Emotions and Well-Being in Older Adulthood:
Exploring the Roles of Age, Stress, and Motivational Processes

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ABSTRACT

Emotions and Well-Being in Older Adulthood: Exploring the Roles of Age, Stress, and Motivational Processes

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Functional approaches to emotion posit that different negative emotions serve adaptive functions by facilitating distinct motivational processes in response to situational demands. The discrete emotion theory of affective aging provides a lifespan developmental framework for examining the age-related fluctuations in the adaptive value of discrete negative emotions across older adulthood. With increasingly stressful life circumstances, the motivational concomitants of anger (i.e. persistence) may become relatively maladaptive, while those associated with sadness (i.e. disengagement) become paramount. This dissertation sought to examine the divergent associations of anger and sadness with motivational processes, emotional well-being, and physical health, and to explore the moderating roles of age and stress. Finally, this dissertation sought to demonstrate the adaptive value of the sadness-disengagement process.

Study 1 investigated the age-related associations between older adults' anger and sadness with chronic low-grade inflammation (i.e., IL-6 and CRP) and chronic illness using cross-sectional data from 226 older adults. Results suggested that anger, but not sadness, was associated with chronic inflammation and illness in old-old, but not young-old, adults. Further, the age-related association between anger and chronic illness was mediated by chronic inflammation.

Study 2 explored the associations of sadness and anger with goal disengagement capacities, emotional well-being (i.e. positive and negative affect), and stress (i.e. perceived stress, and diurnal cortisol) using 10-year longitudinal data from 184 older adults. The results revealed a within-person association between sadness, but not anger, and goal disengagement capacities among older adults with generally elevated cortisol. Further, older adults who disengaged more when they experienced sadness were buffered from declines in positive affect associated with elevated levels of cortisol.

Study 3 sought to examine the adaptive value of goal disengagement, and its association with quality of life. Using meta-analytic techniques to synthesize 421 effect sizes from 31 samples, the analyses revealed goal disengagement was associated with higher quality of life,

particularly in older samples. Further, the association between goal disengagement and lower depressive symptoms was reversed in samples at risk-for depression.

This dissertation integrates theory and research from the fields of emotion, lifespan development, personality, and evolutionary psychiatry, and contributes to the literature on successful aging.

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CONTRIBUTIONS OF AUTHORS

This dissertation is composed of three separate research papers. The first two papers utilized data from the *Montreal Aging and Health Study*. In collaboration with Dr. Carsten Wrosch, I conducted all statistical analyses and prepared manuscripts for submission. Dr. Jean-Phillipe Gouin and Dr. Ute Kunzmann collaborated on the preparation of the manuscript for Study 1, and Tehila Sacher, Dr. Jeremy Hamm, Dr. Ute Kunzmann, and Dr. Gregory Miller collaborated on the preparation of the manuscript for Study 2. Funding for this research study was obtained by CIHR research grants awarded to Dr. Carsten Wrosch. For the third paper of this dissertation, I conducted the literature search, coding, and data analyses. In addition, Dr. Carsten Wrosch and Dr. Jennifer McGrath consulted throughout the process and collaborated on the preparation of the manuscript.

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CHAPTER 1:
GENERAL INTRODUCTION

While dimensional approaches to emotion often group emotions based on valence or arousal (e.g., Watson & Tellegren, 1985), functional accounts of emotion posit that different negative emotions have evolved to serve distinct roles in signaling and addressing imbalances between individuals and their environments in response to different situational demands (e.g., Ekman, 1999; Frijda et al., 1989; Lazarus, 1991; Nesse, 2000). On the one hand, anger has been associated with persistence and described as an approach-oriented affect (Carver & Harmon-Jones, 2009) that can be triggered by obstacles to goal pursuit (Lazarus, 1991). On the other hand, sadness has been associated with letting go of goals and is generally experienced in response to irreversible losses and unattainable goals (Klinger, 1975; Kunzmann & Grühn, 2005; Kunzmann et al., 2017; Nesse, 2000; Wrosch & Miller, 2009).

Building from functional approaches to the study of emotion, the discrete emotion theory of affective aging (DEA) integrates lifespan developmental psychology and provides a conceptual framework for explaining age differences in the salience and adaptive value of discrete emotions across the adult lifespan (Kunzmann et al., 2014). More specifically, theories from lifespan psychology highlight that biological, sociocultural, and age-normative factors in older adulthood often result in steep reductions in individuals' opportunities for goal attainment among older adults, increasing the likelihood of unattainable goals (Heckhausen, 1999; Schulz & Heckhausen, 1996). Therefore, the DEA posits that as individuals advance into old age anger should become generally less salient and adaptive, while sadness should become more salient and adaptive (Kunzmann et al., 2014).

Although stressors tend to become more severe in older adulthood (Baltes, 1987; Heckhausen, Wrosch, & Schulz, 2010; Schulz & Heckhausen, 1996), aging is a heterogeneous process (Baltes & Smith, 2003). Therefore, in this discussion age is conceptualized as a proxy of an individual's developmental context. Accordingly, the adaptive value of anger and sadness should also vary as a function of stressful life circumstances. More specifically, while anger could still serve relatively adaptive functions in older adults who maintain ample opportunities for goal attainment (Barlow et al., 2015; Heckhausen, Wrosch & Schulz, 2013), anger should become relatively less adaptive among older adults who experience more stressful life circumstances. Conversely, sadness should become paramount for older adults whose resources

are severely constrained by stressful life events (Wrosch et al., 2003).

Further, it may be the case that distinct negative emotions may not only impact situation-specific responses, but also general tendencies in responses to stressful life events. If a discrete emotion repeatedly triggers the use of adaptive motivational process, over time, this recurrent experience could reinforce the tendency to utilize this motivational process in the future. In turn, this may lead to improvements in individual differences in self-regulatory processes. Of interest, goal adjustment capacities represent individual differences in tendencies to selectively adjust goal striving in the face of unattainable goals. Two categories have been defined: goal disengagement and goal reengagement. Goal disengagement capacities reflect individual differences in the tendency to withdraw commitment and effort from an unattainable goal, while goal reengagement capacities reflect individual differences in the tendency to identify, commit to, and pursue alternative goals in the face of unattainable goals (Wrosch et al., 2003a, 2003b). While both goal disengagement and reengagement capacities are thought to facilitate well-being, goal disengagement capacities may become paramount in old age if they facilitate the effective adjustment to the experience of unattainable goals (cf. Brandtstädter & Renner, 1990; Heckhausen, Wrosch, & Schulz, 2019).

Given the importance of goal disengagement capacities in older adulthood, research identifying psychological factors that can facilitate goal disengagement capacities in older adults is warranted. Accordingly, considering that sadness is thought to enable goal disengagement processes, sadness may be associated with improvements in goal disengagement capacities among older adults facing more intractable losses and unattainable goals (Baltes & Smith, 2003; Klinger, 1975; Kunzmann et al., 2014; Lazarus, 1991; Nesse, 2000; Wrosch & Miller, 2009). More specifically, among older adults who experience more stressful life circumstances, over time, sadness may reinforce the use of these processes in the future. Anger, by contrast, is unlikely to be associated with goal disengagement capacities, as it is typically linked with strategies associated with persistence (Carver & Harmon-Jones, 2009; Lazarus, 1991).

Importantly, the DEA highlights that by facilitating motivational processes that are differentially adaptive across developmental contexts, distinct negative emotion may also uniquely impact psychological well-being and physical health across older adulthood. This may be the case because the emotional distress associated with a failure to employ opportunity-adjusted motivation processes could also impact physical health by impeding health behaviors

(e.g., physical activity, Roshanaei-Moghaddam et al., 2009) or dysregulating physiological and immune processes (Cohen et al., 2007; Kiecolt-Glaser et al., 2002; Miller, Cohen, & Ritchey, 2002). Given the different motivational concomitants of anger and sadness, the DEA suggests that anger should be associated with relatively poorer psychological well-being and physical health, whereas sadness should be associated with relatively better psychological well-being and physical health, as individuals are faced with more age-related stressors (Kunzmann et al., 2014).

Finally, it is also important to distinguish the proposed adaptive sadness-disengagement process from maladaptive processes associated with depression. More specifically, the abandonment of goals has often been viewed solely as an unfortunate consequence of failure (e.g., learned helplessness; Seligman, 1975). In this vein, insight can be garnered from extant theory and research from evolutionary and personality psychology which highlights that depressive symptoms can sometimes serve an adaptive function by facilitating disengagement from unattainable goals (e.g., Klinger, 1975; Koppe & Rothermund, 2016; Nesse, 2000; Wrosch & Miller, 2009). For example, it is posited that depressive mood may have evolved as a defense mechanism that permits individuals to preserve resources (Beck, 2002; Klinger, 1975) and elude danger while pursuing unattainable goals (Keller & Nesse, 2006; Nesse, 2000).

Consequently, while goal disengagement capacities can protect individuals from the experience of depressive symptoms when faced with unattainable goals (Dunne et al., 2011), depressive symptoms may also enable disengagement from unattainable goals (Wrosch & Miller, 2009; Koppe & Rothermund, 2016). Accordingly, the association between goal disengagement and reduced depressive symptoms may be blunted or reversed in individuals with, or at-risk for, depression. This may be the case as these individuals may more frequently experience insurmountable goal-related impediments and the consequent depressive mood. Therefore, these experiences may trigger repeated cycles of adaptive disengagement, and reinforce the link between depressive mood and improved goal disengagement capacities (Wrosch & Miller, 2009). Thus, any association between goal disengagement capacities and lower depressive symptoms may be attenuated in populations at-risk for depression if depressive symptoms are more likely to facilitate individuals' goal disengagement capacities in these populations.

In summary, the extant literature suggests that the adaptive values of distinct discrete negative emotions, such as anger and sadness, vary across older adulthood as a function of the individuals' opportunities to overcome life stressors. However, several limitations in the

literature remain to be addressed. First, there is a need for more research demonstrating the role of age and stressful life circumstances in the adaptive value of different negative emotions. Second, there is a lack of research examining the divergent functions and consequences of multiple distinct negative emotions, resulting in a lack of discriminate validity in the field. Third, there is a need for more process-oriented research demonstrating the downstream consequences of distinct negative emotions and the associated motivational processes on emotional well-being and physical health across older adulthood. Finally, the existing body of work could be strengthened by integrating work from personality psychology and evolutionary psychology. More specifically, research should extend the existing literature to the effects of discrete negative emotions on individual differences in self-regulatory processes (e.g., goal disengagement capacities). Additionally, future research should integrate theoretical and empirical work that highlights the adaptive value of depressive symptoms in triggering adaptive goal disengagement.

Research Objectives

This dissertation consists of three studies that were conducted to contribute to a broader understanding of the functions, and consequences, of negative emotions in older adulthood. Specifically, this research advances our understanding of the adaptive value of anger, sadness, and related constructs (i.e. depressive mood), in facilitating motivational processes, and promoting physical health and emotional well-being in the elderly. The purpose of this research is to elucidate the differential mechanisms and contexts under which anger and sadness may serve distinct adaptive functions. This dissertation has five main objectives:

Objective 1*: To investigate the differential adaptive value of anger and sadness for emotional well-being and physical health in older adulthood.*

Objective 2*: To determine the moderating role of age and stress on the differential adaptive values and functions of anger and sadness.*

Objective 3*: To examine the differential associations of anger and sadness with goal disengagement capacities in older adulthood.*

Objective 4*: To explore the adaptive value of goal disengagement capacities and identify key moderating variables (e.g., age).*

Objective 5*: To elucidate the association between depressive symptoms and goal disengagement capacities in normative, and at-risk for depression, samples.*

Study 1*: Is anger, but not sadness, associated with chronic inflammation and illness in older adulthood?*

This study addresses the first and second research objectives of this dissertation. More specifically, it investigated whether older adults' experiences of anger and sadness were differentially associated with biomarkers of chronic low-grade inflammation and chronic illness using cross-sectional data from the *Montreal Aging and Health Study*. Further, this study examined whether the divergent associations of anger and sadness with physical health would become paramount in advanced old age. Study 1 addresses the following research questions:

> ***Question 1****: Are anger and sadness differentially associated with chronic inflammation and illness across older adulthood?*
>
> ***Question 2****: Are the age-related effects of anger and sadness on chronic illness mediated by chronic inflammation?*

Study 2*: Discrete negative emotions and goal disengagement in older adulthood: context effects of stress and associations with emotional well-being.*

This study addresses the first, second, third, and fourth research objectives of this dissertation, by exploring the associations of sadness and anger with older adults' goal disengagement capacities and emotional well-being (i.e. positive and negative affect) in the context of stress (i.e. perceived stress, and diurnal cortisol). More specifically, it used 10 years of longitudinal data from the *Montreal Aging and Health Study* to determine if the within-person association between sadness (but not anger) and goal disengagement capacities was moderated by between-person levels of stress, and buffered individuals from the adverse consequences of elevated within-person stress on emotional well-being. Study 2 addresses the following research questions:

> ***Question 1****: Is sadness, but not anger, associated with within-person fluctuations in goal disengagement capacities?*
>
> ***Question 2****: Is the association between sadness with goal disengagement capacities most pronounced among older adults facing generally higher levels of stress?*
>
> ***Question 3****: Does the sadness-disengagement process protect individuals' emotional well-being in times of higher-than-normal stress?*

Study 3*: Goal adjustment capacities and quality of life: a meta-analytic review*

This study addresses the fourth and fifth research objectives of this dissertation: to explore the adaptive value of goal disengagement capacities, identify key moderating variables, and elucidate the association between depressive symptoms and goal disengagement capacities in normative, and at-risk for depression, samples. To accomplish our objectives, we conducted a meta-analysis of 421 effect sizes from 31 independent samples. We utilized these effect sizes to quantify the associations between both goal disengagement and reengagement capacities with indicators of quality of life and explore the moderating roles of other factors of interest (e.g., age, depression risk status). Study 3 addresses the following research questions:

Question 1*: Are goal adjustment capacities associated with quality of life?*

Question 2*: Are the associations between goal adjustment capacities and quality of life moderated by other key factors?*

Question 3*: Is the association between depressive symptoms and goal disengagement capacities attenuated or reversed in samples at-risk for depression, as compared to normative samples?*

CHAPTER 2:
LITERATURE REVIEW

Although the study of emotion has a long history in psychological science, disagreements persist in how to best answer a fundamental question: what is an emotion? Agreeing on a universal definition of emotion has proven difficult because emotions consist of a plethora of responses, varying on several dimensions including intensity, duration, and complexity. Despite the lack of consensus (e.g., Kleinginna & Kleinginna, 1981), experts tend to agree that emotions have a limited number of components and characteristics, but fail to agree on the details (Izard, 2006, 2009). The modal model of emotion outlined by Gross and Thompson (2007) summarizes features present across multiple approaches to emotion and suggests that emotions involve a feedback loop in which a person-situation transaction occurs (*Step 1*), compels attention (S*tep 2*), is appraised by the individual (*Step 3*), and elicits an emotional response (S*tep 4*). In turn, this emotional response can then contribute to modifying the situation.

The modal model of emotion also highlights two core features of emotion: the context and the multifaceted nature. The importance of the context of an emotion can be drawn back to appraisal theory, which posits that individuals experience an emotion when they attend and appraise a situation as goal-relevant (Lazarus, 1991; Scherer, Schorr, & Johnstone, 2001). Therefore, the goal gives meaning to the situation, and the meaning results in the emotion. Accordingly, the emotion can change depending on the context (i.e. the situation, goal, or meaning).

On the other hand, the multifaceted nature of emotions highlights that emotions involve changes in subjective experience, behavior, and physiology (Mauss, Levenson, McCarter, Wilhelm & Gross, 2005), and do not consist solely of the subjective "feeling". Emotions can also facilitate action (Frijda, 1986), for example, through facial expressions or specific instrumental behaviors (e.g., running). Further, emotions are associated with autonomic and neuroendocrine changes that may facilitate actions, or follow motor activity (Lang & Bradley, 2010). Building from these core features, functional accounts of emotion suggest that the multifaceted nature of emotions can serve functions that help individuals achieve their goals (e.g., Ekman, 1999; Frijda et al., 1989; Lazarus, 1991; Levenson, 1999; Nesse, 2000).

Functional Accounts of Emotion

Much of the existing emotion research has utilized dimensional approaches to emotion

that conceptualize broad factors, differing in valence and arousal. For example, some dimensional approaches have separated emotions into two (e.g., positive and negative affect; Watson & Tellegren, 1985; Watson, Clark, & Tellegen, 1988), three (e.g., pleasantness-unpleasantness, relaxation-tension, and calm-excitement; Wundt, 1905), or even four dimensions (e.g., activation, relatedness, hedonic tone, and competence; Davitz, 1969).

Contrary to these approaches, functional accounts of emotion posit that different negative emotions have evolved to serve distinct roles in signaling and addressing imbalances between individuals and their environments in response to diverse situational demands (e.g., Ekman, 1999; Frijda et al., 1989; Lazarus, 1991; Nesse, 2000). Therefore, emotions can aid in organizing and motivating adaptive responses to threats to an individual's survival or well-being (Izard, 2009). Accordingly, functional approaches often assume that discrete negative emotions are associated with distinct response patterns (e.g., physiological activity, action impulses, and cognitive appraisals) tailored at correcting specific imbalances between the individual and their environment (Krebig, 2010).

For example, different discrete negative emotions can enable individuals to cope effectively with different situational circumstances that involve threat (through anxiety, Levenson, 1992), uncontrollable losses (through sadness, Nesse, 2000), or blocked goals (through anger, Carver & Harmon-Jones, 2009; Frijda et al., 1989; Keltner & Gross, 1999; Pekrun et al., 2007). Further, anger, shame, and guilt can facilitate different regulatory strategies for social interactions (Fischer & Manstead, 2008). Although not a focus of the present research, positive emotions can also serve adaptive functions. For example, positive emotions, such as joy, can motivate interest in exploring novel activities, thought, and relationships, and expanding one's personal resources (Fredrickson et al., 2008), as well as undoing the cardiovascular aftereffects of negative emotions (Fredrickson, Mancuso, Branigan, & Tugade, 2000).

Discrete Emotion Theory of Affective Aging

Building from these functional approaches to the study of emotion, the discrete emotion theory of affective aging (DEA) incorporates prepositions from lifespan developmental theory, providing a conceptual framework for explaining age differences in the salience and adaptive value of discrete emotions across the adult lifespan (Kunzmann et al., 2014). To this end, the DEA postulates that different discrete negative emotions may differentially support or hinder effective age-related self-regulation processes across the lifespan. Accordingly, the salience and

adaptive value of distinct discrete emotions should depend on the extent to which the emotion facilitates the successful management of age-specific developmental opportunities and constraints, residing in the individual, the environment, or both (Kunzmann et al., 2014; Kunzmann & Wrosch, 2017).

Lifespan developmental theories suggest that individual agency and contextual factors interact to shape individuals' opportunities for goal attainment across the life course (Baltes, 1987, 1997; Heckhausen, 1999; Lerner & Busch-Rossnagel, 1981). Therefore, while people can actively influence their development by identifying, pursuing, and regulating goal pursuits, external limitations may arise (e.g., negative life events, declining personal resources) requiring individuals to selectively pursue their goals (Schulz & Heckhausen, 1996). For example, certain goals may have to be abandoned to ensure the attainment of other goals (e.g., not going out with friends to focus on work). In this regard, lifespan theories postulate that normative trajectories in constraints, opportunities, and personal resources result in age-graded fluctuations in control capacity (Heckhausen, 1999; Heckhausen & Schulz, 1995; Heckhausen et al., 2010; Schulz & Heckhausen, 1996). More specifically, young adulthood is typically described as a life phase characterized by plenty of opportunities for overcoming goal-related problems and few constraints to achieve developmental tasks (Baltes, 1987; Heckhausen et al., 2010). In contrast, older adulthood is typically characterized by increasing irreversible losses and developmental constraints, along with reductions in personal resources (Baltes & Smith, 2003). Particularly, the control capacity of individuals declines sharply in late-life, as goal pursuits are increasingly impeded by age-related decreases in biological, social, and motivational resources and limited time horizons (Carstensen, Isaacowitz, & Charles, 1999; Heckhausen & Schulz, 1995; Schulz & Heckhausen, 1996).

A corollary of the previous discussion is that in order to optimize development in response to the developmental fluctuations in control capacity, individuals must employ opportunity-adjusted motivational responses (Barlow, Wrosch, Heckhausen, Schulz, 2017; Heckhausen et al., 2010; Heckhausen & Schulz, 1995; Heckhausen, Wrosch, & Fleeson, 2001; Wrosch & Heckhausen, 1999). Said another way, to adjust to age-related challenges effectively, lifespan theory and research suggests that individuals need to adjust their motivational responses to age-related variations in opportunities and constraints. Therefore, development can be optimized in older adulthood by generally switching from attempts to overcome insurmountable

goal-related obstacles at younger ages, to adjusting psychologically to the experience of unattainable goals in older adulthood (Brandtstädter & Renner, 1990; Heckhausen, 1999; Heckhausen et al., 2010). Given the age-related adaptive values of processes associated with persistence and disengagement, research identifying potential triggers may provide insight into pathways to successful aging.

