewness, and kurtosis for the measures used in the study. To examine age differences, the sample was stratified into two groups using a median split. Participants 55 years and older reported less negative emotional complexity (EC^3), less global emotion diversity (ED), and marginally less overall EC than participants under 55 years of age. Married participants reported more positive ED ($M_{MARRIED} = 2.758$, $M_{UNMARRIED} = 2.751$; $t(167.18) = -2.09$, $p = .038$) and marginally less global ED ($M_{MARRIED} = 3.35$, $M_{UNMARRIED} = 3.36$; $t(178) = 1.92$, $p = .057$) than non-married participants. Individuals who were employed full-time reported more negative ED than those who were not employed full-time ($M_{EMPLOYED} = 2.75$, $M_{NOT\ EMPLOYED} = 2.73$; $t(93.96) = -2.48$, $p = .015$). No group differences in EC and ED were found for gender and race. Hispanic participants tended to report more overall EC ($M_{HIS} = 0.05$, $M_{NON\text{-}HIS} = -0.01$; $t(183) = -2.77$, $p = .006$), more negative EC ($M_{HIS} = 0.40$, $M_{NON\text{-}HIS} = -0.08$; $t(183) = -3.09$, $p = .002$), and marginally more positive EC ($M_{HIS} = 0.29$, $M_{NON\text{-}HIS} = -0.06$; $t(183) = -1.84$, $p = .006$) than their non-Hispanic counterparts.

Emotional Complexity

Structural models. Attempts were made to utilize the identified latent factor structure for emotional complexity as predictors of the physical functioning and the distress and well-being latent factors as outlined in the analytic plan (see Table 3 for correlations between emotional complexity and follow-up outcome items). However,

problems with model convergence related to the large amount of missing data for overall and negative differentiation indices necessitated the creation of factor scores derived from the emotional complexity CFA, which were used in place of the latent factor structure. Partial correlations controlling for the subsample with overall/negative differentiation scores were conducted to assess whether a covariate representing the subgroup reporting variability in negative affect was required in testing the associations between EC and the outcome variables. The strength of associations was slightly attenuated, but did not significantly alter the pattern of correlations between EC and outcome indicators, so the covariate was not included in subsequent analyses. Time between assessments was included as a covariate, as it ranged widely from 6 months to 3 years and 10 months.

Model 1 examined the influence of overall EC on distress, well-being, and physical functioning at the follow-up assessment. The model provided adequate fit to the data (χ^2 (10) = 29.45, p = .001; RMSEA = .115, CFI = .966; TLI = .929; SRMR = .030) and identified overall EC as a significant predictor of increased physical functioning (see Figure 3). Models 2 and 3 examined negative and positive EC respectively as predictors of the same outcomes. The fit for these models was also adequate (Model 2: χ^2 (10) = 32.24, p < .001; RMSEA = .123, CFI = .962; TLI = .920; SRMR = .032; Model 3: χ^2 (10) = 27.67, p = .002; RMSEA = .110, CFI = .969; TLI = .934; SRMR = .028). Contrary to study hypotheses, positive and negative EC did not significantly predict distress, well-being, or physical functioning, nor did overall EC predict distress or well-being. Overall EC was associated with enhanced physical functioning, and a trend toward increased physical functioning was noted for positive EC (see Figures 4 and 5). The addition of

gender, income, education level, race/ethnicity, marital status, and employment status as covariates did not change the findings and were therefore not included in subsequent analyses.

Moderation analyses. Interaction effects were tested to determine whether differing levels of perceived stress moderated the effects of overall, positive, and negative on distress, well-being, and physical functioning. Inconsistent with study hypotheses, no significant interaction effects were found for any of the EC indices (see Table 5 for parameter estimates). Significant main effects for perceived stress on distress were found, with increased perceived stress associated with increased distress (overall EC: $\beta = .221$, $p = .001$; negative EC: $\beta = .218$, $p = .001$; positive EC: $\beta = .224$, $p = .001$). The lack of significant main effects for stress on well-being (overall EC: $\beta = .030$, $p = .576$; negative EC: $\beta = -.028$, $p = .599$; positive EC: $\beta = -.027$, $p = .605$) and physical functioning (overall EC: $\beta = .114$, $p = .113$; negative EC: $\beta = .103$, $p = .144$; positive EC: $\beta = .122$, $p = .097$) suggests that perceived stress did not influence well-being and physical functioning. EC main effects were consistent with those found in the structural models.

Emotion Diversity

In addition to the EC indices, indicators of ED were examined as another potential aspect of emotional complexity.

Structural models. Structural models identifying indicators of global, negative, and positive ED as predictors of distress, well-being, and physical functioning were tested in the same manner as the EC models. Table 4 displays the correlations among the emotion diversity and outcome variables. Model 4 examined global ED's associations with distress, well-being, and physical functioning. Model fit was good ($\chi^2 (13) = 38.91$,

$p < .001$; RMSEA = .117, CFI = .959; TLI = .915; SRMR = .029) and in direct opposition to study hypotheses. Global ED was significantly associated with greater distress, lessened well-being, and poorer physical functioning (see Figure 6). Model 5 examined associations between negative ED and distress, well-being, and physical functioning. The model provided good fit to the data (χ^2 (13) = 28.46, p = .008; RMSEA = .090, CFI = .972; TLI = .943; SRMR = .027), and showed greater negative ED was associated with lessened distress, enhanced well-being, and better physical functioning, consistent with study hypotheses (see Figure 7). Model 6 evaluated positive ED as a predictor of the same outcomes. Model fit was good (χ^2 (13) = 31.13, p = .003; RMSEA = .098, CFI = .966; TLI = .930; SRMR = .026). Positive ED was not significantly associated with the outcome variables as hypothesized, but trends toward decreased distress and greater well-being were observed (see Figure 8).

Moderation analyses. Perceived stress by ED interactions were tested to ascertain whether perceived stress moderated the influence of global, positive, and negative ED on distress, well-being, and physical functioning. All interactions were nonsignificant (see Table 5 for parameter estimates). The global ED by perceived stress interaction approached significance, though the nature of the interaction was unexpected. Consistent with study hypotheses, the relationship between perceived stress and distress appeared to be marginally stronger for participants who reported low global ED compared to participants who reported high global ED (see Figure 9). However, inconsistent with study hypotheses, global ED was positively related to distress, such that greater global ED was associated with more distress (β = .420, $p < .001$). There were no significant main effects for perceived stress on distress (global ED: β = -4.448, p = .109;

negative ED: β = 6.300, *p* = .231; positive ED: β = .127, *p* = .986), well-being (global ED: β = -1.003, *p* = .641; negative ED: β = 4.055, *p* = .316; positive ED: β = .777, *p* = .816), and physical functioning (global ED: β = -.224, *p* = .950; negative ED: β = -3.124, *p* = .638; positive ED: β = 9.755, *p* = .149). ED main effects mirrored those found in structural models 4, 5, and 6.

Discussion

Complex, differentiated emotional experience has been proposed as a potential characteristic of resilient functioning. The current study sought to investigate the relationships between commonly used time-based indicators of emotional complexity in order to determine the nature of any underlying constructs. We also examined the predictive value of emotional complexity on psychological distress, emotional well-being, and physical functioning. Furthermore, we accounted for the influence of stressful contexts and determined whether differing levels of stress moderated the influence of emotional complexity on distress, well-being, and physical functioning. Lastly, we examined emotion diversity as another representation of complex emotional experience.

