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The Effects of Daily Co-Occurrence of Affect on Older Adults' Reactivity to Health Stressors

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Abstract

Objectives—The present study examined age differences among older adults in the daily co-occurrence of affect and its potential role in buffering the negative effects of health stressors.

Design—Participants were from the Veterans Affairs Normative Aging Study (NAS) and included 249 young-old adults (age = 60–79 years, $M=71.6$) and 64 old-old adults (age = 80–89, $M = 82.9$) who completed questionnaires assessing stressors, physical health symptoms, and positive and negative affect on eight consecutive days.

Results—An independent samples t-test showed young-old and old-old adults did not significantly differ in their mean levels of daily co-occurrence of affect. The between-person relationships among stressors, health, and daily co-occurrence of affect revealed that neither stressors nor health were significantly related to daily co-occurrence of affect. However, results from a multilevel model revealed a three-way cross-level interaction (Health Stressor X Age Group X Co-Occurrence of Affect) where old-old adults with higher levels of co-occurrence of affect were less emotionally reactive to health stressors than young-old adults.

Conclusion—These findings provide support for the assertion that co-occurrence of affect functions in an adaptive capacity and highlight the importance of examining domain specific stressors.

Keywords

Daily Co-Occurrence of Affect; Health Stress; Negative Affect; Aging

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Introduction

Older adults often experience declines in several domains of functioning, including physical functioning (Baltes, 1997). The magnitude and impact of these declines on health and well-being outcomes differ among individuals (Fagundes, Gillie, Derry, Bennett, & Kiecolt-Glaser, 2012). Stress is one individual difference factor shown to exaggerate the effects of normative aging on physical functioning. However, aging can be viewed in a more optimistic light when one also considers functioning in the emotional domain and associated well-being outcomes. Emotional functioning and regulation may continue to improve into old age (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Labouvie-Vief & Medler, 2002). Emotional complexity has been suggested as a means through which regulatory abilities are maintained or even improved with age (Carstensen et al., 2000; Labouvie-Vief & Medler, 2002; Ong, Mroczek & Riffin, 2011).

Currently, emotional complexity is commonly operationalized in two distinct ways. The co-occurrence index (Ong & Bergeman, 2004), or poignancy (Carstensen et al., 2000) refers to an individual's ability to experience both positive and negative emotions during a specific time frame. Alternatively, differentiation (Carstensen et al. 2000; Ong & Bergeman, 2004) measures the degree to which individuals are able to distinguish among discrete emotions. Differentiation and co-occurrence have been consistently shown to measure separate aspects of emotional complexity (Carstensen et al., 2000; Hay & Diehl, 2011; Ong & Bergman, 2004). Findings showing that co-occurrence and differentiation are separable provide rationale for the decision to examine the potential adaptive advantages provided by co-occurrence to the exclusion of the differentiation measure of emotional complexity.

Daily co-occurrence of affect may be an important factor enabling older adults to maintain adaptive functioning when faced with age-related declines (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Ong & Bergeman, 2004).

Co-Occurrence of Affect and Age—Two lifespan developmental theories posit that emotional development continues to improve into adulthood but differ in regards to when emotional functioning and related adaptive advantages reach their peak. Dynamic integration theory (DIT; Labouvie-Vief, 2005) incorporates some of the same co-occurrence and differentiation aspects as emotional complexity. DIT posits that representations increase in cognitive complexity as the affective dynamics of self in relation to the social world are reorganized in concurrence with the differentiation of new cognitive and affective systems (Labouvie-Vief, 2005). Increases in cognitive complexity enable increases in the complexity of emotion representations such that these emotion representations shift from simple automatic schemas to more differentiated representations which enable complex emotional experiences, eventually evolving into higher-order integrations (Labouvie-Vief, 2005). This increased complexity of cognitive operations is associated with more complex, and thus adaptive emotional responses and more flexibility in coping abilities (Labouvie-Vief, 2005). DIT posits that the function of emotional representations across the lifespan should show an inverted U-shape, suggesting that emotional and intellectual functioning peaks in middle age (Labouvie-Vief, 2005). If functioning does peak in middle age, then there should be a decline in co-occurrence of affect across older adults. When this cognitive-developmental

approach is taken, studies examining developmental trajectories of emotional complexity show the expected age pattern such that emotional complexity peaks in late middle age and declines in older age (Labouvie-Vief, Diehl, Jain, & Zhang, 2007).

