Examining the Effects of Sadness and Anger Intensity and Variability on Stress and Health Symptoms in Old Age: The Role of Perceived Control

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ABSTRACT

Examining the Effects of Sadness and Anger Intensity and Variability on Stress and Health Symptoms in Old Age: The Role of Perceived Control

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This study examined whether the effects of sadness and anger intensity and variability on stress and health measures were moderated by between- and within-person differences of perceived control. It was expected that elevated and stable sadness would be associated with less stress and fewer health symptoms compared to anger. These associations were hypothesized to be more pronounced for older adults with generally low perceptions of control and who perceive lower-than-normal levels of control relative to older adults who generally perceive high or higher-than-normal levels of control, respectively. Community-dwelling older adults (n=178; 64-98 years) completed a seven-day daily diary study. Each day, participants reported their most significant stressor, stressor-specific levels of sadness and anger, perceived levels of control, daily stress and health symptoms. Hierarchical linear modeling demonstrated main effects, linking sadness and, more strongly, anger intensity with elevated stress and health symptoms. The negative consequences of sadness intensity were dampened for participants with generally low, but not high, levels of control, but were amplified when adults faced less, compared to more, controllable stressors. The analyses further demonstrated a main effect of sadness variability, indicating that low, but not high, sadness variability predicted less stress. An interaction effect showed that anger variability predicted fewer health symptoms for adults with high control and high anger variability, exclusively. The results support the idea that discrete emotion intensity and variability have unique consequences on well-being and health, which are uniquely moderated by between- and within-person differences of perceived control.

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Contribution of Authors

Parisa Sepehri performed the literature review, conducted the statistical analyses, and wrote drafts of the manuscript. Dr. Carsten Wrosch designed the study and assisted with the revision of the manuscript drafts. All authors contributed to and have approved the final manuscript.

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Examining the Effects of Sadness and Anger Intensity and Variability on Stress and Health Symptoms in Old Age: The Role of Perceived Control

Introduction

Functional theories of emotion postulate that emotions evolved to alert us of relevant changes in our environment and motivate adaptive behaviours (Ekman, 1999; Lazarus, 1991). The discrete emotion theory of affective aging (DEA) considers that distinct negative emotions, such as sadness and anger, may enable humans to behave adaptively across the lifespan (Kunzmann, Kappes, & Wrosch, 2014; Kunzmann & Wrosch, 2018). From this perspective, sadness can facilitate disengagement from uncontrollable stressors and the rearrangement of resources to manage loss (Lazarus, 1991; Nesse, 2000). By contrast, anger is thought to mobilize resources to motivate persistence in overcoming manageable obstacles (Lazarus, 1991). Importantly, older adults typically experience a host of severe developmental constraints and irreversible losses (Heckhausen, Wrosch, & Schulz, 2010). As such, sadness and anger are proposed to have divergent consequences in old age. Whereas sadness should become increasingly adaptive for well-being and health-related behavioural functioning (e.g., physical activity), the consequences of anger should become less effective (Barlow, Wrosch, Gouin & Kunzmann, 2019; Kunzmann et al., 2014).

The majority of emotion research has investigated emotion intensity, but there is an evident gap in understanding the role and adaptive value of emotion variability. To address this paucity of work, we consider variability as a novel and essential element of emotional health that captures the dyamic nature of emotion. Akin to the proposed relationship between emotion intensity and perceived control, the adaptive value of emotion variability may similarly differ

across emotions such that stable and consistent measures of sadness, as compared to anger, could be more adaptive in older adulthood.

Although older adulthood is frequently associated with increased levels of developmental constraints and losses, the nature of the aging process is heterogeneous (Baltes, 1987). To this end, perceived control has been shown to be a key factor in successful aging (Bandura, 1997; Heckhausen & Schulz, 1995) and may provide context of the aging process. Specifically, low perceptions of control may be an indicator of the severe amount of constraints an older person confronts, whereas high perceptions of control may indicate mild obstacles and developmental limitations. As such, perceived control may be an important construct that influences the effects of emotion intensity and variability in older adulthood.

The Discrete Emotions Theory of Affective Aging

According to functional theories of emotion, negative emotions differ in their associated physiological activity, cognitive appraisals, and motivated actions (Levenson, 1992). In addition, they play unique roles for signalling to individuals imbalances between them and their environment. Consequently, different negative emotions serve unique and adaptive functions by helping individuals navigate and cope effectively with their ever-changing environment (Ekman & Davidson, 1994; Frijda, 1986; Lazarus, 1991). The discrete emotion theory of affective aging (DEA) extends functional theories of emotion by integrating life span developmental theory, which emphasizes a conceptual framework for the changing adaptiveness of emotions across the lifespan (Kunzmann et al., 2014; Kunzmann & Wrosch, 2018). DEA assumes that the adaptive experience of distinct emotions is dependent on their ability to facility effective management of and responses to age-specific developmental opportunities and constraints within themselves or their environment. As such, sadness and anger are proposed to uniquely shift across the lifespan.

Sadness is elicited in response to intractable stressors and irreversible losses and can promote disengagement and the reprioritization of resources in response to irreversible losses (Heckenhause, Wrosch & Schulz, 2019; Kunzmann et al., 2014). Anger, by contrast, is triggered by obstacles to goal pursuit and is described as an approach-oriented emotion. Anger motivates persistence to overcome barriers and reverse surmountable losses or injustice (Carver & Harmon-Jones, 2009; Lazarus, 1991). In young adulthood, a period characterized by an abundance of opportunities and very few constraints, the experience of anger would align well with people's resources and environmental demands. In older adulthood, when personal resources and opportunities become increasingly limited or lost, the motivations and behaviours that accompany anger would be less adaptive and should become less salient (Kunzmann et al., 2014). By contrast, other discrete emotions, such as sadness, are likely to be more adaptive and salient as people advance in age. Sadness is an emotion that may have evolved to signal the need of social support to others (Andrews & Thomson, 2009) and may facilitate the abandonment of goals that may be futile (Nesse, 2000). Given the frequent occurrence of unavoidable stressors associated with aging, DEA posits that sadness should become more salient and adaptive in old age by promoting adaptive psychological and behavioural responses.

Research based on DEA has shown support for these predictions (Kunzmann & Grühn, 2005; Kunzmann & Richter, 2009; Kunzmann, Rohr, Wieck, Kappes & Wrosch, 2017; Wrosch, Barlow & Kunzmann, 2018). Including experimental and field studies that investigated age differences in the frequency and intensity of sadness and anger (Kunzmann & Thomas, 2014; Kunzmann, Richter & Schmukle, 2013), findings consistently show older adults experience less anger compared to young adults and similar or greater levels of sadness (for a review, see Kunzmann & Wrosch, 2017). There is also evidence that such age-related differences in the

experience of sadness and anger can exert effects on important outcomes. To investigate the differential adaptive values and consequences of sadness and anger in older adulthood, for example, Barlow and colleagues (2019) examined the distinct effects of older adults' daily experiences of sadness and anger on the development of physical disease. They showed that anger was related to elevated biomarkers of inflammation and chronic illness in advanced old age. In contrast, sadness was associated with decreased levels of inflammation and chronic illness in both early and advanced old age. In another study, Barlow and colleagues (2021) found that when older adults, with high stress experiences (as indicated by their cortisol levels), perceived greater than usual sadness, they also increased their capacity to adjust to unattainable goals. Moreover, this link between sadness and goal disengagement capacity protected older adults' emotional well-being in the context of stressful life circumstances (Barlow, Wrosch, Hamm, Sacher, Miller & Kunzmann, 2021).

Emotion Variability

Theoretical approaches to emotion research have primarily examined the effects of emotions in terms of intensity, which presents a static snapshot of an emotional experience. Traditionally, with this perspective, emotions have either been studied as a singular, binary state in response to an event or as an individual's consistent dispositional tendency of experiencing emotions (Houben, Van Den Noortgate & Kuppens, 2015). This research has undoubtedly produced important insights, but it fails to explore a fundamental feature of emotions – their dynamic nature. Including measures of the dynamic properties of emotions provides a complementary and nuanced perspective to emotional functioning (Jenkins, Hunter, Cross, Acevedo & Pressman, 2018).

One measure that captures emotion dynamics is the variability experienced in an emotion over time. Emotion variability refers to the range or amplitude of an individual's emotional state across time. Higher variability reflects larger deviations from the individual's average intensity. For example, consider two individuals, each with moderate levels of average affect over the course of a week (see Figure 1). One person may be relatively stable in their affect levels (i.e., low variability), whereas the other may be more labile (i.e., high variability). Without incorporating affect variability in the emotion profile, these two individuals would otherwise appear similar, despite their notable difference in emotion experiences.

Research on variability in psychological experiences is a burgeoning area of work. Individual differences for within-person personality and emotion variability are thought to have broad implications for a person's life (Baird, Le & Lucas, 2006), although theorists differ in their assumptions about the nature of effects. In fact, various theorists have made contradictory predictions about the nature and consequences of variability. On the one hand, variability may in part be due to the variation of one's environment and situations encountered. Here, high levels of emotional persistence (i.e., low variability of negative or positive affect) have been shown as indicative of psychological maladjustment. Such blunted or flat responses may show an insensitivity towards environmental cues (Kuppens, Allen & Sheeber, 2010; Lawton, Parmelee, Katz & Nesselroade, 1996). Said differently, greater within-person variance may reflect functional flexibility, which allows the individual to respond and act in the most successful way given the situational circumstances (Fleeson, 2001; Paulhus & Martin, 1988). If so, variability may be adaptive.

Alternatively, researchers and theorists suggest that emotion variability may be an indicator of incoherence and maladaptive emotion regulation ability (Hardy & Segerstrom, 2017;

Jenkins et al., 2018; Jones et al., 2020). A meta-analysis examined the relations between patterns of emotion variability over a short period of time with indicators of psychological well-being (e.g., self-esteem, satisfaction with life, psychopathology symptoms; Houben et al., 2015). Findings from this study broadly suggest that emotions that are less variable are indicative of greater psychological well-being. Moreover, such an association appears to be stronger for negative compared to positive emotions, for which the significance fluctuated between significant and non-significant.