In brief, we found that complex relationships exist between the different time-based indicators of emotional complexity, which seem to cluster into underlying overall, positive, and negative aspects of emotional complexity. In contrast to our hypotheses, these broader aspects of emotional complexity did not predict decreased psychological distress or enhanced emotional well-being, though we did find that overall and and to some degree positive aspects of emotional complexity were associated improved physical functioning. The inclusion of stress did not change our findings, and there was no evidence that emotional complexity buffered against the effects of stress on

psychological distress, emotional well-being, or physical functioning. Preliminary exploration of emotion diversity revealed positive and negative emotion diversity was associated with an adaptive profile, though several questions remain about the meaning and utility of this construct.

Emotional Complexity as a Construct

The findings of our study with respect to measurement and clarification of construct were generally consistent with our hypotheses. As expected, same-type time-based indices of emotional complexity were strongly related. Similarly, indicators with the same valence across emotional complexity type were strongly related, as well. These associations were compared to those found in other studies. Results were mixed. Of the 21 possible associations, only 10 had been examined in one or more studies. Of those comparisons, all but one were in the same direction. Seven of the associations were in the same direction and statistically significant (see Table 6). While there is not enough data to make definitive conclusions, broadly, it appears that the relationships between the time-based indicators are similar to those found in other studies, though the strength of the associations varied substantially.

Results from the confirmatory factor analyses support our hypothesis that emotional complexity is multifaceted and comprised of overall, positive, and negative aspects, as opposed to a unitary construct. In this respect, our results were consistent with those found in Grühn and colleagues' (2013) study, which is the only other study to our knowledge that examined the latent factor structure underlying commonly used time-based indicators of emotional complexity. Differences between our model and theirs were likely due to the following: a) we did not include measures of variation for theoretical

reasons, b) we included positive and negative indices of differentiation in our model, and c) we allowed each indicator to load on only one latent factor for ease of interpretation, while Grühn and colleagues (2013) allowed indicators to load on multiple latent factors. The delineation of latent factors by valence in our model of emotional complexity parallels convention in emotion research, which examines positive and negative affective systems as independent dimensions (e.g., Davis, Zautra, & Smith, 2004). Further studies in this field ought to separate positive and negative aspects of emotional complexity, as they appear to be associated with phenomena in a differential manner.

In addition to the positive and negative valence latent factors, the confirmatory factor analysis yielded a third, "overall" emotional complexity latent factor. This factor reflects the capacity to distinguish between and experience distinct emotional experiences, as well as the ability to experience positive and negative emotion simultaneously.

Moreover, there is much overlap between overall and positive aspects of emotional complexity, as they were highly correlated in this study ($r = .909$, $p < .001$). This overlap was also represented in Grühn et al. (2013)'s study, with indices of overall differentiation, overall granularity, and positive granularity all loading on the positive emotional complexity latent factor. The case could be made that our overall and positive emotional complexity factors should be combined, however, we contend that the three-factor model is more defensible both statistically and conceptually. Post hoc confirmatory analyses of a two-factor model with combined overall and positive factors yielded worse fit than the three-factor model ($SRMR_{TWO\ FACTOR} = .214$, $SRMR_{THREE\ FACTOR} = .069$), lending more support for the three-factor model.

The PA-NA covariation index loaded lowly ($\lambda = .353$) on the overall emotional complexity factor, and created its own factor altogether in Grühn et al.'s study (2013). This finding suggests co-occurring emotions are conceptually distinct from the other time-based indices of emotional complexity. Though we included the index in our model, it would also be defensible to treat this index as a separate aspect of emotional complexity, independent of the other emotional complexity latent factors.

Interpretation of any findings with respect to the "overall" emotional complexity latent factor ought to be made with care, because it does not represent true, global aspects of emotional complexity—which may include positive and negative aspects—but rather emotional complexity with valence partialled out. Additional examination of the relationship between overall and positive aspects of emotional complexity is needed to better understand this construct.

Further information can be gained by examining the components of the identified latent factors. In the present study, each latent factor was comprised of both granularity and differentiation indices. The negative emotional complexity latent factor represented the ability to experience multiple dimensions of negative emotion (i.e., negative differentiation), and discern between distinct negative emotional states (i.e., negative granularity). Similarly, the positive emotional complexity latent factor represented the ability to experience and distinguish between distinct, positive emotional experiences. For overall and positive emotional complexity latent factors, the granularity index had the highest loading among the indicators that comprised the latent factor. Negative granularity also loaded quite strongly on the negative emotional complexity latent factor ($\lambda_{\text{NEG. GRAN.}} = .909$), highlighting the prominent role of granularity in our analyses. These

findings suggest that the capacity to describe distinct emotions with clarity is a critical part of being emotionally complex. This finding has practical implications for assessment selection. If only one time-based indicator of emotional complexity can be selected, it ought to be the granularity index. Likewise, Grühn and colleagues (2013) identified emotion granularity as a "super indicator" that appeared to reflect a broad spectrum of emotion complexity.

These findings support the assertion that emotional complexity is not a unitary construct, but a multifaceted one. Broadly, there are positive and negative aspects of emotional complexity that are distinct, though correlated, and should be treated as such. These data imply that one can complex in one index and less so in another because they are not mutually exclusive. It is important that we are precise in describing the different indices of emotional complexity because we cannot compare them in a one-to-one fashion.

The Adaptive Value of Emotional Complexity

Contrary to our hypotheses, no aspects of emotional complexity were associated with psychological distress or emotional well-being at a later time, though positive and overall aspects of emotional complexity were associated with reports of enhanced physical functioning. Two explanations exist for the relative absence of significant findings: 1) there truly is no relationship between emotional complexity and the outcomes that were assessed, and 2) we are not accurately assessing emotional complexity and capturing other important contextual factors. If only the former explanation were true, then one would expect uniformly negative findings across studies in the research literature. This does not seem to be the case, as the research literature contains positive

findings. The latter explanation suggests that there may be concerns about the reliability of our emotional complexity measures and/or problems with the specified model.

It is unclear whether the computed time-based indices of emotional complexity were adequately reliable to produce valid results. Only 1.8% of the study sample reported experiencing negative emotions "a little" or more of the time. Approximately 83% of the sample reported so little negative affect, that it restricted our ability to compute indices of negative and overall differentiation. This limited range of negative affect likely affected the computation of other indices, as well. For the PA-NA covariation index, for example, reduced variation in negative affect would affect the potential for co-occurring emotions by limiting the range of correlations between positive affect and negative affect (Grühn et al., 2013). Floor effects for negative affect have also been found in other studies examining emotional complexity, particularly in samples of older adults (e.g., Grühn et al., 2013; Ong & Bergemann, 2004; Carstensen et al., 2000).

In the present study, the restriction of range in negative affect caused large amounts of missing data for the negative differentiation and overall differentiation indices. This issue was addressed by imputing factor scores based on the confirmatory factor analysis. The use of these scores was based upon the premise that the 36 individuals who demonstrated adequate variability in negative affect behaved in the same way as the individuals in the rest of the sample (i.e., the individuals who demonstrated too little variability in negative affect to have scores for negative and overall differentiation). To account for the differences in negative affect variability, we statistically controlled for this grouping in our models. Because no appreciable

differences were found between these models and the original models, we proceeded with analyses utilizing the factor scores.