Accordingly, the DEA has focused on two distinct discrete emotions: anger and sadness. Anger has been described as an approach-oriented affect (Carver & Harmon-Jones, 2009) that can be triggered by obstacles to goal pursuit (Lazarus, 1991). Research has linked anger with a differential pattern of autonomic arousal (as compared to fear and sadness), including increased heart rate and finger temperature (Ekman, Levenson & Friesen, 1983; Levenson, Ekman & Friesen, 1990). Additionally, theorists have proposed that anger occurs when individuals believe they can accomplish a goal that is then lost, but the individual maintains the belief that the goal can be achieved (Stein & Levine, 1990; Stein, Trabasson & Liwag, 1993). Accordingly, anger is thought to support persistence in overcoming goal blockages or reversing injustice (e.g., Frijda et al., 1989; Keltner & Gross, 1999; Kunzmann, Rohr, Wieck, & Wrosch, 2017).

In contrast, sadness is generally experienced in response to irreversible losses (e.g., Cole & Dendukuri, 2003; Kunzmann & Grühn, 2005; Kunzmann et al., 2017), and can facilitate the reprioritization of goals and the pursuit of realistic plans (Heckhausen, Wrosch, & Schulz, 2019; Klinger, 1975; Nesse, 2000; Wrosch & Miller, 2009). Sadness can also serve social functions by signaling the need for social support (Andrews & Thomson, 2009), or triggering individuals to seek emotional or instrument support, thereby facilitating the strengthening social bonds, altruism, and sympathy (Izard, 1993). Accordingly, sadness may facilitate disengagement from futile goals by enabling the psychological adjustment to irreversible losses and unattainable goals (Klinger, 1975; Lazarus, 1991; Nesse, 2000; Wrosch & Miller, 2009), and the recruitment of protective social resources.

Consequently, given the age-related declines in biological, social, and motivational resources (Baltes, 1987; Heckhausen et al., 2010; Heckhausen & Schulz, 1995), the motivational and behavioral concomitants of anger may become less salient and adaptive in older adulthood if anger facilitates persistence (Kunzmann et al., 2014). To this end, age-related decreases in opportunities and increases in constraints could make it possible that anger is particularly maladaptive during older adulthood if it triggers futile pursuit of unattainable goals and repeated

failure experiences. In contrast, the motivational and behavioral concomitants of sadness should become generally more salient and adaptive as individuals advance into old age if it facilitates goal disengagement processes (Kunzmann et al., 2014). This may be the case as the age-related trajectories of control capacity could render sadness paramount in old age if it enables the effective adjustment to irreversible losses, intractable stressors, and unattainable goals.

In support of these assumptions, older adults report less anger than younger adults (Kunzmann & Wrosch, 2017; Kunzmann & Thomas, 2014; Kunzmann et al., 2013). More specifically, research suggests that anger may start decreasing in early midlife (Kunzmann et al., 2013). Conversely, while some studies suggest that older adults report more sadness than young adults (e.g., Kunzmann & Grühn, 2005), other studies point to stability in levels of sadness across the adult lifespan (e.g., Tsai et al., 2000). This topic is further illuminated by one study demonstrating that sadness may be particularly enhanced during the later phases of older adulthood (Kunzmann et al., 2013). In addition, anger has been linked with reductions in within-person perceived control in young-old adults, while sadness longitudinally increased only in older adults who experienced low levels of, or reductions in, perceived control (Wrosch, Barlow & Kunzmann, 2018). Further, past research suggests that responding with sadness, but not anger, to an emotionally neutral film clip facilitated older adults' psychological well-being (Haase et al., 2012).

Although stressors tend to become more severe in older adulthood (Baltes, 1987; Heckhausen, Wrosch, & Schulz, 2010; Schulz & Heckhausen, 1996), and therefore compel generally less (futile) persistence, and more (adaptive) disengagement processes, aging is a heterogeneous process (Baltes & Smith, 2003). Said differently, the severity of older adults' stressors is likely to vary both within, and between, individuals. Therefore, although across older adulthood anger and the associated goal-directed behaviors may generally become less adaptive, while sadness and the associated disengagement processes may generally become more adaptive, in this discussion age is conceptualized as a proxy of the individuals' developmental context. Accordingly, the salience and adaptive value of anger and sadness should also vary as a function of stressful life circumstances. More specifically, in older adults who face more stressful life circumstances, anger may become relatively less adaptive, whereas sadness may become relatively more adaptive. Accordingly, anger could serve relatively adaptive functions in older adults whose resources are not constrained by stressful life events, allowing for the maintenance

of important goal pursuits (Barlow et al., 2015; Heckhausen, Wrosch & Schulz, 2013). Conversely, sadness should be most adaptive in older adults whose resources are severely constrained by intractable and stressful life events, rendering goal disengagement processes paramount (Wrosch et al., 2003).

Discrete Emotions and Goal Adjustment Capacities

To date, discrete emotion theory and research has largely focused on the role of discrete emotions in situation-specific motivational responses. The previous discussion of functional approaches to emotion outlines how distinct discrete emotions may prompt specific motivational processes in response to different situational demands (Carver & Harmon-Jones, 2009, Klinger, 1975; Lazarus, 1991; Nesse, 2000). However, it may also be the case that over time, negative emotions can impact an individual's general tendency to respond to situational demands. Therefore, sadness may not only be associated with individual's situation-specific goal disengagement processes, but also an individual's general tendency to let go of goals when they have become unattainable, or too costly.

In this vein, numerous theories of self-regulation have approached the adjustment to unattainable goals from an individual difference perspective (Brandtstädter & Renner, 1990; Wrosch et al., 2003a). In particular, goal adjustment capacities represent individual differences in the tendencies to selectively adjust goal striving in the face of unattainable goals. Two broad categories of goal adjustment capacities have been conceptualized: goal disengagement and goal reengagement. Goal disengagement capacities reflect individual differences in individuals' tendency to withdraw commitment (i.e. reduce the importance, significance, or value of the goal) and effort (i.e. decrease goal-directed activity) from an unattainable goal (Wrosch et al., 2003a). In contrast, goal reengagement capacities reflect individuals' tendency to identify, commit to, and pursue alternative goals in the face of unattainable goals (Wrosch et al., 2003a, 2003b).

Goal disengagement and goal reengagement capacities are conceptualized as independent personality factors that impact individuals' subjective well-being by serving different self-regulatory functions (Wrosch et al., 2003a, 2003b, 2007). More specifically, goal disengagement capacities can facilitate subjective well-being by enabling individuals to withdraw psychological and behavioral resources from unfeasible goals, avoid the repeated experience of failure, and reallocate resources to the management of pressing demands or the pursuit of other valuable activities (e.g., abandoning peripheral goals to care for a sick family member; Wrosch et al.,

2003, 2011). Goal reengagement capacities, in contrast, can enable subjective well-being by providing purpose for living through the pursuit of new goals and mitigating some of the psychological distress associated with goal failure (Wrosch et al., 2013). Unsurprisingly, the extant literature highlights the positive associations between goal disengagement and goal reengagement capacities with subjective well-being (Wrosch et al., 2003a, 2007, 2011, 2013).

In addition, theory and research highlights that goal disengagement and goal reengagement capacities may also facilitate physical health. This may be the case if the pursuit of new goals is associated with health-promoting behaviors (e.g., physical activity, Wrosch & Sabiston, 2013). Further, goal disengagement and goal reengagement may influence physical health through their effects on psychological well-being (Castonguay et al., 2017; Wrosch et al., 2007). Therefore, goal disengagement and goal reengagement capacities may also promote better physical health by preventing downstream disruption of the normative regulation of health-relevant physiological processes associated with emotional distress (e.g., in the hormonal or immune systems, Cohen, Janicki-Deverts & Miller, 2007; Pressman & Cohen, 2005). In support of these assertions, past research has linked both goal disengagement and goal reengagement capacities with physical health (Wrosch et al., 2007, 2013; Wrosch & Sabiston, 2013).

Importantly, goal disengagement capacities may become paramount in old age if they facilitate the effective adjustment to the experience of unattainable goals in the context of increasing age-related constraints on the pursuit of personal goals (cf. Brandtstädter & Renner, 1990; Heckhausen, Wrosch, & Schulz, 2019). This notion is supported by existing literature demonstrating goal disengagement processes increase with advancing age (Brandtstädter & Renner, 1990; Wrosch et al., 2003), and protect older adults with functional disabilities from increases in depressive symptoms (Dunne et al., 2011). Given the importance of goal disengagement capacities in older adulthood, research aimed at identifying psychological factors that can facilitate goal disengagement capacities in older adults is warranted.

Accordingly, sadness, but not anger, may represent such a factor. More specifically, if a discrete emotion triggers adaptive opportunity-adjusted motivational processes, over time the repeated experience of the emotion could reinforce this tendency in the future. In turn, this reinforcing cycle could result in fluctuations in individual differences in self-regulatory processes. Accordingly, given that older adulthood can generally be characterized by a more frequent experience of age-related stressors (Baltes & Smith, 2003), sadness is more likely to

enable adaptive opportunity-adjusted goal disengagement processes (Klinger, 1975; Kunzmann et al., 2014; Lazarus, 1991; Nesse, 2000; Wrosch & Miller, 2009). In contrast, given that anger is an approach-oriented affect that may trigger active goal pursuits, and attempts at overcoming surmountable goal obstacles and reversing injustices (Carver & Harmon-Jones, 2009; Lazarus, 1991), anger is less likely to trigger disengagement in response to increasing age-related stressors (Kunzmann et al., 2014). Accordingly, sadness, but not anger, may be associated with higher levels of goal disengagement capacities in older adulthood, as over time sadness may reinforce the opportunity-adjusted use of goal disengagement processes in the future.

Considering the Adaptive Value of Anger and Sadness Across Older Adulthood

Implicit in the previous discussion is that discrete negative emotions may also uniquely impact well-being across older adulthood, by differentially supporting adaptive opportunity-adjusted motivational processes. While young-old adults are more likely to encounter some surmountable challenges that could be resolved through active goal pursuit (Baltes & Smith, 2003), individuals in advanced old age are more likely to experience a sharp increase in intractable losses (Gerstorf et al., 2010). Therefore, given the different motivational concomitants of anger and sadness, the DEA suggests that as individuals progress into advanced old age and are confronted with more intractable stressors, anger should become associated with relatively poorer well-being, whereas sadness should become associated with relatively better well-being (Kunzmann et al., 2014).

Importantly, if the negative emotions elicited by stressful experiences fail to facilitate effective adaptation through context-appropriate motivational processes, these negative emotions may become chronic and degrade not only psychological well-being, but also physical health (Kunzmann & Wrosch, 2018). This may be the case because the chronic experience of negative emotions may threaten health behaviors (e.g., physical activity, Roshanaei-Moghaddam et al., 2009) or dysregulate physiological and immune processes (Cohen et al., 2007; Kiecolt-Glaser et al., 2002; Miller, Cohen, & Ritchey, 2002). In addition, the dysregulation of immune function has been considered a core physiological pathway to morbidity and mortality (Ershler & Keller, 2000). Given that older adults frequently show elevated levels of chronic inflammation (Franceschi et al., 2014; Piazza et al., 2010), a risk factor for the development of chronic illness (e.g., heart disease, osteoarthritis, diabetes, and cancer; Allin & Nordestgaard, 2011; Danesh et al., 2004), this process may become paramount in older adulthood.

Finally, although the outlined theoretical model assumes that the sadness-disengagement process is adaptive (Kunzmann et al., 2014), it is important to distinguish the proposed sadness-disengagement process from maladaptive processes historically associated with depression. For example, Seligman (1975) proposed that repeated exposure to uncontrollable outcomes can result in goal disengagement and depression, despite the individual's opportunities for goal pursuit (i.e. learned helplessness). However, important insight can be gathered from the existing body of theory and research from evolutionary psychiatry and personality psychology which highlights that depressive symptoms can sometimes serve an adaptive function by facilitating disengagement from unattainable goals (e.g., Klinger, 1975; Nesse, 2000). More specifically, this work assumes that depressive mood may have evolved as a defense mechanism that permits individuals to evade danger in the pursuit of unattainable goals (Keller & Nesse, 2006; Nesse, 2000), sustain realistic perceptions of their environment (Dykman, Abramson, Alloy, & Hartlage, 1989), choose feasible life goals (Taylor & Gollwitzer, 1995), and preserve resources (Beck, 2002; Klinger, 1975). These assumptions are consistent with research demonstrating reciprocal longitudinal associations between depressive symptoms and goal disengagement capacities. More specifically, Wrosch and Miller (2009) demonstrated that high levels of depressive symptoms at baseline forecasted increases in goal disengagement capacities, while increased goal disengagement capacities forecasted decreases in depressive symptoms. Further, the proposed process is in line with experimental work demonstrating faster disengagement from unsolvable, but not solvable, tasks in clinically depressed individuals as compared to the non-depressed control group (Koppe & Rothermund, 2016).

Therefore, while goal disengagement capacities may generally protect individuals from the experience of depressive symptoms when faced with unattainable goals (Dunne et al., 2011), depressive symptoms may also facilitate disengagement from unattainable goals, particularly in populations that are more likely to experience depressive symptomatology. Accordingly, the association between goal disengagement and lower depressive symptoms may be attenuated or reversed in individuals with, or at-risk for, depression. This may be the case because individuals who are at-risk of experiencing depression may experience intractable goal-related obstacles and subsequent depressive mood more frequently. In turn, this process may trigger repeated cycles of adaptive disengagement, and reinforce the association between depressive mood and goal disengagement capacities (Wrosch & Miller, 2009). Consequently, any association between goal

disengagement capacities and reduced depressive symptoms may be blunted in populations at-risk for depression, if depressive symptoms are more likely to facilitate individuals' goal disengagement capacities in these populations.

Limitations in the Previous Literature

Together, the existing body of theory and research points to the impact of age-related stress on the adaptive value of the motivational functions of anger, sadness, and related constructs. However, several limitations in the extant literature remain, which the current research aims to address:

1) *First, despite theoretical considerations pointing to the importance of considering individuals developmental context when exploring the adaptive value of negative emotions, previous research has only just begun to examine the role of age and stress experiences.*
2) *Second, research examining the divergent functions and consequences of different negative emotions is limited. The existing research often fails to provide discriminate validity for the effects of distinct negative emotions, such as anger and sadness.*
3) *Third, although theory points to divergent and age-related fluctuations in the adaptive value of distinct negative emotions, limited research has demonstrated age-related consequences of distinct negative emotions on emotional well-being and physical health. Further, the existing literature lacks process-oriented research, demonstrating the motivational mechanisms linking distinct negative emotions with differential patterns of emotional and physical well-being across older adulthood.*
4) *Fourth, given the vast literature demonstrating the benefits of letting go of unattainable goals in old age when resources are constrained, the field could benefit from a qualitative and quantitative synthesis.*
5) *Finally, more research is needed to clarify the nature and adaptive value of the sadness-disengagement process in older adulthood. Research and theory from personality and evolutionary psychology highlights the potentially adaptive value of a related process between depressive symptoms and goal disengagement capacities. Research demonstrating the impact of sadness on goal disengagement capacities, and the adaptive role of this related process could strengthen the theoretical arguments.*

Present Research

This dissertation consists of three studies that were designed to address the limitations of the previous literature. The present research aims to test and expand existing developmental and functional accounts of emotion by investigating and qualifying the associations of negative emotions with indicators of psychological well-being, physical health, and motivational processes.

Study 1 (Chapter 3) explored the age-related associations between older adults' daily experiences of anger and sadness with indicators of chronic low-grade inflammation (i.e., IL-6 and CRP) and chronic illness (e.g., arthritis, cancer, or diabetes) using cross-sectional data from the *Montreal Aging and Health Study*, an age-heterogeneous sample of community-dwelling older adults. The specific hypotheses of this study were:

Hypothesis 1.1*: Anger will be positively associated with levels of inflammation and illness particularly in advanced, as compared to early, old age.*

Hypothesis 1.2*: Sadness will be unrelated to, or associated with reduced, levels of chronic inflammation and illness, particularly in advanced, as compared with early, old age.*

Hypothesis 1.3*: The age-related associations between anger and sadness with chronic illness would be statistically mediated by levels of chronic inflammation.*

Study 2 (Chapter 4) investigated whether the associations between within-person sadness, anger, and goal disengagement capacities were moderated by between-person levels of stress (i.e. perceived stress and daily cortisol). In addition, this study examined the adaptive value of the sadness-disengagement process, by testing whether individuals who improve their goal disengagement capacities when they experienced sadness were buffered from the detrimental within-person associations between stress (i.e. perceived stress and daily cortisol) and emotional well-being (i.e. positive and negative affect). We tested these hypotheses using 10 years of data from the *Montreal Aging and Health Study*. The specific hypotheses of this study were:

Hypothesis 2.1*: Sadness, but not anger, will be associated with improved goal disengagement capacities.*

Hypothesis 2.2*: The association between sadness and improved goal disengagement capacities will be most pronounced among individuals who had generally higher levels of stress.*

Hypothesis 2.3*: Individuals who are more generally able to disengage in response to the*

experience of sadness will be buffered from the negative impact of stressful life circumstances on their emotional well-being.

Study 3 (Chapter 5) focused on the associations between goal adjustment capacities and quality of life and explored the moderating role of key factors such as age, and depression risk status, using meta-analytic techniques. This meta-analysis quantified more general associations between goal disengagement and goal reengagement with indicators of quality of life, and explored the moderating role of quality of life type (i.e. psychological well-being vs. physical health), subtypes (i.e. positive vs. negative indicators of psychological well-being, and self-report vs. objective measures of physical health), and sample demographics (e.g., age). Additionally, this meta-analysis quantified and compared the associations between goal disengagement capacities in samples at-risk for depression and normative sample. This meta-analysis aggregated 421 effect sizes from 31 independent samples. The specific hypotheses of this study were:

Hypothesis 3.1*: Goal disengagement and goal reengagement capacities will be positively linked to higher levels of quality of life.*

Hypothesis 3.2*: The associations between goal disengagement and goal reengagement capacities with quality of life will be moderated by other key factors (e.g., quality of life subtype).*

Hypothesis 3.3*: The relation between goal disengagement capacities and depressive symptoms will be attenuated or reversed in samples at-risk for depression.*

CHAPTER 3:
STUDY 1

Is anger, but not sadness, associated with chronic inflammation and illness in older adulthood?

Note: Copy edited version of this study was published in *Psychology and Aging*, May 2019

Abstract

The discrete emotion theory of affective aging postulates that anger, but not sadness, becomes increasingly maladaptive during older adulthood in predicting health-relevant physiological processes and chronic disease (Kunzmann & Wrosch, 2018). However, it is largely unknown whether different negative emotions have distinct functional consequences in the development of older adults' physical disease. To start examining this possibility, we investigated whether older adults' daily experiences of anger and sadness were differentially associated with two biomarkers of chronic low-grade inflammation (interleukin-6 [IL-6] and C-reactive protein [CRP]) and the number of chronic illnesses (e.g., heart disease, cancer, etc.). In addition, we examined whether such divergent associations would become paramount in advanced, as compared to early, old age. A community-dwelling study of 226 older adults (age 59 to 93; M = 74.99, SD = 7.70) assessed participants' anger and sadness over one week, inflammatory processes, number of chronic illnesses, and relevant covariates. Regression analysis showed that anger predicted higher levels of IL-6 and chronic illness in advanced, but not in early, old age. The age effect of anger on chronic illness was mediated by increased IL-6 levels. Sadness exerted a reversed, but non-significant, association with IL-6 and chronic illness, independent of age. No emotion or age effects were obtained for CRP. The study's findings inform theories of health, emotion, and lifespan development by pointing to the age-related importance of discrete negative emotions in predicting a major physiological pathway to physical health across older adulthood.

Keywords: sadness; anger; chronic inflammation; chronic illness; older adulthood.

Introduction

Functional approaches to emotion posit that specific negative emotions can exert different functions, associated with distinct behavioral and physiological signatures (e.g., Ekman, 1999; Lazarus, 1991). Extending this view, the discrete emotion theory of affective aging postulates that the adaptive value of specific negative emotions varies across the life course (DEA, Kunzmann et al., 2014). This perspective assumes that anger can support overcoming blocked, but attainable, goals, while sadness may facilitate disengagement from unattainable goals. As such, anger, but not sadness, may become increasingly maladaptive and forecast health-related problems during old age; a life period characterized by a decline in personal control and a corresponding increase in intractable losses and unattainable goals (Heckhausen et al., 2010). Although negative emotions may compromise health particularly in older adulthood (Charles, 2010), research has yet to examine whether the experience of different negative emotions, such as anger and sadness, is differentially predictive of physical health. We explored this possibility by examining the associations between older adults' daily experiences of anger and sadness with a major physiological pathway to age-related disease (i.e., chronic low-grade inflammation, Allin & Nordestgaard, 2011) and their levels of chronic illness. Assuming that the distinct motivational responses associated with sadness and anger could differently modulate the experience of challenging life circumstances and associated health-relevant processes, we hypothesized that anger, but not sadness, would reliably predict higher levels of chronic inflammation and associated illnesses, particularly in advanced old age. These differential associations of anger and sadness with chronic inflammation and illness, by contrast, were expected to be relatively reduced in early old age.