It should be noted that most studies examined the variability of broad emotion dimensions (i.e., negative affect versus positive affect, as constructed by a host of different positive and negative emotions), which may or may not extend to various discrete emotions. From a discrete emotion perspective, emotion variability should be investigated for individual negative emotions, such as sadness or anger. In older adulthood, everyday life typically becomes less eventful (Brose, Scheibe & Schmiedek, 2013) and past experiences often have provided opportunities for individuals to master stressful encounters and regulate their emotions effectively (Scheibe & Carstensen, 2010). Older adults that more readily respond with sadness, rather than anger, may be better adjusted and prepared for the stressors accompanying old age (Katzorreck, Nestler, Wrosch & Kunzmann, 2021). Considering the evidence showing that more intense sadness, but not anger, is adaptive in older adulthood, it may also be adaptive for older adults to experience more consistent and stable sadness responses (i.e., low variability). Here, low sadness variability in older adulthood may reflect an emotional preparedness to respond with sadness to the inevitable losses associated with aging. By contrast, high sadness variability may indicate an older adult who is emotionally unequipped for the inevitable age-related obstacles and stressors, as evidenced by the inconsistent responses of sadness within the contexts of

stressors. By contrast, stable experiences of anger may reflect futile persistence in old age related to a maladaptive tendency to experience and respond with anger or maladaptive rumination (Wilkowski & Robinson, 2010). As such, older adults that respond with inconsistent anger (i.e., high variability) may show a more flexible emotional response style for which anger may be experienced and utilized only on occasions when stressors are able to be resolved, followed by a return to a sufficiently low level of anger.

The Role of Perceived Control

People vary in both their responses to stressors and their ability to successfully cope with them. These individual differences result in significant heterogeneity in individuals' aging experience across many domains, such as the subjective experiences of stress or health. For example, some individuals are frequently affected by high levels of stress, whereas others are resilient to such experiences; some individuals suffer from numerous and severe physical health symptoms, whereas others rarely experience any form of illness. A psychological construct that is likely related to individual differences in older adults' ability to overcome age-related stressors is perceived control. Perceived control, or the belief about the likelihood that one can bring about desired outcomes, has been long emphasized as a critical component to successful aging (Bandura, 1997; Heckhausen & Schulz, 1995).

The majority of research examined between-person differences of perceived control, which has established a positive association between perceived control with health and well-being, suggesting perceived control serves as a protective factor (Robinson & Lachman, 2017). Individuals with elevated levels of perceived control were found to have improved psychological and emotional well-being (Kunzmann, Little & Smith, 2002), and better health and longevity (Infurna, Ram & Gerstorf, 2013; Turiano, Chapman, Agrigoroaei, Infurna &Lachman, 2014).

Using a daily diary design, Neupert and colleagues (2007) explored the relations between beliefs of control and physical symptoms and emotional distress in response to everyday stressors. Their findings indicated that individuals with elevated control beliefs reported less emotional distress and fewer physical symptoms in response to work and social stressors. Lachman and Weaver (1998) showed between-person differences of control beliefs predicted improved well-being and health in individuals from lower socioeconomic strata.

Of importance, general levels of perceived control have been shown to decline with age, likely in response to the emergence of more frequent and intractable age-related obstacles (Drewelies, Wagner, Tesch-Römer, Heckhausen & Gerstorf, 2017; Lachman & Firth, 2004; Mirowsky & Ross, 2007). As such, perceived control is an important proxy of the observed variability that exists in the extent to which older adults are able to overcome stressful experiences or confront intractable losses. As a consequence, perceived control may modulate the salience and adaptive functions of sadness and anger intensity and variability. In support of this possibility, research has shown that sadness increases in older adults, particularly among those individuals who perceive low and declining levels of control (Wrosch et al., 2018).

Building on the latter findings, it seems plausible that the adaptive functions of sadness (e.g., adapting to intractable losses) should be particularly observed among older adults with low levels of perceived control. Here, low levels of control might indicate fewer available resources and greater limitations for the individual. As such, the experience of sadness may support the individual's adjustment process. By contrast, given anger's problem-focused function, a poorer sense of control over one's life and abilities may contribute to unsuccessful attempts at overcoming stressors despite the experience of anger, which in turn may yield negative consequences on health and well-being. Said differently, if older individuals have generally

elevated levels of control over their life, the behaviours motivated by anger may be more likely to be executed successfully and thus lead to better outcomes. Along a similar vein, older adults who generally have less control over their life would reap greater benefits from experiencing more consistent and stable levels of sadness, whereas more variable anger could serve adaptive purposes for older adults.

The match between emotion function and perceived control is important and highlights the nuanced experiences and effects of emotions. In essence, if an older adult's abilities and resources (as indicated by levels of perceived control) do not align with the emotion's function (e.g., anger's drive to persevere to overcome a stressor), the conflict and misalignment may produce negative consequences. These matches may be examined with regards to differences of between-person perceived control and within-person fluctuations of perceived control.

Although individuals perceive a typical, general level of control, their levels may fluctuate from day to day and in response to various stressors. Over both long- and short time frames (i.e., weekly and daily fluctuations), within-person differences of beliefs of control were found to significantly fluctuate within older adults (Eizenman, Nesselroade, Featherman & Rowe, 1997; Neupert & Allaire, 2012). Above and beyond average levels of perceived control, within-person declines have been shown to predict important outcomes, such as mortality (Eizenman et al., 1997). Whereas between-person differences provide information about the effects of an individual's general levels of control, within-person differences examine a critical part of coping with events that deviate from an individual's average level of control. In support of this assumption, a recent literature review highlights the importance of considering within-person variations of control in the context of stressors, as control can play an important role in the process of overcoming stressors (Robinson & Lachman, 2017).

The implications observed at the between-person level may reflect an aggregated representation of the processes occurring at the within-person level. In essence, older individuals may experience more stress and poorer outcomes when enduring a situation that is perceived as less controllable than their usual experiences. When facing a less controllable than usual experience, sadness may be more beneficial due to its disengaging motivation and ability to elicit support. Furthermore, older adults who exhibit more stable and consistent sadness may be better prepared and well-adapted to cope with intractable age-related stressors. By contrast, the negative outcomes predicted for anger and low levels of between-person control may extend to responding to uncontrollable situations with similar implications. Instead, when aligned with a more controllable situation, the motivation fueled by anger may yield successful resolution of the event. Furthermore, inconsistent and variable anger may represent an ability to respond with anger when it adaptively aligns with the context, whereas stable anger may reflect a blunted anger response resulting in a missed opportunity for resolution.

The Present Study

This study examined the experiences of sadness and anger in a daily diary study of community-dwelling older adults. The daily diary design allowed for the examination of emotions, stress and health symptoms of older adults as a direct response to daily stressors (i.e., when stressors are actually happening rather than through retrospective reports; Almeida & Kessler, 1998; Bolger, Davis & Rafaeli, 2003; Neupert, Almeida & Charles, 2007). Across seven consecutive days, participants reported a daily stressor, their sadness and anger levels in response to the stressor, and their perception of their control to resolve the stressor. This methodological approach enabled us to analyze distinct relations between (a) sadness and anger intensities, (b) sadness and anger variabilities with physical health symptoms and emotional well-being.

Furthermore, we examined the interaction effect of between- and within-person differences of perceived control with sadness and anger intensity and variability. First, we hypothesized that older adults who experience high levels of anger will report greater daily stress levels and more numerous health symptoms than older adults who reported greater sadness. Secondly, we predicted that older adults who experience less variable sadness, but not anger, will report lower stress levels and fewer health symptoms. Third, for older adults who generally perceive low control (between-person differences) and who perceive lower-than-normal levels of control (within-person differences), the distinct effects of sadness and anger intensity and variability were hypothesized to be more pronounced, compared to older adults who generally perceive high or higher-than-normal levels of control.

Methods

Participants and Procedures

Study participants were part of the Daily Experience of Older Adults (DEOA) study. The DEOA recruited 178 community-dwelling older adults through advertisements in local newspapers from the Montreal, Quebec, Canada area. These participants were initially part of the Montreal Aging and Health Study (MAHS). The only inclusion criterion was that participants had to be 60 years or older because we were interested in obtaining a normative sample of older adults. The MAHS and DEOA were approved by the University Research Ethics Committee. Before participation, written consent was obtained.

Because we were interested in examining the relation between well-being and emotion responses to daily stressors, we included all individuals who reported daily stressors and responded to the sadness and anger assessments for at least two of the seven days. One-hundred-sixty-nine participants met this criterion. These participants were on average 77 years old (*SD* =

7.38; range = 64-98), 108 participants were female, and 56% had obtained a university education.

Individuals interested in participating in the study were screened on the phone and mailed questionnaire packages. Participants were asked to complete a general questionnaire, which included sociodemographic variables and a number of commonly used psychological scales. In addition, participants completed a daily diary questionnaire that asked them to report their most significant daily stressor, emotional experiences in response to the stressor and perceptions of control for resolving the stressor. Participants were further asked to report their daily stress levels and the presence or absence of various physical health symptoms. Participants were compensated financially for their efforts ($50).

Measures

Daily stressor. Each day, participants were asked to report the most severe problem or stressor they encountered. Stressors included interpersonal conflicts, issues at work or school, or health struggles. Participants reported stressors on most days (M = 5.88, SD = 1.72; 0 stressors = 1.8%, 1 stressor = 3.6%, 2 stressors = 1.8%, 3 stressors = 4.1%, 4 stressors = 6.5%, 5 stressors = 10.1%, 6 stressors = 19.5%, 7 stressors = 58.0%).

Perceived control. We measured perceived control by administering two items each day. Participants were asked to rate on a five-point Likert scale the likelihood that their reported stressor could be and would be resolved (1 = *Very unlikely*, 5 = *Very likely*). Positive associations were obtained across the two item scores used to measure perceptions of control (rs = .82 to .91, ps = <.001, $M[r]$ = .86). Composite scores were calculated by taking the arithmetic mean and multiplying it by a factor of two (M_{D1} = 6.78, SD_{D1} = 2.73; M_{D2} = 6.71, SD_{D2} = 2.78; M_{D3} = 6.81, SD_{D3} = 2.89; M_{D4} = 6.76, SD_{D4} = 2.75; M_{D5} = 6.85, SD_{D5} = 2.71; M_{D6} = 6.97, SD_{D6} = 2.95; M_{D7} =

6.81, SD_{D7} = 2.85). Perceived control scores were moderately positively correlated across days (*r*s = .24 to .43, *p*s < .002, *M*[*r*] = .33). Additionally, we averaged the scores of perceived control across the seven days to obtain an indicator of between-person differences in the level of perceived control over the week (*M* = 6.84, *SD* = 1.84).