Some suggestions have been made to address concerns about reduced variability in negative emotion. Ready and colleagues (2012) suggest that floor effects may be mitigated by increasing the number of emotions that are assessed, which theoretically increases the opportunity for greater variability. Similarly, increasing the range of response items could increase variability, as well. For instance, one could use a 10-point Likert scale versus a 5-point scale. Selecting commonly experienced emotions—such as sadness and anger—and restricting use of less common emotions—like contempt and embarrassment—may also increase variability in negative emotion (e.g., Tramp, Quoidbach, & Taquet, 2015; Hay & Diehl, 2011). Future studies should consider these methodological suggestions, which may help prevent restriction of range in negative affect.

Context Matters

Much of research literature operates under the assumption that emotional complexity is dispositional, however we contend that emotional complexity may be state-like and prone to fluctuate, rather than stable and trait-like. The mixed findings in the research literature on emotional complexity and the present study are in part influenced by the different contexts in which the construct was examined.

Stress. We posed stress as one context that affects the influence of emotional complexity on outcome variables. We did not find evidence of moderation effects. Specifically, our hypothesis that emotional complexity was associated with better outcomes when stress was high, but not when stress was low, was not supported.

The relationship between stress and emotional complexity is not well understood, and little work has been done to examine this relationship. One exception is Ong and Bergeman's study (2004), which found increased perceived stress was associated with less overall differentiation and decreased PA-NA covariance ($r_{\text{OVERALL DIFFERENTIATION}}(38) = -.37$ and $r_{\text{PA-NA COVARIANCE}}(38) = -.41$, ps $< .05$; Ong & Bergeman, 2004), a finding that is inconsistent with negative findings from the present study (see Table 3). Ong and Bergeman's finding concerning co-occurring emotion is consistent with the Dynamic Model of Affect, which posits that the relationship between positive and negative emotions depends on the level of stress present in the environment. Positive and negative affect form a singular bipolar dimension during times of high stress, in contrast to experiencing positive and negative affect as two independent, but related dimensions when stress is low (Davis et al., 2004). Put another way, we are at our least emotionally complex when stress is high, experiencing emotions as, "good *or* bad," versus experiencing positive and negative emotions simultaneously in a complex fashion when stress is low. There is substantial support for the Dynamic Model of Affect (e.g., Zautra, Berkhof, & Nicolson, 2002; Zautra, Reich, Davis, Potter, & Nicolson, 2000), which suggests the present study may not have adequately captured the relationship between stress and emotion.

In addition to the reliability concerns we described above, differences in the time between assessment of emotion ratings (and thus emotional complexity) and perceived stress/outcome variables (i.e., psychological distress, emotional well-being, and physical functioning,) may help to explain the discrepancy between our findings and theirs. Ong and Bergman (2004) assessed perceived stress and emotion ratings simultaneously, while

the lag between emotion ratings and perceived stress was ranged from 6 to 46 months in the present study. The assessments may have been too far apart in time to adequately evaluate the potential association, though some investigators have argued that some measure of time is needed to reflect on emotional experience (Ready, Åkerstedt, & Mrozek, 2008). It is also possible that our use of subjective measures of stress did not accurately capture stress. Objective measures of stress—for instance, event inventories and cortisol—may provide a better assessment of stress that is free from self-presentation bias. Future studies to help determine the ideal circumstances in which to assess emotional complexity (e.g., time between assessments, procedure for assessment—experience sampling, daily diary, or emotion induction paradigms, subjective versus objective measures of stress) are needed.

Other researchers have postulated that certain aspects of emotional complexity (i.e., positive granularity) are most influential under a low-stress context (Tugade et al., 2004). This position is in opposition to our initial theory, that increased emotional complexity under the context of high stress—but not low stress—is most influential, though neither position was supported in our data analyses. The absence of findings may be a result of not adequately accounting for other contextual factors that may also impact the emotional complexity. Age is one such context. Ramsey and colleagues (2016) found higher co-occurrence of positive and negative affect was associated with less emotional reactivity to health stressors in old-old adults age 80-89 years, but not in young-old adults age 60-79 years. This finding represents an instance in which assessment of multiple contexts was required to reveal meaningful information about emotional complexity.

Age. Age has been relatively well studied in the emotional complexity literature. Two competing developmental theories have been presented to describe emotional development, and each has different implications for emotional complexity. Cognitive developmental approaches propose that increases in cognitive complexity coincide with increases in emotional complexity (e.g., Labouvie-Vief, Diehl, Jain, & Zhang, 2007). Thus, as cognitive ability and complexity peak during middle age and decline thereafter, so does emotional complexity. In contrast, socioemotional selectivity theory posits that as individuals age and near death, they are more selective about their experiences, valuing emotionally meaningful goals such as cultivating relationships (Carstensen et al., 2000). Consequently, older adults look for and find meaning in existing experiences—even if they are not intrinsically positive—resulting in greater potential for emotionally complex experiences as age.

No consistent pattern of age effects has been detected in the literature on time-based indicators of emotional complexity (see Grühn et al., 2013 for a brief review). The present study found age was associated with less negative EC and marginally less overall EC in our sample of middle-aged adults. Results in the research literature have been mixed, with some studies finding older age associated with more emotional complexity, others finding less emotional complexity with age, and other studies finding no association at all for PA-NA covariation and differentiation indices (Ready et al., 2008; Hay & Diehl, 2011; Ong & Bergeman, 2004; Carstensen et al., 2000; Grühn et al., 2013; Ramsey et al., 2016; Bodner, Palgi, & Kaveh, 2013). However, these findings are valuable nonetheless because they represent examples in which emotional complexity is context-dependent. Though we do not have a clear understanding of age effects, it

appears to be an important context to consider and should at the very least be accounted for in examinations of emotional complexity.

Culture. Differing cultural contexts may also contribute to the variability and inconsistency of findings in the emotional complexity research literature. Dialecticism and interpersonal interdependence are two cultural factors that may influence emotional complexity. Dialecticism is a construct that is very similar to co-occurring emotion. Beyond representing the tendency to experience positive and negative emotion states together, it includes acceptance of the complementarity of opposites (Lindquist & Barrett, 2008; Grossman, Huynh, & Ellsworth, 2015). Interdependence refers to the tendency to consider the needs of others within the social context of one's in-group (Mesquita, 2001)

Grossman and colleagues (2015) found that cultural differences in dialecticism and interpersonal interdependence were associated with varying degrees of emotional complexity (i.e., PA-NA covariation, positive and negative granularity, and positive and negative emotion diversity) across countries. For example, they found individuals from Western countries such as the United States and United Kingdom demonstrated less co-occurring emotions, less positive granularity, and less negative granularity compared to their counterparts in Japan and India—countries that have dialectical belief systems and high interdependence (Grossman et al., 2015). The present study did not evaluate cultural contexts, but future studies ought to consider cultural factors when evaluating the effects of emotional complexity.

Stress, age, and culture are but a few contextual factors that appear to influence the expression of emotional complexity. Further examination of these contexts and

exploration of other contexts are needed to better understand the effects of emotional complexity.

What is Emotion Diversity?