The Discrete Emotion Theory of Affective Aging

Theories highlight that different negative emotions serve unique roles in signaling and addressing imbalances between individuals and their environments (e.g., Ekman, 1999; Frijda et al., 1989; Lazarus, 1991; Nesse, 2000). These functional approaches assume that discrete negative emotions are associated with distinct patterns of physiological activity, action impulses, and cognitive appraisals, each designed to address a specific imbalance between individuals and their environment (Krebig, 2010). The discrete emotion theory of affective aging extends functional approaches of emotion by offering a theoretical account that integrates lifespan developmental theory (DEA, Kunzmann et al., 2014). This approach assumes that opportunities

and constraints for pursuing personal goals change across the adult lifespan. While young adulthood is characterized by plenty of opportunities for overcoming goal-related problems, older adults often confront increasing irreversible losses, a reduction of personal resources, and the frequent experience of unattainable goals (Baltes & Smith, 2003). To adjust to these age-related challenges effectively, lifespan theory and research has shown that individuals need to adjust their motivational responses to age-related opportunities and constraints by switching from attempts to overcome goal-related challenges at younger ages to adjusting psychologically to the experience of unattainable goals in older adulthood (Heckhausen et al., 2010).

To this end, the DEA posits that discrete negative emotions may support or hinder effective age-related adaptation processes. These emotions may reflect individual differences in response to specific situations (e.g., emotional states) or across different contexts (e.g., daily, weekly, or trait-level emotions). Irrespective of these different levels of functioning, the DEA assumes that the adaptive value of discrete emotions depends on the degree to which they enable the successful management of age-specific opportunities and constraints, residing in the individual, the environment, or both (Kunzmann et al., 2014; Kunzmann & Wrosch, 2017).

This theory has focused, so far, on anger and sadness. Anger has been described as an approach-oriented affect (Carver & Harmon-Jones, 2009) that can result from obstacles to goal pursuit (Lazarus, 1991). Anger is often associated with a highly aroused physiological profile that supports persistence in overcoming goal blockages or reversing injustice (e.g., Frijda et al., 1989; Keltner & Gross, 1999; Kunzmann, Rohr, Wieck, & Wrosch, 2017). Sadness, by contrast, is typically experienced as a response to irreversible losses (e.g., Cole & Dendukuri, 2003; Kunzmann & Grühn, 2005; Kunzmann et al., 2017), and can facilitate the reprioritization of goals and the pursuit of realistic plans either directly or through the recruitment of social support (Heckhausen, Wrosch, & Schulz, 2019; Klinger, 1975; Nesse, 2000; Wrosch & Miller, 2009).

Based on the premise that different negative emotions serve distinct functions, research on the age-related trajectories of sadness and anger has shown that the salience of anger tends to decline from young adulthood to old age, while the salience of sadness increases with age, particularly during the later parts of older adulthood when many individuals confront an increasing number of irreversible developmental losses (e.g., Kunzmann & Thomas, 2014; Kunzmann, Richter, & Schmukle, 2013; Wrosch, Barlow, & Kunzmann, 2018). The emergence of age differences in the salience of different negative emotions could further imply that sadness

and anger become differentially adaptive in older adulthood, considering that psychological processes are particularly prominent during life phases when they serve an adaptive function (cf. developmental evolutionary psychology, Buss, 1995). To this end, age-related declines in opportunities and increases in constraints during older adulthood could make it possible that anger is particularly maladaptive during this life period if it fosters the continued pursuit of unattainable goals and prompts repeated failure experiences (Kunzmann et al., 2014). Sadness, by contrast, may become relatively more functional among older adults if it facilitates the effective adjustment of unattainable goals (Nesse, 2000; Wrosch & Miller, 2009). Previous research has provided preliminary support for this proposition by showing that responding with sadness, but not anger, to an emotionally neutral film clip facilitated older adults' psychological well-being (Haase et al., 2012).

Discrete Negative Emotions and Health-Related Processes in Old Age

Negative life events and stressful experiences can elicit a host of negative emotions that can become chronic and jeopardize health behaviors (e.g., physical activity, Roshanaei-Moghaddam et al., 2009) or dysregulate physiological processes in the neuroendocrine and autonomic systems (e.g., cortisol, Cohen et al., 2007; Kiecolt-Glaser et al., 2002), which may further modulate immune function (e.g., chronic low-grade inflammation, Miller, Cohen, & Ritchey, 2002). Thus, stress-related psychological and physiological responses may fuel chronic inflammation and place individuals at risk of developing chronic disease. In support of this argument, the dysregulation of immune function has been considered a core physiological pathway to morbidity and mortality (Ershler & Keller, 2000). This process may become particular important in older adulthood, when individuals frequently show elevated levels of chronic inflammation (Franceschi et al., 2014; Piazza et al., 2010), which can contribute to the development of chronic illness, including heart disease, osteoarthritis, diabetes, or some cancers (Allin & Nordestgaard, 2011; Danesh et al., 2004).

While negative emotions are widely thought to contribute to chronic illness by linking stressful experiences and chronic inflammation (Cohen et al., 2007), most of the extant work is limited in at least three respects. First, it has focused on a dimensional view of affect, combining different negative emotions. As such, there is a paucity of research examining whether distinct negative emotions, such as anger and sadness, are equally predictive of physical disease (Kunzmann & Wrosch, 2018; Suls, 2018). Considering their distinct physiological and

motivational functions (Carver & Harmon-Jones, 2009; Frijda et al., 1989; Keltner & Gross, 1999; Nesse, 2000), however, it would be plausible to assume that anger and sadness are differentially related to inflammatory processes and physical health.

Second, the small literature on the health effects of specific negative emotions is mixed, with some studies demonstrating links between the experience of anger and increased IL-6 (Carroll et al., 2011) and others finding no association with indicators of inflammation (Moons & Shields, 2015). In addition, research comparing the effects of different negative emotions frequently relies on examining trait-level emotions (Suls, 2018). However, trait-level negative emotions, as compared to more transient and fluctuating situation-specific emotional experiences, generalize across circumstances and may become disconnected from their original functions. As such, trait-level negative emotions may be frequently maladaptive, independent of the specific emotion experienced, which could explain their widely observed adverse effects on physical disease (Cohen et al., 2007; Suls, 2018). For example, at a trait level, all negative emotions may tend to be dysfunctional, given that they are arguably decoupled from contextual demands. Thus, trait sadness and anger, which is not elicited by particular events, may serve maladaptive functions and jeopardize individuals' physical health (e.g., Glaser et al., 2003). By contrast, at a state-level, the differential functions of specific negative emotions (e.g., in situations, over days, or over weeks) may become more evident, and their distinct consequences may at times be functional and, thus, not health-damaging. For example, the experience of sadness in response to irreversible losses may foster necessary psychological adaptation and ameliorate health-related physiological processes (Heckhausen, Wrosch, & Schulz, 2019).

Third, and perhaps most importantly, past work has not considered the possibility that the associations between discrete negative emotions and physical health may depend on an individual's age. Different from earlier life phases, older adulthood is characterized as a life phase that involves increasingly frequent experiences of intractable losses and unattainable goals (Heckhausen et al., 2010). In addition, theory and research point to older adults' increased vulnerability to the adverse health effects of emotional distress due to an age-related decrease in the organism's ability to down-regulate physiological arousal (Charles, 2010; Graham et al., 2006). Although the latter argument may suggest a general age-related physiological mechanism, in which a wide range of negative emotions could increase older adults' vulnerability to inflammation and disease, our approach further considers that age-adapted emotions can help

individuals to overcome age-normative problems in their daily lives. From this perspective, older adults generally encounter relatively few circumstances in which anger could contribute to overcoming emerging losses and problems with futile goals. Instead, older adults may more frequently experience situations that require them to respond with sadness to emerging challenges, fostering necessary goal adjustment and ameliorating individuals' stress experiences and associated inflammation and disease. Thus, an age-adapted experience of negative emotions, characterized by reduced anger and comparably enhanced sadness in response to situational challenges, could exert some important functions in old age. In addition, the instigation of successful adaptation processes could prevent these emotions from becoming chronic and render them less likely to affect disease-related processes (Kunzmann & Wrosch, 2018).

Considering both the generally enhanced vulnerability to the adverse health effects of negative emotions in older adulthood as well as the different motivational consequences of distinct negative emotions, we would expect an adverse association to emerge particularly between older adults' anger and their levels of chronic inflammation and physical health. By contrast, adverse effects of sadness on health-related outcomes should be considerably reduced or even reversed as long as these emotions are elicited in response to specific challenges and do not become chronic (Kunzmann & Wrosch, 2018). Importantly, however, such a differential pattern may be observed particularly in advanced old age, when many individuals confront an increasing number of intractable losses (Gerstorf et al., 2010). In early old age, by contrast, individuals are more likely to encounter still manageable challenges that could be resolved through active behavioral responses (e.g., during the onset of age-related declines; for distinguishing early from advanced old age, see Baltes & Smith, 2003). As such, in early old age, anger could at times still contribute to overcoming emerging problems, while sadness may exert a comparatively maladaptive function (Wrosch et al., 2018). A corollary of this argument is that reliable differences in the relative effects of anger and sadness on inflammatory processes and chronic illness should become paramount in advanced old age, but potentially reduced in early old age.

The Present Study

This study examined the age-related associations between older adults' daily experiences of anger and sadness with indicators of chronic low-grade inflammation (i.e., IL-6 and CRP) and chronic illness (e.g., arthritis, cancer, or diabetes) in an age-heterogeneous sample of

community-dwelling older adults. Given that anger could become increasingly maladaptive, and sadness increasingly adaptive during older adulthood, we hypothesized interaction effects to emerge between sadness and anger with age in predicting older adults' chronic inflammation and illness. That is, anger was expected to be positively associated with levels of inflammation and illness in advanced old age, but to a lesser extent in early old age. Sadness, by contrast, was expected to be unrelated to or to even predict reduced levels of chronic inflammation and illness, particularly in advanced, as compared with early, old age. Finally, considering that a dysregulation of immune function could underlie the experience of chronic disease, we hypothesized that the age-related associations between anger and sadness with chronic illness would be statistically mediated by levels of chronic inflammation.

Methods

Participants and Procedures

Data were drawn from the Montreal Aging and Health Study (MAHS). The MAHS originally sampled 215 community-dwelling older adults aged from the Montreal, Quebec, Canada area. After ten years of data collection, the MAHS sample was refreshed, and new measures that are pertinent for the present study (e.g., IL-6) were added. Consequently, only cross-sectional data from this time point were analyzed. Participants were recruited via newspaper advertisements in the Montreal area. The MAHS was approved by the institutional ethics review board. Written informed consent was obtained from participants prior to participation.

The current sample included 268 participants (96 original and 172 newly recruited participants) who were assessed in their homes or in the laboratory. Study attrition of the original participants from baseline to 10-year follow up was attributable to death (n = 43), refusal to participate in the study (n = 17), loss of contact (n = 20), withdrawal due to personal reasons (n = 9), inability to follow study directions (n = 3), or unknown reasons (n = 27). At the original baseline of the study, participants who had dropped out were not significantly different from those 96 participants who remained in the study, for most of the available study variables (i.e., sex, SES, BMI, smoking, chronic illness, sadness, and anger; all ps > .40). However, participants who dropped out were significantly older than those who remained in the study (t(211.74) = 3.73, p < .01).

The assessment consisted of a general questionnaire, the collection of blood drops, and

subsequent daily assessment of emotions. Because we were interested in participants' normative experiences, for the daily assessment they were instructed to complete short questionnaires over the course of one week towards the end of three non-consecutive typical days (days during which they did not expect extraordinary events; e.g., an unusual doctor's appointments). Sample size was determined a-priori, based on power calculations reported in the associated grant proposal. The analytic sample was restricted to 226 participants (age range = 59 to 93) with available IL-6, CRP, and discrete emotions data. Six of the excluded participants had CRP scores that exceeded 10 mg/L, indicating the likely presence of acute infections (Pearson et al., 2003). Excluded participants had significantly higher levels of IL-6 (M = 0.60, SD = 0.57) and CRP (M = 0.24, SD = 0.70) than those retained (IL-6: M = 0.12, SD = 0.0.34; t(7.183) = -2.41, p = .05; CRP: M = -0.06, SD = 0.42; t(24.82) = -2.10, p = .05), but did not differ on any of the other main study variables (|ts| < 1.13, ps > .27).

Instrumentation

Chronic inflammation. Interleukin-6 (IL-6) and C-reactive protein (CRP) were measured using dried blood spots. Research assistants collected up to five drops of whole capillary blood using a finger prick with a disposable single-use lancet, and filter paper designed for this purpose (Whatman 903; GE Healthcare, Piscataway, NJ). The filter paper was left out to dry and then stored in a freezer. After completion of the study, the samples were analyzed in the Laboratory for Human Biology Research at Northwestern University, using a high sensitivity enzyme-linked immunosorbent assay (ELISA) protocol to quantify IL-6 and CRP levels. This protocol has demonstrated appropriate levels of precision, reliability, accuracy, and high correlations with serum-based results (McDade, Burhop & Dohnal, 2004; Miller & McDade, 2012). In the present study, the averaged inter-assay coefficient of variation was 7.51% for IL-6 and 5.84% for CRP.

Chronic illness. Participants were asked to respond to a previously used checklist (Wrosch et al., 2007) that asked them to report whether they were diagnosed with 17 different common age-related chronic illnesses (e.g., cardiovascular problems, arthritis, cancer, or diabetes). Chronic illness was indexed by counting the number of medical diagnoses reported. 10.2% of participants reported no chronic illness, 20.8% one, 23.5% two, 22.6% three, 9.7% four, 6.2% five, and 6.9% reported six or more chronic illnesses.

Sadness and anger. Participants were asked to report the extent to which they

experienced specific emotions during the day at the end of three non-consecutive typical days. They completed the assessment within one week, and non-consecutive days were chosen to decrease the likelihood that emotional experiences were related to one single event. Sadness and anger were measured with single items, using 5-point Likert-type scales ranging from 0 (*very slightly or not at all*) to 4 (*extremely*). To obtain scores of discrete emotions, the sum scores of anger and sadness were separately computed across days. Positive associations were obtained across the three days for both anger (r = .23 to .42, ps < .01) and sadness scores (r = .54 to .58, ps < .01), indicating some stability of emotional experiences across days. The magnitude of these correlations indicates an intermediate level of emotional experience, in between situation-specific and trait-like emotions, and is consistent with longitudinal research (using the same methodology) showing low to moderate size positive associations over 2-year intervals (Wrosch et al., 2018).

Sociodemographic variables. Information was collected on participants' age, sex, objectively measured BMI (weight in kilograms divided by height in meters squared), smoking status (0 = no, 1 = yes), education (ranging from 0 = *no education* to 16 = *doctorate*), income (0 = less than $17,000, 1 = up to $34,000, 2 = up to $51,000, 3 = up to $68,000, 4 = up to $85,000, 5 = more than $85,000), and perceived socioeconomic status (ranging from 1 = *low* to 10 = *high* on a ladder diagram). A composite mean score of education, income, and perceived socioeconomic status (rs = .32 to .48, ps < .01) was computed to obtain a reliable measure of SES. Sex, BMI, smoking status, and SES were included in the analysis as covariates to control for their possible confounding effects on inflammation and disease reported in other research (Danesh et al., 2000; Duncan et al., 2003).

Data Analysis

Prior to data analyses, values of IL-6 and CRP were log transformed to stabilize variance. The distribution of chronic illness was found to be approximately normal (skewness = 1.38, kurtosis = 3.35; Kline, 2009). Preliminary analyses were conducted to describe the sample and examine zero-order correlations among study variables. The study's hypotheses were tested using three separate multiple regression analyses, predicting levels of IL-6, CRP and chronic illness (SPSS V. 23.0). These analyses followed the same procedure. Predictor variables were standardized prior to conducting the main regression analyses. Given the proportion of missing data was less than 2% on any one variable, missing scores of covariates were replaced with the

sample mean. In the first step, the main effects and covariates (anger, sadness, age, sex, BMI, smoking status, and SES) were entered into the regression equation to predict individuals' levels of IL-6, CRP, or chronic inflammation. In the second step, the interaction effects of anger and age, and of sadness and age were additionally and separately entered into the model. Significant interactions were followed up by estimating the simple slopes and regions of significance of the associations between specific emotions and inflammation and health separately for individuals in early and advanced old age (i.e., +/- 1 SD about the sample mean). Further, follow-up mediation analyses were conducted by calculating the indirect effects in bootstrap analyses (95% bias-corrected confidence interval [BCI] using 5000 bootstraps) using PROCESS (Hayes, 2017) to determine if the significant age-related interaction effects of sadness and anger in predicting chronic illness were mediated by levels of chronic inflammation.

Results

Preliminary Analyses

Descriptive statistics are reported in Table 1. Participants were on average 75 years old (*SD* = 7.81), and approximately 62% of the sample was female. They were largely balanced across income levels (34% had an income less than $34,000, 36% had an income between $34,001 and $68,000, and 30% had an income greater than $68,000), and the sample was well educated (47% received at least a Bachelor's degree). The average perceived social status was somewhat above mid-range. Finally, the average BMI was in the normal range, only a minority of participants reported smoking (5%), and participants reported an average of 2.57 chronic illnesses.

The zero-order correlations between the main study variables are reported in Table 2. Of note, anger and sadness were moderately positively correlated ($r = .37$, $p < .01$), suggesting that these emotions are related, but distinct constructs. Both indicators of chronic inflammation were associated with higher BMI (IL-6: $r = .22$, $p < .01$; CRP: $r = .28$, $p < .01$), lower SES (IL-6: $r = -.16$, $p = .01$; CRP: $r = -.18$, $p < .01$), and more chronic illness (IL-6: $r = .21$, $p < .01$; CRP: $r = .13$, $p = .04$). Levels of IL-6 and CRP were moderately positively associated ($r = .40$, $p < .01$), and IL-6 levels were higher in male compared to female participants ($r = -.15$, $p < .05$), whereas CPR was associated with smoking ($r = .16$, $p < .05$). In addition, Age was associated with higher IL-6 ($r = .23$, $p < .01$), more chronic illness ($r = .21$, $p < .01$), less smoking ($r = -.17$, $p = .01$), and a lower SES ($r = -.19$, $p < .01$). Finally, smoking was associated with a lower BMI ($r = -.14$,

Table 1.

Means, Standard Deviations, and Frequencies of Main Study Variables (N = 226)

Constructs	Mean (SD) or Percentage	Range
Interleukin-6 (log IL-6)	0.12 (0.34)	-0.96 – 1.26
C-reactive protein (log CRP)	-0.06 (0.42)	-1.22 – 0.86
Number of Chronic Illnesses	2.57 (1.92)	0 – 12
Anger	0.62 (1.27)	0 – 9
Sadness	1.11 (1.94)	0 – 12
Age	75.00 (7.81)	59 – 93
Female (%)	61.5	
Body mass index	27.01 (4.62)	14.81 – 43.25
Smoking (%)	4.5	
Education (%)		
Primary school/other	5.2	
High school	34.8	
College/trade	13.6	
Bachelor	27.7	
Master/PhD	18.8	
Annual income (%) (T1)		
Less than $17,000	9.2	
$17,001 - $34,000	25.1	
$34,001 - $51,000	25.6	
$51,001 - $68,000	10.6	
> $68,000	29.5	
Perceived social status (T1)	6.74 (1.70)	1 – 10

Table 2.

Zero-Order Correlations Between Study Variables (N = 226)

	1	2	3	4	5	6	7	8	9
1. Interleukin-6 (log IL-6)									
2. C-reactive protein (log CRP)	.40**								
3. Number of Chronic Illnesses	.22**	.13*							
4. Anger	.08	.02	.09						
5. Sadness	-.04	.06	-.00	.37**					
6. Age	.23**	.05	.21**	-.11	-.07				
7. Female	-.15*	.01	.02	.03	-.05	-.04			
8. Body mass index	.23**	.28**	.11	.04	-.12	-.03	-.07		
9. Smoking	.12	.16*	-.10	-.00	.08	-.17*	-.01	-.14*	
10. Socioeconomic status	-.16*	-.18**	-.12	-.11	-.07	-.19**	-.11	-.10	-.07

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

$p < .05$).