Sadness and anger. Participants were asked to report the extent to which they experienced specific emotions during or after the reported stressor. The experience of sadness and anger were measured with three items each (i.e., sadness via items *sad*, *depressed* and *dejected*; anger via *angry*, *irritated* and *furious*), using 5-point Likert-type scales (0 = *Very slightly* or not at all; 4 = *Extremely*). Positive associations were obtained across the three item scores used to measure sadness (*r*s = .45 to .77, *p*s < .001; *M*[*r*] = .60) and between item scores for anger (*r*s = .39 to .81, *p*s < .001; *M*[*r*] = .64). Composite scores were calculated by taking the arithmetic mean and multiplying it by a factor of three (Sadness: M_{D1} = 1.83, SD_{D1} = 2.45; M_{D2} = 1.92, SD_{D2} = 2.89; M_{D3} = 1.63, SD_{D3} = 2.30; M_{D4} = 1.78, SD_{D4} = 2.26; M_{D5} = 1.69, SD_{D5} = 2.52; M_{D6} = 1.89, SD_{D6} = 2.64; M_{D7} = 1.82, SD_{D7} = 2.48; anger: M_{D1} = 2.28, SD_{D1} = 2.53; M_{D2} = 2.26, SD_{D2} = 2.83; M_{D3} = 2.28, SD_{D3} = 3.13; M_{D4} = 2.19, SD_{D4} = 2.47; M_{D5} = 2.16, SD_{D5} = 2.87; M_{D6} = 2.14, SD_{D6} = 2.92; M_{D7} = 2.09, SD_{D7} = 2.82).

Daily Stress. Daily stress was measured using one item. Participants were asked to rate on an 11-point Likert scale (0 = *None at all*, 10 = *A lot*) how much stress they experienced during the entire day (M_{D1} = 4.33, SD_{D1} = 2.78; M_{D2} = 3.86, SD_{D2} = 2.63; M_{D3} = 3.94, SD_{D3} = 2.85; M_{D4} = 4.20, SD_{D4} = 2.96; M_{D5} = 4.02, SD_{D5} =2.83; M_{D6} = 3.99, SD_{D6} = 2.81; M_{D7} = 4.28, SD_{D7} = 2.72). Daily stress ratings were moderately correlated (*r*s = .30 to .56, *p*s < .001, M[*r*] = .46) across the seven days.

Physical Health Problems. 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. To obtain an indicator of physical health problems, we computed sum scores by multiplying the arithmetic mean by twelve (M_{D1} = 1.51, SD_{D1} = 1.53, 0 health symptoms = 27.2%, 1-2 health symptoms = 55.6%, 2-5 health symptoms = 36.2%, 5+ health symptoms = 4.2%; M_{D2} = 1.38, SD_{D2} = 1.55, 0 health symptoms = 36.1%, 1-2 health symptoms = 29%, 2-5 health symptoms = 30.8%, 5+ health symptoms = 4.2%; M_{D3} = 1.42, SD_{D3} = 1.57, 0 health symptoms = 32%, 1-2 health symptoms = 30.8%, 2-5 health symptoms = 30.3%, 5+ health symptoms = 4.8%; M_{D4} = 1.53, SD_{D4} = 1.63, 0 health symptoms = 30.8%, 1-2 health symptoms = 28.5%, 2-5 health symptoms = 31.5%, 5+ health symptoms = 6.6%; M_{D5} = 1.55, SD_{D5} = 1.74, 0 health symptoms = 29.6%, 1-2 health symptoms = 29%, 2-5 health symptoms = 30.2%, 5+ health symptoms = 6.6%; M_{D6} = 1.44, SD_{D6} = 1.57, 0 health symptoms = 32.5%, 1-2 health symptoms = 27.2%, 2-5 health symptoms = 29.7%, 5+ health symptoms = 6%; M_{D7} = 1.57, SD_{D7} = 1.72, 0 health symptoms = 32.5%, 1-2 health symptoms = 25.4%, 2-5 health symptoms = 29.1%, 5+ health symptoms = 8.3%). Across the seven days, health symptoms scores were positively correlated (rs = .59 to .78, ps < .001, $M[r]$ = .72)

Sociodemographic variables. Baseline measures of age, sex, and education were included into the analyses based on participants' self-reports. Education was measured by asking participants to report their highest level of education level (*No education* = 0, *Primary school 5* = 1.2%, *Primary school 6* = 2.4%, *Secondary school 7* = 3.6%, *Secondary school 8* = .6%, *Secondary*

school 9 = 1.8%, *Secondary school 10* = 1.8%, *Secondary school 11* = 7.1%, *Secondary school 12* = 8.3%, *College diploma* = 16%, *Bachelor's* = 26.6%, *Master's* = 21.9%, *Doctorate* = 7.7%, *Other* = .6%, *Missing* = .6%).

Data Analysis

Preliminary analyses were conducted to describe the sample (means, standard deviations and frequencies) and to obtain general associations between variables within the sample. Then, the main hypotheses were examined by conducting separate sets of hierarchical linear models (HLM 8.0). Across the different HLM analyses, Level-2 predictor variables were standardized prior to analyses.

First, we examined changes in daily stress and reported health symptoms by conducting separate sets of analyses using hierarchical linear modeling analyses. In the Level-2 models, we estimated variability of the outcome variables by an intercept, average emotion intensity, emotion variability, perceived control, sociodemographic variables, and a residual term. In these models, the intercept represents the average levels of daily stress and reported physical health symptoms across the sample. To further examine the occurrence of interaction effects, the interaction terms between between-person differences in perceived control and sadness (or anger) were added to the Level-2 model. Significant interactions were plotted for the upper and lower quartiles of the moderator variables and follow up simple-slope analyses were conducted.

Second, for each model, we added person-centered scores of perceived control at the Level-1. The control slopes represent the effects of person-centered variations in control on variations of daily stress and reported physical health symptoms. Significant cross-level interactions were followed up by plotting the patterns and conducting simple slope analyses.

Separate analyses were conducted for sadness and anger. We opted to examine separate

models for sadness and anger because this is the first study examining differential effects of discrete emotion variability in the elderly population. Due to the paucity of research, the analyses sought to examine each emotion separately to explore the novel relations. Note, however, that different negative emotions, such as sadness and anger, are likely correlated. As a consequence, we also report in the results section how the obtained effects of sadness and anger intensity and variability change if the analysis incorporates both emotions.

Results

Preliminary Analyses

The results of the bivariate correlational analyses of the main variables are reported in Table 1. The analyses showed that sadness and anger intensities were highly and positively correlated with each other and their respective variability levels. Additionally, the variability scores of sadness and anger were highly and positively correlated with one another. Average stress levels were moderately correlated with both sadness and anger intensity and variability scores, as well as with average number of health symptoms reported. Anger intensity scores were also moderately correlated with health symptoms. Table 2 presents the means and standard deviations of the descriptive and study variables. Using a paired-samples t-test, anger intensity and variability were both found to be greater than sadness intensity and variability levels, respectively (Intensity: $t(167) = 3.43$, 95% CI 3.427 [0.175, 0.651], $p=.001$; Variability: $t(167) = 4.53$, 95% CI 4.529 [0.191, 0.487], $p<.001$).

Between-Person Differences of Emotion Intensity, Variability and Perceived Control

The study's main hypotheses were tested using hierarchical linear modelling. The first set of analyses sought to examine the effects of between-person differences of emotion intensity, variability and perceived control on stress levels and health symptoms (Tables 3 and 4). The

results of all the Level-2 models indicated that the average levels of daily stress and health symptoms were significantly different from zero (see significant intercept coefficients). The first model examined average sadness intensity, sadness variability and perceived control. The results indicated that older adults with more intense (Figure 2, top) and more variable sadness (Figure 3) responses experienced greater daily stress than older adults with less intense and more stable sadness responses, respectively. Furthermore, the effects of sadness intensity extended to physical health such that older adults who reported greater sadness also reported more health symptoms than older adults who reported less intense sadness (Figure 2, bottom). The results did not show a main effect of control.

To explore the potential moderating effects of between-person differences of control, we included the interactions between Level-2 control and sadness intensity and variability in two separate, additional models. The results showed that perceived control significantly moderated the effects of sadness intensity in predicting daily stress. The observed pattern suggests that higher levels of sadness were associated with more daily stress, particularly among older adults with high levels of control, but to a lesser extent among their counterparts who perceived lower levels of control (Figure 4, top). Follow up analyses of the simple slopes support this interpretation by indicating that greater sadness intensity was more strongly associated with more daily stress among older adults who perceived high levels of control (*slope coefficient* = 1.24, *SE* = 0.29, $t = 4.30$, $p \leq .001$, 95% CI [0.67, 1.82]) compared to older adults who perceived low levels of control (*slope coefficient* = 0.61, *SE* = 0.15, $t = 3.99$, $p = <.001$, 95% CI [0.31, 0.92]).

Regarding physical health symptoms, the analyses revealed a trend effect, indicating that perceived control marginally moderated the effects of sadness intensity in predicting health symptoms (Figure 4, bottom). Similar to the found moderations effect of control on stress levels,

sadness intensity was more strongly associated with increased levels of health symptoms for older adults with high, but not low, levels of control (high perceived control: *slope coefficient* = 0.90, *SE* = 0.31, *t* = 2.90, *p* = 0.004, 95% CI [0.29, 1.52]; low perceived control: *slope coefficient* = 0.38, *SE* = 0.22, *t* = 1.72, *p* = 0.09, 95% CI [-0.06, 0.82]). The results did not show an interaction effect between control and sadness variability in predicting stress levels or health symptoms.

Identical models were conducted by replacing sadness with anger. These models examined variability in daily stress and health problems as a function of average anger intensity levels, anger variability and perceived control. The findings showed that older adults with more intense anger responses experienced greater daily stress and more numerous health symptoms than older adults who reported lower levels of anger (Figure 2). However, there were no significant main effects of anger variability, nor control. Furthermore, the subsequent interaction models did not show a significant interaction between perceived control and anger intensity. Still, they showed that older adults with high perceived control and high anger variability experienced significantly fewer health symptoms than the remaining participants, all of whom experienced similar levels of health symptoms (Figure 5). Anger variability was significantly associated with fewer health symptoms for older adults with high perceived control across the week (*slope coefficient* = -0.49, *SE* = 0.21, *t* = -2.31, *p* = .02, 95% CI [-0.91, -0.07]), but not among their counterparts who have relatively lower levels of control (*slope coefficient* = 0.008, *SE* = 0.22, *t* = 0.04, *p* = 0.97, 95% CI [-0.42, 0.44])[1].