We explored emotion diversity as a potential measure of complex emotional experience. This construct appears to be conceptually distinct from time-based indicators of emotional complexity, and this is supported in the general lack of significant correlations between the emotion diversity and emotional complexity variables (see Table 1). One might expect that having a relative abundance of emotional experiences (i.e., emotion diversity) is related to experiencing many dimensions of affect (i.e., emotional differentiation) and increased potential to experience co-occurring emotions (i.e., PA-NA covariation), but this was not demonstrated in the current study. Furthermore, we found that increased negative ED was associated with less negative granularity, and similarly, more positive ED was associated with less positive granularity (see Table 1). In other words, individuals high in positive ED or negative ED, who by definition reported more emotions at greater frequencies, were not discerning between different emotion items of the same valence as distinct emotional states compared to individuals low in positive ED or negative ED. These results are contrary to our hypothesis and Quoidbach and colleagues' (2014) proposal that emotional granularity is a prerequisite for high emotion diversity. It begs the question: can one have diversity of emotional experience while not distinguishing the differences between those very emotions? It is unclear what exactly is being measured by this construct. One possible explanation may be that our findings are indicative of a yes-bias response style.

Our finding that greater negative emotion diversity was associated with less psychological distress and better physical functioning was consistent with Quoidbach and colleagues' (2014) findings. We also found enhanced positive emotion diversity trended toward decreased psychological distress. Puzzlingly, our findings for global emotion diversity were significant and in the opposite direction as expected, demonstrating a maladaptive profile with greater psychological distress, less emotional well-being, and decreased physical functioning. Much like the emotional complexity analyses, we did not find evidence that emotion diversity moderated the relationship between stress and the outcome variables. A trend for the interaction between global emotion diversity and perceived stress was observed, but the main effects were again in the opposite direction expected. It is not clear why the valenced emotion diversity indices showed an adaptive profile, while the global emotion diversity index showed a maladaptive profile, given that the indices were derived from the same dataset. It may be possible that that the global emotion diversity findings represent a statistical anomaly, or perhaps the presence of multicollinearity.

Interpretation of the emotion diversity findings is especially challenging because there are few empirical studies from which we can make comparisons. Further exploration of this construct through replication in other samples could shed light on the matter. Given that the emotion diversity formula is sensitive to the number of discrete emotions endorsed, careful selection of emotion items is needed because of the potential bias involved. Choosing less common emotions would bias the sample towards less emotion diversity, for example. Statistically controlling for positive affect and negative affect will be important as well, as it will allow us to isolate effects related to emotion

diversity unobscured by the effects of positive and negative emotion. Until more empirical studies are done to evaluate this construct, caution in interpreting emotion diversity findings is warranted.

Conclusion/Future Directions

The present study aimed to examine the construct of emotional complexity and its adaptive value, while taking stressful contexts into consideration. Future studies of emotional complexity ought to use standard nomenclature when describing different time-based indices, as they represent different aspects of emotional complexity. Positive and negative aspects of emotional complexity should be treated separately as well, as we found evidence that they are conceptually and statistically distinct. The present study brought to light concerns about reliability and measurement, which may in part explain some of the inconsistencies in the research literature. It will be integral to first address concerns about the reliability of time-based indices in the future, through replication of our efforts and assessment of emotional complexity at across time. We also highlight the importance of context in evaluating emotional complexity and conceptualize emotional complexity as having potentially state-like qualities, contrary to past conceptualizations of emotional complexity as being dispositional. The extent to which emotional complexity is malleable is not yet known, but further examination of contextual factors such as stress, culture, age and others is vital initial step to furthering our understanding of emotional complexity.

NOTES

[1]Variability refers to the fluctuation of emotional states over time and the metric used is the standard deviation. Like granularity, variability can be an omnibus or composite measure—across all emotions—or it can be assessed by valence separately—positive and negative variability. Though variability was included in Grühn and colleagues' (2013) study, as a fourth category of emotional complexity, it was not included in the present review, as few studies have approached variability as a metric for emotional complexity.

[2]The differentiation indices were created using the P-technique. The first index was the number of principal components as previously described. The second differentiation index was the variance *not* accounted for by the first extracted component. Greater unshared variance indicated more differentiated and thus greater emotional complexity. This metric was not included in the present study, as few studies have utilized this metric as a measure of emotional complexity.

[3]From this point forward, emotional complexity factor scores derived from the emotional complexity CFA will be used in the following analyses for ease of interpretation and denoted as, "EC."

Table 1

Correlations Among Individual Emotional Complexity and Emotion Diversity Indicators, (ns range from 35 to 186)

	1	2	3	4	5	6	7	8	9
1. PA-NA Cov.									
2. Overall Gran.	.348***								
3. Neg. Gran.	.127†	.564***							
4. Pos. Gran.	.353***	.887***	.203**						
5. Overall Diff.	.477**	.883***	.607***	.860***					
6. Neg. Diff.	.270†	.570***	.819***	.182	.432**				
7. Pos. Diff.	.307***	.757***	.117	.876***	.785***	.155			
8. Global ED	-.112	-.033	.116	-.107	-.184	-.142	-.122		
9. Neg. ED	-.109	.019	-.255**	.103	-.014	-.069	.082	-.248**	
10. Pos. ED	-.166*	-.190*	.123	-.202**	-.105	-.053	-.130	-.102	.185*

Note: PA = positive affect, NA = negative affect. Cov. = covariation. Gran. = granularity. Diff. = differentiation. Neg. = negative. Pos. = positive. ED = emotion diversity. †p<.10, *p<.05, **p<.01, ***p<.001

Table 2

Descriptive Statistics for Study Sample (n = 191)

Variable	Mean	SD	Skewness	Kurtosis
Emotional Complexity (diaries)				
PA-NA Cov.	-0.216	0.316	0.411	0.992
Overall Gran.	0.629	0.168	-0.051	0.093
Negative Gran.	0.668	0.241	-0.802	0.688
Positive Gran.	0.606	0.195	0.021	-0.301
Overall Diff.	7.861	1.900	-0.054	-0.438
Negative Diff.	3.100	0.778	-0.179	0.661
Positive Diff.	2.455	1.012	0.048	-1.075
Emotion Diversity (diaries)				
Global ED	3.352	0.049	-0.362	-0.347
Negative ED	2.743	0.033	-2.667	10.132
Positive ED	2.755	0.024	-3.871	20.481
Outcome Variables (follow-up assessment)				
MHI Anxiety	2.281	1.043	1.177	1.154
MHI Dep.	1.868	0.885	1.725	2.925
Well-Being	4.150	1.146	-0.778	-0.359
Vitality	65.333	20.462	-0.795	0.185
Social Fxn	82.533	25.863	-1.592	1.642
Physical Fxn	86.489	21.381	-2.038	3.509
Moderator (follow-up assessment)				
Stress	0.886	0.949	2.732	10.457

Note: PA = positive affect, NA = negative affect. Cov. = covariation. Gran. = granularity. Diff. = differentiation. ED = emotion diversity. Dep. = depressive symptoms. Fxn = functioning.