Main Analyses

The results of the regression analyses are reported in Table 3. The first step, including all covariates and main effect variables, showed significant model effects for IL-6 ($F(7, 218) = 6.97$, $p < .01$, $R^2 = .18$), CRP ($F(7, 218) = 5.58$, $p < .01$, $R^2 = .15$), and chronic illness ($F(7, 218) = 2.64$, $p = .01$, $R^2 = .08$). Of the covariates, a higher BMI (IL-6: $\beta = 0.08$ $SE = .02$, $t = 3.73$, $p < .01$, $R^2 = .05$; CRP: $\beta = 0.13$, $SE = .03$, $t = 4.90$, $p < .01$, $R^2 = .09$), and being a smoker (IL-6: $\beta = 0.06$, $SE = .02$, $t = 2.99$, $p < .01$, $R^2 = .03$; CRP: $\beta = 0.09$, $SE = .03$, $t = 3.14$, $p < .01$, $R^2 = .04$), were significantly associated with higher levels of IL-6 and CRP. Finally, the main effects model showed that age was associated with IL-6 ($\beta = 0.09$, $SE = .02$, $t = 3.94$, $p < .01$, $R^2 = .06$), and chronic illness ($\beta = 0.39$, $SE = .13$, $t = 3.00$, $p < .01$, $R^2 = .04$), indicating that older, as compared to younger, participants had higher levels of IL-6 and more chronic illnesses. No other covariate or main effects emerged.

The second step of the analysis showed significant interaction effects between anger and age on levels of IL-6 and chronic illness (see Table 3; IL-6: $\beta = 0.06$, $SE = .02$, $t = 2.39$, $p = .02$, $R^2 = .02$; chronic illness: $\beta = 0.30$, $SE = .14$, $t = 2.12$, $p = .04$, $R^2 = .02$). The interaction effect between sadness and age did not predict levels of IL-6 or chronic illness, and no statistically significant interactions emerged for CRP. The significant interaction effects are plotted in Figure 1. The observed pattern suggests that participants in advanced old age, who experienced high levels of anger, exhibited the highest levels of IL-6 and chronic illnesses. Comparatively lower levels of chronic inflammation and illness were observed among young-old participants, who experienced high levels of anger, and among participants, who generally experienced low levels of anger (independent of age). Follow-up analyses of the simple slope supported this interpretation. Higher levels of anger were significantly associated with higher levels of IL-6 and chronic illness among participants in advanced old age (IL-6: $\beta = 0.10$, $SE = .03$, $t = 3.00$, $p < .01$; chronic illness: $\beta = 0.52$, $SE = .20$, $t = 2.57$, $p = .01$), but not among their relatively younger counterparts (IL-6: $\beta = -0.02$, $SE = .03$, $t = -0.41$, $p = .68$; chronic illness: $\beta = -0.09$, $SE = .19$, $t = -0.46$, $p = .64$). Conversely, a higher age was significantly associated with greater levels of IL-6 and chronic illness among individuals who experienced high levels of anger (IL-6: $\beta = 0.15$, $SE = .03$, $t = 4.40$, $p < .01$; chronic illness: $\beta = 0.72$, $SE = .20$, $t = 3.58$, $p < .01$), but not among individuals with comparatively lower levels of anger (IL-6: $\beta = 0.03$, $SE = .03$, $t = 1.09$, $p = .28$;

Table 3.

Multiple Regression Analyses Predicting Chronic Low-Grade Inflammation (IL-6), C-Reactive Protein (CRP), and Chronic Illness

	Interleukin-6 (log IL-6)			C-reactive protein (log CRP)			Chronic Illness		
	ß (SE)	T Ratio	*p*	*ß* (SE)	T Ratio	*p*	*ß* (SE)	T Ratio	*p*
Step 1									
Intercept	0.12 (0.02)	5.56**	.00	-0.06 (0.03)	-2.38**	.00	2.57 (0.13)	20.64**	.00
Female	-0.05 (0.02)	-2.17*	.03	0.01 (0.03)	0.41	.68	0.04 (0.13)	0.32	.75
SES	-0.03 (0.02)	-1.37	.17	-0.05 (0.03)	-1.76	.08	-0.13 (0.13)	-0.97	.33
BMI	0.08 (0.02)	3.73**	.00	0.13 (0.03)	4.90**	.00	0.19 (0.13)	1.49	.14
Smoking	0.06 (0.02)	2.99**	.00	0.09 (0.03)	3.14**	.00	-0.10 (.013)	-0.81	.42
Age	0.09 (0.02)	3.94**	.00	0.03 (0.03)	1.16	.25	0.39 (0.13)	3.00**	.00
Anger	0.04 (0.02)	1.81	.07	-0.01 (0.03)	-0.47	.64	0.20 (0.14)	1.47	.14
Sadness	-0.02 (0.02)	-1.07	.29	0.04 (0.03)	1.33	.19	-0.02 (0.14)	-0.18	.85
Step 2									
Age × Anger	0.06 (0.02)	2.39*	.02	0.02 (0.03)	0.61	.54	0.30 (0.14)	2.12*	.03
Age × Sadness	0.01 (0.02)	0.42	.68	0.02 (0.03)	0.55	.58	0.06 (0.13)	0.44	.66

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

Note. The interaction effects were tested in separate models.

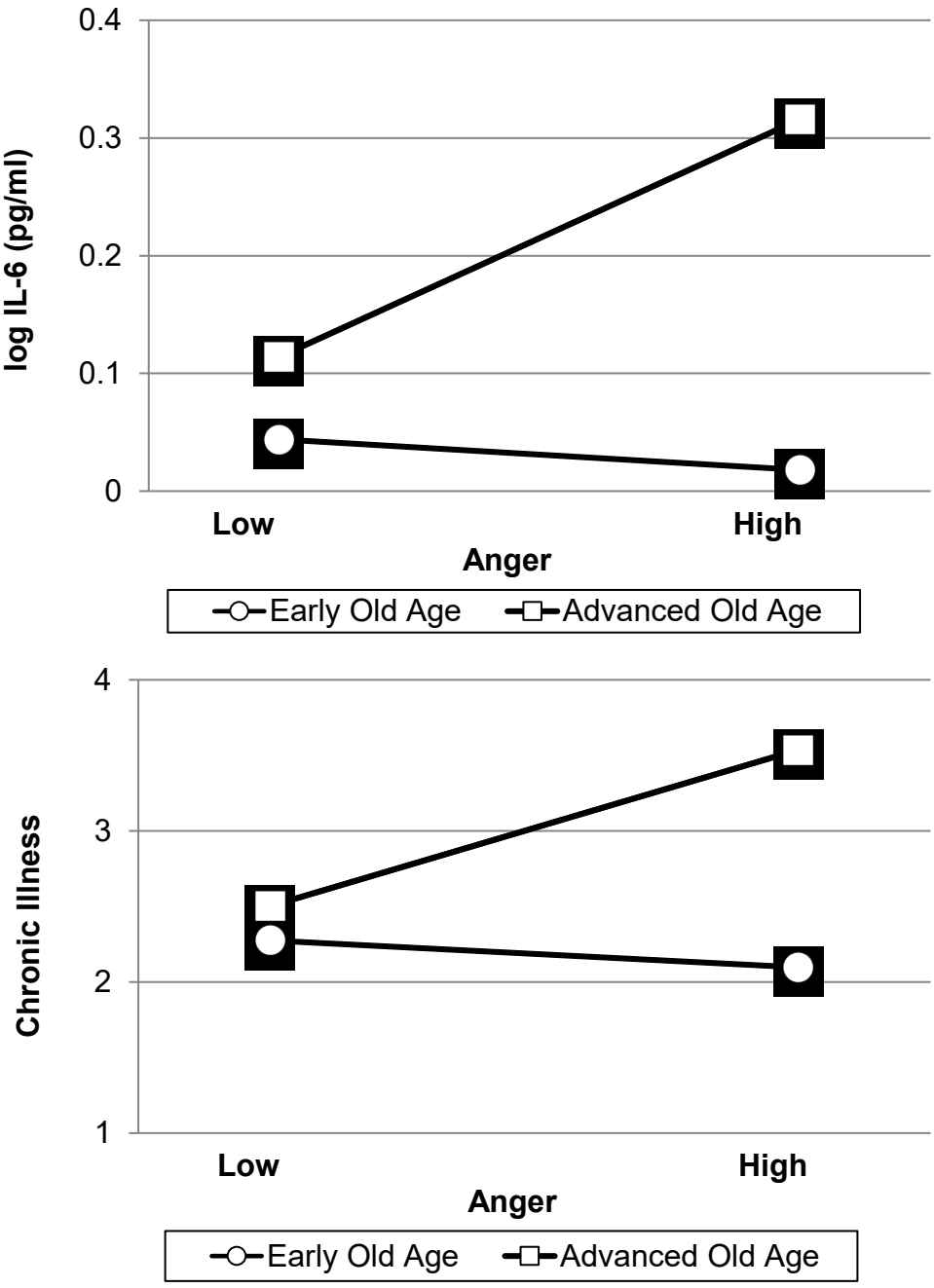

Figure 1. The association between anger and levels of IL-6 (upper panel), and number of chronic illnesses (lower panel), separately for individuals in early old age (-1 SD) and advanced old age (+1 SD). High and low anger is plotted at one standard deviation above and below the sample mean.

chronic illness: $\beta = 0.11$, $SE = .19$, $t = 0.61$, $p = .54$). Further, a slope region of significance test (Preacher, Curran & Bauer, 2006) revealed that the slope among participants in advanced old age became significant at the age of 75.00 for IL-6, and 76.60 for chronic illness. The slope for IL-6 or chronic illness did not become significant within the observed age range among relatively younger participants.

Mediation analyses were conducted to determine if the interaction of anger and age for predicting chronic illness was mediated by IL-6. The results of the mediation analyses are illustrated in Figure 2 and showed that adding IL-6 to the regression model rendered the interaction between anger and age on chronic illness non-significant ($\beta = 0.26$, $SE = 0.14$, $t = 1.79$, $p = .08$). In addition, they confirmed a significant indirect effect of IL-6 in explaining the interaction effect of anger and age on the number of chronic illnesses (95% BCI [0.003, 0.138]). This indirect effect was significant among older participants (+1 SD: 95% BCI [0.055, 0.232]), but not among younger participants (-1 SD: 95% BCI [-0.080, 0.031]). These findings suggest that the higher number of chronic illnesses reported among participants in advanced old age who also experienced higher levels of anger, were partially mediated by their elevated levels of IL-6.[1]

Discussion

This study showed in a sample of community-dwelling older adults that the association between the daily experience of anger with levels of chronic inflammation and illness was moderated by participants' chronological age. In particular, the findings indicated that anger was related to higher levels of IL-6 and chronic illness, but only among individuals in advanced, and not early, old age. Further, individuals' IL-6 levels mediated the age-related association between anger and chronic illness. Sadness, by contrast, showed a negative, but non-significant, association with levels of IL-6 and chronic illness across older adulthood, but did not exert age-differential effects.

The reported results contribute to the extant literature on emotion and health by

[1] Additional analyses were conducted to determine the impact of trait-level negative affect on the reported results. To this end, our study included a measure of high-arousal negative affect, experienced during the past year (e.g., hostile, afraid, or upset), which has been shown trait-like stability (Watson et al., 1988). When negative affect was included in the analyses, the obtained interaction effects (IL-6: $\beta = 0.06$, $SE = .02$, $t = 2.57$, $p = .01$, $R^2 = .02$; chronic illness: $\beta = 0.28$, $SE = .14$, $t = 1.96$, $p = .05$, $R^2 = .02$) and mediation effect remained significant (overall: 95% BCI [0.002, 0.075]; older participants: 95% BCI [0.006, 0.132]; younger participants: 95% BCI [-0.043, 0.019]).

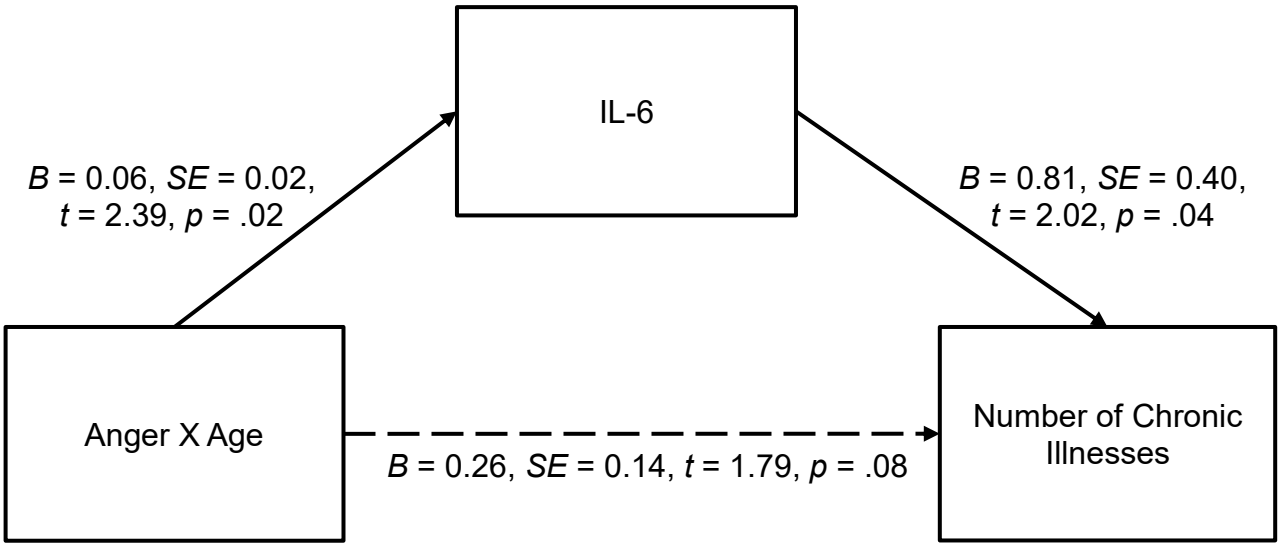

Figure 2. The indirect effect of IL-6 in the associations between the interaction effect of anger and age with the number of chronic illnesses.

highlighting the distinct roles of anger and sadness for predicting chronic inflammation and disease in older adulthood. More specifically, they suggest that anger, but not sadness, was associated with higher levels of IL-6 and chronic illness in advanced old age. Further, the age-related associations between anger and IL-6 remained significant when controlling for a number of sociodemographic and health-relevant covariates (see Table 3) as well as trait-like high arousal negative affect (e.g., hostile, afraid, or upset; Footnote 1). These results suggest that the divergent effects of these two negative emotions on chronic inflammation and illness across older adulthood may not be due to the generalized experience of negative affect or other measured covariates. They are further consistent with the theoretical claims that anger and sadness can exert different age-related functions, and that health effects of these two discrete negative emotions may depend on individuals' age-related opportunities and constraints for addressing developmental challenges (Kunzmann et al., 2014). However, we note that our study did not explicitly examine age-related opportunities and constraints and only included a trait-like measure of high-arousal negative affect. As such, it did not include a trait-measure of sadness, and future research is needed to replicate the observed findings and substantiate our conclusions. Such research may examine specific emotion-by-situation interactions and corresponding trait measures of emotions to disentangle health effects of situation-specific negative emotions from the corresponding experience of generalized negative affect.

The study's results may inform research postulating that anger could contribute to motivational attempts aimed at overcoming pressing problems and blocked goals (Carver & Harmon-Jones, 2009; Frijda et al., 1989; Keltner & Gross, 1999), while sadness is likely to facilitate adjustment to unattainable goals by promoting effective goal disengagement processes (Klinger, 1975; Nesse, 2000; Wrosch & Miller, 2009). In particular, towards the end of life, many individuals are likely to encounter a steep increase in intractable developmental losses across different areas of life (Baltes & Smith, 2003; Gerstorf et al., 2010). Here, the experience of anger may become particularly dysfunctional for effectively adjusting to uncontrollable age-related declines if it interferes with adaptive motivational processes by promoting persistence instead of needed adjustment to unattainable goals (Wrosch et al., 2013). In addition to targeting older adults' generally enhanced vulnerability to the health-related consequences of negative emotions (Charles, 2010), anger may prolong stressful circumstances and facilitate a dysregulation of neuroendocrine processes in advanced old age, which could have significant

implications for individuals' inflammatory processes and chronic illness (Cohen et al., 2007). In early old age, by contrast, individuals are more likely to experience the onset of age-related problems that may still be partially controllable. Here, the motivational concomitants of anger (e.g., persistence) may allow individuals to effectively counteract emerging age-related losses more frequently and ameliorate stressful experiences, thereby preventing adverse effects of challenges on chronic inflammation and disease.

The reported results further revealed that the age-related association between anger and chronic illness was statistically mediated by older adults' levels of IL-6. This pattern of results demonstrates that the stronger effect of anger on higher levels of chronic illness in advanced, as compared to early, old age was partially explained by participants' elevated levels of IL-6. It is further consistent with the notion that IL-6 represents a major physiological pathway to several age-related diseases, including heart disease, osteoarthritis, diabetes, or cancer (Allin & Nordestgaard, 2011; Danesh et al., 2004). Note, however, that these results were not replicated for predicting CRP. This may be the case because our study showed only a moderate correlation between CRP and IL-6 (r = .40 see Table 2). While the strength of the relation between these two biomarkers can depend on the physiological context (Czarkowska-Paczek et al., 2005), associations of similar magnitude have been shown in other community-dwelling samples of older adults (Puzianowska-Kuznicka et al., 2016). In addition, IL-6 appears to be more strongly related to affective symptoms than CRP (Howren et al., 2009), which could imply that IL-6 is a particular potent mediator for linking negative emotions and chronic illness. Finally, we acknowledge that the obtained differential associations between age-related negative emotions and different markers of inflammations could be due to measurement error. In this regard, we note that IL-6, but not CRP, was positively correlated with age in our sample (see Table 2). Since research has shown that chronic inflammation typically increases with age (Franceschi et al., 2014; Piazza et al., 2010), our measure of CRP may have incorporated some measurement error, which would explain its weaker association with participants' age and emotional experiences. Thus, future studies should obtain multiple samples of biomarkers to address measurement error in their analyses.

Note that the obtained age-related associations between anger, IL-6, and chronic illness were based on cross-sectional data, which could lead to alternative interpretations of the data. One issue with cross-sectional data frequently relates to possible "third variables" that could

explain associations with health-related variables (e.g., neuroticism, Watson & Pennebaker, 1989). Since our study included objectively measured health-relevant processes, however, we minimized the emergence of method overlap and consider this possibility as relatively unlikely. Nonetheless, chronic illness could also trigger certain negative emotions and associated chronic inflammation. In addition, such a process may be observed to a larger extent in advanced old age when physical health problems typically become more severe. We think that this possibility is plausible as well and does not compromise our interpretation of age-related effect of discrete negative emotions and health-related variables. In fact, theoretical models in lifespan developmental psychology have conceptualized bi-directional and reciprocal associations between negative emotions and health, and recent work suggests that such an association can increase with advancing age (Barlow, et al., 2017, Kunzmann, Schilling, et al., 2019, Wrosch, Schulz, & Heckhausen, 2004). Thus, the observed age-related link between anger, inflammation, and chronic illness could be triggered or become aggravated by disturbances in each of the processes involved and result in a downward spiral that compromises both older adults' emotional experience and their health.

Of note, although anger was negatively correlated with age in our study, this association did not reach statistical significance. Considering that past research has documented that older adults experience less anger than young adults (for a review, see Kunzmann & Wrosch, 2017), the latter finding seems somewhat inconsistent with this extant literature. However, it should be noted that a study including middle-aged adults demonstrated that anger may begin to decline in early midlife and can rebound slightly in older adulthood (Kunzmann et al., 2013). Therefore, it may be that a non-linear relation between anger and age has blunted the association, or that the levels of anger have already begun to plateau in our sample of community-dwelling older adults.

Further, it is important to address that sadness showed a negative, but non-significant, association with older adults' levels of IL-6 and chronic illness. The absence of an association between sadness and health-relevant outcomes does in our view not rule out the possibility that sadness could have exerted some beneficial health functions in our study. Given that older adults are generally vulnerable to the physiological and health consequences of negative emotions (Charles, 2010), the experience of sadness may have rendered such an adverse process less health-disruptive by enabling older adults to psychologically adjust to uncontrollable age-related challenges (Wrosch et al., 2013). This possibility would be consistent with our data in that anger,

but not sadness, predicted enhanced inflammation and chronic disease in advanced old age.