Between-Person Differences of Emotion Intensity, Variability and Within-Person Differences of Perceived Control

The next set of analyses explored potential moderating effects of within-person differences of perceived control of daily stressors. Results from the subsequent multi-level models are reported in Tables 5 and 6. Similar to the previous models, the findings showed that levels of daily stress and health symptoms were significantly different from zero (see significant intercept coefficients). The analyses further showed that the within-person variation of perceived control was not significantly associated with daily stress or physical health symptoms.

For the sadness models, perceived control over the stressor significantly and marginally moderated the effects of sadness intensity on reported daily stress and physical health symptoms, respectively (Table 5). With respect to daily stress, the effects of sadness intensity were less pronounced for older adults on days that they faced stressors that were perceived to be more controllable than normal (*slope coefficient* = 0.46, *SE* = 0.25, *t* = 1.79, *p* = .07, 95% CI [-0.05, 0.96]). By contrast, on days when confronted with less controllable than usual stressors, the effects of sadness intensity were greater (*slope coefficient* = 1.10, *SE* = 0.24, *t* = 4.53, *p* < .001, 95% CI [0.62, 1.58]; Figure 6, top). A similar pattern of findings was found for predicting physical health symptoms (Figure 6, bottom). Health symptoms were associated with greater sadness intensity on days that older adults faced stressors they were perceived as being less, rather than more, controllable than usual (less controllable stressors: *slope coefficient* = 0.65, *SE* = 0.25, *t* = 2.60, *p* = .01, 95% CI [0.16, 1.15]; more controllable stressors: *slope coefficient* = 0.42, *SE* = 0.26, *t* = 1.61, *p* = .11, 95% CI [-0.10, 0.94]). There were no cross-level interactions between stressor controllability and anger intensity or anger variability[2].

Discussion

The primary purpose of this study was to examine the effects of sadness and anger intensity and variability on indicators of subjective well-being and physical health in a

heterogenous sample of community-dwelling older adults. Results from the daily diary study showed that the intensity and variability of sadness and anger responses to daily stressors differed and were uniquely associated with stress and health outcomes. In addition, this study sought to examine the moderating effects of older adults' control perceptions. Results indicated that both between- and within-person differences of control interacted with emotion intensity and variability in predicting older adults' well-being and health. The present study advances theory and research by suggesting that a discrete emotion approach to understanding the roles of intensity and variability of different emotions in older adulthood may be useful and can contribute to better understanding how older adults may effectively respond to the changing controllability of life circumstances.

Sadness and Anger Intensity and Variability

The discrete emotion theory of affective aging (DEA) hypothesizes that the salience of sadness and anger differ in older adulthood. Research based on DEA has found that the salience of anger decreases across the lifespan, whereas sadness remains stable or increases such that in older adulthood, sadness is experienced more frequently and intensely than anger (Kunzmann & Wrosch, 2017). Indeed, sadness was found to be significantly positively correlated with age in the present study, but in contrast with existing discrete emotion studies, anger responses were found to be more intense than sadness responses. The latter finding may be related to the nature of this study and the types of situations reported. Specifically, our participants were asked to report their emotions in direct response to daily stressors, which differs from existing studies of discrete emotions. Typically, studies have examined discrete emotions in response to ambiguous stimuli or general experiences, which include both stressors and losses (e.g., Kunzmann & Thomas, 2014, Wrosch et al., 2018). Considering that sadness is typically elicited by irreversible

loss and anger by goal blockages, it may be that more numerous obstacles and blockages were reported in the current study. This may be because stressors are more commonly characterized by challenges and impediments to day-to-day living rather than loss, traumatic life events or bereavement (Piazza, Charles, Sliwinski, Mogle & Almeida, 2013). Alternatively, perhaps obstacles and anger are more cognitively salient such that participants recalled those experiences more frequently and intensely compared to sadness when they were filling out the questionnaires. According to DEA theory, the nature of an event influences the intensity and type of emotion that is triggered. The present study focused on the intensity of discrete emotions, specifically in response to concrete daily stressors. In the grand scheme of aging, older adults may experience greater sadness compared to anger (for a review, see Kunzmann & Wrosch, 2017), but within the specific context of stressors, the existing claims may not be true within various specific domains of life.

Another inconsistency is that our findings did not replicate prominent divergent effects between sadness and anger on health and well-being outcomes (Barlow et al., 2019; Kunzmann & Wrosch, 2018; Suls, 2018), which may be related to the time frame for which consequences were examined. Specifically, the present study examined short-term associations of sadness and anger experiences with corresponding measures of well-being and health (i.e., within one week), whereas divergent effects have typically been found when examined within long-term contexts (e.g., years; Barlow et al., 2019; Barlow et al, 2021; Wrosch et al., 2018). These long-term opposite effects may in part be caused by direct or indirect disturbances of health-relevant behaviors and physiological processes which are not yet observable within a one-week timeframe.

DEA proposes that anger is associated with approach-oriented behaviours, whereas sadness is with internal adjustment behaviours. Although both emotions are designed to be adaptive, anger in older adulthood may involve an overestimation of personal control and result in futile persistence and repetitive failures (Wrosch, Scheier & Miller, 2013). Over time, such repetitive failures may result in reductions of older adults' self-esteem, which has been shown to contribute to elevated stress responses in older adulthood (Liu, Wrosch, Miller & Pruessner, 2014). Indeed, on a physiological level, anger responses to stressors are associated with increased testosterone and cardiovascular activity, which may contribute to high blood pressure and cardiovascular disease (Suls, 2013; Tops et al., 2017; Yildirim & Derksen, 2012). Furthermore, anger responses may create additional stressors (e.g., damage to interpersonal relationships) and perpetuate more anger, thus yielding more pronounced negative outcomes, compounded and observable over time.

Sadness, by contrast, may be less damaging to stress and health in the long-term because older adults often encounter more numerous experiences that benefit from the concomitants of sadness (e.g., seeking support, disengaging from the stressor, moving on to another goal) to adjust in an adaptive manner (Kunzmann & Wrosch, 2018). Furthermore, sadness has not been found to be associated with negative physiological outcomes and maladaptive behaviours to the same degree as anger (e.g., Barlow et al., 2019). As such, when examining long term outcomes, the divergent consequences of sadness and anger are likely due to accumulated and amplified consequences of the emotions, which are not yet observable on shorter time scales.

We note, however, that while both sadness and anger intensity were associated with increased stress and more numerous health symptoms, sadness was less detrimental than anger. The present findings suggest that the beneficial processes motivated by sadness in response to

loss may also be adaptive for older adults responding to daily stressors, despite anger having been found to be more intense than sadness. Specifically, the signal for support associated with feelings of sadness (Andrews & Thomson, 2009) may aid in overcoming a stressor that older adults may otherwise be unable to resolve independently. Additionally, adjusting to, rather than persisting through, unresolvable stressors (Nesse, 2000) may be a particularly beneficial concomitant of sadness that extends to daily stressors, as well as loss. Here, stressors in older adulthood are typically less resolvable compared to stressors experienced in younger adulthood due to a variety of factors (Kunzmann et al., 2014). As such, when sadness is elicited, either concurrently with anger or in isolation, the behaviours and processes associated with sadness may promote less detrimental outcomes compared to anger.

Of novel contribution, this study showed distinct findings for emotion variability above and beyond the effects of emotion intensity for both sadness and anger. Existing research on emotion variability frequently combined sadness and anger, as well as other emotions, to form broad constructs of negative affect (Brose et al., 2013; Carstensen, Pasupathi, Mayr & Nesselroade, 2000; Röcke, Li & Smith, 2009). The current literature on such broad emotion variability is riddled with conflicting results, thus necessitating clarity. The present study began to address the heterogeneity by taking a discrete emotions approach to discover distinctions that had not yet been identified.

Paralleling the predictions for emotion intensity based on DEA, which postulate that sadness is more salient and adaptive than anger in older adulthood, it was expected that sadness may also be more stable (i.e., less variable) than anger in older adulthood. Indeed, the present study found that older adults' sadness responses were more stable than anger responses. Said differently, anger was found to be less consistent than sadness. Furthermore, we postulated that

stable sadness would be more adaptive than inconsistent sadness, whereas the opposite prediction was made for anger variability. Again, the reported findings support discrete emotion predictions, indicating that low sadness variability was associated with reduced stress levels relative to high sadness variability. To this end, low sadness variability in older adulthood may reflect stable sadness, which may indicate an emotional preparedness to face some of the inevitable stressors and losses associated with aging. Furthermore, given that sadness has been shown to be more frequent in older adulthood (Kunzmann & Wrosch, 2017), experiencing consistent, rather than drastically fluctuating and intermittent, sadness in response to stressors may reflect elevated emotion regulation abilities (Birditt, Fingerman & Almeida, 2005). Here, stress may be ameliorated because older adults can reap the benefits of the behaviours associated with sadness (e.g., receiving support, letting go unresolvable stressors) without experiencing the mental and physiological exhaustion associated with intense emotion experiences. Importantly, the effects of anger variability were unique from sadness variability and did not show significant associations in the present analyses. Together, these findings shed light on the distinct patterns of sadness and anger variabilities in older adulthood, above and beyond sadness and anger intensity. Such distinctions may partially explain the mixed findings presently in the literature, thus warranting further research on emotion variability from a discrete emotion approach.

An important consideration is that while emotions are unique and function distinctly from one another, they are not mutually exclusive. For example, a stressor may trigger both feelings of sadness and anger, which warrants questions about how these emotions affect health and well-being if and when they are experienced simultaneously. Indeed, sadness and anger were correlated with one another in the current study. When both emotions were included in the same model, there was an overall weakening of the effects compared to those found when the

emotions were analyzed in separate models. However, the current analyses also showed that even when sadness and anger are considered together, they maintain some of their distinct effects. This pattern of reductions, as well as the maintenance of several significant effects, provides further support for a discrete emotions approach.