Table 3

Correlations Among Individual Emotional Complexity Indicators and Follow-Up Outcome Measures (ns range from 27 to 186)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. PA-NA Cov.													
2. Overall Gran.	.348***												
3. Neg. Gran.	.127†	.564***											
4. Pos. Gran.	.353***	.887***	.203**										
5. Overall Diff.	.477**	.883***	.607***	.860***									
6. Neg. Diff.	.270†	.570***	.819***	.182	.432**								
7. Pos. Diff.	.307***	.757***	.117	.876***	.785***	.155							
8. Anxiety	-.021	.053	.108	.009	-.182	-.182	.032						
9. Depression	-.012	.031	.110	-.029	-.392*	-.080	.038	.815***					
10. Well-Being	-.003	-.001	-.112	.067	.275	.116	.019	-.735***	-.734***				
11. Vitality	.023	.056	-.065	.105	.207	.088	.081	-.687***	-.702***	.844***			
12. Social Fxn	-.051	.107	.008	.109	.264	.112	.121	-.654***	-.658***	.703***	.711***		
13. Physical Fxn	-.008	.164*	.085	.166*	.176	.312†	.174†	-.333***	-.434***	.523***	.655***	.597***	
14. Stress	-.012	.058	.224**	-.034	-.113	.001	.046	.485***	.456***	-.401***	-.350***	-.171*	-.077

Note: PA = positive affect, NA = negative affect. Cov. = covariation. Gran. = granularity. Diff. = differentiation. Neg. = negative. Pos. = positive. Fxn = functioning. †p<.10, *p<.05, **p<.01, ***p<.001

Table 4

Correlations Among Emotional Complexity Factor Scores, Emotion Diversity Indicators, and Follow-Up Outcome Measures (ns range from 27 to 186)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Overall EC												
2. Neg. EC	.353***											
3. Pos. EC	.348***	.278***										
4. Global ED	-.050	.091	-.108									
5. Neg. ED	.027	-.141†	.106	-.248**								
6. Pos. ED	-.146†	.015	-.196**	-.102	.185*							
7. Anxiety	.043	.087	.008	.463***	-.268**	-.253**						
8. Depression	.022	.111	-.030	.364***	-.290	-.264**	.815***					
9. Well-being	.024	-.086	.070	-.512***	.338***	.231**	-.735***	-.734***				
10. Vitality	.076	-.037	.107	-.444***	.401***	.217**	-.687***	-.702***	.844***			
11. Social Fxn	.112	.046	.109	-.404***	.311***	.218**	-.654***	-.658***	.703***	.711***		
12. Physical Fxn	.185*	.096	.169*	-.271**	.379***	.112	-.333***	-.434***	.523***	.655***	.597***	
13. Stress	.057	.198*	-.034	.304***	-.134	-.136	.485***	.456***	-.401***	-.350***	-.171*	-.077

Note: PA = positive affect, NA = negative affect. Cov. = covariation. Gran. = granularity. Diff. = differentiation. Neg. = negative. Pos. = positive. Fxn = functioning. †p<.10, *p<.05, **p<.01, ***p<.001

Table 5

Standardized Parameter Estimates (and Standard Errors) for Stress by Emotional Complexity, and Stress by Emotion Diversity Interactions, Predicting Distress, Wellbeing, and Physical Functioning; n = 145)

	Distress	Well-Being	Physical Functioning
Overall EC	0.023 (0.023)	-0.003 (0.044)	-0.005 (0.066)
Negative EC	-0.039 (0.040)	-0.057 (0.045)	0.000 (0.069)
Positive EC	0.051 (0.083)	0.025 (0.041)	0.002 (0.066)
Global ED	4.669 (2.793)†	0.994 (2.162)	0.347 (3.601)
Negative ED	-6.071 (5.242)	-4.080 (4.028)	3.245 (6.614)
Positive ED	0.100 (7.302)	-0.804 (3.339)	-9.628 (6.749)

Note: EC = emotional complexity. ED = emotion diversity. †$p<.10$, *$p<.05$, **$p<.01$, ***$p<.001$. EC variables are latent factor scores derived from CFA of individual emotional complexity indicators. Overall EC is composed of PA-NA covariation, overall granularity, and overall differentiation indicators. Negative EC is composed of negative granularity and negative differentiation indicators. Positive EC is composed of positive granularity and positive differentiation indicators. Distress represents a latent factor comprised of anxiety and depressive symptoms. Well-being represents a latent factor comprised of vitality, social functioning, and well-being variables. Physical functioning is a manifest variable.

Table 6

Comparison of Correlations Among Individual Emotional Complexity Indicators from the Current Study and Other Studies

	PA-NA Cov.		Overall Gran.		Neg. Gran.		Pos. Gran.		Neg. ED	
	Current study	Other studies	Current study	Other studies	Current study	Other studies	Current study	Other studies	Current study	Other studies
Overall Gran.	.35**	-.37**[A]								
Neg. Gran.	.13†	.02 [A] .45**[E]	.56**	.30**[A]						
Pos. Gran	.35**	.12 [A] .24** [E]	.89**	.54**[A]	.20**	.07[A] .35**[B D] .28** [E]				
Overall Diff.	.48**	.07 [A] .23**[C] .26**[F]	.88**	.27**[A]	.61**	.02[A]	.86**	.41**[A]		
Neg. ED	-.11	.15* [E]	.02		-.26**	.06[E]	.10	-.13[E]		
Pos. ED	-.17*	.004**[E]	-.19*		.12	-.12*[E]	-.20**	-.12[E]	.19*	.45**[E]

Note: Pos. = positive, neg. = negative, cov. = covariation, gran. = granularity, diff. = differentiation, ED. = emotion diversity. [A]Gruhn et al., 2013. [B]Boden et al., 2013. [C]Carstensen et al., 2000. [D]uncorrelated result from Demiralp et al., 2012, coefficent and *p* value not provided. [E]Grossman et al., 2015 study 2 US sample. [F]Ong & Bergeman, 2004. †$p<.10$, *$p<.05$, **$p<.01$

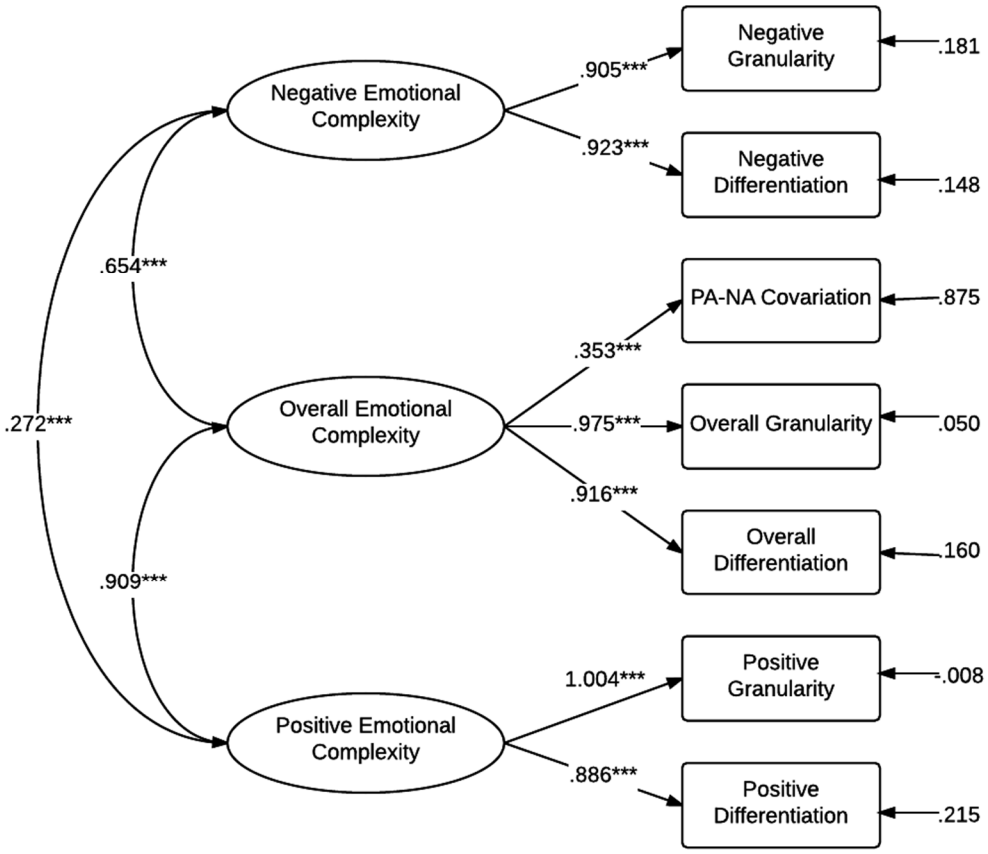

Figure 1. CFA of emotional complexity variables, three-factor model. Parameter estimates are standardized. †$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