We also note that our theoretical framework expected that sadness could be relatively more adaptive during the later, as compared to earlier, parts of older adulthood. The reported data, however, did not support this hypothesis. In this regard, it could be possible that different types of sadness-related phenomena (e.g., ordinary feelings of sadness versus chronic sadness or depression, cf. Andrews & Thompson, 2009) exerted opposing effects on health-relevant outcomes in our study. For example, it has been argued that although feelings of sadness could provide some benefit to well-being and health by facilitating adaptive goal disengagement processes, the experience of chronic feelings of sadness could contribute to undesirable outcomes by depleting a person's motivational resources altogether or trigging dysfunctional health behaviors (Seligman, 1975; Heckhausen, Wrosch, & Schulz, 2019; Wrosch & Miller, 2009). Such opposing health effects may have prevented the detection of age effects for sadness in our study. In fact, steep reductions in well-being, including depressive symptomatology, have been reported as individuals enter advanced old age (Dunne, Wrosch, & Miller, 2011), and may have counteracted potential age-related associations of ordinary sadness. To shed further light on these possibilities, more research is needed to reveal the circumstances in which sadness and anger exert unique effects on individuals' health. We feel that such work is warranted and likely to illuminate the consequences of discrete emotional experiences on health-relevant outcomes across the adult lifespan.

Limitations and Future Directions

To the best of our knowledge, the present study is unique in providing a theory-based investigation of the divergent age-related effects of anger and sadness on a major physiological pathway to chronic illness. Indeed, research examining whether different negative emotions can exert varying effects on physical health outcomes has only begun, and often lacks a theoretical foundation (Suls, 2018; Kunzmann & Wrosch, 2018). Although the reported findings lend support to a lifespan perspective on discrete emotions and health-relevant outcomes, more theoretical and empirical work is needed to substantiate our conclusions. Here, we address the study's limitations and outline future research that may be needed to arrive at a comprehensive theory of discrete emotional experiences and developmental health outcomes across the adult lifespan.

First, the study's results were drawn from cross-sectional data, making it impossible to

determine causality. Future research should therefore replicate our findings using longitudinal and experimental designs. Second, our study asked participants to report their daily emotional experiences at the end of three days during one week. This approach should be complemented by studies using ecological momentary assessment of emotions (Shiffman, Stone, & Hufford, 2008), as well as measuring other emotion response systems (e.g., emotional expression and physiology; Levenson, 2000), trait-level emotions, and personality factors (e.g., neuroticism) that could influence the experience of emotions and health outcomes. Such work could reduce biases in the report of emotions and establish whether diverging effects of different negative emotions on inflammatory processes and health may generalize across different emotion response systems and varying stability of emotional reactions. In addition, it may identify important individual difference variables that could influence the situation-specific experience of negative emotions and exert associated effects on individuals' health. Third, potential mediators of the link between different negative emotions and chronic inflammation and illness should be studied. Such research may be capable of illustrating the entire process including individuals' emotional experiences in specific contexts, their mediating behavioral and physiological responses, and long-term health outcomes. For example, our theoretical model assumes that certain motivational processes (i.e., persistence versus disengagement, Heckhausen et al., 2010; Wrosch et al., 2013) and states of psychological and physiological stress (e.g., cortisol output, Cohen et al., 2007) could explain the different links between specific negative emotions and health-related outcomes. Fourth, the present study was restricted to older participants and future research should broaden the age range of inquiry. Since opportunities for overcoming developmental challenges change significantly from young adulthood to old age (Heckhausen et al., 2010), such research may determine stronger age effects of discrete negative emotions on emerging physiological risk factors of physical disease. Fifth, our approach considered age as a proxy for reductions in individuals' opportunities to overcome common developmental challenges. Future research should therefore assess age-related opportunity structures more directly by studying individuals' particular problems and exposure to stressors as well as the likelihood they could overcome them. Sixth, research should improve measurement by distinguishing ordinary sadness from chronic and severe feelings of sadness. There may be a tipping-point, when extreme and lasting negative emotional responses associated with depression reverse some of the potentially adaptive functions of sadness and result in maladaptive behavioral and health outcomes (Wrosch

& Miller, 2009). Finally, the study examined only sadness and anger because our theoretical model has focused thus far on the age-related functions of these two discrete emotions. Nonetheless, other negative emotions and different positive emotions may also serve divergent age-related functions. More theoretical work and subsequent empirical research is needed to illuminate the effects of a variety of discrete emotions on psychological processes, specific physiological pathways, and physical health outcomes across the lifespan.

Conclusion

The present study showed that the daily experience of anger, but not sadness, predicted elevated levels of low-grade inflammation and chronic illness in advanced, but not early, old age, when many individuals encounter a steep increase in insurmountable developmental losses. In addition, it suggested that the age-related effects of anger on chronic illness were partially explained by individuals' levels of IL-6. These findings support propositions from a discrete emotion approach to physical health (Kunzmann & Wrosch, 2018) by documenting divergent effects of different negative emotions on a major physiological pathway to a number of age-related diseases. Negative emotional experiences, such as anger, may exert strong effects on physical health if they are mismatched with the declining opportunities and motivational affordances of older adulthood. By contrast, other negative emotional experiences, such as sadness, could facilitate psychological adjustment to irreversible age-related losses in old age and buffer older adults' increased vulnerability to the health effects of emotional distress (Charles, 2010). A discrete emotion approach to physical health across the adult lifespan may thus represent a promising theoretical model that is capable of addressing both the potential benefits and adverse effects of different negative emotions.

CHAPTER 4:
STUDY 2

Discrete negative emotions and goal disengagement in older adulthood: context effects of stress and associations with emotional well-being

Abstract

This study examined whether sadness, but not anger, could facilitate adaptive goal disengagement capacity in older adulthood. To this end, we investigated the within-person effects of sadness and anger on older adults' goal disengagement capacity in the context of different stress markers. In addition, we tested whether such an association could protect emotional well-being when older adults encounter stressful circumstances. The study used data from a six-wave 10-year longitudinal study of 184 community-dwelling older adults (M_{age} = 72.08, SD_{age} = 5.70). Participants' sadness, anger, goal disengagement capacity, stress markers (i.e., perceived stress and diurnal cortisol levels), emotional well-being (i.e., positive and negative affect), and sociodemographic variables were assessed at each wave. Hierarchical linear modeling showed that within-person increases in sadness, but not anger, predicted improved goal disengagement capacity among older adults who generally secreted high levels of cortisol. Moreover, older adults' who disengaged more easily when they felt sad were protected from declines in positive affect during assessments in which they secreted high, but not low, levels of cortisol. The study's findings suggest that older adults' stressful life circumstances may facilitate an association between sadness and their goal disengagement capacity. This process prevented stress-related declines in emotional well-being.

Key words: goal disengagement capacities; sadness; anger; stress; aging.

Introduction

Functional approaches to emotion suggest that distinct negative emotions have evolved to help people cope with different situational demands (Ekman, 1999; Lazarus, 1991). The discrete emotion theory of affective aging (DEA, Kunzmann, Kappes, & Wrosch, 2014) extends these accounts by integrating a lifespan perspective and suggesting that the adaptive value of negative emotions should depend on the degree to which they facilitate the successful management of age-related opportunities and constraints for attaining specific goals or resolving stressors. Given that opportunities for addressing goal-related problems decline with advancing age (Heckhausen, Wrosch, & Schulz, 2010), DEA postulates that sadness may become relatively adaptive in older adulthood, as it could enable a person to disengage from overcoming intractable stressors and pursuing unattainable goals (Kunzmann et al., 2014). Other negative emotions, such as anger, may not exert the same function in old age, since anger is typically associated with counteracting surmountable problems or reversing injustice (Lazarus, 1991; Carver & Harmon-Jones, 2009). We tested these possibilities in a longitudinal sample of older adults by examining the associations and adaptive value of within-person changes in sadness and anger in predicting goal disengagement capacities in the context of different stress markers. We hypothesized that sadness, but not anger, would predict higher levels of older adults' goal disengagement capacity, and that such an association would be observable particularly among older adults who experience high stress levels. In addition, we explored whether the extent to which sadness facilitates goal disengagement capacity would protect older adults' emotional well-being during circumstances that involve enhanced levels of stress.

Discrete Negative Emotions, Goal Disengagement, and Well-Being in Old Age

Functional theories of emotion highlight that different negative emotions can serve unique roles in signalling and addressing imbalances between people and their environments. From this perspective, negative emotions have evolved to restore balance between persons and their environments in response to different situational demands (e.g., Ekman, 1999; Frijda, 1996; Lazarus, 1991; Nesse, 1990). Extending functional accounts of emotion, the discrete emotion theory of affective aging (DEA, Kunzmann et al., 2014) integrates lifespan developmental theory to explain age differences in the salience and adaptive value of discrete emotions across the adult lifespan (Kunzmann et al., 2014). In this regard, DEA posits that discrete negative emotions may be more salient and conducive to well-being and health if they are experienced in the context of

complementary age-specific opportunities and constraints for attaining personal goals and managing stressful encounters (Kunzmann & Wrosch, 2018). Such effects may be observed if an emotion is associated with motivational processes that foster adjustment to age-related problems (Barlow et al., 2019b; Consedine & Moskowitz, 2007; Kunzmann et al., 2014, 2018; Wrosch et al., 2018).

A corollary of the latter assumptions is that DEA provides a theoretical framework for identifying specific emotions that could facilitate or hinder processes of successful aging. To this end, theories of lifespan psychology have postulated that age-related changes in biological, socio-structural, and age-normative factors can reduce an older person's capacity to control a wide array of developmental outcomes (Baltes, 1987; Heckhausen & Schulz, 1995). For example, older adulthood frequently involves an increasing number of irreversible losses, a reduction in personal resources, and the frequent experience of unattainable goals (Brandtstädter & Rothermund, 2002; Heckhausen, Wrosch, & Schulz, 2010, 2019). As a consequence, older adults confront reduced opportunities to overcome age-related stressors and attain personal goals (Schulz & Heckhausen, 1996).

In order to optimize development in response to increasing age-related constraints, lifespan theories propose that older adults should engage in opportunity-adjusted motivational processes by switching from attempts to counteract goal-related stressors to disengaging from goals that have become unattainable (Brandtstädter & Renner, 1990; Heckhausen et al., 2010). This motivational process can be facilitated by people's goal disengagement capacity, which reflect a person's general tendency to withdraw effort and commitment from unattainable goals across domains (Wrosch et al., 2003, 2013). Narrative and meta-analytic reviews have linked goal disengagement capacities with high levels of subjective well-being and physical health, and shown that these associations are enhanced in older, as compared to younger, populations (Barlow, Wrosch, & McGrath, 2019a; Wrosch et al., 2013, Wrosch & Scheier, 2019). Such adaptive effects may occur because goal disengagement capacity can prevent the experience of repeated failure in the context of intractable stressors and unattainable goals, and preserve motivational resources that can be reallocated to the pursuit of other important activities (Wrosch et al., 2003, 2013).

Given that older adulthood is marked by increases in developmental constraints that may require people to disengage from unattainable goals more frequently (Baltes, 1987; Heckhausen

et al., 1995, 2010), DEA posits that sadness should become more salient and adaptive in old age. In this regard, the experience of irreversible losses and unattainable goals may elicit feelings of sadness, which could help older adults to disengage from unattainable goals and protect their general well-being (Kunzmann et al., 2014). Research based on DEA has shown that the salience of sadness increases with age, particularly during older adulthood (e.g., Kunzmann, Rohr, Wieck, Kappes, & Wrosch, 2017; Kunzmann & Thomas, 2014; Kunzmann, Richter, & Schmukle, 2013; Wrosch et al., 2018). In addition, experimental studies suggest that different from their younger counterparts, older adults' sadness experiences in response to neutral films were associated with higher levels of well-being, and their facial expression of sadness in response to watching other people's distress predicted an increase in their relational connectedness (Haase et al., 2012; Lwi et al., 2019).

Effects of sadness on goal disengagement processes, however, have not yet been demonstrated in older adulthood. Despite this lack of empirical evidence, theory from personality, social, and evolutionary psychology has posited that depressive mood, which is often associated with sadness, can facilitate de-commitment from an improbable incentive when people cannot overcome goal-related barriers (Klinger, 1975, see also Carver & Scheier, 2017). In a similar vein, Nesse (2000) theorized that depressive mood may confer an evolutionary advantage by facilitating the abandonment of goals whose pursuit is likely to result in danger, loss, or wasted effort. Moreover, sadness could signal the need for social support, which may, if provided, help older adults to accept the occurrence of irreversible losses (Andrews & Thomson 2009; Heckhausen et al., 2019).

Consistent with these ideas, research with populations other than older adults has provided empirical support for a link between sadness-related emotions and goal disengagement capacity. For example, experimental work showed that depressed adults disengaged faster from unsolvable, but not solvable, tasks as compared to a non-depressed control group (Koppe & Rothermund, 2016). In addition, longitudinal research demonstrated that depressive mood can predict increases in adolescents' goal disengagement capacity. Importantly, these observed increases in goal disengagement capacity were associated with subsequent improvements in emotional well-being (Wrosch & Miller, 2009).

A limitation of previous studies, however, relates to their focus on the predictive value of between-person differences in affective states. While the vast majority of empirical research in

psychological sciences has explored between-person associations, many psychological theories make predictions that could be better tested in within-person analyses (Voelkle et al., 2014). DEA, for example, assumes that people experience different functional emotions, as they move through different contexts that require divergent adaptation processes (Kunzmann et al., 2014). Thus, given that emotions can fluctuate across time and contexts, and that such changes may exert important motivational functions, research demonstrating that within-person increases in older adults' sadness can be functionally associated with improvements in their goal disengagement capacity would provide strong support for the proposed model.

The reported research on the link between emotion and goal disengagement is further limited as it did not examine whether negative emotions other than sadness or depressive mood would elicit similar or distinct effects. This is important because DEA considers that effects of negative emotions on older adults' goal disengagement capacities are uniquely related to the experience of sadness, and may not extend to other discrete emotions, such as anger (Kunzmann et al., 2014). In fact, anger is thought to represent an approach-oriented affect that triggers persistence in active goal pursuits, overcoming surmountable goal obstacles, and reversing injustices (Carver & Harmon-Jones, 2009; Lazarus, 1991). As such, anger is rather unlikely to facilitate disengagement from unattainable goals, and may become less salient and adaptive in older adulthood, when many people confront an increasing number of developmental losses and unattainable goals (Kunzmann et al., 2014). Consistent with these assumptions, empirical research has shown that older adults generally experience less anger than their younger counterparts (Kunzmann, Richter, & Schmukle, 2013; Kunzmann, Rohr, Wieck, Kappes, & Wrosch, 2017; Kunzmann & Thomas, 2014; Kunzmann & Wrosch, 2017). In addition, it documented that the experience of anger, but not sadness, was associated with increased levels of chronic inflammation and physical disease as older adults advanced in age (Barlow et al., 2019b).

The Role of Individual Differences in Older Adults' Stress Experiences

The previous discussion suggests that increases in sadness, but not anger, could facilitate older adults' adjustment to an increasing number of age-related stressors by fostering disengagement from unattainable goals and protecting their general emotional well-being. Although DEA builds on the idea that aging involves an increasingly frequent exposure to severe stressors that constrain the pursuit of self-relevant goals (Baltes, 1987; Heckhausen et al., 2010),

it is important to note that there is significant heterogeneity in older adults' stress experiences, and some people may encounter more severe or different stressors than others (Baltes & Smith, 2003). Such individual differences may be reflected in psychological perceptions of stress (Cohen, Kamarck, & Mermelstein, 1983). In addition, they could relate to biological markers of stress, such as diurnal cortisol levels (Kirschbaum & Hellhammer, 1989; Schaeffer & Baum, 1984). Diurnal cortisol levels have been shown to be enhanced particularly during stressful life circumstances that involve loss and uncontrollability (for a meta-analysis, see Miller, Chen, & Zhou, 2007). In addition, cortisol output is typically enhanced when people encounter the onset of new or acute stressors, but can become reduced when stressors become long-lasting or chronic (Hoppmann et al., 2018; Miller et al., 2007). It is therefore plausible to assume that high cortisol levels over longer periods of time are indicative of people who frequently experience the onset of different new and relatively intractable stressors.

Regardless of the type of stress marker, we suggest that these experiences may play an important role in the associations between discrete emotions, goal disengagement, and well-being. For example, it would be possible that older adults' stress levels could be involved in the emergence of a link between sadness and improved goal disengagement capacity. If the frequent onset of uncontrollable stressors repeatedly elicits a sadness response and fosters associated motivational and emotional adjustment, this process may be reinforced over time, contributing to the establishment of a link between the experience of sadness and goal disengagement capacity. Among older adults who experience no or only minor age-related stressors, by contrast, goal disengagement processes are less likely needed and an association between sadness and goal disengagement capacity may not be observed. This view is consistent with the idea that critical life events can provide a context for co-occurring changes in a person's goal disengagement capacity (Wrosch & Scheier, 2019), and that people may have to experience repeated cycles of goal failure and subsequent adjustment processes to improve their goal disengagement capacity (Wrosch & Miller, 2009). As a consequence, sadness may be associated with improved goal disengagement capacity particularly among those older adults who experience the onset of multiple uncontrollable stressors over time.

We further suggest that stressful experiences may also play a role in the emotional consequences of the process linking sadness and goal disengagement capacity in older adulthood. This idea is consistent with DEA, postulating that sadness may produce adaptive

effects particularly in situational circumstances that involve irreversible losses or other age-related constraints (Kunzmann et al., 2014). The prolonged or chronic experiences of sadness, by contrast, may rather be indicative of failure in effective adjustment processes and is unlikely to exert adaptive function (Barlow et al., 2019b). In a similar vein, research suggests that goal disengagement capacity becomes paramount for protecting well-being among people who confront specific stressors that render the attainment of desired goals impossible (Dunne, Wrosch, & Miller, 2011; Wrosch et al., 2013, 2019). Given that a person's stress experiences can change over time, it would thus be plausible to assume that an association between sadness and improved goal disengagement capacity could protect older adults' emotional well-being particularly during those life circumstances that involve intractable stressors and unattainable goals.

The Present Study

The present longitudinal study examined associations between sadness, anger, goal disengagement capacity, and emotional well-being in the context of older adults' psychological and biological stress experiences. We first hypothesized that within-person increases in sadness, but not anger, would predict improvements in older adult's goal disengagement capacity, and that such an association would be observed particularly among older adults who generally encounter high, but not low, levels of stress. Second, we hypothesized that the extent to which sadness is associated with improvements in goal disengagement capacity would protect older adults' emotional well-being in circumstances they experience high, as compared to low, levels of stress.

Methods

Participants

The present study analyzed longitudinal data collected from a heterogeneous sample of community-dwelling older adults who participated in the Montreal Aging and Health Study (MAHS). The MAHS was launched in 2004 by assessing 215 participants. The sample size was determined by power analysis in the funded grant proposal. Subsequent waves were conducted at approximately 2-year intervals after baseline. Participants who did not provide data on the study's main time-varying variables (i.e. anger, sadness, and goal disengagement) at two or more assessments over the course of the study (n = 31) were excluded from the analysis. Study attrition from baseline to 10-year follow up was attributable to death (n = 10), refusal to

participate in the study (n = 3), loss of contact (n = 11), inability to follow study directions (n = 1), or for unknown reasons (n = 6). The final analytic sample consisted of 184 participants. Participants who dropped out of the study were significantly older at baseline (M = 74.39, SD = 6.83) than those who remained in the study (M = 72.08, SD = 5.70; $t(213) = 2.02$, p = .04), but did not differ on any other baseline study variables. The distribution of sociodemographic variables was within the normative range of older Canadians residing at home (National Advisory Council on Aging, 2006).

Procedure

Participants were recruited through newspaper advertisements in the greater Montreal area. In order to obtain a normative sample of community-dwelling older adults, the only inclusion criterion was an age requirement of 60 years or older. At each study assessment participants completed a questionnaire either in the laboratory or at home. The questionnaire included measures of goal disengagement, positive and negative affect, and sociodemographic variables. At each wave, participants were further asked to respond to daily questionnaires that included assessments of anger, sadness, and perceived stress. They were instructed to complete the daily questionnaires over the course of one week towards the end of three non-consecutive typical days (i.e. days during which they did not expect unusual or extraordinary circumstances). Participants were further asked to collect five saliva samples on the same three non-consecutive days to obtain a measure of diurnal cortisol. After completion of study measures, all materials were collected. Participants were compensated $50 for their participation in each of the first three waves and $70 for the participation in each subsequent wave. Informed consent was obtained from all participants prior to participation, and the Concordia University Research Ethics Board approved all procedures and methods (certification number: 10000402).

Materials

Sadness and anger were assessed on three non-consecutive days at each wave, using single-item measures. These items were: “During the past day I felt sad” and “During the past day I felt angry”. Participants responded using 5-point Likert-type scales ranging from *very slightly or not at all* (0) to *extremely* (4). For each wave, sadness (αs = .59 to .90; ICCs = .65 to .74) and anger (αs = .64 to .83; ICCs = .37 to .62) were indexed as a sum of participants’ responses across the three days.

Perceived stress was assessed on three non-consecutive days at each wave, using a

single-item measure. This item was: "During the past day I felt stressed". Participants responded using 5-point Likert-type scales ranging from *very slightly or not at all* (0) to *extremely* (4). At each wave, perceived stress was indexed as the sum of participants' responses across the three days. Participants' general level of perceived stress was computed as a mean of their perceived stress sums across the six waves (αs = .74 to .85; ICCs = .48 to .64).