Effects of Perceived Control

The reported study points to the important role of perceived control. Perceived control is an important reflection of the observed heterogeneity across older adults' capacity to overcome stressful experiences. As such, the adaptive values of sadness and anger intensity and variability may vary as a function of perceptions of control. The analyses showed that the negative effects of intense sadness were dampened for individuals with generally low, but not high, levels of perceived control (between-person differences). Here, high control may reflect older adults with mild or no developmental constraints or loss (Kunzmann et al., 2014) who more closely resemble adults in early-old age for whom, according to DEA, sadness would not be an optimal alignment between capability and emotion (Kunzmann & Wrosch, 2018). By contrast, low control may in part reflect those older adults who have more limited resources or severe constraints (Drewelies et al., 2017). Thus, these individuals may face stressors akin to those experienced by individuals in advance old age, thus requiring greater adjustments and support from others, which are both behaviours elicited and associated with sadness.

Contrary to our predictions and to the findings associated with between-person control, an opposite pattern was found for within-person fluctuations of control. The analyses showed that the negative effects of sadness on stress and health symptoms were amplified for stressors that were less controllable and less detrimental for more controllable stressors. Here, an important consideration is that within-person differences can occur for older adults with both

high and low general levels of control. Thus, the expected effects of sadness may not have emerged because these two groups were not distinguished in the analyses conducted for within-person variability of perceived control. It is possible that the process of acknowledging that a stressor is less controllable than usual is difficult to experience, itself. When we examined individuals that experience intense sadness, the combination of processes including accepting their reduced control, experiencing intense sadness and adjusting to the stressor may be particularly stressful, resulting in significantly more negative outcomes. Indeed, there is support indicating that lower than usual control perceptions are associated with poorer functioning; the observed pattern being especially true for older adults with generally low levels of control (Neupert & Allaire, 2012), which also may be a factor driving the outlined findings. For these individuals, experiencing intense sadness and facing a stressor that is less controllable than they are accustomed to may be especially detrimental, whereas it may be easier to adjust to a less controllable than usual obstacle for individuals with generally high levels of control. This may be because these adults have other areas of their life for which they can exert high control, so the singular daily stressor does not significantly impact their overall well-being or health. Alternatively, for adults with generally high levels of control, a less controllable stressor may still be resolvable for them. Thus, despite feeling more intense sadness, they can utilize the emotions' motivation to adjust more effectively than individuals with generally low levels of control.

Although the reported analyses did not find a main effect of anger variability, perceived control did interact with anger variability. The results indicated that anger variability was associated with significantly fewer health symptoms, exclusively for older adults with high, but not low, control (between-persons). Older adults with high levels of perceived control and high

anger variability reported significantly fewer health symptoms than the rest of the sample. It might be that anger is a common emotion triggered by stressors, such as those reported in the present study. As such, anger is likely to be experienced and, on occasions, may still be beneficial in older adulthood. For example, for individuals with greater control, which may reflect their maintained resources or speak to the types of stressors they encounter, the occasional motivational concomitants of anger (e.g., persistence) may actually promote effective resolutions (Carver & Harmon-Jones, 2009; Lazarus, 1991). Importantly, high anger variability, which reflects an emotion profile consisting of oscillations from low to intense anger experiences, may indicate emotional flexibility and the ability to return back to low anger baselines. Older adults with low control and high anger variability may represent people that have emotional flexibility but lack resources and opportunities to apply anger's motivation, thus still leading to failures. By contrast, low anger variability may correspond to blunted or persistent anger responses, both of which may be maladaptive. Blunted anger responses may result in the stressor remaining unresolved, which could directly impact older adults' health. For example, frequent and severe health symptoms are typical and often inevitable in older adulthood. As such, it is plausible that some daily stressors are health-related (e.g., a sore back). Therefore, when unresolved, these daily health-related stressors may further deteriorate (e.g., more severe back pain) or impact other facets of health (e.g., immobility spreading to other body parts), resulting in more severe and additional health problems. Alternatively, low anger variability could reflect persistent anger and prolonged experiences of stress, dysregulation and physical inflammatory responses (Cohen et al., 2007), which can indirectly contribute to poorer health regardless of the older adults' perceptions of control or resolution of the stressor.

Contributions

The present study incorporates several important strengths and contributes to both research and clinical practice. First, in terms of study design and conceptualization, the daily diary design captures nuanced human experiences in a way that traditional designs cannot by offering opportunities to address questions regarding an individual's typical or average experience, as well as how they differ from these averages (Bolger et al., 2003). Additionally, research examining intensity and variability of distinct negative emotions has just begun and much of the existing research lacks a theoretical foundation. To the best of our knowledge, this study is unique in providing a theory-based investigation.

Second, the reported findings contribute to the emotion literature by expanding on the existing associations found between sadness and anger reactivity with well-being and health. Apart from laboratory studies or single measures of emotions, the majority of emotion research examines patterns and consequences of sadness and anger on grand scales (i.e., years; Barlow et al., 2019; Barlow et al, 2021; Wrosch et al., 2018) and in reference to general experiences (e.g., "Indicate to what extent you experience the following emotions during the past year"). The current study provides evidence for the relatively adaptive function of sadness, compared to anger, on a shorter timeframe of one week and in direct response to specific daily stressors. The results draw attention to the importance of considering context (e.g., stressor-specific emotions versus general experiences) when examining emotion function and adaptivity. Although DEA outlines contexts specific to distinct emotions, researchers should actively consider and examine the role that context and trigger type play in the experience of emotions and the consequences associated with these emotions. The current study highlighted that within the domain of stressors in older adulthood, anger may be more salient than sadness, which contrasts theorized predictions. Importantly, whereas anger responses were more intense in the current sample,

sadness was less detrimental for predicting both stress and health outcomes. Here, the adaptive value of sadness, typically associated with loss, appears to extend to daily stressors, as well. Furthermore, our results highlighted that the distinct pattern of and consequences of sadness and anger are appreciable even within short periods of time, for which there is a paucity of research.

A third valuable contribution of the present research is the novel identification of distinct patterns and consequences of sadness and anger variability. Some researchers suggest high emotion variability is adaptive and reflects flexibility (Fleeson, 2001; Paulhus & Martin, 1988), whereas low variability corresponds to maladaptive unresponsiveness to situational cues (Kuppens, et al., 2010; Lawton et al., 1996). In direct contradiction, other researchers argue for the opposite. Here, researchers argue that high variability relates to poor emotion regulation and worse outcomes than low variability (Jenkins et al., 2018). The existing research considered sadness and anger as a single negative affect construct, which fails to address the discrete and, previously found, divergent effects of sadness and anger intensity (e.g., Barlow et al., 2019; Kunzmann & Wrosch, 2018; Suls, J. 2018). The present research found sadness variability was more stable than anger variability in older adulthood and that stable sadness predicted lower levels of stress compared to inconsistent sadness, above and beyond emotion intensity. The latter relationship highlights the unique dynamic nature of the emotion experience that warrants significantly more attention in future research. Additionally, when taken together, the present study offers clarity to the current theoretical conflicts. Specifically, the results suggest that the traditional approach to examining negative affect in broad constructs lacks nuance and may be producing conflicting results driven by heterogeneity across constructs. Although research examining this possibility remains inconclusive, our findings highlight the importance of

investigating emotion variability for separate emotions as distinct factors of well-being, in addition to emotion intensity.

Fourth, the reported results informs control and stress appraisal theories by documenting within-person differences of control above and beyond between-person differences. Although possible, it is not necessarily always the case that between-person effects merely mimic within-person differences (Eizenman et al., 1997). The current findings highlight the distinct relationships that occur at the two levels of analyses and the subtleties that have failed to be documented in existing emotion research. Here, contradicting DEA predictions and the pattern found at the between-person level, more intense sadness did not buffer against stress when facing a less controllable than usual stressor. Importantly, the observed findings may reflect a compounding stress effect from experiencing negative emotions (i.e., sadness) and perceiving, as well as accepting, the less controllable stressor. Processes and complex relations such as those reported in the current study are lost when control perceptions and emotion experiences are examined exclusively at the between-person level.

Finally, the study's findings draw attention to the need for psychological interventions in older adulthood. Consistent with existing work that identified elevated anger as a vulnerability to health and well-being deficits in older adulthood (e.g., Barlow et al., 2019), persistent anger is a complementary, and perhaps more important, identifier of vulnerability. Considering that some individuals cannot avoid or change their emotion reactions, it may be more important to be cognisant of and treat the stability and persistence of anger. Furthermore, sadness intensity and stability were found to have an ameliorating effect compared to anger. In this regard, the findings lend support for the need of appraisal re-framing strategies that older adults can use in their daily lives. Such skills may enable older adults to adjust their perception of a stressor, thus shifting the

emotion being experienced (e.g., sadness rather than anger), as well as the associated behaviours (e.g., adjustment rather than persistence), hereby promoting emotional and physical well-being.

Limitations and Future Research

Although our study has a number of strengths, it also contains several limitations that need to be addressed in future research. First, the outlined results were found from a relatively small sample of community-dwelling older adults in a geographically limited region of Canada. In addition, information on ethnicity and culture were not collected, which limits the generalizability of the findings. Furthermore, this research is based on developmental assumptions. As such, the presented approach should be extended to the entire lifespan. Such research could clarify whether the intensity and variability of sadness and anger exhibit different patterns in early adulthood, a period of life with comparably more abundant resources and control than older adulthood. Additionally, it would expand on the preliminary exploration of emotion function in tandem with individual fluctuations of control. Therefore, future research should replicate these findings in broader lifespan samples and assess generalizability.

Second, the study focused on sadness and anger variability in older adulthood, which have been the primary two negative emotions focused on thus far in older adulthood. While the results do point to a potential explanation for the mixed findings in the existing research on affect variability (i.e., that discrete emotions have distinct patterns and effects which muddle the findings when they are merged into one construct), more research is needed. Future studies should replicate and expand on the present findings, both with regards to sadness and anger variability, but also for other discrete emotions that have been identified (Roseman, Wiest & Swartz, 1994), such as feelings of anxiety, interest, excitement, or guilt. Such studies would help tease apart the contradicting consequences and proposed associations between broad affect

variability and well-being. Furthermore, this future work may reveal how different discrete emotion variability profiles may protect or harm older adults' well-being. Additionally, the current study asked participants to report a stressor and their corresponding emotional responses and control perceptions once, at the end of the day. This method should be complemented with future research using ecological momentary assessment of emotions (Shiffman, Stone & Hufford, 2008). Physiological measures of stress and proxies of heath should be used to expand on the outlined findings. Given the subjective nature of self-report measures, such work would clarify the outlined associations between emotion variability, as well as intensity, on health and stress outcomes.