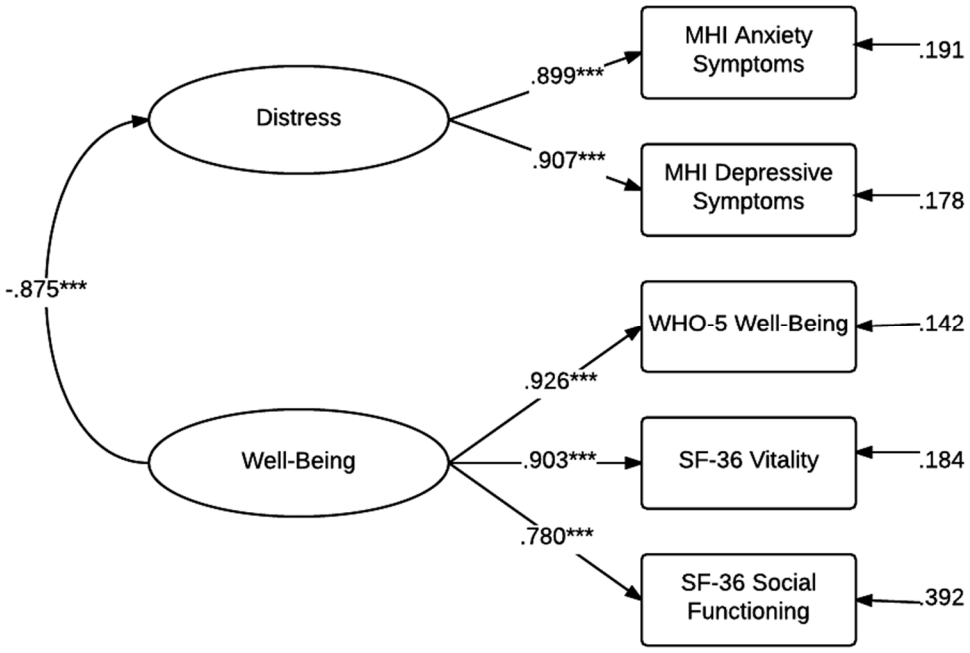

Figure 2. CFA of outcome variables from follow-up assessment. Parameter estimates are standardized. †$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

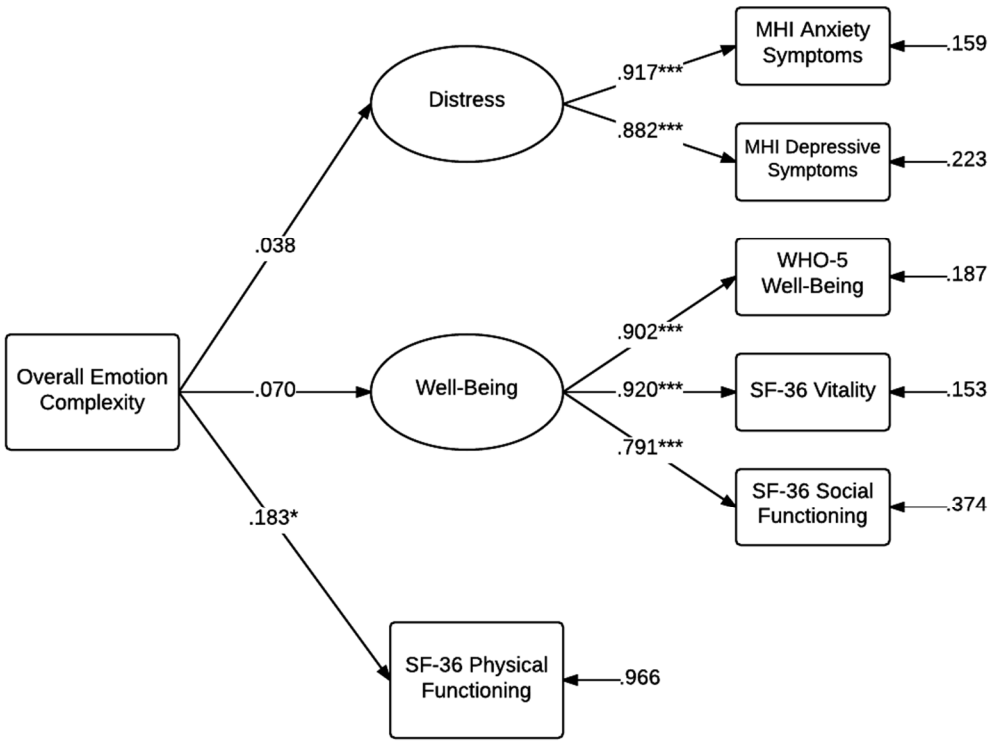

Figure 3. Model 1 depicts overall emotional complexity as a significant predictor of physical functioning at follow-up, but not of distress and well-being (χ^2 (10) = 29.45, p = .001; RMSEA = .115, CFI = .966; TLI = .929; SRMR = .030). Parameter estimates are standardized. †p < .10, *p < .05, **p < .01, ***p < .001.

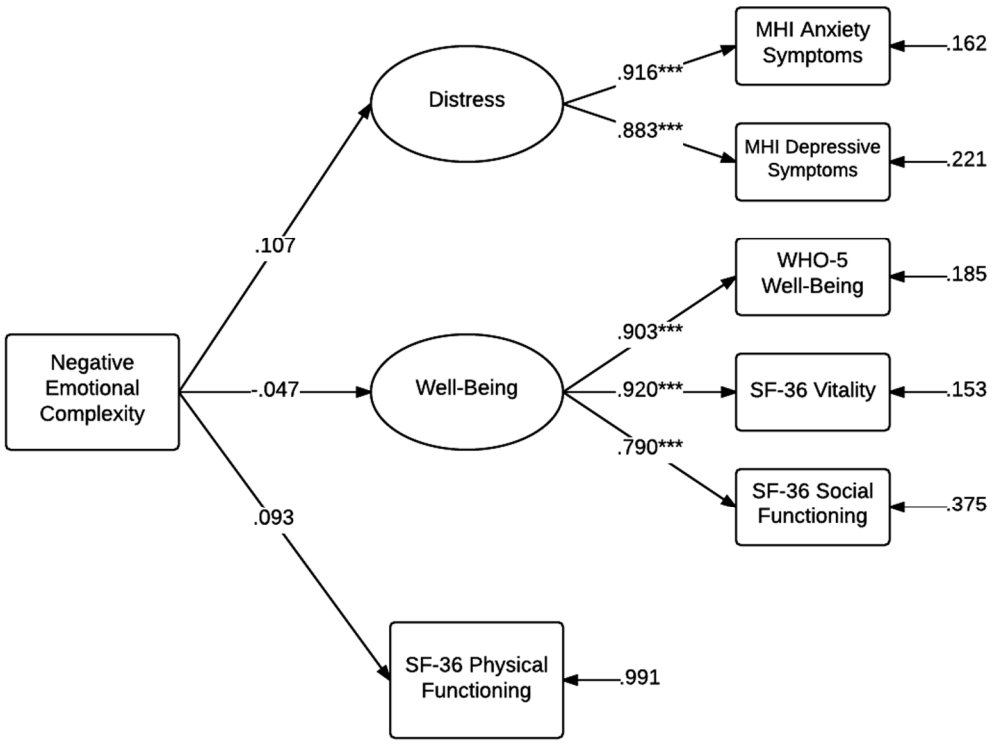

Figure 4. Model 2 depicts negative emotional complexity as a nonsignificant predictor of distress, well-being, and physical functioning at follow-up (χ^2 (10) = 32.24, $p < .001$; RMSEA = .123, CFI = .962; TLI = .920; SRMR = .032). Parameter estimates are standardized. †$p < .10$, *$p < .05$, **$p < .01$ ***$p < .001$.

