Calmness and Excitement Intensity and Variability in Old Age: Linking Stressful Circumstances to Well-Being and Health

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Abstract

The Discrete Emotion Theory of Affective Aging posits that the adaptive effects of emotions vary depending on their ability to facilitate effective responses to developmental constraints and opportunities. Research suggests that calmness and excitement are two positive emotions with distinct functions and that calmness, but not excitement, supports effective adjustment to developmental constraints in old age, particularly when control perceptions are low. In the present research, we conducted a one-week daily diary study with 169 community-dwelling older adults (M_{age} = 76.6, SD = 7.2). Data was collected in 2018. We examined the effects of calmness and excitement intensity (between- and within-person differences) and variability within the context of stressful experiences on older adults' well-being and health. We expected that levels, increases, and consistency (i.e., low variability) of calmness, but not excitement, may be adaptive, particularly among older adults with low control perceptions. Results from hierarchical and linear regression models showed that calmness intensity was associated with better well-being and health, on both the between- and within-person levels. Between-person levels of excitement intensity, by contrast, predicted poorer health and depressive symptoms among individuals with low perceived control. Compared to variable calmness, consistent calmness was associated with adaptive outcomes, particularly for older adults with low perceived control. By contrast, excitement variability was largely unrelated to well-being and health, except for a positive association with depressive symptoms among adults with low control. Findings inform functional theories of emotion by suggesting that positive emotions with disparate motivational functions can exert diverging effects in older adulthood.

Keywords: discrete positive emotions, perceived control, well-being, health, aging

Introduction

Lifespan theory and research on discrete emotions show that negative emotions can differ in terms of salience (i.e., prominence, intensity) and adaptive value (i.e., usefulness) across the adult lifespan (Barlow et al., 2019; Kunzmann et al., 2017). Such differences may occur because the disparate functions of negative emotions become differentially beneficial as individuals age and encounter different challenges, such as functional and cognitive changes, significant life transitions, or new social roles (Baltes & Smith, 2003). There is, however, a paucity of research on the experience and function of discrete positive emotions, such as calmness and excitement. To this end, a recent study showed that calmness, but not excitement, increased from young to older adulthood, and buffered against 10-year declines in subjective well-being and physical health among older adults with low levels of perceived control (Hamm et al., 2021). Such effects might occur because calmness could be more adaptive in older, compared to younger, adulthood since calmness is a positive emotion that encourages acceptance and adjustment to changing priorities and interests. Unlike other positive emotions, such as excitement, which is linked to action and active goal engagement, calmness supports well-being in situations where resources or energy may need to be conserved, such as in older adulthood (Gilbert, 2014; Tamir et al., 2016). This might be particularly evident when older adults perceive their control options as low, which tends to occur in response to losses in health, cognitive, or social functioning (Drewelies et al., 2017; Mirowsky & Ross, 2007).

Positive emotions are known to serve important functions during stressful situations. Although positive emotions are less frequently elicited directly by stressors, positive emotions arising from other aspects of an individual's life may still exert meaningful influence as the individual navigates stressors. In the present study, we conducted a week-long daily diary study to examine the distinct effects of calmness and excitement, both at the between- and within-person level, on older adults' well-being and physical health as they manage daily stressors. In addition, we explored the associations between intra-individual variability in calmness and excitement with older adults' well-being and physical health.

Since some emotions (e.g., calmness) may be more useful and more salient in older adulthood than others (e.g., excitement), we reasoned that the consistent (i.e., low variability), compared to inconsistent (i.e., high variability), experience of adaptive emotions would be associated with better outcomes. Specifically, we predicted that the consistent experience of calmness, but not excitement, would exert protective effects on older adults' well-being and physical health, and that these effects would be paramount among older adults with low levels of perceived control.

The Discrete Emotion Theory of Affective Aging (DEA)

Functional theories of emotion propose that emotions differ in their physiological arousal, subjective feelings, behavioural expressions, and action impulses (Levenson, 1992). From this perspective, different emotions serve distinct adaptive functions, helping individuals respond effectively to environmental demands (Ekman & Davidson, 1994; Frijda, 1986; Lazarus, 1991). While these theories have largely focused on negative emotions, positive emotions also play important functional roles (Fredrickson, 2003). The Discrete Emotion Theory of Affective aging (DEA) builds on functional theories of emotion by integrating a lifespan developmental conceptual framework (Kunzmann et al., 2014; Kunzmann & Wrosch, 2018). A central tenet of lifespan developmental theories is that each life stage presents unique environmental challenges, personal needs, beliefs, and future expectations (Heckhausen & Schulz, 1995). Although there is heterogeneity in the aging experience, older adulthood frequently involves the experience of constraints and losses, associated with declines in physical and cognitive resources and social losses (Schulz & Heckhausen, 1996). To this end, there is ample evidence suggesting that the ratio of developmental gains and losses shifts in older adulthood, with losses becoming more prominent (e.g., Baltes & Smith, 2003). While there certainly are individual differences in the number and severity of losses that occur with advancing age, the management of losses and stressors becomes an important developmental task for most older adults.

According to DEA, emotions that facilitate this process gain in salience and adaptive value in

older adults. DEA shares similarities with other developmental theories of emotion, such as the Socioemotional Selectivity Theory (SST; Carstensen, 1992, 1995, 2006) and the Strength and Vulnerability Integration model (SAVI; Charles, 2010), all of which assert that the experience and impact of emotions vary across the lifespan. However, DEA uniquely focuses on the function of discrete emotions, whereas SST and SAVI emphasize broad emotion constructs determined by dimensionality, specifically valence, and physiological arousal, respectively. In addition, DEA posits that qualitative shifts in emotion adaptivity are dependent on distinct developmental contexts (e.g., different life stages), whereas SST and SAVI attribute emotion changes to linear age-related shifts, such as altered time horizons or increased physiological vulnerabilities.

These theoretical differences are especially evident when considering high-arousal positive emotions, such as “active”, “strong”, or “cheerful”. According to SAVI’s dimensional approach, these emotions are proposed to be maladaptive in older adulthood due to older adults’ increased vulnerability to heightened physiological arousal (Charles, 2010). Yet, empirical findings have associated high-arousal positive emotions with beneficial outcomes (e.g., Pressman et al., 2019; Zhang & Han, 2016). A discrete emotions perspective offers a potential explanation, suggesting that these associations may partly reflect effects due to factors related to the emotion, such as exercise levels or rates of sedentary behaviour (Cohen & Pressman, 2006; Pressman & Cohen, 2005). Given the mixed theoretical and empirical results, it is recommended to disentangle the functions and consequences of different emotions from a discrete emotions approach (Pressman et al., 2019).

The majority of DEA’s work has studied distinct negative emotions, such as sadness and anger (e.g., Barlow et al., 2019; Kunzmann et al., 2017). In this regard, experimental and field studies suggest that the adaptive value of sadness is proposed to increase across the lifespan, whereas the opposite is posited for anger. DEA postulates that sadness may be more useful in older adulthood, compared to younger adulthood, as it can foster acceptance and goal disengagement (Klinger, 1975; Nesse, 2000), thereby helping older individuals adjust to an increasing number of developmental constraints (e.g.,

mobility or sensory limitations) and irrevocable losses (e.g., death of loved ones; Baltes & Baltes, 1990; Heckhausen et al., 2010). By contrast, anger is thought to motivate persistence and actions for reversing injustice (Frijda, 1986; Lazarus, 1991), which can be more useful in young adulthood, but less effective in older adulthood (Kunzmann et al., 2017). Consistent with these assumptions, Barlow and colleagues (2019) showed in a daily diary study that sadness was not associated with negative health outcomes in older adulthood, whereas anger predicted poorer well-being and physical health.

Research on discrete negative emotions has been growing, yet there is a paucity of work on the age-related experiences and consequences of discrete positive emotions. Emotion theories suggest that positive emotions promote social, intellectual, and physical resources by fostering relationships and encouraging exploration (Fredrickson, 1998, 2001). Although positive emotions themselves may be transient, their protective functions appear to be long lasting and facilitate coping and resilience (Cohn et al., 2009), which is critical for maintaining quality of life in old age. Indeed, studies consistently note reliable benefits of positive emotions in older adulthood (e.g., Cohn et al., 2009; Diener & Chan, 2011; Fredrickson, 2003; Ong et al., 2006). Importantly, DEA asserts that not all positive emotions are equally beneficial in old age; rather, positive emotions that support effective stressor management within the developmental context are beneficial.