Another lifespan developmental theory focuses on gains and losses in emotional functioning across the lifespan. Socioemotional Selectivity Theory focuses on the shift in the salience of social goals in later life (Carstensen, Isaacowitz, & Charles, 1999). According to this theory, older adults are motivated by the perceived limited time remaining in life to gain satisfaction. They gain satisfaction by prioritizing emotionally meaningful goals over informational goals. As such, older adults will attempt to find meaning in existing relationships or situations that are not inherently positive, resulting in more frequent complexity of emotional experience. Carstensen et al. (2000) conducted an experience-sampling study of adults ranging in age from 18 to 94. Significant positive correlations were found between age and the number of principle components (more components indicate higher levels of emotional complexity). Additionally, age was significantly and positively correlated with the covariation score. Young and middle-aged adults showed a stronger negative correlation between positive and negative affect than older adults, indicating that younger and middle-aged adults showed less blending of positive and negative affect than older adults. Carstensen et al. (2011) conducted a follow up study with the same participants which included wave 2 (five years after initial experience sampling occasion) and wave 3 (ten years after the initial experience sampling occasion). They found a significant age-related change in the covariation score such that with every year of age the intraindividual correlation between positive and negative affect shifted from a negative correlation to a correlation closer towards 0, representing higher levels of emotional complexity in older age.

The different trajectory of emotional functioning at later portions of the lifespan that these two theories indicate suggests that levels and effects of co-occurrence of affect differ by age. Prior research on age differences in co-occurrence provides inconsistent evidence for whether or not older adults experience more mixed emotions than younger adults. Some studies found older adults are more likely than younger adults to experience co-occurrence of positive and negative affect (Carstensen et al., 2000). Other studies found no age differences in the tendency to experience positive and negative emotions concurrently (Ong & Bergeman 2004; Grünh, Rebucal, Diehl, Lumley, & Labouvie-Vief, 2011; Hay & Diehl, 2011). However, research does clearly indicate a disparity between young-old and old-old adults regarding physical and cognitive functioning (Baltes, 1997). The lifespan continues to increase for older adults and there are dramatic declines in functional status from the third (young-old, 60–79) to fourth (old-old, 80+) age (Baltes, 1997). Old-old adults are likely to experience more declines in cognitive functioning, and thus experience losses in cognitive resources such as speed of processing and working memory (Bopp & Verhaeghen, 2005). They also experience declines in physical functioning and losses in physical resources such as motor skills (Baltes, 1997). As such, old-old adults may be more likely than young-old adults to rely on abilities not subject to increasing impairments. If emotional functioning continues to improve with age as research guided by Socioemotional Selectivity Theory (Carstensen et al., 1999) suggests, and older age is associated with greater likelihood of

experiencing positive and negative emotions at the same time, then the adaptive value of co-occurrence of affect may be greater in the oldest-old (Carstensen et al., 2000).

Adaptive Advantages of Co-Occurrence of Affect—Similar to the results pertaining to age differences in co-occurrence of affect, evidence for the adaptive value of co-occurrence of affect in later portions of the lifespan are mixed. Ong and Bergeman (2004) examined the co-occurrence of positive and negative emotions in a sample of 40 adults ranging in age from 60 to 85 years over a 30-day period. Stress, neuroticism, trait resiliency, physical health and well-being were examined as possible factors associated with co-occurrence. The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was used to measure daily positive and negative affect. Ong and Bergeman (2004) determined the co-occurrence of positive and negative affect by averaging the intraindividual correlation between positive and negative affect across the 30 days. Results showed that individuals with greater co-occurrence of positive and negative affect also tended to show greater overall psychological resilience, lower levels of stress, and lower levels of neuroticism. This suggests co-occurrence of affect is an important factor in enabling an individual to be resilient during periods of stress.

Grühn et al. (2012) examined the adaptive value of co-occurrence of affect in a sample of 109 adults ranging in age from 23 to 90 years who reported negative and positive affect via the PANAS five times a day for one week. They operationalized co-occurrence in the same manner as Ong and Bergeman (2004). Results showed that co-occurrence was not correlated with life satisfaction, depressive symptoms, anxiety, or neuroticism, which is inconsistent with Ong and Bergeman's findings (2004). When compared directly, these findings suggest that co-occurrence of affect may provide an adaptive advantage, but that this advantage could be specific to reactivity to stressors.