Third, future studies examining daily stressors should incorporate data on the event that triggered the emotion. The present study begins to provide contextual information by focusing exclusively on daily stressors, rather chronic stressors, loss or general emotional experiences. Still there is heterogeneity across daily stressors. For example, common domains of daily stressors include, but are not limited to, interpersonal or health-related stressors, as well as home and family demands and responsibilities (Hay & Diehl, 2010). It is possible that different types of stressors are prone to eliciting different emotions (Dhabhar, 2018). Conducting comprehensive studies, along the lines envisioned, may clarify the differences found in the present study and previous work based on DEA. Additionally, including contextual information about the events triggering the investigated emotions may shed light on the function of various emotions within each domain. For example, sadness and anger intensity and variability may be differentially adaptive dependent on the domain of stressor.

Fourth, it is also important to consider the conceptual and empirical overlap between sadness and anger. Indeed, the reported results showed significant zero-order correlations

between the two emotions, but we also found the majority of the distinct effects were sustained, although to a reduced extent, when both emotions were considered together. As such, given that sadness and anger may occur simultaneously, but independently, various combinations of emotion intensities and variabilities may be experienced. For example, investigating the consequences of experiencing intense sadness and mild anger compared to concurrently intense sadness and anger will benefit research by exploring the complex human experience of emotions. Furthermore, this approach may lead to novel gains for emotion and aging research by clarifying whether adaptive aging is related to the presence of sadness or the absence of anger. Such findings will inspire clinical research and practice to identify the emotion regulation strategies that will most effectively improve older adults' daily and aging experiences.

Conclusion

The present study showed in a sample of community-dwelling older adults that the intensity and variability of sadness and anger responses to daily stressors were uniquely associated with stress and health-related symptoms. Furthermore, both between- and within-person perceived control measures moderated the effects of the distinct emotions' intensity and variability. The results support the idea that discrete emotions have unique patterns, which may partially explain the contradictory theories surrounding emotion variability across the lifespan. The findings represent an important contribution to the literature as it clarifies questions about unique patterns and consequences of discrete emotions in older adulthood, while considering control differences between individuals and within the same adult. Additionally, the study highlights that emotion variability may be clinically important in addition to intensity and should be considered when intervening to promote older adults' subjective well-being and physical health.

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Footnotes

[1] When both emotions are included in the same model, average daily stress and health symptoms were still significantly different than zero (*p*s < .001). The association between sadness variability and daily stress remained significant in this combined model ($p = .04$), whereas the effect of sadness intensity on stress ($p = .09$) and the moderating effect of between-person control for sadness intensity on stress reflected trend effects ($p = .06$). The associations found for anger intensity on stress ($p = .005$) and health symptoms ($p = .001$) were still significant, as was the moderating effect of between-person control on anger variability remained ($p = .002$).

[2] Similar to the previous results, when both emotions are included in the same model, average daily stress and health symptoms were still significantly different than zero. Sadness variability was found to marginally predict daily stress ($p = .06$), and level-1 perceived control was still found to significantly and marginally moderate the effects of sadness intensity on daily stress ($p = .03$) and health symptoms ($p = .07$). Anger intensity still significantly predicted daily stress ($p = .009$) and health symptoms ($p = .001$).

Table 1.

Zero-Order Correlations Between the Main Study Variables (N=168).

	1	2	3	4	5	6	7	8	9	10
1. Sex										
2. Age	-.02									
3. Education	-.21**	-.16*								
4. Control	-.13	-.14	.22**							
5. Sadness-M	.06	.16*	-.15	-.23**						
6. Anger-M	-.02	-.04	-.04	-.11	.66**					
7. Sadness-SD	.10	.03	-.06	-.21**	.66**	.50**				
8. Anger-SD	.04	-.09	-.08	-.05	.44**	.75**	.64**			
9. Daily Stress	.09	.06	.01	-.10	.52**	.49**	.47**	.39**		
10. Health Symptoms	.07	.10	-.05	-.18*	.36**	.42**	.21**	.23**	.44**	

Note. Sex was coded such that higher values correspond to females. Sadness-M and Anger-M = average intensity levels of anger and sadness responses. Sadness-SD and Anger-SD = variability of anger and sadness responses. Daily stress and health symptoms scores represent averaged responses across the seven days. * $p < .05$; ** $p < .01$.

Table 2.

Means, Standard Deviations, and Frequencies of Main Study Variables.

	Mean	Standard Deviation
Sex		
Male = 61; Female = 107		
Age	76.5	7.2
Education		
Primary school to Secondary school	26.2%	
CEGEP/College Diploma	16.1%	
Bachelor's	26.8%	
Master's	22.0%	
Doctorate	7.7%	
Other/Missing	1.2%	
Control	6.83	1.84
Sadness Intensity	1.79	1.82
Anger Intensity	2.20	1.93
Sadness Variability	1.50	1.08
Anger Variability	1.84	1.20

Table 3.

Results from HLM Analyses Examining Between-Person Sadness and Control Effects on Daily Stress and Health Symptoms

	Daily Stress Average levels (Intercept)			Health Symptoms Average levels (Intercept)		
	Coefficient (SE)	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*
Level-1	4.111 (0.132)	31.05	<.001	1.497 (0.101)	14.76	<.001
Level-2						
Sadness-M	0.795 (0.196)	4.05	<.001	0.533 (0.249)	2.14	.03
Sadness-SD	0.466 (0.199)	2.35	.02	-0.090 (0.170)	-0.53	.60
Control	0.070 (0.149)	0.47	.64	-0.155 (0.125)	-1.23	.22
Sex	0.129 (0.141)	0.91	.36	0.070 (0.106)	0.66	.51
Age	0.025 (0.134)	0.19	.85	0.056 (0.113)	0.49	.63
Education	0.186 (0.130)	1.43	.16	0.061 (0.128)	0.48	.63
Control x Sadness-M	0.239 (0.098)	2.44	.02	0.197 (0.116)	1.70	.09
Control x Sadness-SD	0.100 (0.149)	0.671	.50	0.009 (0.113)	0.08	.94

Note. Analyses were conducted separately for each interaction term. SE = standard error. Sadness-M = average intensity levels of sadness responses. Sadness-SD = variability of sadness responses. Dfs = 161 (Level-2 main effects); 160 (Level-2 interactions).

Table 4.

Results from HLM Analyses Examining Between-Person Anger and Control Effects on Daily Stress and Health Symptoms

	Daily Stress Average levels (Intercept)			Health Symptoms Average levels (Intercept)		
	Coefficient (SE)	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*
Level-1	4.111 (0.136)	30.21	<.001	1.497 (0.097)	15.48	<.001
Level-2						
Anger-M	0.949 (0.172)	5.52	<.001	0.780 (0.219)	3.56	<.001
Anger-SD	0.123 (0.172)	0.71	.48	-0.254 (0.178)	-1.43	.15
Control	-0.061 (0.137)	-0.45	.66	-0.160 (0.114)	-1.40	.16
Sex	0.220 (0.143)	1.55	.12	0.110 (0.102)	1.07	.29
Age	0.189 (0.136)	1.39	.17	0.137 (0.111)	1.23	.22
Education	0.163 (0.140)	1.17	.25	0.023 (0.128)	0.18	.86
Control x Anger-M	0.008 (0.141)	0.05	.96	-0.084 (0.143)	-0.59	.56
Control x Anger-SD	-0.026 (0.136)	-0.19	.85	-0.189 (0.094)	-2.02	.046

Note. Analyses were conducted separately for each interaction term. SE = standard error. Anger-M = average intensity levels of anger responses. Anger-SD = variability of anger responses. *Df*s = 161 (Level-2 main effects); 160 (Level-2 interactions).

Table 5.

Results from HLM Analyses Examining Between-Person Sadness and Within-Person Control Effects on Daily Stress and Health Symptoms

	Daily Stress						Health Symptoms					
	Average levels (Intercept)			Perceived control change (Slope)			Average levels (Intercept)			Perceived control change (Slope)		
	Coefficient (SE)	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*
Level-1	4.234 (0.134)	31.71	<.001	-0.038 (0.030)	-1.28	.20	1.507 (0.102)	14.84	<.001	-0.016 (0.011)	-1.39	.17
Level-2												
Sadness-M	0.761 (0.197)	3.86	<.001	-0.114 (0.054)	-2.13	.035	0.532 (0.250)	2.13	.035	-0.040 (0.022)	-1.82	.07
Sadness-SD	0.461 (0.199)	2.32	.02	0.058 (0.046)	1.26	.21	-0.092 (0.170)	-0.54	.59	0.024 (0.017)	1.39	.17
Control	0.062 (0.152)	0.41	.68				-0.156 (0.126)	-1.23	.22			
Sex	0.177 (0.145)	1.23	.22				0.072 (0.107)	0.67	.50			
Age	0.005 (0.136)	0.04	.97				0.047 (0.114)	0.41	.68			
Education	0.197 (0.133)	1.48	.14				0.060 (0.128)	0.47	.64			

Note. SE = standard error. Sadness-M = average intensity levels of sadness responses. Sadness-SD = variability of sadness responses.

*Df*s = 165 (Level-1); 161 (Level-2).

Table 6.