The Experience and Effects of Calmness and Excitement in Older Adulthood

Recent work from our group has examined the salience and health consequences of two different positive emotions that have contrasting motivational functions, namely calmness and excitement (Hamm et al., 2021). Calmness is linked to processes of rest, recovery, and resource conservation (Gilbert, 2014; Tamir et al., 2016). In addition, calmness is closely tied to mindfulness and promoting a shift from the mode of doing to the mode of being, in which individuals can observe their goals, needs, and action plans from a distance (Kabat-Zinn, 1990). This reflective stance can facilitate acceptance of uncontrollable life circumstances (e.g., the onset of illness, loss of loved ones; Koopmann-Holm et al., 2013) and, if necessary, disengaging from unachievable pursuits (e.g.,

reversing aging, participating in intensive physical or cognitive tasks) and stressful problems (e.g., managing mobility limitations independently; Tsai et al., 2007).

By contrast, excitement is a future-focused, approach-oriented emotion (Jiang et al., 2016) that supports energy mobilization, novelty seeking, and active goal pursuits (C. Harmon-Jones et al., 2016; E. Harmon-Jones et al., 2013; Izard, 1977). Excitement promotes an implemental mindset conducive to exploration and identity formation, which are central developmental tasks in young adulthood (E. Harmon-Jones et al., 2013). However, in older adulthood, individuals often prioritize stability over exploration. As such, the motivations driven by excitement may not always align with the available resources, personal, and social contexts of older adults.

The findings from our initial longitudinal study showed that high levels of calmness, but not excitement, buffered against 10-year declines in older adults' well-being and physical health. Notably, the protective effect of calmness emerged only among older adults who generally have low levels of perceived control (Hamm et al., 2021). Here, perceived control reflects individuals' belief about the extent to which they can influence life outcomes, which is shaped by health and social factors (Antonucci, 2001), both of which tend to decline with age in response to the emergence of more frequent and intractable age-related obstacles (e.g., physical limitations, social isolation, deaths of loved ones; Drewelies et al., 2017; Lachman & Firth, 2004; Mirowsky & Ross, 2007). While there is heterogeneity in the aging experience, global perceptions of control likely capture a broader developmental context reflecting individual differences in exposure to age-related obstacles and losses. Averaging control perceptions across multiple time points offers a reliable indicator of this construct by reducing measurement error and increasing reliability (Brose et al., 2013; Eid & Diener, 1999).

Of note, calmness and excitement also differ in their physiological arousal whereby calmness reflects a low arousal emotion (Gilbert, 2014; Russell, 2003) and excitement reflects a high arousal emotion (Izard, 1977; Russell, 2003). To shed light on the confound between function and arousal, Hamm and colleagues (2021) replicated their multilevel analyses with other low arousal (i.e.,

satisfaction) and high arousal (i.e., pride) emotions and compared the pattern of results to that found for calmness and excitement. They found that the set of patterns observed for calmness and excitement were not replicated by other positive emotions with comparable arousal, providing evidence of effects related to emotion functionality rather than exclusively from arousal.

Within-Person Effects, Stressor-Related Emotions, and Emotion Variability

The discussed research provides evidence that a discrete emotion approach should also address positive emotions. With this in mind, there are several important questions that have not yet been examined. First, research on the age-related effects of distinct positive emotions has only examined the effects of between-person differences. Yet, emotions are inherently dynamic and fluctuate over time (Kuppens & Verduyn, 2017). As such, within-person changes in emotion may also have significant implications for health and well-being. Indeed, within-person changes in other psychological constructs has been shown to substantially predict health-relevant outcomes (Voelkle et al., 2014) beyond the effects of between-person differences (Ong & Ram, 2016). As such, longitudinal designs with multiple measurements are needed to disentangle both types of effects.

Second, previous research has not examined the specific contexts in which positive emotions are experienced. For example, in our earlier work, we assessed the intensity of calmness and excitement during a “typical day” (Hamm et al., 2021), without accounting for the circumstances surrounding those emotions. Since emotions are theorized to support the adaptive management of stressors (Lazarus & Folkman, 1984), understanding their effects within this context is essential. Positive emotions, in particular, are known to serve important functions during stressful situations, despite being less frequently elicited directly by the stressor. For example, positive emotions have been linked to lower levels of cortisol (Tugade & Fredrickson, 2004), reduced inflammation (Steptoe et al., 2009), improved cardiovascular health (Pressman & Cohen, 2005), and greater resilience in the face of adversity (Fredrickson, 2003). Furthermore, positive emotions support adaptive coping strategies, such as problem-solving and seeking social support (Folkman & Moskowitz, 2000). Given their

significance, it is important to examine how positive emotions may influence well-being and physical health outcomes within the context of stressors.

Third, emotion theories have primarily examined emotions either as a singular, binary state in response to an event or as an individual's dispositional tendency (Houben et al., 2015). While important, these approaches do not address the dynamic nature of emotions (Jenkins et al., 2018). One dynamic aspect of emotion is variability, which reflects within-person fluctuations over time and is a relatively stable individual difference variable (Jenkins et al., 2018). Most commonly, emotion variability is operationalized as an index of dispersion measured by the standard deviation. Here, high emotion variability reflects an individual who experiences more extreme highs and lows of an emotion over time, whereas low emotion variability indicates a more consistent intensity in the experience of the emotion. Although criticism has emerged regarding the use of standard deviation as a metric and novel measures have been proposed (e.g., mean squared successive differences, relative standard deviation), research has demonstrated that using the standard deviation to measure emotion variability is reliable (Trull et al., 2008), stable within individuals (Eid & Diener, 1999), and independent of overall emotion levels (Chow et al., 2005). Furthermore, Dejonckheere and colleagues (2019) concluded that the proposed more complex measures of variability do not add novel information beyond using the standard deviation, which reflects the more parsimonious measure.

Despite growing interests, the literature on emotion variability is empirically mixed and theoretically inconsistent (e.g., Gruber et al., 2013; Hardy & Segerstrom, 2017; Houben et al., 2015; Jenkins et al., 2018; D. R. Jones et al., 2020; Kuppens & Verduyn, 2017). One inherent issue in the extant research on emotion variability is that studies typically use broad, dimensional constructs of positive or negative affect, which aggregate multiple different emotions (e.g., Brose et al., 2013; Gruber et al., 2013; Röcke et al., 2009). As such, the consistent experience of some emotions may be adaptive, while for other emotions it may not. When grouped together into broad, dimensional constructs, these distinctions may be obscured, resulting in the mixed literature (Katzorreck et al.,

2022). Another possible contribution to the mixed literature may be due to studies assessing emotion variability without accounting for the context in which the emotions are experienced (Geukes et al., 2017). From the DEA perspective, developmental context is crucial to understanding the function and consequences of discrete emotion variability (Geukes et al., 2017; Kunzmann & Wrosch, 2018).

The noted issues suggest that the DEA framework offers a valuable perspective into understanding the role of emotion variability. From our perspective, certain emotions are more useful than others in specific developmental contexts and thus also more frequently and intensely experienced. For example, older adults have been shown to experience more intense calmness than excitement, and benefit relatively more from the higher, compared to lower, levels of calmness (Hamm et al., 2021). In turn, research from our group asserts that consistent experiences of developmentally salient and useful emotions may be adaptive (Katzorreck et al., 2022), such as calmness in older adulthood. By contrast, consistent experiences of less salient and less useful emotions may be less consequential or even maladaptive, such as excitement in older adulthood. Our recent research supports this idea, showing that variability may be adaptive or maladaptive depending on the emotion in question and its relevance to the developmental context (Katzorreck et al., 2022).

The Present Study

The present daily diary study investigated the effects of two distinct positive emotions, calmness and excitement, on older adults' well-being and physical health in the context of stressful events. We had several specific objectives towards this goal. First, we intended to build upon the discrete positive emotion literature by examining the associations between calmness and excitement intensity with subjective well-being and physical health outcomes at the between-person level, as well as at the within-person level. Second, we examined the effects of calmness and excitement variability on older adults' subjective well-being and physical health to explore whether consistent, compared to variable, calmness within the context of daily stressors would be associated with better well-being outcomes. Third, we investigated whether control perceptions, as an indicator of developmental

context, would moderate the observed associations. Finally, we also explored in supplemental analyses two other positive emotions with comparable arousal levels (pride and satisfaction) to examine the specificity of our study findings.