Hay and Diehl (2011) further examined relationships among age, co-occurrence and emotion regulation. Participants included 239 male and females ranging in age from 18 to 89 who reported their daily positive and negative affect for 30 consecutive days via the PANAS. Co-occurrence was operationalized in the same way as in Ong and Bergeman (2004) and Grühn et al. (2012). Individuals reporting higher levels of co-occurrence were faster to recover from high negative affect states than those with lower levels of co-occurrence. This suggests that higher levels of co-occurrence could reduce reactivity to stressors.

Stressors and Co-occurrence of Affect—Stressors are typically associated with an increase in negative affect (Reich, Zautra, & Davis, 2003), often referred to as emotional reactivity (Almeida, 2005), so the effects of daily co-occurrence of affect may be especially important when examining the daily stress process. According to the Dynamic Model of Affect (DMA: Zautra, Potter, & Reich, 1997), context can have a profound impact on the dimensionality of emotional experience. Similar to DIT (Labouvie-Vief, 2005), DMA suggests that highly arousing or stressful situations can limit the amount of cognitive resources available for complex processing of emotional information (Reich et al., 2003). Stress affects the structure of emotional experience such that individuals tend to experience

positive and negative affect in a bipolar as opposed to multidimensional manner when exposed to stressors (Reich et al., 2003)

Additionally, individuals report higher negative affect relative to positive affect in response to stressors (Mroczek & Almeida, 2004). Presumably, negative emotions would not be as prominent in individuals with higher levels of co-occurrence of affect. The reasoning behind this supposition is that these individuals would experience positive emotions along with negative emotions. These positive emotions may serve to dampen the detrimental effects of the negative emotions on reactivity to stressful situations (Levenson, 1999). In line with previous studies (e.g., Almeida, 2005; Neupert, Mroczek, & Spiro, 2008), reactivity is operationalized as the within-person relationship between a stressor and a given outcome. It follows then, that individuals with higher levels of co-occurrence of affect could show less reactivity in response to daily stressors. Extreme emotional responses in which an individual experiences high levels of negative affect in relation to positive affect are maladaptive. The ability to experience positive and negative emotions concurrently even in times of stress inhibits these extreme responses. Thus, individuals reporting higher levels of co-occurrence of affect should exhibit greater resiliency than those reporting lower levels of co-occurrence of affect (Ong & Bergeman, 2004). There is evidence that resilient individuals are more likely to experience their positive and negative emotions as blended, or occurring at the same time (Tugade & Fredrickson, 2004). Importantly, this suggests an evolutionarily-based physiological mechanism behind this adaptive function. In instances involving threatening stimuli, such as a stressor, positive and negative affect can operate in conjunction with one another. In these situations, the function of negative affect is to counteract homeostasis and elicit a response to the threatening stimuli while positive affect functions to return the individual to a homeostatic state in order to avoid the detrimental consequences of prolonged arousal (Levenson, 1999; Tugade & Fredrickson, 2004).

Health Stressors and Co-occurrence of Affect—The detrimental effects of stressors on health and well-being outcomes are well-known (Cicchetti, 2011; Fagundes, et al., 2012). These effects may be especially harmful to older adults. Both young-old and old-old adults undergo normative physical and psychological declines which are exaggerated by the effects of stress, including the detrimental effects of allostatic load and reduced immune functioning (Cicchetti, 2011; Fagundes, et al., 2012). The effects of daily stressors are important as these seemingly minor hassles can have immediate and cumulative effects on well-being outcomes in later life (Stawski, Mogle, & Sliwinski, 2013). Specifically, daily stressors have been associated with increases in negative affect, physical health symptoms, and memory failures (Almeida, Wethington, & Kessler, 2002; Neupert, Almeida, Mroczek, & Spiro, 2006; Stawski, et al., 2013). Additionally, the relationship between stressors and health outcomes can depend on stressor domain and its salience (Aldwin, 2007). Health stressors may be especially salient to the current sample as older adults, and old-old adults in particular, are known to be at increased risk for health problems (Wolff, Starfield, & Anderson, 2002). Health stressors have been associated with increased psychological distress (Hay & Diehl, 2010). Although young-old and old-old adults may not differ in their experience of positive and negative affect on the same day, the adaptive advantages of daily co-occurrence of affect provides could differ between these age groups.