Diurnal cortisol level was assessed on three non-consecutive days at each wave. Each day, participants were asked to collect five saliva sample using salivettes at awakening, 30 minutes after awakening, 2 PM, 4 PM, and bedtime. Participants were instructed to start a timer after taking the first sample at awakening to increase compliance in collecting the second sample 30 minutes after awakening. Participants were then telephoned at 2 PM and 4 PM to aid in compliance for the afternoon samples. For each sample, participants were instructed to record the time of collection, and not to brush their teeth or eat prior to saliva collection to prevent food or blood contamination. Participants were then asked to insert a salivette into their mouths for 30 seconds to collect saliva, and store the sample in their home refrigerators until they were returned to the laboratory (2-3 days), where they were frozen until study completion.

The cortisol analysis was performed at University of Trier using a time-resolved fluorescence immunoassay with a cortisol-biotin conjugate as a tracer. The intra-assay coefficient of variance was < 6% across waves (*range* = 3.57-5.28%). All cortisol scores were log-transformed to stabilize variance. Individual samples were excluded if they deviated more than 3 standard deviations from the sample mean as such scores may indicate food or blood contamination. Diurnal cortisol levels were calculated using the area-under-the-curve with respect to ground (AUC) across each day separately, using the trapezoidal method based on hours after awakening (Pruessner et al., 2003), for participants who provided a minimum of four usable samples on each collection day. The 30-minute after awakening sample was excluded from the calculation of AUC, as it is relatively independent from overall cortisol level (Chida & Steptoe, 2009). Diurnal cortisol was computed at each wave as the mean of the AUC scores across the three days. Participants' general level of diurnal cortisol was indexed as a composite mean of their AUC means across the six waves.

Goal disengagement capacity was assessed at each wave using the 4-item goal disengagement subscale of the Goal Adjustment Scale (GAS; Wrosch et al., 2003). Participants were asked to indicate how they usually react if they can no longer pursue an important goal.

Participants responded using 5-point Likert-type scales ranging from *strongly disagree* (1) to *strongly agree* (5). Sample items included, "It's easy for me to reduce my effort towards the goal", and "It's easy for me to stop thinking about the goal and let it go." Goal disengagement capacity was indexed by computing a mean score of the four items. Meta-analytic research has shown that the goal disengagement scale exerts satisfactory reliability (Barlow et al., 2019a). In our study, the average Cronbach's alpha was .63 (range = .49 to .74).

Positive and negative affect were assessed at each wave using the 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants were asked to indicate the extent to which they generally experienced 10 positive emotions (e.g., interested, excited, or active) and 10 negative emotions (e.g., distressed, guilty, or afraid) over the past year. Participants responded using a 5-point Likert-type scales ranging from *very slightly* (0) to *extremely* (4). Positive and negative affect were indexed at each wave by computing a mean score of the 10 positive emotions (αs = .88 to .91), and the 10 negative emotions (αs = .87 to .89), respectively

Sociodemographic Variables. Self-reports of participants' age, sex, and socioeconomic status were measured at baseline. Socioeconomic status (SES) was measured by asking participants to report their highest level of education (0 = *no education*, 1 = *high school*, 2 = *collegial or trade school*, 3 = *bachelor's degree*, 4 = *masters or doctorate*), annual family income (0 = *less than $17,000*, 1 = *up to $34,000*, 2 = *up to $51,000*, 3 = *up to $68,000*, 4 = *up to $85,000*, 5 = *more than $85,000*) and perceived social status (Adler et al., 2000). These three indicators of SES were correlated (rs = .39 to .53, ps < .01, α = .72), and their standardized scores were averaged to obtain a reliable measure of SES.

Data Analyses

Preliminary analyses were conducted to describe the sample and examine zero-order correlations between variables. The study's main hypotheses were subsequently tested using hierarchical linear modeling (HLM 6.0). The first set of analyses (Model 1) sought to examine within-person associations between sadness and anger with goal disengagement capacity, and if older adults' average perceived stress and diurnal cortisol levels moderated these associations. These analyses used data from 184 participants. In a first step, a Level-1 model was estimated to determine the impact of variations from the individual mean level of time, sadness, and anger on goal disengagement capacity. These analyses tested whether variations in time, participants'

sadness and anger scores, and a residual term would predict within-person variability in goal disengagement across waves. In this model, the intercept reflected average levels of goal disengagement capacity across waves, and the slopes represented the effect of person-centered variations in time, sadness, or anger on variations in goal disengagement. In a second step, a Level-2 model estimated the between-person (i.e. cross-level interaction) effects of average perceived stress, average diurnal cortisol levels, and relevant covariates (i.e. age, sex, and SES) on the variability in participants' intercept (average levels of goal disengagement) and slope values (effect of variations in time, sadness, and anger on goal disengagement). Finally, significant interaction effects were plotted and followed up by estimating the simple slopes.

The second set of analyses (Model 2) sought to examine if the strength of older adults' sadness-disengagement slopes moderated the within-person associations between stress markers (i.e. perceived stress and cortisol) and emotional well-being (i.e. positive and negative affect). Positive and negative affect were predicted in separate models that followed the same analytic procedure. In order to conduct these analyses, participants' ordinary least squares (OLS) sadness-disengagement slopes were saved from the first set of analyses. These slope values quantify the association between within-person sadness and goal disengagement capacity for each participant. For example, a positive sadness-disengagement slope would indicate that when people experience elevated sadness, they also report improved goal disengagement capacity. These analyses utilized data from the 121 participants for which a slope value could be calculated. In a first step, Level-1 models were estimated to determine the effects of time and variations from the individual mean level of perceived stress and diurnal cortisol on emotional well-being. This analysis tested whether variations in time, perceived stress, cortisol levels, and a residual term would predict within-person variability in emotional well-being across waves. In this model, the intercept indicated average levels of emotional well-being across waves, and the slopes represented the effect of person-centered variations in time, perceived stress or diurnal cortisol on variations in emotional well-being. In a second step, Level-2 models were estimated to investigate the between-person (i.e. cross-level interaction) effects of participants' sadness-disengagement slopes, and relevant covariates (i.e. age, sex, and SES) on the variability in their intercept (average levels of emotional well-being) and slope values (effect of variations in time, perceived stress, and diurnal cortisol on emotional well-being). Finally, significant interaction effects were plotted and followed up by estimating the simple slopes.

Results

Preliminary Analyses

As reported in Table 4, 52% percent of the sample was female, and participants were on average 72 years old at baseline. Approximately 35% of participants obtained a university degree, and more than half of the participants had an annual income between $17,000 and $51,000. The average perceived socioeconomic status fell slightly above the scale mid-point. The sociodemographic and health characteristics of this sample were within the normative range of community-dwelling older adults (National Advisory Council on Aging, 2006).

The zero-order correlations between study variable averages and covariates are reported in Table 5. Sadness and anger were positively associated with each other, In addition, sadness and anger were positively associated with perceived stress and negative affect, and negatively associated with goal disengagement capacity, and positive affect. Further, perceived stress was negatively associated with goal disengagement capacity, positively associated with negative affect, and it was higher in females than males. Additionally, while positive and negative affect were negatively associated with each other, positive affect was positively associated with goal disengagement capacity and SES, while negative affect was negatively associated with goal disengagement capacity and SES. Finally, diurnal cortisol level was positively associated with age, and was higher in males.

Main Analyses

The first set of analyses is summarized in Table 6. In the first step, a Level-1 model was estimated, predicting the variability in goal disengagement capacity by an intercept, within-person variations in time, sadness, and anger, and a residual term. This analysis revealed a significant intercept (95% CI *B* [3.00, 3.15]), suggesting that average levels of goal disengagement capacity were significantly different from zero. The within-person effects of time (95% CI *B* [-0.01, 0.01]), sadness (95% CI *B* [-0.01, 0.01]), and anger were not significant (95% CI *B* [-0.05, 0.04]). Note that the analysis confirmed considerable variability around the average intercept ($\chi^2 > 433$, $p < .01$) and the average within-person slope of sadness ($\chi^2 > 74$, $p = .08$), but comparatively less variability in the average within-person slope of anger ($\chi^2 > 63$, $p = .34$).

In the second step, a Level-2 model estimated the between-person effects of average levels of perceived stress, cortisol, and relevant covariates (i.e., age, sex, and SES). The analysis revealed a significant effect of sex on the intercept (95% CI *B* [0.01, 0.15]) and on the time slope

Table 4.

Means, Standard Deviations, and Frequencies of Study Variables (N = 184)

Constructs	Mean (SD) or percentage	Range
Average sadness	1.00 (1.24)	0 – 6
Average anger	0.65 (0.88)	0 – 3.80
Average goal disengagement	3.07 (0.54)	1.58 – 4.38
Average perceived stress	1.68 (1.61)	0 – 7.30
Average diurnal cortisol	12.01 (1.94)	7.32 – 18.55
Average positive affect	3.27 (0.62)	1.60 – 5.00
Average negative affect	1.85 (0.57)	1.00 – 3.90
Age (T1)	72.08 (5.70)	64 – 94
Female (%) (T1)	52.2	
Education (%) (T1)		
None	3.4	
High school	29.9	
College/trade	31.6	
Bachelor	24.1	
Master/PhD	10.9	
Annual income (%) (T1)		
Less than $17,000	21.3	
$17,001 - $34,000	38.5	
$34,001 - $51,000	19.5	
$51,001 - $68,000	12.4	
> $68,000	8.2	
Perceived social status (T1)	6.15 (1.72)	0 – 10

Table 5.

Zero-Order Correlations Between Study Variable Averages and Covariates

Constructs	1	2	3	4	5	6	7	8	9
1. Average sadness									
2. Average anger	.53**								
3. Average goal disengagement	-.24**	-.19*							
4. Average perceived stress	.67**	.64**	-.34**						
5. Average diurnal cortisol	.05	-.01	.06	-.01					
6. Average positive affect	-.32**	-.19**	.19*	-.14	.01				
7. Average negative affect	.50**	.55**	-.25**	.52**	-.13	-.20**			
8. Age (T1)	-.03	-.05	.01	-.14	.29**	-.07	-.19		
9. Female (T1)	.07	.05	.04	.17*	-.25**	.09	.14	.03	
10. Socioeconomic status (T1)	-.12	-.15*	.04	-.02	.12	.21**	-.22**	-.05	-.14

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

Table 6.

Results of Model 1 Predicting Goal Disengagement by Sadness, Anger, and Between-Person Stress (N = 184)

	Goal Disengagement					
	Average Levels (Intercept)		Sadness (Slope)		Anger (Slope)	
Effects	Coefficient (SE)	T Ratio	Coefficient (SE)	T Ratio	Coefficient (SE)	T Ratio
Level 1	3.08 (0.04)	88.00**	0.03 (0.02)	1.63	-0.00 (0.02)	-0.13
Level 2						
Female	0.08 (0.04)	2.18*	-0.00 (0.02)	0.14	0.01 (0.02)	0.24
SES	0.02 (0.04)	0.42	-0.03 (0.02)	-1.71	0.00 (0.02)	0.15
Age	-0.04 (0.04)	-1.15	-0.00 (0.02)	-0.24	0.04 (0.03)	1.14
Average Perceived Stress	-0.20 (0.04)	-5.53**	0.01 (0.01)	0.57	-0.00 (0.02)	-0.15
Average Diurnal Cortisol	0.06 (0.04)	1.70	0.04 (0.02)	2.22*	-0.04 (0.03)	-1.65

* $p < .05$; ** $p < .01$; SES = Socioeconomic status.

Note. These analyses controlled for time on Level-1. The Level-1 model had 183 *dfs*, and the Level-2 models had 178 *dfs*.

(95% CI *B* [0.001, 0.03]), suggesting that females, as compared to males, reported higher average levels of, and increases in, goal disengagement capacity. Further, the analysis revealed a significant effect of average perceived stress on the intercept (95% CI *B* [-0.27, -0.13]), documenting that participants with higher levels of perceived stress reported lower levels of goal disengagement capacity across waves. Finally, and in support of our hypotheses, the analysis confirmed a significant effect of average cortisol levels (95% CI *B* [0.004, 0.07]) in predicting the within-person association between sadness and goal disengagement capacity.

To further examine the significant cross-level interaction effect, the within-person association between sadness and goal disengagement capacity was plotted in Figure 3 for the average upper and lower quartiles of the between-person cortisol distribution. The pattern of obtained interaction effects suggests that that the highest levels of goal disengagement capacity were obtained in waves participants experienced increased levels of sadness, among those participants who secreted high, but not low, levels of cortisol across the study period. By contrast, goal disengagement capacity was comparatively reduced among participants who secreted low levels of cortisol across waves, independent of their within-person changes in sadness (see Figure 3). Follow-up simple slope analyses supported this interpretation by demonstrating that within-person increases in sadness predicted higher levels of goal disengagement capacity among participants who secreted relatively high levels of cortisol across waves (*coefficient* = 0.08, *SE* = 0.03, *t* = 2.57, *p* = .01, 95% CI [0.02, 0.14]), but not among their counterparts who secreted relatively lower levels of cortisol (*coefficient* = -0.02, *SE* = 0.03, *t* = -0.57, *p* = 0.57, 95% CI [-0.08, 0.04]).

The second set of analyses is summarized in Table 7. In the first step, Level-1 models were estimated to predict the obtained variability in positive and negative affect by an intercept, within-person variations in time, perceived stress, cortisol level, and a residual term. This analysis revealed a significant intercept effect for both positive affect (95% CI *B* [3.09, 3.32]), and negative affect (95% CI *B* [1.90, 2.11]), suggesting that average levels of positive and negative affect were significantly different from zero. In addition, there was a significant time slope effect on positive affect (95% CI *B* [-0.06, -0.03]), but not on negative affect (95% CI *B* [-0.03, 0.001]), indicating that while positive affect declined over time, negative affect remained relatively stable. The analysis further yielded significant within-person effects of perceived stress on positive affect (95% CI *B* [-0.06, -0.01]), and negative affect (95% CI *B* [0.02, 0.06]),

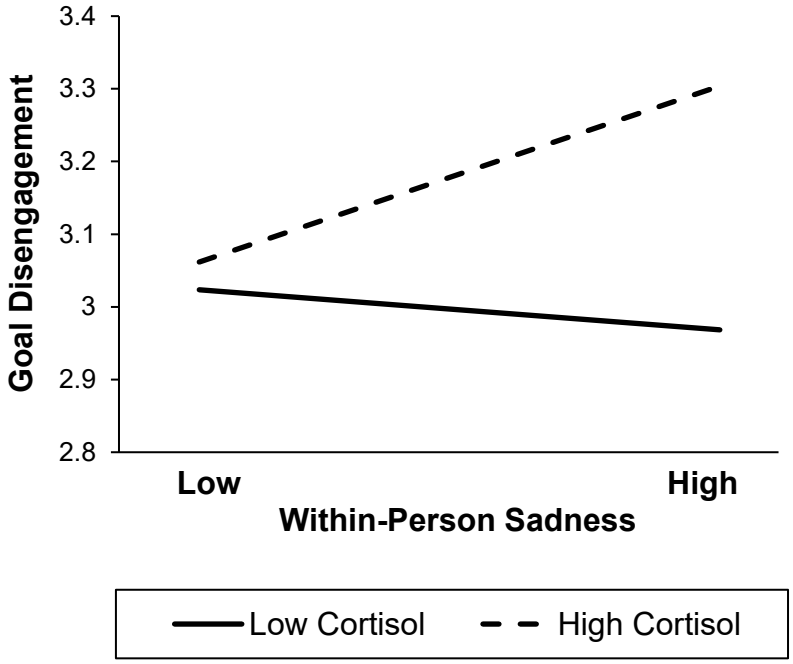

Figure 3. Within-person associations between sadness and goal disengagement capacity as a function of diurnal cortisol level averaged across the study period.

Table 7.

Results of Model 2 Predicting Affect by Within-Person Stress and Sadness-Disengagement Slopes (N = 121)

	Average levels (Intercept)		Diurnal cortisol (Slope)		Perceived stress (Slope)	
	Coefficient (SE)	T Ratio	Coefficient (SE)	T Ratio	Coefficient (SE)	T Ratio
Effects	Model 2a: Positive Affect					
Level 1	3.21 (0.06)	55.00**	-0.00 (0.01)	-0.65	-0.03 (0.01)	-2.87**
Level 2						
Female	0.10 (0.06)	1.88	0.00 (0.01)	0.61	0.01 (0.02)	0.91
SES	0.17 (0.05)	3.04**	0.00 (0.01)	0.20	-0.01 (0.01)	-0.64
Age	-0.05 (0.07)	-0.75	0.01 (0.01)	0.74	0.02 (0.01)	1.54
S-D slope	0.10 (0.05)	1.94	0.03 (0.01)	2.47*	-0.02 (0.01)	-1.59
	Model 2b: Negative Affect					
Level 1	2.01 (0.05)	38.33**	-0.00 (0.01)	-0.28	0.04 (0.01)	3.38**
Level 2						
Female	0.06 (0.05)	1.24	-0.01 (0.01)	-1.42	-0.00 (0.01)	-0.03
SES	-0.16 (0.05)	3.10**	0.01 (0.01)	0.93	-0.00 (0.02)	-0.17
Age	-0.04 (0.05)	-0.95	-0.00 (0.01)	-0.05	0.00 (0.01)	0.23
S-D slope	-0.01 (0.04)	-0.34	0.01 (0.01)	0.48	0.01 (0.01)	0.91

* $p < .05$; ** $p < .01$; SES = Socioeconomic status. S-D slope = Sadness-Disengagement slope.

Note. These analyses controlled for time on Level-1. The Level-1 model had 120 *dfs*, and the Level-2 models had 116 *dfs*.

documenting that increases in perceived stress predicted lower levels of positive affect, and higher levels of negative affect. No other statistically significant effects emerged. Note that the analysis confirmed considerable variability around the average intercepts (positive affect: $\chi^2 > 1501$, $p < .01$; negative affect: $\chi^2 > 1136$, $p < .01$), the time slope for positive affect ($\chi^2 > 124$, $p = .01$) and negative affect ($\chi^2 > 105$, $p = .10$), and the within-person slope effects of perceived stress (positive affect: $\chi^2 > 95$, $p = .11$; negative affect: $\chi^2 > 95$, $p = .29$), but comparatively less variability for the within-person slope effect of cortisol level (positive affect: $\chi^2 > 84$, $p > .50$; negative affect: $\chi^2 > 78$, $p > .50$).

In the second step, the Level-2 models estimated the between-person effects of participants' sadness-disengagement slope scores and relevant covariates (i.e. age, sex, and SES). The analysis revealed a significant effect of SES on the intercept of both positive affect (95% CI *B* [0.05, 0.28]), and negative affect (95% CI *B* [-0.26, -0.05]). These results suggest that participants with a lower, as compared to a higher, SES reported lower levels of positive affect and higher levels of negative affect across waves. No other significant effects of the covariates emerged. Finally, and in support of our hypotheses, the analysis confirmed a significant effect of the obtained sadness-disengagement slope scores in predicting the within-person effect of cortisol level on positive affect (95% CI *B* [0.01, 0.05]), but not negative affect (95% CI *B* [-0.02, 0.03]).

To further examine the significant cross-level interaction effect, we plotted in Figure 4 the within-person association between cortisol level and positive affect for the average upper and lower quartiles of the between-person sadness-disengagement slope distribution. The pattern of obtained interaction effect suggests that the highest levels of positive affect were observed among participants who tended to disengage if they felt sad, in those waves they experienced relatively enhanced, as compared to reduced, levels of cortisol. By contrast, comparably lower levels of positive affect were obtained in waves participants secreted relatively enhanced levels of cortisol, particularly among those participants who did not tend to disengage when they felt sad (see Figure 4). Follow-up simple slopes analyses were consistent with this interpretation by demonstrating that greater sadness-disengagement slope scores predicted higher levels of positive affect in waves participants secreted enhanced cortisol levels (*coefficient* = 0.21, *SE* = 0.07, *t* = 2.97, $p < .01$, 95% CI [0.07, 0.35]), but not in waves they secreted reduced levels of cortisol (*coefficient* = -0.00, *SE* = 0.06, *t* = -0.01, $p > 0.99$, 95% CI [-0.12, 0.12]).