We hypothesized that within- and between-person levels of calmness intensity, but not excitement, would be associated with higher levels or changes of subjective well-being and physical health symptoms. In addition, we expected that consistent, compared to variable, calmness (but not excitement) would predict better well-being and health. We further hypothesized that the beneficial effects of intense and consistent calmness would be paramount among older adults who perceive low, compared to high, control over their stressful life events. Finally, we predicted that the supplemental analyses will reveal that while the two supplemental positive emotions share comparable arousal levels, our study findings will remain distinct, highlighting the unique functions of calmness and excitement.

Methods

Transparency and Openness

We follow the APA Journal Article Reporting Standards (JARS; Appelbaum et al., 2018). This study is part of a broader project about the daily experience of older adults, which launched in 2018. This study was not pre-registered and uses a subset of data that has not yet been examined. We report all measures and manipulations that were analyzed to address our research questions, how we determined sample size, and any data exclusions. The study materials, formulas, and data can be found on OSF (https://osf.io/p4735/?view_only=13bd15a151374132b1c4a41c90bc7cb5).

Participants and Procedures

Participants were community-dwelling older adults recruited through advertisements in local newspapers from the Montreal, Quebec, Canada area. Because we were interested in obtaining a normative sample of older adults, the only inclusion criterion was that participants had to be 60 years or older. To determine sample size, power analysis was completed for the funded grant proposal using G*Power. Power was estimated using the available literature assuming effect sizes ranging from .03 to

.16 (Dunne et al., 2011; Wrosch et al., 2005, 2017; Wrosch & Heckhausen, 1999). The study was approved by the University Research Ethics Committee. Written consent was obtained before participation. We chose to include all individuals who reported daily stressors and responded to the calmness and excitement assessments for at least three of the seven days; 169 participants met this criterion. These participants were on average 76.5 years old (*SD* = 7.19; range = 64 to 98), 63.3% of participants were female, and 56.5% had obtained a university education (Primary school to Secondary school: 26.0%; CEGEP/College Diploma: 16.0%; Bachelor's degree: 26.6%; Master's degree: 21.9%; Doctorate degree: 7.7%; Other/Did not report: 1.8%).

Individuals interested in participating in the study were screened by phone and mailed questionnaire packages in their preferred language (i.e., English or French). Participants were asked to complete a general questionnaire, which included sociodemographic questions and several commonly used psychological scales. In addition, participants completed a daily diary questionnaire that asked them to report their most significant stressor of the day, emotion ratings in response to the stressor, and their perceptions of control for resolving the stressor. Participants were also asked to report their satisfaction with the day, daily stress levels, and report the presence or absence of various physical health symptoms that day. Participants were compensated financially for their efforts ($50).

Measures

Daily Stressor. Each day, participants were asked at the end of the day to report the most severe problem or stressor they encountered. Examples of reported stressors include, "*Extreme pain in my left shoulder after a fall*", "*Loneliness wishing I had a friend to invite over. I have no one to talk to*", or "*Getting to my appointment. I cannot drive my car anymore due to bad eyesight*". Participants reported stressors on most of the seven study-days (*M* = 6.16, *SD* = 1.23; 3-4 stressors = 13%, 5-6 stressors = 29%, 7 stressors = 58.0%).

Perceived Control. We measured control perceptions by administering two items each day. Participants were asked to rate on a five-point Likert scale *"How likely was it that the problem/stressor*

could in fact be resolved?" And *"How likely was it that the problem/stressor would in fact be resolved?"* (1 = *Very unlikely*, 5 = *Very likely*). The two items were formulated based on literature showing that individuals who score higher in their sense of control strongly believe there are things they can do and intend to do to bring about desired outcomes (Lachman & Firth, 2004). Positive associations were obtained across the two item scores (*r*s = .82 to .91, *p*s = <.001, *M*[*r*] = .86). Sum scores were calculated by the mean of the items multiplied by a factor of two (*M*s = 6.69 to 6.98, *SD*s = 2.71 to 2.89). Scores were moderately and positively correlated across days (*r*s = .24 to .43, *p*s < .002, *M*[*r*] = .33). We averaged the scores across the seven days to obtain an indicator of between-person differences in the level of perceived control over the week (*M* = 6.83, *SD* = 1.83).

Calmness and Excitement Intensity and Variability. Participants were given a list of discrete emotions and asked to respond to the following question: "*To what extent did you experience each of the following emotions during or after the problem/stressor you indicated for today?*" The intensities of calmness and excitement were measured with one item each (i.e., *calmness* and *excitement*), using 5-point Likert-type scales (0 = *Very slightly* or *not at all*; 4 = *Extremely*; Calmness: *M*s = 1.50 to 1.59, *SD*s = 1.17 to 1.28; Excitement: *M*s = 0.44 to 0.64, *SD*s = 0.83 to 1.04). The averages of the intensity scores were calculated across the seven days to reflect between-person differences in calmness and excitement intensity (Calmness Intensity: *M* = 1.56, *SD* = 0.87; Excitement Intensity: *M* = 0.55, *SD* = 0.70). Calmness and excitement variability were calculated by the standard deviation of daily scores (Calmness Variability: *M* = 0.86, *SD* = 0.39; Excitement Variability: *M* = 0.57, *SD* = 0.52).

Daily Outcomes.

Satisfaction with the Day. Satisfaction with the day was measured using three-items adapted from the Satisfaction with Life Scale (Diener et al., 1985): "*In most ways my day was close to my ideal*", "*The conditions of my day were excellent*", "*I am satisfied with my day.*" Items were rated on a 7-point Likert scale (0 = *Strongly disagree*, 6 = *Strongly agree*). Composite scores were calculated by the mean of the items multiplied by a factor of three (*M*s = 11.33 to 11.70, *SD*s = 4.64 to 5.28). Scores

showed moderate positive correlations across the seven days (*r*s = .26 to .54, *p*s ≤ .001, M[*r*] = .40).

Daily Stress. Daily stress was measured using one item. Participants rated how much stress they experienced during the entire day on an 11-point Likert scale (0 = *None at all*, 10 = *A lot*; *M*s = 3.87 to 4.36, *SD*s = 2.62 to 2.96). Scores showed moderate positive correlations across the seven days (*r*s = .28 to .54, *p*s < .001, M[*r*] = .45).

Daily Physical Health Symptoms. On each day, participants responded to a symptom checklist of twelve health problems. They were asked to indicate whether they had been bothered by the specified health symptom that day: (a) stomach pain, (b) back pain, (c) pain in your arms, legs or joints, (d) pain or problems during sexual intercourse, (e) headaches, (f) chest pain , (g) dizziness, (h) fainting spells, (i) feeling your heart pound or race, (j) shortness of breath, (k) constipation, loose bowels, or diarrhea, (l) nausea, gas or indigestion. This list of symptoms was adapted from the PRIME MD patient questionnaire screener (Spitzer et al., 1994). To obtain an indicator of physical health, we calculated the mean and multiplied by a factor of 12 (*Ms* = 1.38 to 1.57, *SDs* = 1.53 to 1.74; 0 health symptoms = 27.2% to 35.5%, 1-3 health symptoms = 51.5% to 62.2%, 4-6 health symptoms = 6.8% to 13%, > 6 health symptoms = 0.6% to 3%). Across the seven days, scores were positively correlated (*r*s = .59 to .78, *p*s < .001, *M*[*r*] = .70).

Global Outcomes

Satisfaction with Life. Satisfaction with life was measured using the 5-item Satisfaction with Life Scale (Diener et al., 1985). Sample items include, "*I am satisfied with my life*" and "*If I could live my life over, I would change almost nothing.*" Items were rated on a 7-point Likert scale (0 = *Strongly disagree*, 6 = *Strongly agree*). Composite scores were calculated by taking the mean and multiplying it by a factor of five (*M* = 20.2, *SD* = 6.26).