The Present Study

The present study extends previous work on the relationships between age, co-occurrence of affect, stress, and health in several unique ways. We examined age differences in co-occurrence of affect for young-old (60–79) and old-old (80+) adults. Due to the different trajectories of emotional functioning across the lifespan predicted by SST (Carstensen et al., 1999) and DIT (Labouvie-Vief, 2005), and the inconsistent findings regarding age differences in emotional complexity, age differences were examined without favoring a particular hypothesis. Instead, we sought to examine whether there were age differences in co-occurrence of affect in young-old as compared to old-old adults. Age was treated as a categorical variable in all analyses where old-old and young-old adults are compared directly.

Second, we examined whether stressors and physical health symptoms were related to co-occurrence of affect by examining the possible relationship between, and age differences in, stressors and physical health symptoms within people over eight consecutive days. As both stressors and health have been shown to predict levels of emotional complexity, we hypothesized that both stressors and health would be related to co-occurrence of affect, with individuals who report fewer stressors and better physical health also reporting higher levels of co-occurrence of affect (Carstensen et al., 2000; Ong & Bergeman, 2004).

Third, we examined co-occurrence of affect as a potential moderator for reactivity to stressors in the health domain. We hypothesized that daily co-occurrence of affect would moderate age differences in reactivity to stressors in the health domain, with old-old adults with higher levels of daily co-occurrence being less emotionally reactive to health stressors.

Method

Participants and Procedure

The sample was from a 2002–2003 daily diary investigation of stressors and well-being which included 333 Veterans Affairs Normative Aging Study (NAS) respondents and their wives (Neupert et al., 2006; Spiro, & Bossé, 2001). Participants included 249 young-old adults ranging in age from 60–79 years ($M=71.6$, $SD=4.90$) and 64 old-old adults ranging in age from 80–89 years ($M=82.9$, $SD=2.62$) (Baltes, 1997). Males comprised 56.5% of the participants. Participants completed questionnaires assessing stressors, physical health symptoms, and positive and negative affect on 8 consecutive days (Neupert et al., 2006). Participants who completed 5 or more of the 8 study days received \$30; those who completed 4 or fewer days received \$15.

Daily Measures

Daily stressors were assessed using a 7-item paper-pencil version of the Daily Inventory of Stressful Events (DISE) (Almeida et al., 2002). This semi-structured inventory possesses construct validity; stressor content and focus variables accounting for 8% of the variance in physical symptoms and 12% of variance in negative mood (Almeida et al., 2002). This paper-pencil version of the DISE has been used with previous results from the NAS diary data (e.g., Neupert et al., 2006; Neupert et al., 2008) as well as other daily diary studies (e.g.,

Neupert, Ennis, Ramsey, & Gall, 2015). Participants respond yes or no to whether arguments, potential arguments, work or volunteer setting stressors, home stressors, network stressors, health stressors, and other stressors occurred each day. For the purposes of the current study, a composite score for each day represented the sum of the total number of stressors reported for that day. Higher scores indicate more stressors. The daily health stressor item (Neupert et al., 2006) asked participants to respond yes or no to the question ‘Did anything stressful happen in the last 24 hours regarding your personal health?’ On days when a health stressor was reported, participants were asked to indicate the specific domain of the stressor (medication-related issue [69 days], illness [86 days], health insurance issue [16 days], accident [5 days], problem receiving treatment [46 days], and other [98 days]).

Daily physical health symptoms were measured with a 16-item shortened version of Larsen and Kasimatis’s (1991) physical symptom checklist (Neupert et al., 2006). Examples of symptoms include headaches, backaches, sore throat, and poor appetite. Respondents received a score of 0 when they had not experienced a symptom and a score of 1 for each symptom experienced. For the purposes of our study, one composite score for the sum of the total reported physical symptoms was calculated for each day. Higher scores indicate more reported physical symptoms, or poorer physical health. The construct validity of this measure of physical health is evidenced by the significant positive association between stressor exposure and physical health (Neupert et al., 2006).