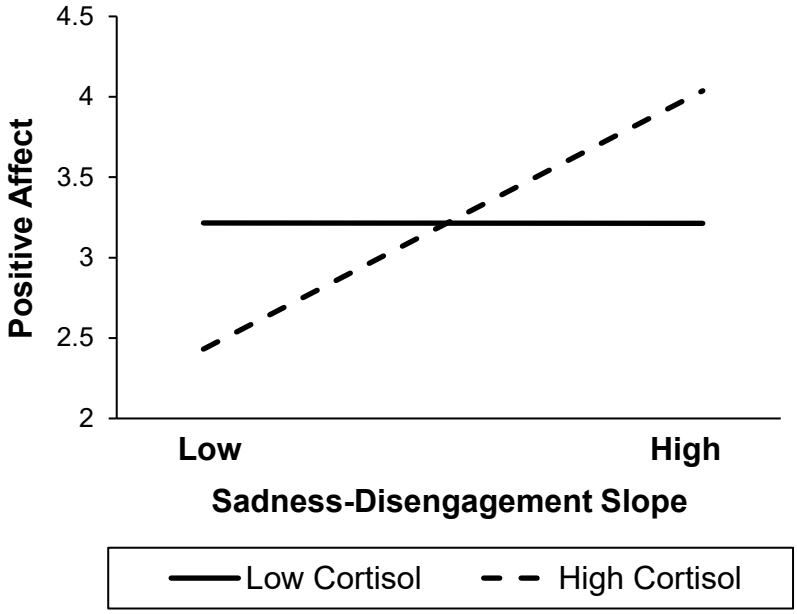

Figure 4. Associations between sadness-disengagement slope values and positive affect as a function of within-person diurnal cortisol levels.

Discussion

This study showed that within-person increases in sadness, but not anger, predicted improved levels of goal disengagement capacity among older adults who generally exhibited high, but not low, levels of the biological stress marker cortisol. In addition, older adults who disengaged more easily from unattainable goals when they felt sad were protected from experiencing reduced levels of positive affect in circumstances they secreted higher, as compared to lower, levels of diurnal cortisol.

These findings are consistent with postulates of DEA, suggesting that sadness can serve an adaptive function in older adulthood by facilitating motivational processes associated with psychological adjustment to intractable stressors and irreversible losses (Kunzmann et al., 2014). In addition, the results support theory and research from personality and evolutionary psychology, highlighting that depressive mood, which is often associated with sadness, can facilitate a person's capacity to disengage from unattainable goals (Barlow et al., 2019a; Klinger, 1975; Koppe & Rothermund, 2016; Nesse, 2000; Wrosch & Miller, 2009). Note that this process was uniquely related to the experience of sadness, and did not extend to older adults' anger. Since anger has been thought to motivate persistence and attempts at reversing injustice, but not disengagement from unattainable goals (Carver & Harmon-Jones, 2009; Lazarus, 1991), these findings point to the unique role that sadness can play in facilitating motivational processes that support the adjustment to age-related stressors in older adulthood (Kunzmann et al., 2014).

The reported study further highlights the importance of considering contextual factors that impact age-related and individual differences in the adaptive value of negative emotions. In this regard, the results revealed that within-person increases in sadness predicted higher levels of goal disengagement capacity among older adults who secreted high, but not low, levels of diurnal cortisol across the entire study period. We suggest that such a process may occur if sadness facilitates disengagement from multiple, specific unattainable goals in response to older adults' stress experiences, which may reinforce over time an adaptive link between the experience of sadness and a person's goal disengagement capacity (Wrosch & Miller, 2009).

In this process, generally higher levels of cortisol could represent a biological marker of the onset of multiple new and intractable stressors, considering that diurnal cortisol levels can be particularly elevated among people who encounter such life circumstances (Hoppmann et al., 2018; Miller, Chen & Zhou, 2007). By contrast, among people who experience chronic stress

over a long period of time, or only few stressors, cortisol levels would likely be relatively reduced (Miller et al., 2007). As a consequence, our data is consistent with the idea that life circumstances involving the frequent experience of different new and uncontrollable stressors may provide a context that allows older adults to establish a link between sadness and improved goal disengagement capacity. Through this process, sadness may contribute to an opportunity-adjusted motivational response that could foster patterns of successful aging (Barlow et al., 2019a; Heckhausen et al., 2010; Wrosch, Scheier, & Miller, 2013).

The study's findings were related only to biological, but not psychological, stress markers. Although we would have expected to observe similar effects for both constructs, the obtained results were not consistent with this assumption. In this regard, we note that perceptions of stressful changes and occurring events may be positively biased, as compared to objective changes, and that this discrepancy can increase in older adulthood (for a discussion of health events, see Kunzmann et al., 2019). In addition, the divergent patterns of psychological and biological stress markers could imply that elevated levels of diurnal cortisol, but not perceptions of stress, are indicative of the onset of multiple new and uncontrollable stressors (Hoppmann et al., 2008; Miller et al., 2007). Consistent with this possibility, the reported zero-order correlations showed that a higher chronological age, which is typically characterized by the frequent onset of intractable age-related stressors (Baltes & Smith, 2003), was positively associated with older adults' levels of diurnal cortisol, but not with their psychological perceptions of stress (see Table 5). It is therefore possible that older adults' psychological stress perceptions related to both controllable and uncontrollable problems, which could have blurred the association between psychological stress and age. As such, and different from enhanced cortisol output, high levels of psychological stress perceptions could derive, in part, from chronic and long-term problems, which may be less likely than recent stressors to provide a context for the establishment of a link between sadness and goal disengagement capacity. Instead, such chronic perceptions of stress could point to a person's inability to adjust effectively to uncontrollable stressors (Wrosch & Scheier, 2019).

Given that these possibilities could provide an explanation for the independence of different stress markers with respect to their associations and effects in the presented study, we feel that the inclusion of a biological stress marker represents an important strength of our study. In this regard, observed discrepancies between different stress markers could contribute to

clarifying the contextual factors that determine whether specific negative emotions facilitate adaptive motivational processes. As a consequence, we suggest that more research is needed on the quality and quantity of different stress experiences as well as their emotional and motivational consequences.

The study's findings further showed that the strength of the obtained link between sadness and goal disengagement moderated the effect of within-person increases in older adults' diurnal cortisol levels on reduced levels of positive affect. In particular, older adults who had an easier time disengaging from unattainable goals when they felt sad were protected from experiencing reduced levels of positive affect in circumstances they secreted elevated, as compared to reduced, levels of cortisol. This result supports our hypotheses by pointing to the adaptive value of the link between sadness and goal disengagement (Wrosch & Miller, 2009). It could imply that sadness-related increases in goal disengagement capacity provide resources for the pursuit of other important goals, which could elicit positive affect (Wrosch et al., 2013, for predictors of positive affect, see also Kunzmann, 2008; Watson et al., 1988).

We note, however, that the strength of the link between sadness and goal disengagement only predicted older adults' positive affect, but not their negative affect. The absence of the latter effect is contrary to our hypotheses, and surprising since averaged levels of goal disengagement capacity obtained across the entire study period were associated with lower averaged levels of negative affect in our sample (see Table 5, for general associations between goal disengagement and negative affect, see also Barlow et al., 2019a). A potential explanation for these differential results may be related to the examination of concurrent associations between changes in stress markers and affect. To this end, it is important to note that the negative emotional consequences of failure experiences can be enduring (Frijda, 1988), and even people who already accepted that a certain goal cannot be attained may still feel negative emotions about their loss. To relieve such negative affect, the experience of positive emotions could undo lingering negative affect (Fredrickson, 2001). Since the latter process may take some time, however, it is possible that our analyses did not detect an effect of the sadness-disengagement link on reduced levels of negative affect. In addition, it would be plausible to assume that the obtained effect on older adults' positive affect could reduce their negative affect over time. To test these possibilities, research should conduct fine-grained daily diary studies over an extended period of time to examine whether associations between sadness, goal disengagement processes, and positive affect can

reduce stress-related negative affect.

Together, the study's findings have important implications for different fields of psychology. First, they provide evidence for the adaptive motivational and emotional functions of sadness. To this end, they suggest that sadness can predict older adults' capacity to disengage from unattainable goals, and that such a process may protect their emotional well-being in the context of stressful life circumstances. These results further expand the existing literature on between-person associations, by linking older adults' within-person changes of sadness and goal disengagement capacity with their stress-related emotional outcomes. This methodology provides strong support for theoretical claims of discrete emotion theories by demonstrating that intra-individual changes in sadness are functionally related to older adults' goal disengagement processes, and that the adaptive value of this process depends on a person's contextual experiences (Kunzmann et al., 2014; Wrosch & Scheier, 2019).

Second, the reported study provides further support for the distinct roles of different negative emotions in the adjustment to critical life circumstances. Previous work has highlighted the potential function and adaptive value of depressive mood, which is typically associated with sadness, in facilitating disengagement from goals that have become unattainable, or whose pursuit could lead to harm, loss, or wasted resources (e.g., Klinger, 1975; Koppe & Rothermund, 2016; Nesse, 2000; Wrosch & Miller, 2009). The reported findings expand this research by documenting the unique association between sadness and improved goal disengagement capacity among older adults who secreted elevated levels of diurnal cortisol. As such, the results provide discriminative evidence by showing that the same process was not observed for other negative emotions, such as anger.

Third, the reported results may inform theories of successful aging by documenting the stress-related links between different negative emotions, goal disengagement capacity, and emotional well-being in an elderly sample. Considering that aging is a heterogenous process (Baltes & Smith, 2003), the study's findings suggest that sadness may serve an important motivational function, particularly among those older adults who face the onset of relatively uncontrollable life circumstances. In such circumstances, sadness could promote adaptive changes in the capacity to disengage from unattainable goals, and this process may protect older adults' emotional well-being if they confront increasingly limited opportunities for goal attainment. These conclusions are consistent with past research demonstrating the emotional

benefits of goal disengagement capacities in older adulthood, and point to specific negative emotions, such as sadness, as potential predictors of adaptive motivational processes in older adulthood (Barlow et al., 2019a; Dunne et al., 2011; Kunzmann et al., 2014).

Finally, the study's findings may provide insights relevant for practitioners and clinicians. They bring attention to the potential benefit of considering not only the divergent functions and consequences of different negative emotions in older adulthood, but also the associated motivational processes that foster successful aging. Such an approach could lead to targeting important mechanisms of change in the experience of older adults' emotional well-being by promoting either appropriate, context-specific emotional experiences or adaptive motivational processes.

Limitations and Future Directions

Although the present study provides substantial contributions to theory and research, it is not without limitations. First, although our theoretical model suggests that sadness should elicit changes in a person's goal disengagement capacity, data from longitudinal field studies cannot be used to draw causal inferences. In addition, the reported results stem from a relatively small longitudinal sample of community-dwelling older adults, limiting the generalizability of the findings. Therefore, future research should replicate the present findings using experimental methods and larger samples.

Second, the present study focused on sadness, anger, and goal disengagement capacity. This approach was grounded in extant theory outlining the age-differential adaptive value of these emotions (Kunzmann et al., 2014). However, future work should explore the role of other emotions as well. Since research has identified a number of discrete emotions (Roseman, Wiest, & Swartz, 1994), such studies may reveal how different negative (and positive) emotions may protect or harm older adults' emotional well-being by promoting different motivational processes.

Third, this study assessed different emotional experiences by utilizing one-item self-report measures over three non-consecutive days. To substantiate the study's conclusions, future research should expand this approach by including objective measures, applying ecological momentary assessments of emotion (Shiffman, Stone, & Hufford, 2008), and exploring other emotions response systems (e.g., emotional expression and physiology; Levenson, 2000).

Fourth, the present analysis was limited to a sample of community-dwelling older adults.

This approach should be extended by examining associations between discrete negative emotions, motivational processes, and development outcomes across the entire adult lifespan. Such research may examine whether other emotions, such as anger, are relatively more adaptive at younger ages when people have plenty opportunity to overcome goal-related problems, and identify motivational mediators of this association (e.g., persistence, Kunzmann et al., 2014).

Finally, our theoretical model assumed that the link between sadness and goal disengagement capacity develops over time, and requires a person to undergo repeated cycles of adjustment to intractable stressful life circumstances (Wrosch & Miller, 2009). To this end, research would benefit from a thorough examination of specific stress experiences as well as their controllability. Such research may provide new insights in how the emotional and motivational management of different life experiences can contribute to a person's general self-regulation capacities and well-being. We feel that research along those lines has a great potential to illuminate how discrete emotional experiences and motivational processes work together in facilitating successful development across the lifespan.

Conclusions

This longitudinal study showed that within-person increases in sadness, but not anger, were associated with improved goal disengagement capacity among community-dwelling older adults who experienced high levels of the biological stress marker cortisol. The results further demonstrated that the strength of the association between sadness and improved goal disengagement capacity protected older adults' levels of positive affect in specific life circumstances that were characterized by elevated cortisol secretion. The reported findings extend past work examining the differential functions and consequences of discrete negative emotions. They highlight that the adaptive value of different negative emotions may be related to specific motivational processes and depend on contextual factors, such as stressful life circumstances. These findings contribute to theories of emotion, personality functioning, and successful aging, and provide insights for clinical practice.

CHAPTER 5:
STUDY 3

Goal adjustment capacities and quality of life: A meta-analytic review

Note: Copy edited version of this study was published in *Journal of Personality*, May 2019

Abstract

Objectives: This meta-analysis quantified associations between goal disengagement and goal reengagement capacities with individuals' quality of life (i.e., well-being and health). **Methods:** Effect sizes (Fisher's Z'; $N = 421$) from 31 samples were coded on several characteristics (e.g., goal adjustment capacity, quality of life type/subtype, age, and depression risk status) and analyzed using meta-analytic random effects models. **Results**: Goal disengagement ($r = .08$, $p < .01$) and goal reengagement ($r = .19$, $p < .01$) were associated with greater quality of life. While goal disengagement more strongly predicted negative ($r = -.12$, $p < .01$) versus positive ($r = .02$, $p = .37$) indicators of well-being, goal reengagement was similarly associated with both (positive: $r = .24$, $p < .01$; negative: $r = -.17$, $p < .01$). Finally, the association between goal disengagement and lower depressive symptoms ($r = -.11$, $p < .01$) was reversed in samples at-risk for depression ($r = .08$, $p = .01$), and goal disengagement more strongly predicted quality of life in older samples ($B = 0.003$, $p < .01$). **Conclusions:** These findings support theory on the self-regulatory functions of individuals' capacities to adjust to unattainable goals, document their distinct benefits, and identify key moderating factors.

Keywords: goal adjustment; goal disengagement; goal reengagement; psychological well-being; physical health.

Introduction

Goals structure people's lives and motivate self-regulatory behaviors to overcome obstacles in goal pursuits. In addition, goal attainment has been associated with a variety of psychological and health benefits (Carver & Scheier, 1981, 1998; Emmons, 1986; Heckhausen, Wrosch & Schulz, 2010; Ryff, 1989). Consequently, across most cultures and within the scientific community, discussions of adaptive self-regulation have frequently focused on the importance of commitment, perseverance, and goal attainment (Carver & Scheier, 1998). The adaptive value of relinquishing and replacing goals, by contrast, has received far less attention (Wrosch et al., 2003a). In fact, processes involved in the abandonment of goals have long been viewed as unfortunate consequences of failure, and linked to helplessness and depression (Seligman, 1975; Wortman & Brehm, 1975). During the past decades, however, an increasing body of theory and research derived from personality and lifespan psychology has documented that the adjustment of unattainable goals can be a necessary and adaptive self-regulation process (Brandtstädter & Renner, 1990; Carver & Scheier, 1990; Heckhausen et al., 2010; Wrosch et al., 2003a). This body of work posits that when a goal becomes unattainable, individuals need to disengage from the goal, and pursue alternative goals to maintain optimal levels of well-being and health. While goal disengagement may reduce the psychological distress associated with repeated failure experiences, the engagement in new goals may provide purpose for living and their attainment could enhance positive aspects of well-being. These beneficial psychological consequences of goal adjustment processes may further exert adaptive downstream implications on health-relevant physiological processes and clinical disease (Wrosch et al., 2013).

In the present meta-analysis, we empirically examined the associations of goal disengagement and goal reengagement with indicators of quality of life (i.e., subjective well-being and physical health). We approached this topic from a personality perspective by considering research that distinguishes the effects of general individual differences in goal disengagement and goal reengagement capacities across life domains on indicators of quality of life. This approach is motivated by theory and narrative reviews (e.g., Wrosch et al., 2013), suggesting that goal disengagement and goal reengagement capacities promote well-being and physical health. It may shed light on propositions that these two capacities could predict different aspects of quality of life (e.g., positive versus negative indictors of well-being, Wrosch et al., 2013) and may identify circumstances that could alter associations with individuals' goal

disengagement capacities (e.g., in the context of depression, Wrosch & Miller, 2009).[2]

Goal Adjustment Capacities: Theory, Definitions, and Mechanisms

Theory and research examining how individuals adjust to the experience of unattainable goals postulates that severe goal constraints are a common phenomenon (Brandtstädter & Renner, 1990; Heckhausen et al., 2010; Wrosch 2003a). People may choose an unrealistic goal, or experience a negative life event that renders the attainment of a desired goal unattainable (e.g., being healthy after a medical diagnosis, or paying the mortgage after losing a job). In addition, lifespan developmental theories suggest that individual agency and contextual factors interact in shaping people's opportunities for goal attainment over time (Baltes, 1987, 1997; Heckhausen, 1999; Lerner & Busch-Rossnagel, 1981). While people actively influence their development by identifying, pursuing, and regulating important goals, external constraints may arise or personal resources can become limited, requiring individuals to be selective in the pursuit of their goals (Schulz & Heckhausen, 1996). Thus, individuals may have to abandon certain goals to secure the attainment of other goals (e.g., not going out with friends to care for the children). In addition, lifespan developmental theories suggest that biological, sociocultural, and age-normative factors can diminish individuals' opportunities to produce desired outcomes, increasing the likelihood of experiencing unattainable goals (Heckhausen, 1999; Schulz & Heckhausen, 1996).

Regardless of why a goal is no longer attainable, the pursuit of an unattainable goal creates a problem for a person's quality of life (Wrosch et al., 2013). Individuals pursuing unattainable goals may encounter repeated failure and associated stagnation in goal progress, resulting in psychological distress or a lack of purpose (Carver & Scheier, 1999). Further, the cognitive concomitants of the continued pursuit of an unattainable goal, such as rumination and the maintenance of improbable intentions, have been linked to psychological distress and depression (Carver, La Voie, Kuhl, & Ganellen, 1988; Kuhl & Helle, 1986; Nolen-Hoeksema, Parker, & Larson, 1994). The psychological distress associated with the continued pursuit of

[2] Note that researchers have also conceptualized other, related constructs, such as goal accommodation (Brandtstädter & Renner, 1990) or secondary control strategies (Heckhausen & Schulz, 1995). Since these constructs either can not distinguish empirically between goal disengagement and goal reengagement processes (i.e., in the case of both goal accommodation and secondary control) or assess goal adjustment processes at a goal-specific, but not personality or general tendency level (i.e., in the case of secondary control), research related to these concepts may not answer our main research questions and was not included (for an overview of differences between concepts, see Brandstätter & Herrmann, 2017).

unattainable goals, in turn, could have negative consequences for physical health, as distress has been associated with dysregulation of the endocrine and immune systems (Heim, Ehlert, & Hellhammer, 2000; Segerstrom & Miller, 2004), self-reported health problems (e.g., asthma; Afari, Schmaling, Barnhart, & Buchwald, 2001), and clinical illness (e.g., common cold; Cohen, Doyle, Turner, Alper, & Skoner, 2003).

Given the adverse impact of pursuing unattainable goals on an individual's quality of life, it is important to identify adaptive self-regulatory processes. In this regard, researchers have suggested that the abandonment of an unattainable goal may allow individuals to reprioritize certain goals and redefine a given goal as not necessary for achieving a satisfied life (Sprangers & Schwartz, 1999), psychologically adjust to their inability to achieve the goal (Brandtstädter & Renner, 1990), or free up resources that can be used elsewhere (Wrosch et al., 2003b). In turn, if personal resources are being reallocated to the pursuit of an alternative valued activity or goal, individuals may experience purpose in life and prevent the experience of aimlessness and emptiness associated with failure or lack of goal progress (Carver & Scheier, 1999; Ryff, 1989). The pursuit of new meaningful goals may promote a sense of coherence and feelings of control (Antonovsky, 1987; Kobasa, 1979; Ryff & Keyes, 1995), shift the individual's thought content from the unattainable goal to the newly adopted goal (e.g., Gollwitzer, Heckhausen, & Steller, 1990), and compensate for the distress associated with the inability to attain a desired goal (Wrosch et al., 2013).

Theories of self-regulation have approached the management of unattainable goals from an individual difference perspective (Brandtstädter & Renner, 1990; Wrosch et al., 2003a). These accounts assume that individuals reliably differ in their general tendencies to engage in adaptive self-regulatory processes when confronted with unattainable goals. To this end, goal adjustment capacities have been conceptualized as individual differences in general tendencies to selectively adjust goal striving in the face of unattainable goals across situations, domains, and the lifespan. These individual difference variables can be assessed empirically, by using the Goal Adjustment Scale (GAS, Wrosch et al., 2003a), which is a self-report instrument, developed to measure two distinct self-regulation capacities: goal disengagement and goal reengagement. Whereas goal disengagement capacities refer to the tendency to withdraw commitment and effort from an unattainable goal, goal reengagement capacities relate to the tendency to identify, commit to, and pursue alternative goals when unattainable goals are encountered (Wrosch et al., 2003a, 2003b).