Global Depressive Symptoms. Depressive symptomatology was measured with the 10-item Centre for Epidemiological Studies Depression Scale (CESD-10; Radloff, 1977). Participants were asked to rate how frequently they had experienced 10 depressive symptoms during the past week on a

four-point Likert scale (0 = *less than one day* to 3 = *5–7 days*). Sample items include, "*During the past week, I felt depressed*" and "*During the past week, I could not get 'going.'*" Composite scores were calculated by the mean multiplied by a factor of 10 (M = 6.84, SD = 5.24).

Global Physical Health Symptoms. Global physical health symptoms were assessed by the number of physical health symptoms (see list of items described for Daily Physical Health Symptoms) that participants endorsed experiencing often in the past month. Composite scores were calculated by multiplying the mean of the items by a factor of 12 (M = 2.99, SD = 2.29).

Sociodemographic variables. Age, sex, and education were self-reported. Sex was coded as 1 = *male* and 2 = *female.* Education was measured by participants' highest level of education (0 = *None*, 1 = *Primary School 1*, 2 = *Primary School 2*, 3 = *Primary School 3*, 4 = *Primary School 4*, 5 = *Primary School 5*, 6 = *Primary School 6*, 7 = *Secondary School 7*, 7 = *Secondary School 8*, 9 = *Secondary School 9*, 10 = *Secondary School 10*, 11 = *Secondary School 11*, 12 = *Secondary School 12*, 13 = *Cegep/College Diploma*, 14 = *Bachelor's Degree*, 15 = *Master's Degree*, 16 = *Doctorate Degree*).

Missing Data

We used multilevel and linear regression modeling to analyze the data. Analyses were conducted using HLM 8.0 (Raudenbush & Congdon, 2021), which has the capacity to handle missing data at the within-person level. Missing data at the between-person level was replaced with the sample mean for both the hierarchical and linear regression analyses since less than 5% of missing data were observed (Tabachnick & Fidell L.S., 2018).

Data Analysis

Preliminary analyses were conducted to describe the sample (means, standard deviations, frequencies) and to obtain general associations among variables. For the main analyses, within-person predictor variables were group-centered and between-person predictor variables were standardized prior to analyses. First, we used hierarchical linear modeling (HLM 8.0) to examine predictors of daily outcomes (satisfaction with the day, daily stress, daily physical health symptoms). Separate models

were estimated for each outcome based on the rationale that emotional, cognitive, and health-related processes may influence one another and should therefore be examined independently (Cervone et al., 2001). In a first step, Level-1 models estimated variability in the outcome variables by an intercept, person-centered slopes of calmness and excitement, and a residual term. Intercepts represented average levels of outcomes across the week, and slopes represented the effects of within-person fluctuations in calmness and excitement on the outcomes. At Level-2, cross-level interactions were tested by examining whether perceived control moderated the Level-1 slopes. In addition, Level-2 predictors of the intercepts included average calmness intensity, average excitement intensity, calmness variability, excitement variability, perceived control, and sociodemographic variables. In a second step, we tested between-person interactions for significance by adding into separate models the interaction terms between Level-2 perceived control with average calmness intensity, average excitement intensity, calmness variability, and excitement variability. All significant interactions were plotted using the upper and lower quartiles of the variables and followed up by simple slope analyses.

Second, we examined levels of global outcomes (satisfaction with life, global depressive symptoms, global physical health symptoms) using linear regression models (SPSS 5.0). In a first step, predictors included calmness and excitement intensity and variability, perceived control, and sociodemographic variables. In a second step, interaction terms between perceived control with average calmness intensity, average excitement intensity, calmness variability, and excitement variability were entered in separate models. Significant interactions were plotted by the upper and lower quartiles of the variables and followed up by simple-slope analyses.

Results

Preliminary Analyses

Table 1 presents the means and standard deviations of the study variables. Paired-samples t-test showed that calmness intensity and variability were greater than excitement intensity and variability,

respectively (Intensity: t(168) = 12.78, 95% CI 1.01 [0.85, 1.17], p<.001; Variability: t(168) = 6.25, 95% CI 0.28 [0.19, 0.37], p<.001).

The bivariate correlations among the main study variables are reported in Table 1. The analyses showed that calmness intensity was positively associated with satisfaction with the day and global life satisfaction, and negatively correlated with daily stress and global depressive symptoms. Excitement intensity was positively correlated with calmness intensity and showed a positive association with global physical health symptoms. Calmness and excitement variability were positively correlated with each other. Calmness variability was positively associated with global physical health symptoms, whereas excitement variability was positively associated with daily stress. Excitement intensity and variability were positively correlated, whereas calmness intensity and variability were not. In addition, positive associations emerged between perceived control with satisfaction with the day and global life satisfaction, and negative associations between perceived control and daily physical health symptoms and global depressive symptoms.

Daily Outcomes

The results of the hierarchical linear modeling analyses examining daily outcomes are reported in Table 2. The significant intercept effect at Level-1 indicates that average levels of satisfaction with the day were significantly different from zero. Consistent with our predictions, the calmness, but not excitement, intensity slope was significantly associated with satisfaction with day, indicating that higher than usual calmness, but not excitement, intensity predicted greater satisfaction with the day. At the Level-2, average calmness intensity and perceived control predicted the intercept. As expected, participants who were generally calmer and perceived higher control experienced high levels of satisfaction with the day across the study period. Interestingly, average perceived control did not moderate the slope effect of calmness but exerted a trend effect on the association between the excitement slope and satisfaction with day. This trend effect suggested that within-person increases of excitement intensity predicted greater satisfaction with day among older adults who perceived high

(*β*=0.74, *SE*= 0.24, *p*=.003, 95% *CI* [0.26,1.22]), but not low (*β*=-0.31, *SE*= 0.46, *p*=.50, 95% *CI* [-1.22, 0.59]), control. Finally, none of the interactions between average control and average emotions variables were significant (see Table 2).

For daily stress, the average intercept effect at Level-1 indicates the average levels of daily stress were significantly different than zero. Our results showed that the calmness slope significantly predicted daily stress levels, whereas the excitement slope did not. In support of our hypotheses, these results suggest that higher than usual calmness, but not excitement, intensity predicted lower levels of daily stress. The slope effects of calmness and excitement were not moderated by average perceived control. Of the Level-2 variables, average calmness, but not excitement, intensity predicted the intercept of daily stress levels, again consistent with our expectations, which indicates that participants who were generally calmer across the study period experienced lower levels of daily stress than participants who were generally less calm. The sociodemographic, emotion variability, and control variables at the Level-2 were not associated with average daily stress levels. There was, however, a significant interaction effect between average control perceptions and calmness variability. In support of our hypothesis, the results showed that consistent, compared to variable, calmness was associated with lower levels of daily stress for older adults with low (*β*=0.58, *SE*=0.22, *p*=.008, 95% *CI* [0.16, 1.01]), but not high (*β*=-0.29, *SE*=0.22, *p*=.19, 95% *CI* [-0.72, 0.14]), control perceptions (Figure 1, Top Panel). The remaining interactions between average perceived control and emotion intensity or excitement variability were not significant (see Table 2).

With respect to daily physical health symptoms, there was a significant intercept effect at Level-1 indicating that these levels were significantly different than zero. Surprisingly, we did not obtain significant slope effects for calmness or excitement intensity, or significant moderating effects of perceived control on the slope effects. Similarly, there were no significant associations between Level-2 sociodemographic or emotion variables with average daily health symptoms. However, we obtained a significant association between perceived control and average daily physical health symptoms,

indicating that participants with higher control experienced, on average, fewer physical health symptoms each day. Furthermore, there was a significant interaction between perceived control and calmness variability (Figure 1, Middle Panel). In support of our predictions, results showed that consistent, compared to variable, calmness was associated with fewer daily physical health symptoms among older adults with low (β=0.49, *SE*= 0.16, *p*=.003, 95% *CI* [0.17, 0.80]), but not high (β=-0.16, *SE*=0.14, *p*=.25, 95% *CI* [-0.43, 0.11]), perceived control.

Global Outcomes

Across global outcomes, linear regression analyses showed that perceived control was associated with adaptive outcomes, whereas sociodemographic variables did not significantly predict any of the outcomes (see Table 3). Older adults with high perceived control experienced greater life satisfaction, fewer depressive symptoms, and fewer physical health symptoms compared to their counterparts with low perceived control.