Daily Affect was measured using The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). The PANAS consists of two 10-item mood scales, each containing words describing different feelings and emotions (Watson et al.). Participants indicated to what extent they experienced each emotion during each of the eight consecutive days. Responses ranged from 1 (*slightly or not at all*) to 5 (*extremely*). Co-occurrence of positive and negative affect (co-occurrence of affect) was calculated in the same manner as previous studies (Grühn et al., 2012; Hay & Diehl, 2011; Ong & Bergeman, 2004) by averaging the intraindividual correlation between positive and negative affect. Each person received a single score for co-occurrence of affect. Higher positive correlations indicated higher levels of co-occurrence of affect (Ong & Bergeman). Importantly, co-occurrence of affect reflects each person’s rank-order stability of positive and negative affect, and is conceptually unrelated to the mean levels of affect. Internal consistencies for the current study were high when averaging across all persons on Day 1 (positive affect: $\alpha = .90$; negative affect: $\alpha = .87$), and are congruent with those reported by Grühn et al. (2012) (positive affect: $\alpha = .90$; negative affect: $\alpha = .87$).

Neuroticism—Individual difference characteristics, namely neuroticism, have been shown to influence daily emotional experiences (Carstensen et al., 2000; Ong & Bergman, 2004). Individuals with higher neuroticism scores tend to report more stressors and greater reactivity to stressors (Mroczek & Almeida, 2004; Neupert et al., 2008). We therefore controlled for the effects of neuroticism when examining co-occurrence of affect on stressor responses. We measured neuroticism via the EPI-Q (Floderus, 1974). This is a shortened version of the Eysenck Personality Inventory which contains 18 dichotomous items (9 assessing Extroversion and 9 assessing Neuroticism). Possible scores ranged from 0–9, with

a higher score indicating a higher level of neuroticism. This measure has suitable reliability ($\alpha = .71$) and validity (Neupert et al., 2008).

Results

Table 1 displays descriptive characteristics and Table 2 displays intercorrelations among study variables separately for each age group.

An Independent Samples *t*-test showed no significant difference between the mean daily co-occurrence of affect score for young-old ($M = -.07$) and old-old ($M = -.02$) adults, $t(309) = -.81, p = .42$. As the variances were not equal in both groups, $F = 1.21, p = .006$, the Satterthwaite method was reported. Additional Independent Samples *t*-tests showed a significant difference between mean positive affect scores for young-old and old-old adults, $t(311) = 5.94, p < .01$. Young-old adults ($M = 2.85$) tended to have significantly higher mean positive affect scores than old-old adults ($M = 2.54$). There was not a significant difference in mean negative affect between the two age groups, $t(74.4) = -1.74, p = .08$. The between-person relationships among stressors, health, and daily co-occurrence of affect revealed that neither stressors, $r(331) = -.02, p = .73$, nor health, $r(305) = -.01, p = .89$ were significantly related to daily co-occurrence of affect.

Multilevel modeling (Raudenbush & Bryk, 2002) was used to address the hypothesis of daily co-occurrence of affect as a moderator of age differences in emotional reactivity to health stressors. A fully unconditional model was first conducted to ensure sufficient variability between and within individuals in the outcome variable (Raudenbush & Bryk, 2002: See Appendix A). Results indicated that γ_{00} was .1404 and σ^2 was .1025. Thus the intra-class correlation coefficient was .58, meaning that 58% of variability in daily negative affect was between people and 42% of the variance in the outcome variable was within people. This suggests that individuals tended to vary around their own averages to a similar extent as they differed from others, meaning there was sufficient variability in the outcome variable.