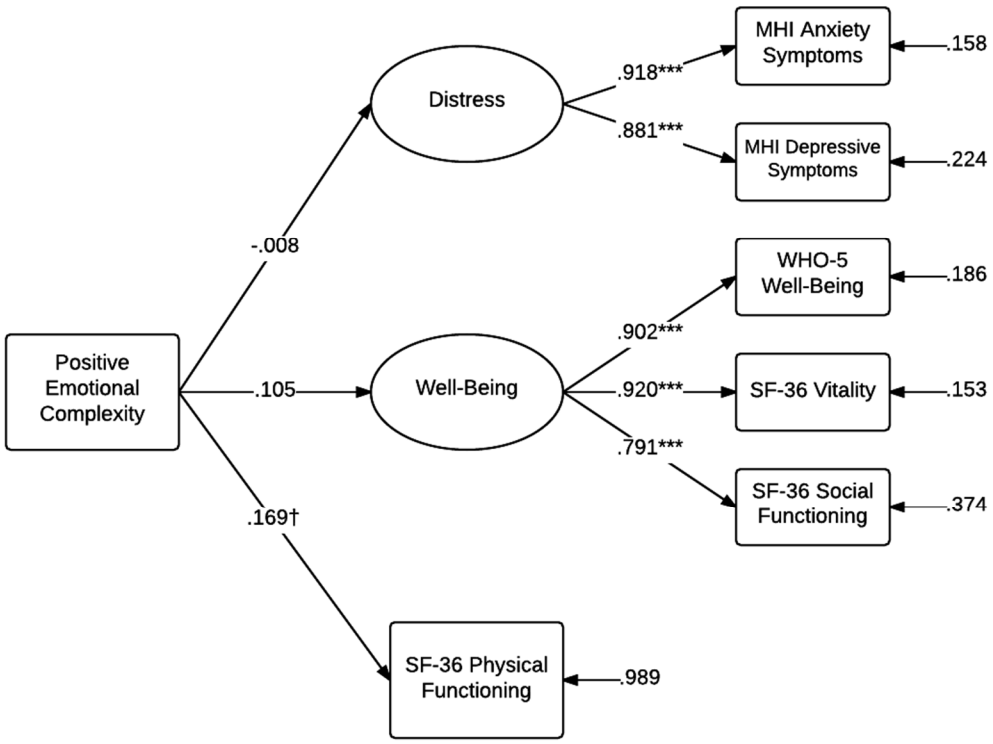

Figure 5. Model 3 depicts positive emotional complexity as a marginally significant predictor of enhanced physical functioning at follow-up, but it is not significant predictor of distress or well-being, and (χ^2 (10) = 27.67, p = .002; RMSEA = .110, CFI = .969; TLI = .934; SRMR = .028). Parameter estimates are standardized. †p < .10, *p < .05, **p < .01 ***p < .001.

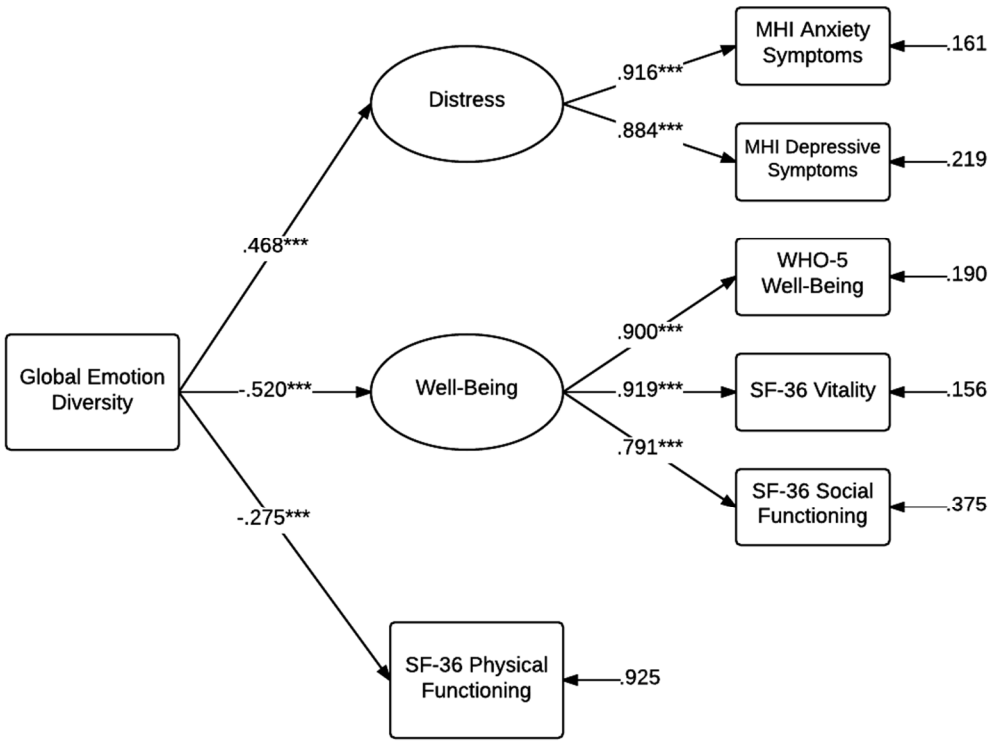

Figure 6. Model 4 depicts global emotion diversity as a predictor of increased distress, lessened well-being, and poorer physical functioning at follow-up (χ^2 (13) = 38.91, p < .001; RMSEA = .117, CFI = .959; TLI = .915; SRMR = .029). Parameter estimates are standardized. †p < .10, *p < .05, **p < .01, ***p < .001.