Of the emotion variables, calmness intensity was significantly associated with global satisfaction with life. In support of our hypotheses, older adults who experienced more, compared to less, intense calmness in the context of stressors reported greater life satisfaction. By contrast, excitement intensity was marginally significant, exerting an opposite association, suggesting that older adults who experienced more, compared to less, intense excitement experienced lower life satisfaction. Interestingly, there were no significant effects of emotion variability on global life satisfaction, and no significant interactions between perceived control and the emotion variables for predicting life satisfaction.

Calmness, but not excitement, intensity was also significantly associated with level of depressive symptoms. In addition, our analysis obtained a significant interaction effect between perceived control and excitement intensity predicting depressive symptoms. In support of our hypotheses, results showed that participants with higher, compared to lower, levels of calmness intensity reported fewer global depressive symptoms. In addition, higher, compared to lower, levels of

excitement intensity were associated with higher levels of depressive symptoms for older adults with low (*ß*=2.82, *SE*=1.12, *p*=.01, 95% *CI* [0.59, 5.04]), but not high (*ß*=0.11, *SE*=0.84, *p*=.89, 95% *CI* [-1.54, 1.77]), levels of control (Figure 2, Top Panel). Perceived control did not moderate the association between calmness intensity and global depressive symptoms.

Although our analyses did not show significant main effects of emotion variability, perceived control moderated the associations between both calmness (Figure 1, Bottom Panel) and excitement variability (Figure 2, Bottom Panel) with levels of global depressive symptoms. Compared to variable, consistent calmness was associated with fewer depressive symptoms among older adults with low control (*ß*=2.36, *SE*=1.10, *p*=.03, 95% *CI* [0.16, 4.52]), but not high control (*ß*=0.47, *SE*=1.11, *p*=.67, 95% *CI* [-1.72, 2.66]). Interestingly, compared to variable excitement, consistent excitement significantly predicted fewer depressive symptoms among older adults with low control (*ß*=2.57, *SE*=1.17, *p*=.03, 95% *CI* [0.26, 4.87]), but not among their counterparts with high control (*ß*=-0.29, *SE*=1.05, *p*=.78, 95% *CI* [-2.37, 1.79]). Given the high correlation between excitement intensity and excitement variability, not observed between calmness intensity and calmness variability, we conducted supplemental multilevel analyses to control for both interaction effects for control and excitement intensity and variability. Results from the analysis revealed that neither effect was significant when controlled for the other (Control x Excitement Intensity: *ß*=-0.24, *SE*=0.68, *p*=.73; Control x Excitement Variability: *ß*=-0.94, *SE*=0.63, *p*=.14).

Regarding global physical health symptoms, calmness intensity was not significantly associated with physical health symptoms, whereas excitement intensity exerted a significant positive effect. Consistent with our predictions, calmness, but not excitement, variability was a significant predictor of global physical health symptoms. Our results showed that consistent, compared to variable, calmness was associated with fewer global physical health symptoms. The addition of the interaction terms did not reveal any significant interactions between the emotion variables and control.

Supplemental Analyses

We further examined whether the observed differences in the adaptivity of calmness and excitement may simply reflect general divergent patterns of low arousal emotions and high arousal emotions. To do so, we examined the consequences of two other positive emotions assessed in the study that have been classified as relatively high arousal (pride) and relatively low arousal (satisfaction; Russell, 2003; Watson & Tellegen, 1985; Yik et al., 2011). If the distinct consequences were solely due to arousal, as opposed to the function of the discrete emotion, calmness and satisfaction should show similar protective effects, whereas pride and excitement should show similarly neutral or relatively negative associations with well-being and physical health. Our supplemental analyses suggested this may not the case. See Supplemental Table S1 and S2 for full results (https://osf.io/p4735/?view_only=13bd15a151374132b1c4a41c90bc7cb5).

Supplemental results revealed that satisfaction had comparable effects to that found for calmness, specifically that generally high levels of satisfaction in response to the stressor was associated with higher satisfaction with the day (β=1.27, *SE*=0.33, p<.001) and lower daily stress levels (β=-0.67, *SE*=0.23, p=.004). Higher than usual satisfaction was also associated with higher daily satisfaction (β=0.84, *SE*=0.14, p<.001), lower daily stress (β=-0.41, *SE*=0.08, p<.001), and fewer daily physical health symptoms (β=-0.09, *SE*=0.04, p=.02). In addition, satisfaction variability did not predict daily well-being or global well-being, similar to calmness variability. In contrast to calmness, there were no interactions between control perceptions and satisfaction intensity or variability on daily or global well-being and physical health outcomes.

Interestingly, pride showed an opposite pattern of results as excitement. Specifically, higher than usual pride was associated with greater satisfaction with the day (β=0.43, *SE*=0.16, p=.007) and less daily stress (β=-0.23, *SE*=0.10, p=.02). We did not find any between-person effects of pride intensity or variability on daily or general well-being and physical health outcomes. In addition, there were no interaction effects between control perceptions and pride intensity or variability.

Discussion

The present study investigated the effects of two discrete and functionally contrasting positive emotions, calmness and excitement, on older adults' well-being and physical health within the context of daily stressors. First, consistent with our hypotheses, higher, compared to lower, calmness intensity was positively associated with daily and global well-being outcomes at both the within- and between-person level. Such associations were not obtained for excitement intensity, which were either non-significant or showed a reversed relationship. Surprisingly, control did not moderate the protective effects of calmness. Second, the findings partially support our hypotheses regarding emotion variability. The results revealed that consistent, compared to variable, calmness was associated with better well-being and health on several outcomes. The effects were seen more prominently among older adults with low, compared to high, levels of perceived control, aligning with our predictions. By contrast, excitement variability was largely unrelated to well-being and health, but showed an unexpected association with reduced levels of global depressive symptoms among older adults with low control. Finally, to tease apart possible arousal effects, we conducted supplemental analyses to examine the consequences of two other positive emotions with comparable arousal levels, namely satisfaction (low arousal) and pride (high arousal). In support of a discrete emotions approach, the results for satisfaction and pride were not identical to the effects of calmness and excitement, suggesting that emotional function rather than arousal was responsible for the observed effects.

The Effects of Stressor-Related Calmness and Excitement Intensity in Older Adulthood

The study showed that higher than usual within-person calmness intensity predicted greater daily satisfaction and less daily stress. In addition, higher average calmness intensity was associated with greater daily and life satisfaction, and with lower daily stress and global depressive symptoms. By contrast, between-person differences of excitement intensity showed an opposite effect, predicting more global physical health symptoms, and higher levels of depressive symptoms among older adults with low control perceptions, but were largely unrelated to the remaining outcomes; both at the within- and between-person level.

Theory and research on discrete emotions postulate that calmness motivates adaptive processes among older adults (Hamm et al., 2021), including rest, recovery, resource conservation (Gilbert, 2014; Tamir et al., 2016), acceptance, and disengagement from intractable stressors (Tsai et al., 2007). By contrast, the processes associated with excitement, such as energy mobilization and pursuits of novelty and stimulation (C. Harmon-Jones et al., 2016; Izard, 1977) are proposed to be less adaptive in old age. The findings of our study replicate previous research (Hamm et al., 2021) and support the claim that higher between-person levels of calmness intensity may be adaptive in older adulthood. Of novelty, our results demonstrated that experiencing greater than usual calmness, relative to one's average, also resulted in better daily well-being outcomes. This finding highlights important within-person effects, above and beyond between-person differences, suggesting that increases of daily calmness exert benefits regardless of one's general level of calmness.