Results from HLM Analyses Examining Between-Person Anger and Within-Person Control Effects on Daily Stress and Health Symptoms

	Daily Stress						Health Symptoms					
	Average levels (Intercept)			Perceived control change (Slope)			Average levels (Intercept)			Perceived control change (Slope)		
	Coefficient (SE)	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*	*Coefficient (SE)*	*T-Ratio*	*P*
Level-1	4.237 (0.136)	31.08	<.001	-0.031 (0.030)	-1.03	.31	1.507 (0.097)	15.56	<.001	-0.014 (0.011)	-1.26	.21
Level-2												
Anger-M	0.900 (0.173)	5.21	<.001	-0.033 (0.045)	-0.74	.46	0.776 (0.219)	3.54	<.001	-0.012 (0.023)	-0.54	.59
Anger-SD	0.161 (0.174)	0.174	.36	0.008 (0.055)	0.15	.89	-0.250 (0.178)	-1.40	.16	0.020 (0.017)	1.12	.26
Control	-0.074 (0.140)	-0.53	.60				-0.158 (0.115)	-1.37	.17			
Sex	0.261 (0.145)	1.80	.07				0.114 (0.102)	1.12	.27			
Age	0.170 (0.137)	1.24	.22				0.129 (0.111)	1.16	.25			
Education	0.172 (0.144)	1.20	.23				0.019 (0.126)	0.15	.89			

Note. SE = standard error. Anger-M = average intensity levels of anger responses. Anger-SD = variability of anger responses. *Df*s = 165 (Level-1); 161 (Level-2).

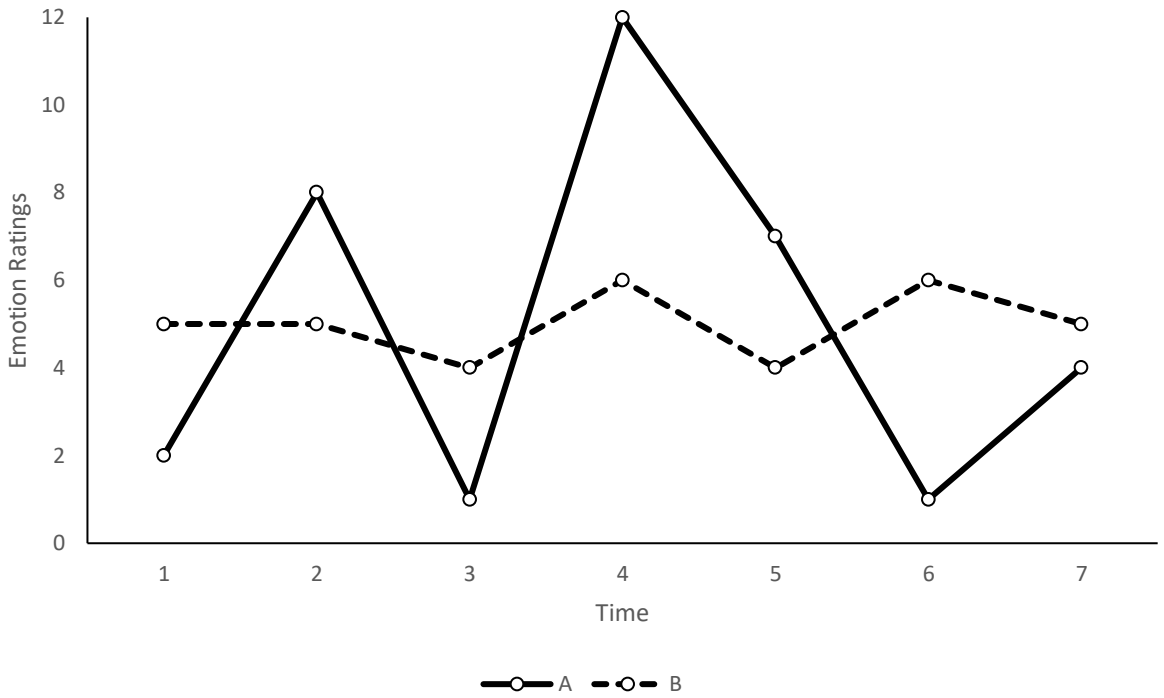

Figure 1. Two possible distributions of emotion responses across seven days. Both individuals' responses reflect identical average scores, but they differ dramatically in the variability of responses across time. Person A represents an individual with more variable responses, whereas Person B represents an individual with more stable responses across time.

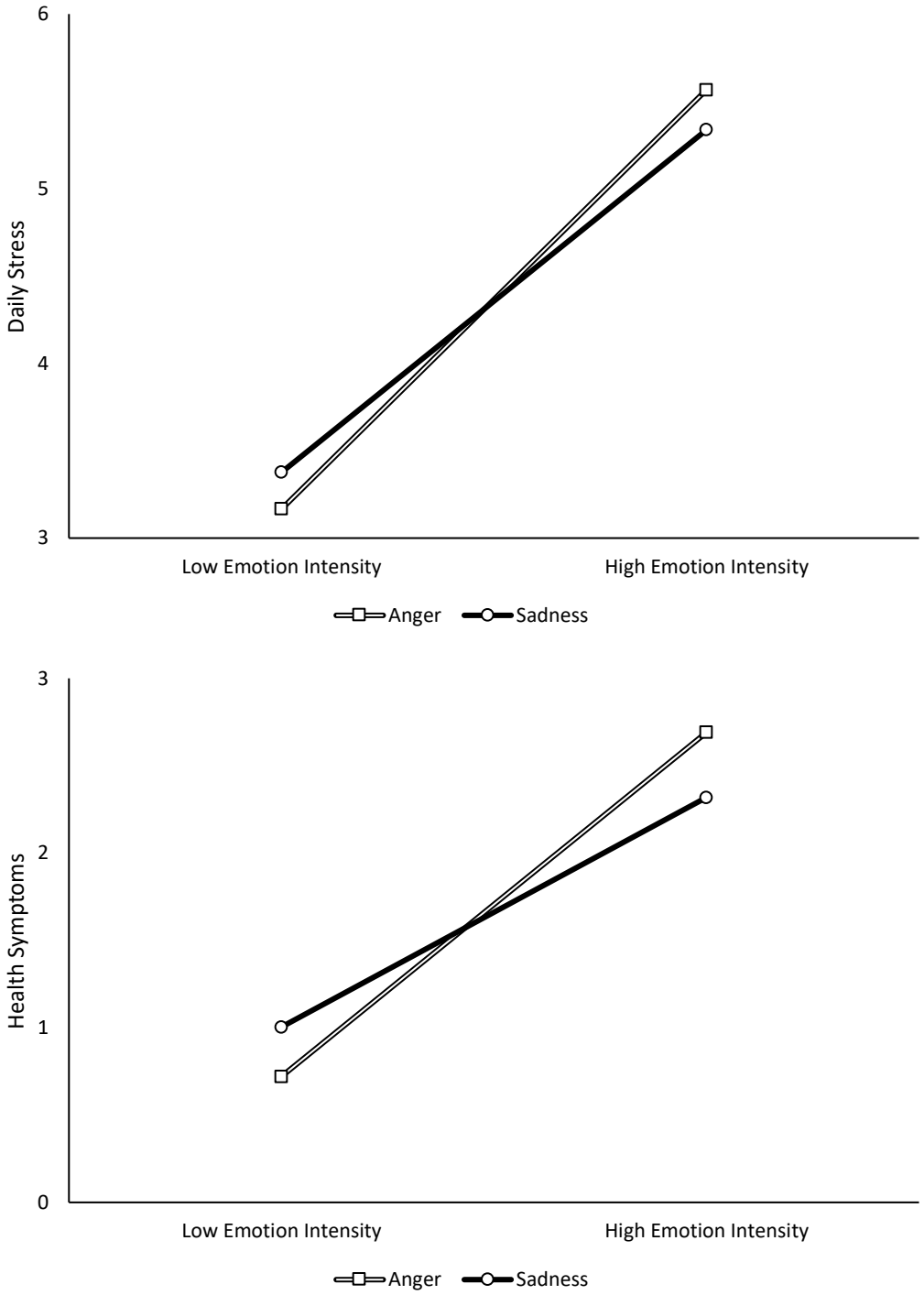

Figure 2. Significant main effects of sadness and anger intensity on daily stress (top panel) and daily health symptoms (bottom panel). Low and high intensity values correspond to lower and upper quartile values.

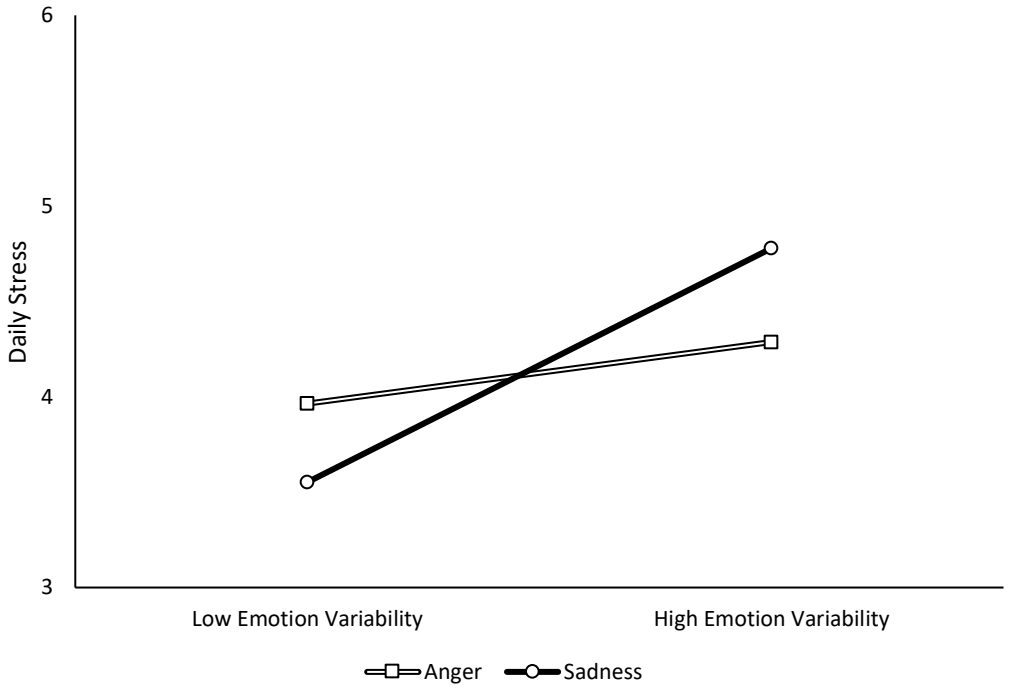

Figure 3. Significant main effects of sadness and anger variability on daily stress. Low and high variability values correspond to lower and upper quartiles.