Multilevel modeling was also employed to determine whether daily-co-occurrence of affect moderated age differences in reactivity to health stressors. It is important to note that age was treated as a categorical variable in the subsequent analyses (See Appendix B). Health stressors were positively associated with participants' daily negative affect scores ($\gamma_{10} = .14, t = 4.03, p < .001$), with occasions of a health stressor associated with higher negative affect on that same day. Age group ($\gamma_{01} = .002, t = .67, p = .50$) was not associated with average levels of daily negative affect. Co-occurrence of affect ($\gamma_{02} = .099, t = 2.23, p = .02$) was associated with average level of daily negative affect with individuals reporting higher levels of co-occurrence of affect also reporting higher levels of daily negative affect. This significant relationship between co-occurrence of affect and daily negative affect was likely driven by the old-old adults as this relationship was not significant for the young-old adults (see Table 2). Neuroticism was positively associated with daily negative affect ($\gamma_{03} = .07, t = 6.52, p < .001$) with individuals reporting higher levels of neuroticism also reporting more daily negative affect. There was an Age X Co-occurrence of Affect interaction on the average level of daily negative affect ($\gamma_{04} = .02, t = 2.42, p = .02$). The relationship between

health stressors and daily negative affect did depend on age group ($\gamma_{11} = -.01, t = -2.27, p = .02$), but did not depend on co-occurrence of affect ($\gamma_{12} = .05, t = .70, p = .48$). Finally, the relationship between health stressors and daily negative affect did simultaneously depend on age and co-occurrence of affect (i.e., Health Stressor X Age X Co-Occurrence of Affect: $\gamma_{13} = -.34, t = -2.13, p = .03$). Using the method outlined by Raudenbush and Bryk (2002), this model accounted for 14% of the within-person and 22% of the between-person variance in negative affect.

The three-way cross level interaction (Health Stressor X Age X Co-Occurrence of Affect) was interpreted via two additional models; one for young-old (60–79 years) and one for old-old (80–89 years) adults. We plotted the slopes of reactivity from these models for low co-occurrence of affect (operationalized as one standard deviation below the mean of the sample), and high co-occurrence of affect (one standard deviation above the mean of the sample). As predicted, the old-old adults with higher levels of co-occurrence of affect were less reactive in the presence of health stressors (see Figure 1). Although the slope for the old-old adults looks negative, the simple slope was not significant, ($\gamma_{10} = 1.77, t = -1.31, p = .19$).¹

Discussion

The current study examined age differences among older adults in daily co-occurrence of affect and its potential role in buffering the negative effects of health stressors. We did not find significant age differences in levels of daily-co-occurrence. This is suggestive of two different developmental trajectories. First, in line with SST, emotional functioning may continue to improve or be maintained in later portions of the life span such that both age groups show similar levels of co-occurrence of affect (Carstensen et al., 1999). Alternatively, in line with DIT, these age groups may exhibit similar levels of co-occurrence of affect because both groups represent later portions of the lifespan. They may have presumably already experienced declines in cognitive and emotional functioning, though these declines are more likely in the latter portions of the life span (Labouvie-Vief, 2005). A longitudinal study would be necessary to determine whether levels of co-occurrence of affect increase or decrease as individuals transition from the third to the fourth age (Baltes, 1997).

In line with our hypothesis, co-occurrence of affect did moderate the relationship among age, health stressors, and negative affect, even controlling for neuroticism. Old-old adults with higher levels of co-occurrence of affect reported less negative affect on days when health stressors were reported compared to young-old adults with higher levels of co-occurrence of affect. This finding, combined with our finding that young-old and old-old adults did not significantly differ in levels of co-occurrence of affect, suggests that old-old

¹To rule out the possibility that fluctuations in negative affect and positive affect were more important than mean co-occurrence of affect, we calculated each individual's within-person standard deviation scores for both positive and negative affect. These scores were then simultaneously entered into the previous model. Results did not change and the three-way cross level interaction (Health Stressor X Age X Co-Occurrence of Affect) remained significant when fluctuations in positive and negative affect were included as covariates.

adults are more efficient at employing regulatory strategies associated with higher levels of co-occurrence of affect.

These results provide support for the assertion that co-occurrence of affect functions in an adaptive capacity (Carstensen et al., 2000; Ong & Bergman, 2004). Importantly, the finding that only old-old adults with higher levels of co-occurrence of affect were less reactive on days when health stressors occurred suggests that young-old and old-old adults do not experience emotions in the same manner and should not be treated as a homogeneous group. This is in line with Baltes's (1997) assertion that individuals 80 years of age and older are developmentally distinct from other age groups, and provides evidence that higher levels of co-occurrence of affect is an adaptive advantage specific to old-old adults exposed to stressors in the health domain. This highlights the importance of differentiating among stressor domains and identifying domains of stressors that are salient to the sample of interest (Aldwin, 2007).