Although we hypothesized that perceived control would moderate the effects of both calmness and excitement intensity, the findings provided only partial support for this prediction. Specifically, perceived control moderated the relation between excitement intensity and depressive symptoms, such that higher excitement was associated with greater depressive symptoms among older adults with low perceived control. This finding suggests that, for adults with limited resources or fewer opportunities to pursue stimulating or novel activities, the experience of intense excitement may negatively affect well-being. Surprisingly, the effects of calmness intensity were not moderated by control, which implies that higher within- and between-person levels of stressor-related calmness are adaptive for older adults regardless of their control perceptions. This finding contrasts the results reported by Hamm and colleagues (2021) who found that perceived control moderated the effects of older adults' daily experiences of both calmness and excitement. One possible explanation for this discrepancy could be related to the different contexts in which the emotions were studied. Our study suggests that calmness may be broadly adaptive when navigating daily stressors in older adulthood, regardless of one's developmental context or sense of control. Indeed, studies have shown that cultivating calmness

through mindfulness interventions can interrupt maladaptive stress reactions across various demographics and contexts (e.g., Bamber & Morpeth, 2019; Botha et al., 2015; D. Jones et al., 2017). Such clarity may also allow individuals with high control to accurately appraise their stressor and implement effective coping strategies.

Calmness and Excitement Variability in Older Adulthood

The reported results indicate that consistent, compared to variable, calmness predicted lower levels of global physical health symptoms, depressive symptoms, daily stress, and daily physical health symptoms among older adults with low control. By contrast, excitement variability was largely unrelated to older adults' well-being and health outcomes, except for a relation between consistent excitement and fewer depressive symptoms among older adults with low control.

From a discrete emotion perspective, some emotions are more useful than others in old age (e.g., calmness compared to excitement; Hamm et al., 2021) and thus may also be more salient (Katzorreck et al., 2022). In our study, older adults experienced substantially more intense calmness than excitement. In addition, our results supported the hypotheses by showing that consistent, compared to variable, calmness was associated with adaptive outcomes among older adults with low perceived control, who may be facing more frequent and severe loss and obstacles. By contrast, for older adults with high control perceptions, the processes motivated by consistent calmness may be less helpful and potentially interfere with pursuing achievable solutions to overcome a resolvable stressor.

We did not obtain consistent effects of excitement variability. A single effect emerged showing that consistent, compared to variable, excitement predicted fewer depressive symptoms among older adults with low, but not high, control. This effect was inconsistent with our predictions. To this end, we noticed that the patterns observed for the two interactions between perceived control with excitement intensity and excitement variability were almost identical (see Figure 2). In addition, the correlation between excitement, but not calmness, intensity and variability was significant and positive (see Table 1). This positive association may have in part occurred because of the relatively low levels of

excitement. Although expected within the context of stressors, emotions with low ranges have been shown to have stronger relations between intensity and variability than emotions with larger ranges (Mestdagh et al., 2018). As such, it may be that the patterns observed for the interaction between excitement variability and control were driven by the observed overlap between excitement intensity and variability. Although we had controlled effects of emotion variability for emotion intensity, a more stringent test would be to control both interaction effects simultaneously (Aschard, 2016). Results from supplemental analyses controlling for both interaction effects revealed that neither effect was significant when controlled for the other. This pattern of findings suggests that emotion intensity and variability should be further examined in contexts where excitement may be experienced at higher levels. Furthermore, it would be fruitful to examine three-way interactions between control, emotion intensity and variability in larger studies with sufficient power to test higher order interaction effects.

Supplemental Analyses

Our supplemental analyses point to the value of a discrete emotions approach to studying emotions and aging. In contrast to the Strength and Vulnerability Integration model, which suggests that older adults are more vulnerable to physiological arousal due to difficulties in regulating high intensity emotions (Charles, 2010), our results showed that certain high arousal emotions may have adaptive effects in older adulthood (e.g., pride). The supplemental analyses show that, whereas excitement was associated with negative outcomes (e.g., global physical health symptoms), pride was associated with beneficial outcomes (e.g., satisfaction with the day, daily stress levels). Furthermore, in line with previous research (Gwozdz & Sousa-Poza, 2010; Hamm et al., 2021), we found that certain low arousal emotions (calmness and satisfaction) exhibit similar, yet not identical, adaptive associations with well-being and health. The observed comparable pattern may be due to calmness and satisfaction sharing some similar functions (e.g., facilitating goal disengagement; C. Harmon-Jones et al., 2016). That being said, our results suggest that the adaptive value of calmness is uniquely robust compared to other low arousal emotions, such as satisfaction. Specifically, consistent calmness showed

protective effects among older adults with low control perceptions, whereas there were no significant findings for satisfaction variability on well-being or physical health, nor any interaction effects showcasing beneficial effects of satisfaction intensity or consistency among older adults with low control perceptions. Thus, these findings suggest that the effects of calmness and excitement may not be fully explained by differences in arousal, further supporting the need for a discrete emotions perspective.

Implications for Theory and Research

The study's findings have important implications for theory and research. First, the results provide further evidence for the claim that a comprehensive understanding of emotions requires research to pursue a discrete emotion approach (Kunzmann & Wrosch, 2024). Studies that rely on a dimensional approach to studying the adaptivity of emotions (e.g., valence, arousal) may yield weaker or misleading results if discrete emotions within the same dimension exert different functions and implications on motivation, decision-making, and interpersonal relationships. For example, studying emotions via the PANAS may not be optimal practice as the aggregate of various emotion adjectives may obscure the differential effects of the discrete emotions. Moreover, the PANAS includes many affective states that are not emotions in the strict sense (e.g., "determined"). While it is a valuable instrument for well-being research, it is less suitable for emotion research. It may be more suitable to select specific emotion adjectives from within the PANAS that are particularly relevant to the emotion research questions.

While earlier work in lifespan developmental psychology has focused on the experience and consequences of distinct negative emotions, such as anger and sadness (Barlow et al., 2019; Kunzmann et al., 2017), examining the roles of different positive emotions has just begun. Our study replicates the beneficial effects of calmness intensity on older adults' well-being and health (Hamm et al., 2021), extending them into the context of daily stressors. Importantly, our results demonstrate that the benefits of calmness intensity in old age, unlike excitement, are evident not only at the between-person level,

but also at the within-person level. These findings support the idea that the present-focused, restorative, and mindfulness-related functions of calmness are particularly adaptive in older adulthood, especially when managing daily stressors. By contrast, the future-focused, novelty- and stimulation-seeking tendencies associated with excitement may be less compatible with the limitations and priorities in old age. As such, experiencing adaptive discrete emotions when managing daily stressors may play a critical role in supporting older adults' well-being and physical health.

In addition, the study provided evidence that consistent calmness is beneficial in older adulthood, specifically for older adults with low control who represent a population of older adults that face more frequent and severe obstacles in their lives. This finding contributes to the ongoing theoretical debate about whether emotion consistency or variability is more adaptive. Existing theories of emotion variability propose conflicting predictions, and empirical findings have similarly supported both perspectives (Gruber et al., 2013; Houben et al., 2015). Notably, the extant research frequently operationalized emotion variability as broad affect constructs (e.g., Brose et al., 2013; Gruber et al., 2013; Röcke et al., 2009), which aggregate multiple discrete emotions with potentially divergent functions. However, this approach is poorly suited to understand the adaptive value of emotion variability. A discrete emotion approach, by contrast, allows for more fine-grained assumptions by postulating that the consistent experience of adaptive emotions within specific developmental contexts may contribute to beneficial outcomes. While our study provided evidence for this assumption, more work is needed on the roles of other emotions, including negative emotions (Katzorreck et al., 2022) and other life phases, such as young adulthood and midlife.

Finally, the study's findings provide valuable insights for practitioners and clinicians. While positive emotions are generally seen as beneficial throughout life, especially in old age, our results highlight the importance of understanding the unique functions and consequences of different positive emotions. Tailored interventions focusing on fostering specific positive emotions that produce the most gains may be particularly relevant for addressing daily stressors among older adults with low control.

Limitations and Future Directions

The present study advances theory and research, but it is not without limitations. First, our results stem from a relatively small study, examining daily emotional experiences over one week within a limited geographical context. Additionally, we did not assess factors such as race, culture, or cognitive functioning, which may influence emotion functioning in older adulthood. Future research should address these limitations by recruiting more diverse samples and extending the duration of data collection. Moreover, although the depressive symptom measure used in our study is a well-validated and widely used tool for older adults (Andresen et al., 1994; Mohebbi et al., 2018), future studies may consider using instruments specifically designed for older populations (e.g., *the Geriatric Depression Scale*; Yesavage et al., 1982).