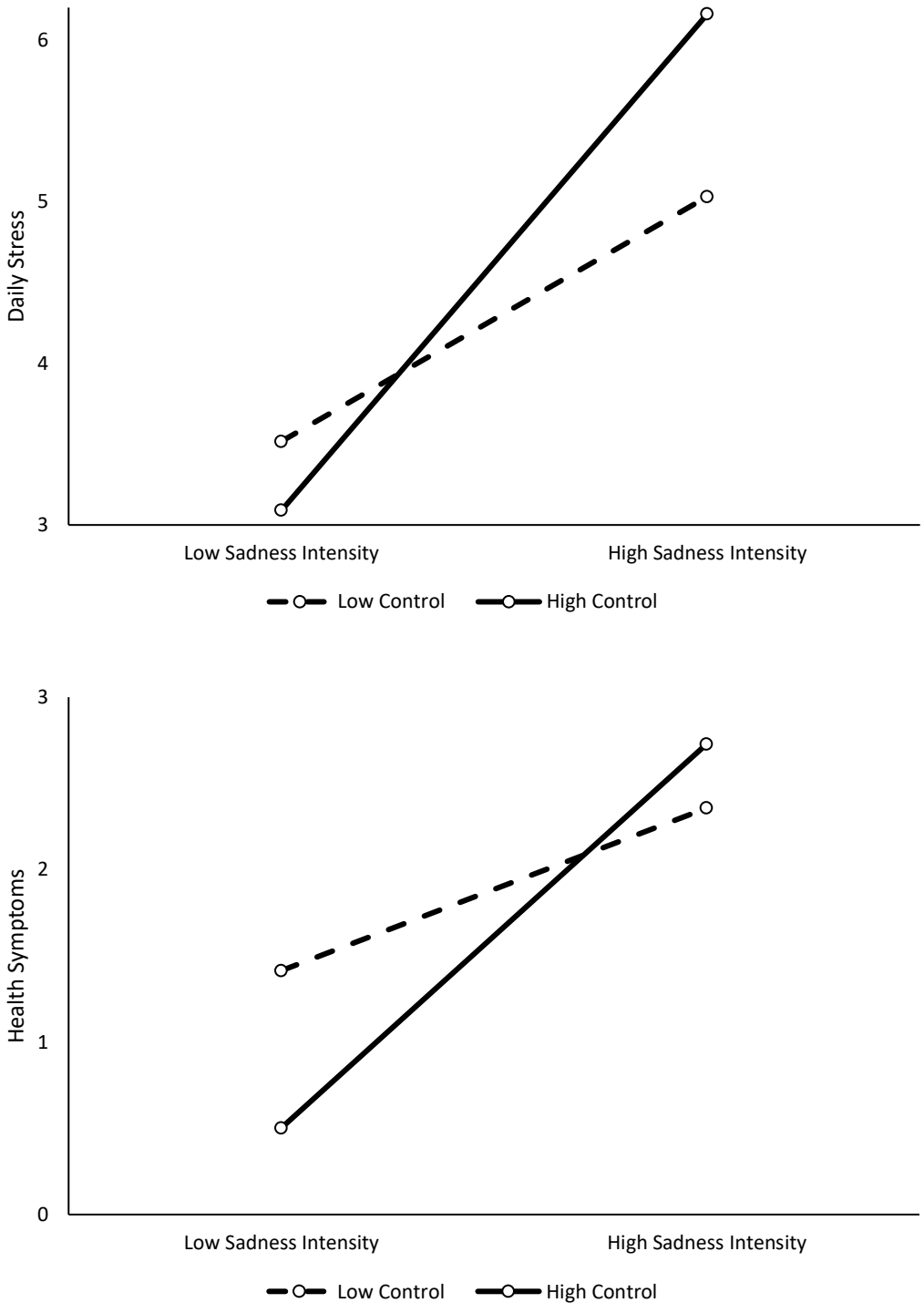

Figure 4. Between-person control significantly (top panel) and marginally (bottom panel) moderated the effects of sadness intensity on daily stress and daily health symptoms. Low and high sadness intensity and control values correspond to lower and upper quartiles.

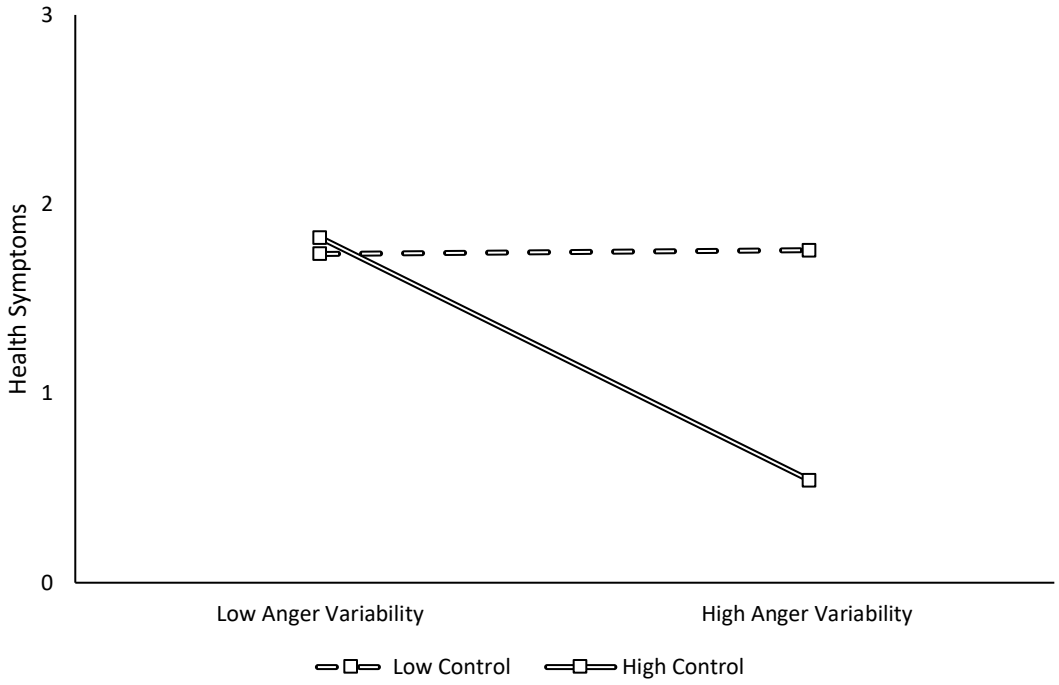

Figure 5. Significant interaction between anger variability and between-person control on health symptoms. Low and high anger variability and control values correspond to lower and upper quartiles.

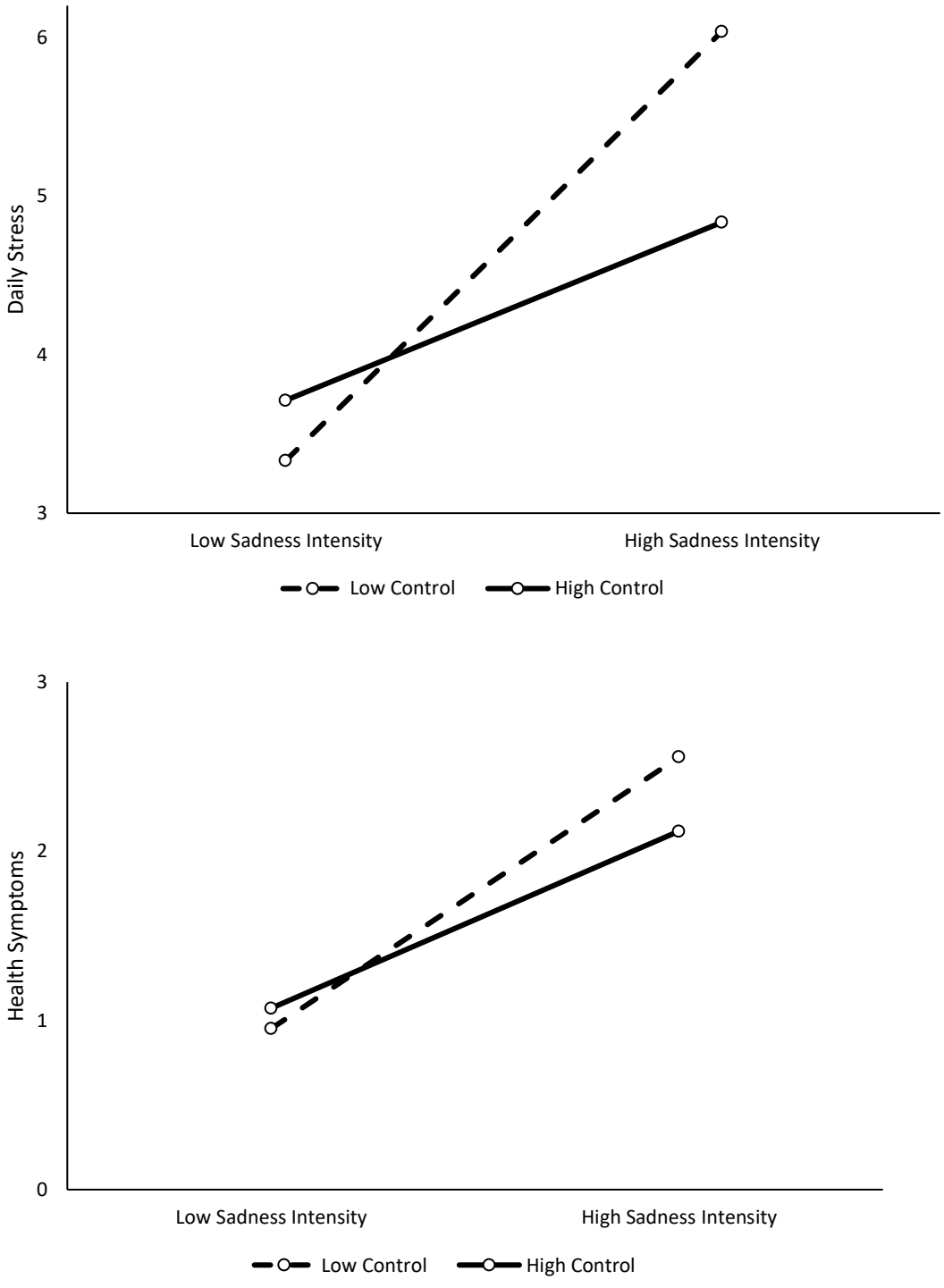

Figure 6. Within-in person control significantly (top panel) and marginally (bottom panel) moderated the effects of sadness intensity on daily stress and daily health symptoms.