While the current results suggest that higher levels of co-occurrence of affect provide an adaptive advantage by reducing reactivity to health stressors, several alternative explanations are possible. As previously stated, declines in physical and cognitive functioning become more pronounced during the fourth age (Baltes, 1997). This suggests that old-old adults will experience more health-related issues and as such more health-related stressors (Baltes, 1997). However, older adults may interpret a certain degree of health stressors as normative and better accommodate health limitations (Piazza, Charles & Almeida., 2007). Old-old adults may be less emotionally reactive to a health stressor as health problems can be perceived as normal and expected, or an on-time event, at this point in development (Neugarten, 1968).

Limitations and Future Directions

The findings of the current study should be considered in light of its limitations. Half of the individual difference variable (co-occurrence of affect) is made up of the daily dependent variable (negative affect), which increases the likelihood of potential circularity. However, the co-occurrence of affect index is based on rank order stability within a person over time, so actual mean values are only present in the dependent variable. The independent variable, co-occurrence of affect, does not include mean level information present in the dependent variable (daily negative affect). Thus, the independent and dependent variables do not contain the same information. The measure of co-occurrence of affect was unrelated to the negative affect measure in the young-old adults and even though negative affect and co-occurrence of affect are related in the old-old, the magnitude is small.

Another potential limitation is that the current study examined daily co-occurrence over a shorter time span than previous studies: 8 days as opposed to 30 days (Ong & Bergeman, 2004). However, the ability to find effects of daily co-occurrence of affect in such a short time frame suggests that this construct could be examined in a more efficient manner that would reduce the time commitment required of participants.

Examining long term changes in daily co-occurrence of affect changes over time is an important next step to determine whether the effects of co-occurrence of affect become

stronger for old-old adults. The data for the present study are part of an ongoing measurement burst design, so longitudinal relationships and questions regarding directions of effects can be addressed in the future.

Regarding the practical implications of our findings, the ability to improve daily stressor reactivity outcomes in older adults has been shown to improve health and well-being outcomes (Almeida et al., 2002; Neupert et al., 2006; Stawski et al., 2013). Our findings suggest that efforts to boost co-occurrence of affect could also improve old-old adults' reactivity to daily stressors in the health domain. Mindfulness training may be one manner of increasing co-occurrence of affect. To our knowledge no studies directly examine the relationship between mindfulness and co-occurrence of affect. However, Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) has been found to improve positive affect in older adults (70+) when the severity of their baseline depressive symptomology was low (Gallegos, Hoerger, Talbot, Moynihan, & Duberstein, 2013). Additionally several studies indicate that MBSR improves emotion regulation efficacy (Jensen, Vangkilde, Frokjaer, & Hasselbalch, 2012; Kilpatrick et al., 2011). Emotional complexity has been shown to be related to emotion-regulation (Carstensen et al., 1999; Hay & Diehl, 2011; Ong & Bergeman, 2004) and has been suggested as a means through which emotion regulation improves with age (Carstensen et al., 2000; Labouvie-Vief & Medler, 2002). Therefore, improving emotion regulation should also positively impact co-occurrence of affect as it is one facet of emotional complexity.

Conclusions

Limitations notwithstanding, our findings add to the understanding of the relationships among co-occurrence of affect, age, and psychological resiliency to health stressors in important ways. Specifically, the findings from our study support the assertion that co-occurrence of affect serves an adaptive function in older age. Additionally, the study further highlights the importance of examining domain specific stressors.

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Appendix A

$$\text{Level 1: Negative Affect}_{it} = \beta_{0it} + r_{it}$$

$$\text{Level 2: } \beta_{0i} = \gamma_{00} + u_{0i}$$

This model provides a point estimate and confidence interval for the grand mean, γ_{00} . The model also provides information about Level 1 and level 2 variability in the outcome variable through two parameters: σ^2 (within-person variability) and τ_{00} (between-person variability). These parameters were used to calculate the intra-class coefficient which is a measure of the proportion of variance in the outcome variable that is between individuals. This correlation can be calculated using the following formula:

$$\rho = \tau_{00} / (\tau_{00} + \sigma^2)$$

Appendix B

$$\text{Level 1: Negative Affect}_{it} = \beta_{0it} + \beta_{1it}(\text{health stress}) + r_{it}$$