Second, this study sought to examine emotions within specific contexts related to older adulthood and the experience of daily stressors. To gain a more nuanced understanding of emotions in older adulthood, future research could build on our findings by further exploring the role of perceived control within the context of aging. For example, future studies could be designed with sufficient power to distinguish the observed effects in young-old and older-old adults by conducting three-way interactions between control, emotion intensity or variability, and age. In addition, it would be interesting to examine positive emotions within the context of positive events to gain a better understanding of the various functions of emotions and how they differ across situational contexts. It is possible that emotions such as excitement, though less adaptive in the context of stress, may serve beneficial functions in the context of positive experiences, even in later life.

Third, we examined two positive emotions, calmness (low arousal) and excitement (high arousal) with distinct motivational and physiological features. While prior research and our supplemental analyses have highlighted their unique effects compared to emotions matched on arousal and valence, future research should investigate a wider range of emotions, both positive and negative, to help determine whether the observed effects stem from emotion functioning, physiological arousal,

or both. Additionally, future studies should examine discrete stressor-related positive and negative emotions simultaneously. Our theoretical rationale would predict that certain combinations of emotional experiences, such as calmness and sadness, could be particularly useful in promoting adaptive management of developmental tasks among older adults.

Fourth, taking a functional account of emotional experience involves causal assumptions, which is necessary for building the conceptual framework. We began exploring these assumptions through correlational analyses. To provide evidence for causal associations, future research should test the described functional assumptions through experimental manipulations.

Fifth, this study adds a discrete emotion approach to the mixed literature on emotion variability. We examined emotion variability via daily diary assessments (i.e., one assessment measure, every day for 7 days). Future research should substantiate our contributions by examining longer periods of time and using alternate methodologies, such as ecological momentary assessments and experimental induction. Furthermore, our study considered context in the examination of emotion variability. Future studies should build on this approach by incorporating additional information such as stressor content, severity, and complexity. In addition, larger studies are needed to examine higher-order interactions between emotion variability and intensity.

Constraints on Generalizability

Finally, our study was restricted to older adults. Future research should thus examine discrete positive emotions in young and middle adulthood as well. For instance, high and consistent levels of excitement may be adaptive for younger adults who have an abundance of resources and opportunities. In midlife, many people still experience continued growth and also begin to face age-related declines. As such, the effects of calmness and excitement intensity and variability may be more mixed in middle-aged adults. We feel that an examination of different positive and negative emotions across the adult lifespan is important and has a potential to contribute to a comprehensive theory of emotional development.

Conclusion

This daily diary study showed that high between-person levels and higher than usual within-person calmness, but not excitement, intensity were associated with older adults' well-being and physical health. In addition, consistent, compared to variable, calmness was associated with adaptive outcomes among older adults with low, but not high, levels of perceived control. Excitement variability was largely unrelated to well-being and physical health, except for a positive association with depressive symptoms among older adults with low perceived control. Findings inform lifespan developmental theories of emotion by highlighting the unique adaptive value of distinct positive emotions for older adults' subjective well-being and health.

Table 1. Means, Standard Deviations, Frequencies and Zero-order Correlations of Main Study Variables (N = 169).

	Mean (Std Dev)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Sex	1.63 (0.48)														
2. Age	76.5 (7.19)	-.01													
3. Education	13.1 (2.45)	-.22**	-.17*												
4. Perceived Control	6.83 (1.83)	-.13	-.14	.21**											
5. Calmness Intensity	1.56 (0.87)	-.14	-.04	-.00	.21**										
6. Excitement Intensity	0.55 (0.70)	-.25**	.02	-.07	.18*	.16*									
7. Calmness Variability	0.86 (0.39)	-.01	.05	.02	.01	-.03	-.03								
8. Excitement Variability	0.57 (0.52)	-.14	-.02	-.02	.27**	.14	.59**	.20*							
9. Satisfaction with the Day	11.51 (3.47)	.05	-.12	-.11	.26**	.26**	.15	-.05	.09						
10. Daily Stress	4.12 (2.06)	.09	.06	.03	-.09	-.31**	.06	.10	.16*	-.57**					
11. Daily Physical Health Symptoms	1.51 (1.42)	.07	.10	-.07	-.18*	-.11	.11	.13	.06	-.27**	.43**				
12. Global Life Satisfaction	20.23 (6.26)	-.10	.03	.00	.19**	.24**	-.04	-.07	.06	.28**	-.24**	-.22**			
13. Global Depressive Symptoms	6.84 (5.24)	.05	.14	-.07	-.25**	-.25**	.10	.13	.09	-.35**	.46**	.49**	-.53**		
14. Global Physical Health Symptoms	2.99 (2.29)	.03	-.03	-.05	-.15	-.11	.19*	.20**	.15	-.16*	.37**	.76**	-.18*	.44**	

Note. Sex coding: 1 = male, 2 = female; * $p<.01$, ** $p<.01$

Table 2. Results of hierarchical linear modeling analyses predicting daily well-being and physical health outcomes.

	Satisfaction with the Day			Daily Stress			Daily Physical Health Symptoms		
Variables	Coefficient	SE	p	Coefficient	SE	p	Coefficient	SE	p
Step 1.									
Average Levels (Intercept)									
Intercept	11.39	0.25	<.001	4.22	0.15	<.001	1.52	0.10	<.001
Age	-0.38	0.24	.12	0.09	0.15	.57	0.01	0.12	.41
Sex	0.29	0.26	.27	0.19	0.17	.25	0.11	0.11	.32
Education	-0.50	0.23	.03	0.22	0.16	.25	0.02	0.13	.90
Control	0.71	0.28	.01	-0.16	0.17	.35	-0.25	0.12	.04
Calmness Intensity	0.71	0.23	.002	-0.65	0.15	<.001	-0.10	0.09	.29
Excitement Intensity	0.27	0.25	.28	0.21	0.14	.15	0.18	0.15	.24
Calmness Variability	-0.06	0.24	.79	0.13	0.16	.40	0.16	0.11	.16
Excitement Variability	-0.13	0.33	.70	0.27	0.18	.14	0.07	0.14	.60
Calmness Slope	0.63	0.14	<.001	-0.41	0.09	<.001	-0.02	0.04	.56
Calmness Slope x Control	-0.06	0.14	.66	-0.06	0.09	.51	0.02	0.04	.52
Excitement Slope	0.24	0.20	.24	0.01	0.12	.96	-0.03	0.06	.56
Excitement Slope x Control	0.40	0.23	.08	-0.19	0.15	.20	-0.06	0.06	.34
Step 2.									
Control x Calmness Intensity Intercept	-0.28	0.25	.26	-0.07	0.17	.69	-0.08	0.08	.34
Control x Excitement Intensity Intercept	-0.43	0.33	.19	-0.21	0.17	.20	-0.16	0.15	.27
Control x Calmness Variability Intercept	0.23	0.20	.26	-0.33	0.13	.01	-0.24	0.09	.005
Control x Excitement Variability Intercept	-0.41	0.30	.18	0.03	0.17	.87	-0.18	0.12	.15