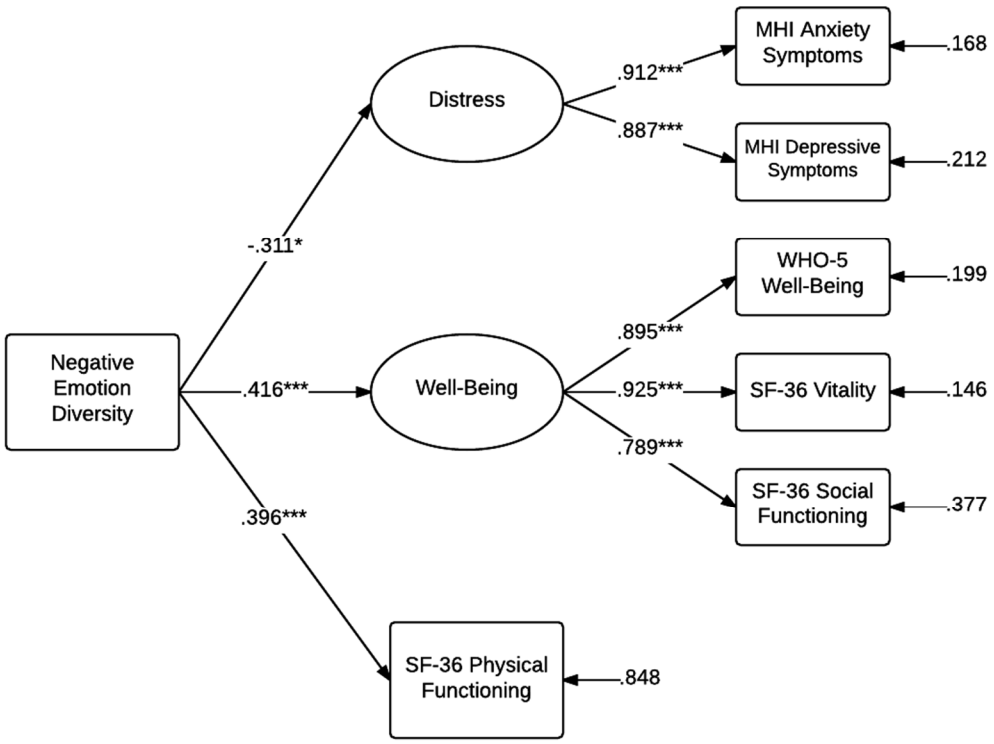

Figure 7. Model 5 depicts negative emotion diversity as a significant predictor of decreased distress, increased well-being, and enhanced physical functioning at follow-up (χ^2 (13) = 28.46, p = .008; RMSEA = .090, CFI = .972; TLI = .943; SRMR = .027). Parameter estimates are standardized. †p < .10, *p < .05, **p < .01, ***p < .001.

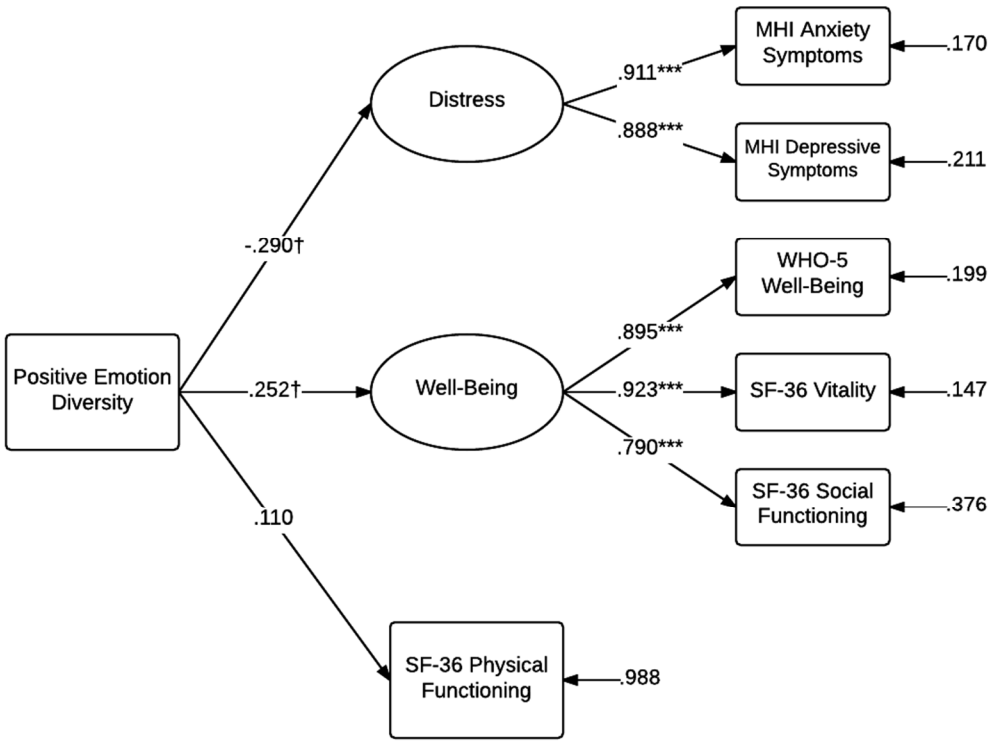

Figure 8. Model 6 depicts positive emotion diversity as a marginally significant predictor of decreased distress and increased well-being at follow-up, but it did not significantly predict physical functioning (χ^2 (13) = 31.13, p = .003; RMSEA = .098, CFI = .966; TLI = .930; SRMR = .026). Parameter estimates are standardized. †p < .10, *p < .05, **p < .01, ***p < .001.

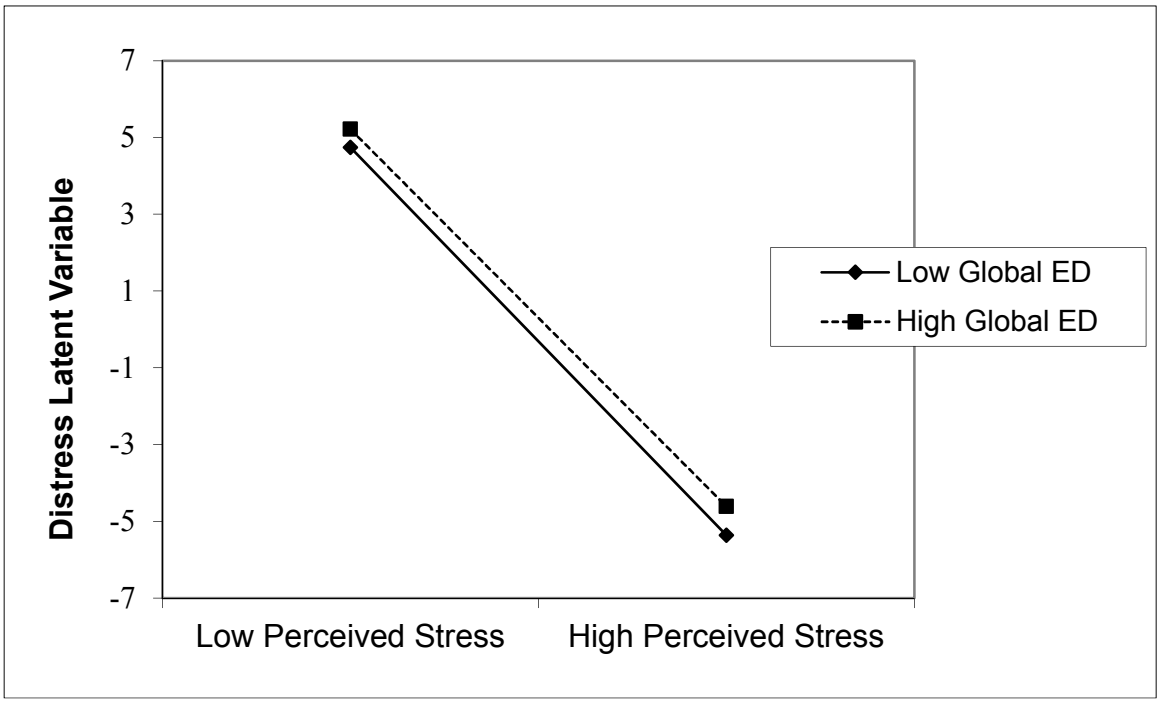

Figure 9. Global emotion diversity by perceived stress interaction, where the association between stress and distress is stronger for participants who report low global ED than participants who report high global ED. ED = emotion diversity.

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