$$\begin{aligned} \text{Level 2: } \beta_{0i} &= \gamma_{00} + \gamma_{01}(\text{age}_i) + \gamma_{02}(\text{co-occurrence of affect}_i) + \gamma_{03}(\text{neuroticism}_i) + \gamma_{04}(\text{age}_i * \text{co-occurrence of affect}_i) + u_{0i} \\ \beta_{1i} &= \gamma_{10} + \gamma_{11}(\text{age}_i) + \gamma_{12}(\text{co-occurrence of affect}_i) + \gamma_{13}(\text{age}_i * \text{co-occurrence of affect}_i) + u_{1i} \end{aligned}$$

In Level 1 (within-person level), negative affect for person i on day t is a function of the intercept β_{0it} , which is the expected level of negative affect for person i on days with no health stressors (health stressor = 0). The slope β_{1it} , is the reactivity slope and it is the expected change in negative affect associated with the occurrence of health stressors, or the change associated with the difference between exposure to no health stressors and exposure to health stressors. The error term, r_{it} , represents the amount person i fluctuates around his or her own mean.

In the Level 2 (between-person level) equations, γ_{00} is the grand mean of negative affect for the average aged person with average levels of co-occurrence of affect and average neuroticism levels, γ_{01} is the main effect of age, γ_{02} is the main effect of co-occurrence of affect, γ_{03} is the main effect of neuroticism, and γ_{04} represents the interaction between age and co-occurrence of affect. In the next equation, γ_{10} is the average reactivity slope or change in negative affect between days with and without health stressors, γ_{11} represents the cross-level interaction examining age differences in the within-person slope (reactivity) of health stressors and negative affect, γ_{12} represents the cross-level interaction examining co-occurrence of affect differences in the within-person slope of health stressors and negative affect, and γ_{13} represents the three-way cross-level interaction (Age Group X Co-Occurrence X Health Stress) examining age and daily co-occurrence differences in the within person slope of health stressors and daily negative affect. The degree to which people vary from the sample mean of negative affect is represented by u_{0i} , and the degree to which people vary from the reactivity slope is represented by u_{1i} .

Figure 1. Co-occurrence as a moderator for the relationship between health stress and daily negative affect (Health Stressor X Age X Daily Co-Occurrence).

Table 1

Descriptive Characteristics for Study Variables by Age Group

Variable	Young-Old			Old-Old		
	M	SD	Range	M	SD	Range
Age	71.60	4.9	60–79	82.9	2.60	80–89
Physical Health	1.49	1.26	0–6	1.89	1.18	0–4.88
Health Stress	.11	.19	0–1	.18	.25	0–1
Co-Occurrence	-.07	.46	-.97–1	-.02	.51	-.92–.99
Positive Affect	2.85	.86	1.01–4.95	2.53	0.94	1–4.43
Negative Affect	1.25	0.33	1–4.09	1.38	0.56	1–4.29
Total Stress	0.77	0.75	0–4.88	0.99	0.92	0–3.63
Neuroticism	-.011	1.96	-2.23–6.77	.35	2.44	-2.23–5.77

Note. N = 249 young-old adults, 64 old-old adults.

Correlations Among All Variables of Interest for Young-Old Adults (top quadrant) and Old-Old Adults (bottom quadrant)

Table 2

	1	2	3	4	5	6	7	8
1. Age	–	.05	.05	.17**	–.2**	–.12	–.03	–.13*
2. Physical Health	.01	–	.42***	–.03	–.15*	.28***	.22**	.14*
3. Health Stress	–.14	.32*	–	–.07	–.01	.33***	.54***	.07
4. Co-Occurrence	–.05	.05	.01	–	–.11	.08	–.06	.01
5. Positive Affect	–.15	–.10	–.24	–.18	–	–.04	–.07	–.29***
6. Negative Affect	.09	.33*	.16	.26*	–.08	–	.49***	.31***
7. Total Stress	–.19	.30*	.71***	.10	–.14	.39**	–	.22**
8. Neuroticism	.03	.18	.19	.08	–.33*	.45**	.20	–

Note.

*
 $p < .05$;**
 $p < .01$;***
 $p < .001$. $N = 249$ young-old adults, 64 old-old adults.