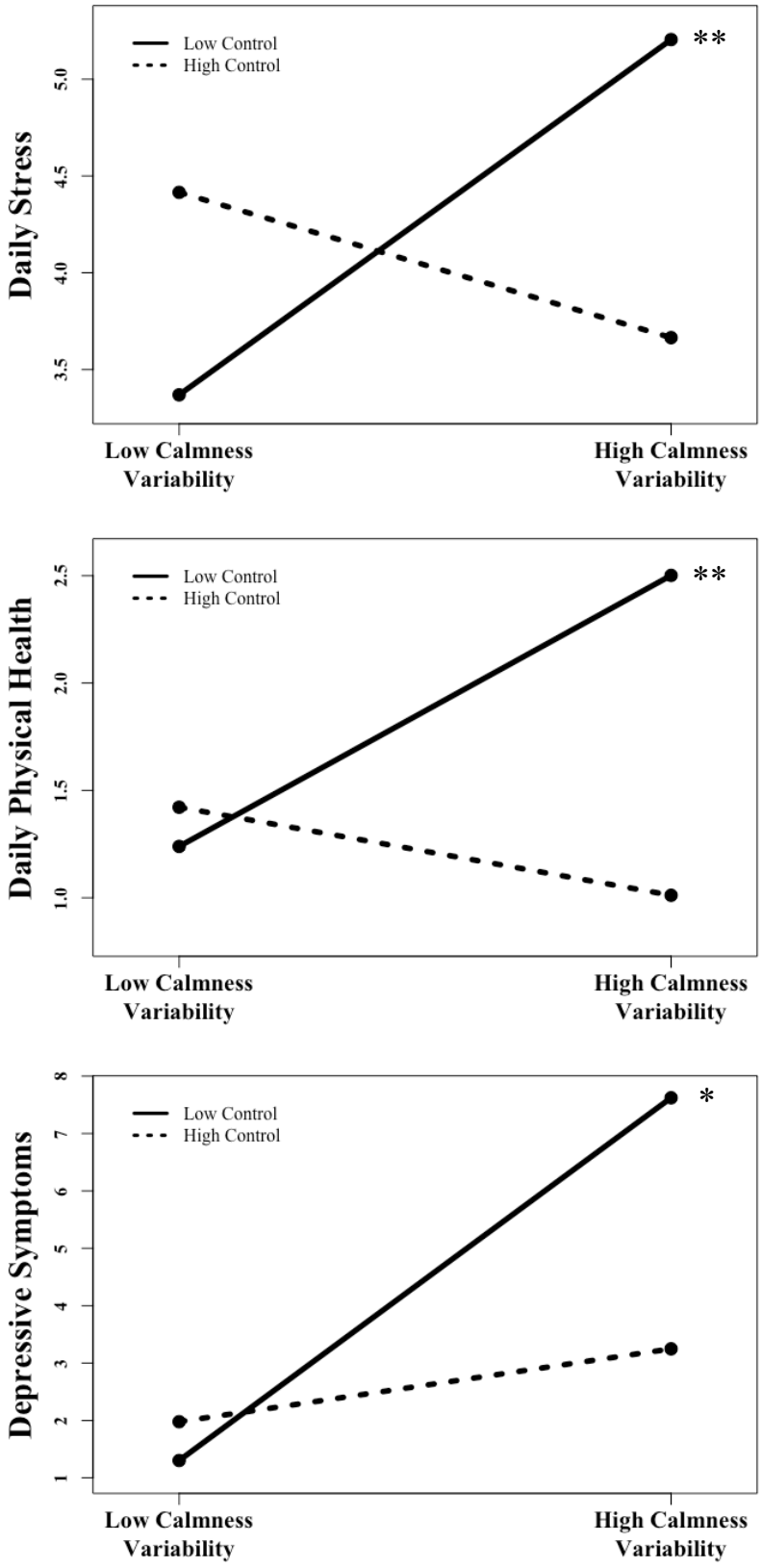
Note. Slopes pertain to fluctuations in within-person measurements. SE = standard error. *Dfs* = 167 (Level-1); 160 (Level 2)

Table 3. Results of linear regression modeling analyses predicting global well-being and physical health outcomes.

	Global Satisfaction with Life			Global Depressive Symptoms			Global Physical Health Symptoms		
	Coefficient	SE	p	Coefficient	SE	p	Coefficient	SE	p
Main effects									
Age	.05	0.07	.44	0.07	0.05	.18	-0.03	0.02	.31
Sex	-1.16	1.04	.27	0.41	0.84	.62	0.28	0.38	.46
Education	-0.13	0.20	.53	0.04	0.17	.83	0.0004	0.07	1.00
Control	0.56	0.28	.04	-0.67	0.23	.003	-0.23	0.10	.02
Calmness Intensity	1.47	0.56	.01	-1.36	0.45	.003	-0.26	0.20	.20
Excitement Intensity	-1.71	0.87	.05	1.05	0.70	.14	0.77	0.31	.02
Calmness Variability	-1.57	1.25	.21	1.45	1.01	.16	1.18	0.45	.01
Excitement Variability	1.23	1.19	.28	0.86	0.96	.37	0.17	0.43	.69
Interactions									
Control x Calmness Intensity	-0.28	0.46	.54	0.06	0.37	.87	0.04	0.17	.79
Control x Excitement Intensity	-0.16	0.64	.81	-1.03	0.51	.04	-0.20	0.23	.38
Control x Calmness Variability	0.27	0.44	.54	-0.72	0.35	.04	-0.17	0.16	.29
Control x Excitement Variability	0.27	0.55	.63	-1.09	0.43	.01	-0.18	0.20	.36

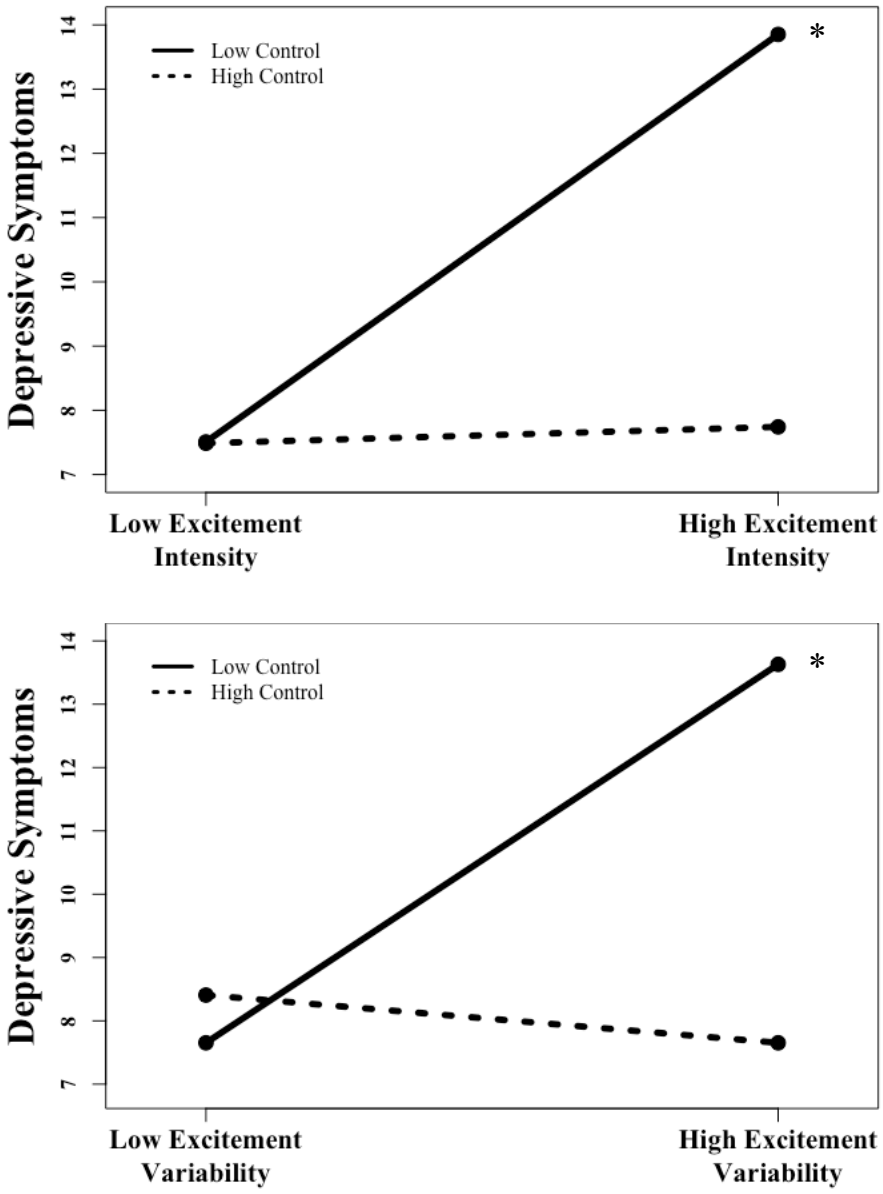
Note. Dfs = 8 (regression); 160 (residual).

Figure 1. Interaction between calmness variability and perceived control predicting daily stress (top), daily physical health symptoms (middle), and global depressive symptoms (bottom).



Note. * $p < .05$; ** $p < .001$. Low and high values correspond to lower and upper quartiles.

Figure 2. Interactions between excitement intensity and perceived control predicting global depressive symptoms (top panel) and between excitement variability and perceived control predicting global depressive symptoms (bottom panel).



Note. * $p < .05$. Low and high values correspond to lower and upper quartiles.

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