Goal disengagement and goal reengagement capacities have been conceptualized as independent factors that influence individuals' well-being and health by serving distinct functions in the self-regulation of behavior (Wrosch et al., 2003a, 2003b, 2007). The primary mechanism linking goal disengagement capacities with quality of life outcomes is thought to relate to the avoidance of repeated failure experiences and an associated reduction of emotional distress deriving from the pursuit of unattainable goals. Note that there may also be other benefits of goal disengagement capacities, related to the preservation of emotional and motivational resources, which could be reallocated to the effective pursuit of other important goals (Wrosch et al., 2003a, 2007, 2013). Goal reengagement capacities, by contrast, may mainly contribute to quality of life because the pursuit of other important goals can provide purpose for living and their attainment may increase positive aspects of well-being. These psychological benefits of goal reengagement capacities may further mitigate some of the negative psychological consequences of goal failure (Wrosch et al., 2013). Moreover, goal disengagement and goal reengagement capacities may facilitate physical health. Such effects may occur, for example, if the engagement in new goals is associated with behaviors that directly improve health (e.g., physical activity, Wrosch & Sabiston, 2013). In addition, given that both reduced levels of emotional distress and increased levels of positive well-being states are important factors in the normative regulation of health-relevant physiological processes (e.g., in the hormonal or immune systems, Cohen, Janicki-Deverts & Miller, 2007; Pressman & Cohen, 2005), goal disengagement and goal reengagement capacities may further benefit health through their effects on psychological well-being (Castonguay et al., 2017; Wrosch et al., 2007).

Goal Adjustment Capacities and Quality of Life

Empirical studies and narrative reviews of the extant literature highlight the links between both goal disengagement and goal reengagement capacities with subjective well-being (Wrosch et al., 2003a, 2007, 2011, 2013). In this regard, some studies suggest that goal disengagement capacities are more strongly associated with a reduction in the experience of negative indicators of well-being (e.g., less distress or depressive symptoms; Wrosch et al., 2007); whereas goal reengagement capacities seem to be more strongly linked to increases in positive indicators of well-being (e.g., enhanced purpose in life or positive emotions; Wrosch et al., 2007, 2013). Note, however, that not all studies consistently show such differential effects on positive versus negative indicators of well-being (e.g., Mens & Scheier, 2015; Wrosch et al., 2003a).

Accordingly, our meta-analysis sought to test this possibility by quantifying and comparing these associations. We hypothesized that both goal disengagement and goal reengagement will be positively associated with better psychological well-being. Further, we predicted that there should be a stronger association between goal disengagement capacities and negative indicators of well-being, as compared to positive indicators. Associations with goal reengagement capacities, by contrast, should be stronger for positive indicators, as compared to negative indicators.

Goal adjustment capacities have also been linked to greater physical health (Wrosch et al., 2007, 2013; Wrosch & Sabiston, 2013). To this end, they may influence physical health either through adaptive behaviors (e.g., exercise, Wrosch & Sabiston, 2013) or their associations with positive and negative indicators of psychological well-being (e.g., Cohen, Janicki-Deverts & Miller, 2007). Interestingly, earlier work on goal adjustment capacities suggested that goal disengagement capacities were more strongly related to better physical health (e.g., fewer acute health problems, less cortisol, better sleep efficiency; Wrosch et al., 2007), as compared to goal reengagement capacities. More recently, however, positive effects of goal reengagement on physical health have also been demonstrated, particularly in clinical disease populations (e.g., breast cancer patients, Castonguay et al., 2017; Mens & Scheier, 2015; Wrosch & Sabiston, 2013). Such associations have often been reported for predicting self-report measures of health, while there is less research with respect to objective indicators of health-relevant physiological processes (e.g., less cortisol or chronic inflammation, Castonguay et al., 2014, Wrosch et al., 2007). Consequently, our meta-analysis sought to clarify the associations between goal adjustment capacities and physical health by comparing the magnitude of these associations. We hypothesized that both goal disengagement and goal reengagement capacities would be positively associated with better physical health. Further, we conducted exploratory analyses to quantify the relative effects of goal adjustment capacities on self-report, as compared to objective, measures of physical health.

Finally, research has begun to explore the complexities of the association between goal disengagement and depressive symptomatology. This research is based on theory derived from evolutionary and personality psychology, suggesting that depressive symptoms can sometimes serve an adaptive function and promote quality of life by facilitating disengagement from unattainable goals (e.g., Klinger, 1975; Nesse, 2000). It assumes that depressive mood may have

evolved in phylogenesis as a defense mechanism, allowing individuals to conserve resources (Beck, 2002; Klinger, 1975), maintain realistic perceptions of the environment (Dykman, Abramson, Alloy, & Hartlage, 1989), select appropriate and feasible life goals (Taylor & Gollwitzer, 1995), and avoid danger, loss, or injury in the pursuit of unattainable goals (Keller & Nesse, 2006; Nesse, 2000). These propositions are consistent with research on adolescent women with high risk for affective disorders, demonstrating longitudinal effects of depressive symptoms on improvements in goal disengagement capacities (Wrosch & Miller, 2009), and experimental work suggesting that clinically depressed individuals, compared to a non-depressed control group, disengage faster from unsolvable tasks (Koppe & Rothermund, 2017). Note that such reversed associations were not found for participants' goal reengagement capacities (Wrosch & Miller, 2009), which makes it possible that effects of depressive symptoms on improved goal adjustment capacities are specific to goal disengagement.

Thus, while goal disengagement capacities may reduce depressive symptoms in the context of unattainable goals (Dunne et al., 2011), depressive symptoms could also make it easier for individuals to disengage from unattainable goals. The latter effect may be observed particularly in populations that are likely to experience depressive symptomatology in the context of severe goal constraints or losses. As such, associations between goal disengagement capacities and reduced depressive symptoms may be difficult to detect in populations at-risk for depression, since the emergence of depressive symptoms may facilitate individuals' goal disengagement capacities, and contribute to a reversed association between these two variables. Accordingly, our meta-analysis aimed to elucidate the contextual factors moderating the association between goal disengagement and depressive symptoms. We hypothesized that the association between goal disengagement capacities and lower levels of depressive symptoms may be reduced or reversed in samples that include individuals at-risk for depression, whereas the association between goal reengagement capacities and lower levels of depressive symptoms should not be affected in such samples (cf. corroborative research in the context of suicidal ideation, O'Connor et al., 2007, 2009, 2012).

The Present Study

This meta-analysis aims to quantify the relations between goal adjustment capacities and different indicators of quality of life to test conclusions drawn from extant, single studies or narrative reviews. We contend that such an analysis could enhance our understanding of adaptive

self-regulation by synthesizing a somewhat mixed literature and clarifying important questions regarding general associations and differential psychological and health outcomes of individuals' goal adjustment capacities as well as identifying circumstances that can alter these associations. Our analysis broadly defined quality of life as both psychological well-being and physical health, which represent core subjective and objective indicators of quality of life (Cummins, 1999). Specifically, we estimated the magnitude of the effect sizes of goal disengagement and quality of life, and goal reengagement and quality of life, and tested whether the obtained effects varied as a function of specified moderator variables.

The above-addressed literature allowed us to specify three directed hypotheses. First, we hypothesized that both goal disengagement and goal reengagement capacities would be positively linked to higher levels of quality of life (i.e., psychological well-being and physical health). Second, we reasoned that these associations between goal adjustment capacities and psychological well-being would be moderated by subtype (i.e. *positive* vs. *negative indicators*). In particular, goal disengagement capacities were hypothesized to be more strongly associated with negative indicators of psychological well-being, while goal reengagement would be more strongly linked to positive indicators of psychological well-being. Third, we hypothesized that the relation between goal disengagement capacities (but not goal reengagement capacities) and depressive symptoms would be moderated by depression risk status. To this end, we reasoned that goal disengagement capacities would be linked to fewer depressive symptoms in samples not characterized by their risk for depression, but that this effect could become smaller or reversed in samples that are at-risk for depression.

In addition to the three directed hypotheses, this meta-analysis tested additional exploratory hypotheses: First, we examined whether the associations between goal adjustment capacities and quality of life would be differentially associated with quality of life types (i.e., *psychological well-being* vs. *physical health*). Second, we investigated whether the associations between goal adjustment capacities and physical health would be moderated by measurement-type (i.e., *self-report* vs. *objective*). Third, we conducted exploratory analyses to determine whether the magnitude of the associations differed as a function of sample and study characteristics (e.g., age, sex, study quality), or the timing of the effect sizes (i.e., cross-sectional, lagged). Finally, we explored the associations between goal adjustment capacities and different specific aspects of well-being and health (e.g., life satisfaction, positive affect).

Methods

Literature Search and Study Selection Strategy

The meta-analysis was conducted in accordance with PRISMA guidelines (Moher et al., 2009). Articles were identified through a literature search of PsycINFO and MedLine electronic databases from January 2003 (i.e., year GAS scale originally published) to April 2017. We chose to be liberal in our literature search by including several variations of goal adjustment capacities for Boolean search terms ("goal adjust*" OR "goal reengag*" OR "goal disengag*" OR "unattain* goal") within any field (e.g., abstract, keywords) to capture all potentially relevant articles (see Figure 5). This initial search yielded 283 articles. Titles and abstracts were then reviewed; articles were excluded if they did not mention goal adjustment capacities (e.g., goal disengagement, goal reengagement) or potentially relevant unspecific concepts (e.g., individual differences or coping), or if they utilized measures beyond the scope of this meta-analysis (e.g., unsolvable anagram task). The title and abstract review yielded 113 articles (selection reliability with second coder (TS) = 93.10%). Ascendancy and descendency approaches were used to identify 77 additional articles. Finally, authors who contributed two or more articles selected for full-text review were contacted to solicit any additional data (published or unpublished), resulting in the addition of 2 articles. Altogether, the search strategy identified 192 potentially relevant articles to be retrieved for full-text review.

Eligibility criteria. Articles retrieved for full-text review were excluded if they: (i) did not measure goal adjustment capacities, (ii) measured only goal, stressor, or domain specific goal adjustment capacities, (iii) did not measure quality of life (well-being or health), (iv) were theoretical articles, (v) provided insufficient statistics to compute effect sizes,[3] (vi) provided only previously included results (e.g., dissertation results redundant with journal article publication), (vii) were in a language other than English, (viii) were experimental studies with no baseline effect sizes reported prior to manipulations, or (iv) could not be retrieved (see Figure 5). Following full-text review, 35 articles were included in the meta-analysis.

Publication bias. Several strategies were employed to minimize publication bias. First, all authors who had contributed two or more articles selected for full-text review were contacted and asked if they had any additional data (published or unpublished) to contribute to the meta-

[3] Authors were contacted, and a request was made to provide all additional information necessary for the computation of effect sizes.

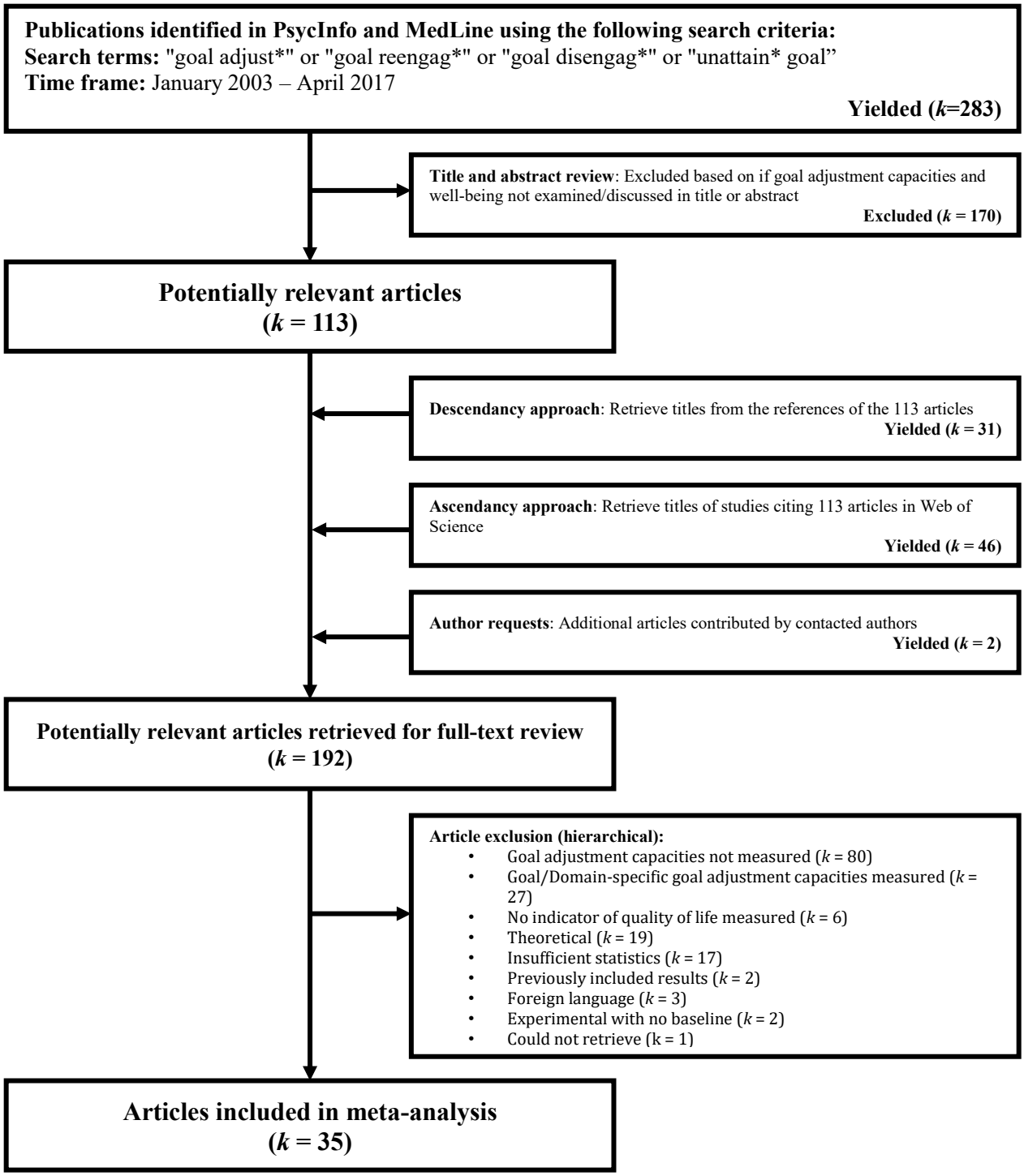

Figure 5. Flowchart of the article search and selection process for the meta-analysis.

analysis. Although the response rate was low, this resulted in the inclusion of additional unpublished effect sizes across multiple samples. Second, PsycINFO, one of the databases we utilized for the initial literature search, includes unpublished sources (i.e. dissertations) that were included in the meta-analysis. Third, we searched the reference lists of all the articles that were included in the full-text review for unpublished data during the descendancy search. Finally, we also utilized Web of Science to search for unpublished and published works citing any of the articles that were included in the full-text review during the ascendancy search. Together, these strategies resulted in the inclusion of 6 dissertations and 2 unpublished manuscripts.

Data Extraction

Data were extracted by a single rater (MB) who coded all studies. Approximately 30 coding decisions were made for each study, including measures of goal adjustment capacities, quality of life, timing, sample demographics (i.e. age, description, % female), study characteristics (i.e. sample size, study quality), and effect sizes calculation. A random selection of articles (20%) coded by a second rater (HH) indicated excellent inter-rater agreement for coding decisions (98.49% overall agreement; 100% effect size calculation); disagreements were resolved through discussion.

Measures

Goal adjustment capacities. Goal adjustment capacities were measured using the Goal Adjustment Scale (GAS; Wrosch et al., 2003a). The GAS contains two subscales: goal disengagement (4 items) and goal reengagement (6 items). Individuals rate how they *usually* react if they can no longer pursue an important goal, on a 5-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (5). Subscales are indexed by computing mean scores of the relevant subscale items. Sample items of the goal disengagement subscale include "It's easy for me to reduce my effort towards the goal", and "It's easy for me to stop thinking about the goal and let it go". Samples items of the goal reengagement subscale include "I start working on other new goals", and "I tell myself that I have a number of other new goals to draw upon." The present meta-analysis only included articles using either or both subscales to measure individuals' general tendencies of goal disengagement and/or goal reengagement; articles that adapted the scale to specific goals, stressors, or domains were not included.

Quality of life. Quality of life was broadly defined as indicators of psychological well-being and health. Quality of life type differentiated between measures of *psychological well-*

being and *physical health*. Quality of life subtypes were nested coding decisions that further differentiated indicators of psychological well-being (*positive* vs. *negative*) and measurement-type of physical health (*self-report* vs. *objective*). Quality of life measures were also coded based on what construct the indicator generally measured, including examples such as: purpose in life (*positive*), depression (*negative*), physical symptoms (*self-report*), or biomarker (*objective*).

Timing of effects. Timing was coded for each effect size as either *cross-sectional* or *lagged*. Lagged was operationally defined as associations between goal adjustment capacities and quality of life at different time points.

Sample demographics, depression-risk status, and study quality. Coded sample demographics included: *sample size*, mean *age*, and *sex* (% female). A qualitative sample description was noted for each sample (e.g., patients who identify as having depressive disorder; undergraduate students) and used to code depression-risk status as either at-risk or not at-risk. Descriptors of samples *at-risk for depression* included: attempted suicide, high-risk for first onset of depressive episode, or diagnosis of major depressive disorder or dysthymia. *Study quality* was derived from five study characteristics (binary coded; 1 = yes, 0 = no): (i) recruitment procedures described, (ii) missing data or attrition discussed, (iii) participant inclusion criteria defined, (iv) sample size greater than 100, and (v) high internal consistency of goal adjustment capacity measures (Cronbach's $\alpha > .80$). Quality characteristics were derived from PRISMA guidelines (Moher et al., 2009) and the relative strengths and weaknesses of the included articles. The total study quality was the sum of the five characteristics (higher score, higher quality).

Effect Size Calculation and Selection

Fisher's Z' was selected as the common effect size metric, as articles predominantly reported zero-order correlations. Fisher's Z' is interpreted similarly to a correlation coefficient, ranges from -∞ to +∞. Bivariate correlations (*r*) were converted using Fisher's variance-stabilizing transformation (Cooper, 1998; Peterson & Brown, 2005).[4] The direction of Fisher's

[4] Only correlation coefficients were included in the present meta-analysis as other effect size estimates may introduce bias (Aloe, 2014). Of note, additional analyses were performed to determine how sensitive the results were to the inclusion of other types of effect sizes. These analyses included effect size estimates derived from standardized regression coefficients, odd-ratios, *p*-values, and results described as non-significant (imputed at 0). Importantly, the pattern

Z' was coded uniformly to ensure that positive values represented greater goal adjustment capacities being associated with better quality of life. For example, a negative correlation between goal adjustment and depressive symptoms was re-coded to represent a positive outcome (e.g., fewer depressive symptoms represent better quality of life); accurate wording was retained in the results for precision (e.g., more goal adjustment was associated with fewer depressive symptoms). To facilitate interpretation, effect size estimates were converted from *Fisher's Z'* to *r* in the text.

For each article, all available and relevant effect sizes were coded, yielding multiple effect sizes per article. The 35 articles contained 31 independent samples. Whenever feasible, redundant samples across articles were linked, such that study level information (e.g., mean sample age) was drawn from the article reporting the most complete information. In cases of completely redundant effect sizes (i.e., effect sizes using identical measures of both goal adjustment capacities and quality of life at same time point), effect sizes calculated based on the largest N were retained.

Prior to data analyses, effect sizes were screened for outliers and publication bias. Outliers were identified and removed using a z-score of ± 3 as the cut-off; two outliers were present for goal disengagement (r = -.56 and -.78) and one outlier was observed for goal reengagement (r = .59).[5] Publication bias was assessed by creating funnel plots of the mean weighted effect sizes for each study using the trim-and fill method (Duval, 2005), which estimates the number of missing studies required to offset potential publication bias (see Figure 6). Review of these plots suggest some evidence of publication bias in the literature for both goal disengagement and goal reengagement, with roughly the same number of missing or unpublished findings for these goal adjustment capacities (disengagement: 2 missing left-side, Z' = .07, p < .01; $Z'_{adjusted}$ = .06, p < .01; reengagement, 3 missing right-side, Z' = .19, p < .01; $Z'_{adjusted}$ = .20, p < .01). Thus, while the goal disengagement effect size estimates may be slightly positively biased, the goal reengagement effect size estimates may be slightly negatively biased.

Analytic Strategy

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of findings for our directed hypothesis was highly similar, suggesting a degree of robustness of these estimates.

[5] Given the small number of outliers, and that these outliers stemmed from samples providing multiple estimates, we evaluated the impact of each single effect size on the aggregated estimates as relatively low, leading us to remove the outliers from the analyses.

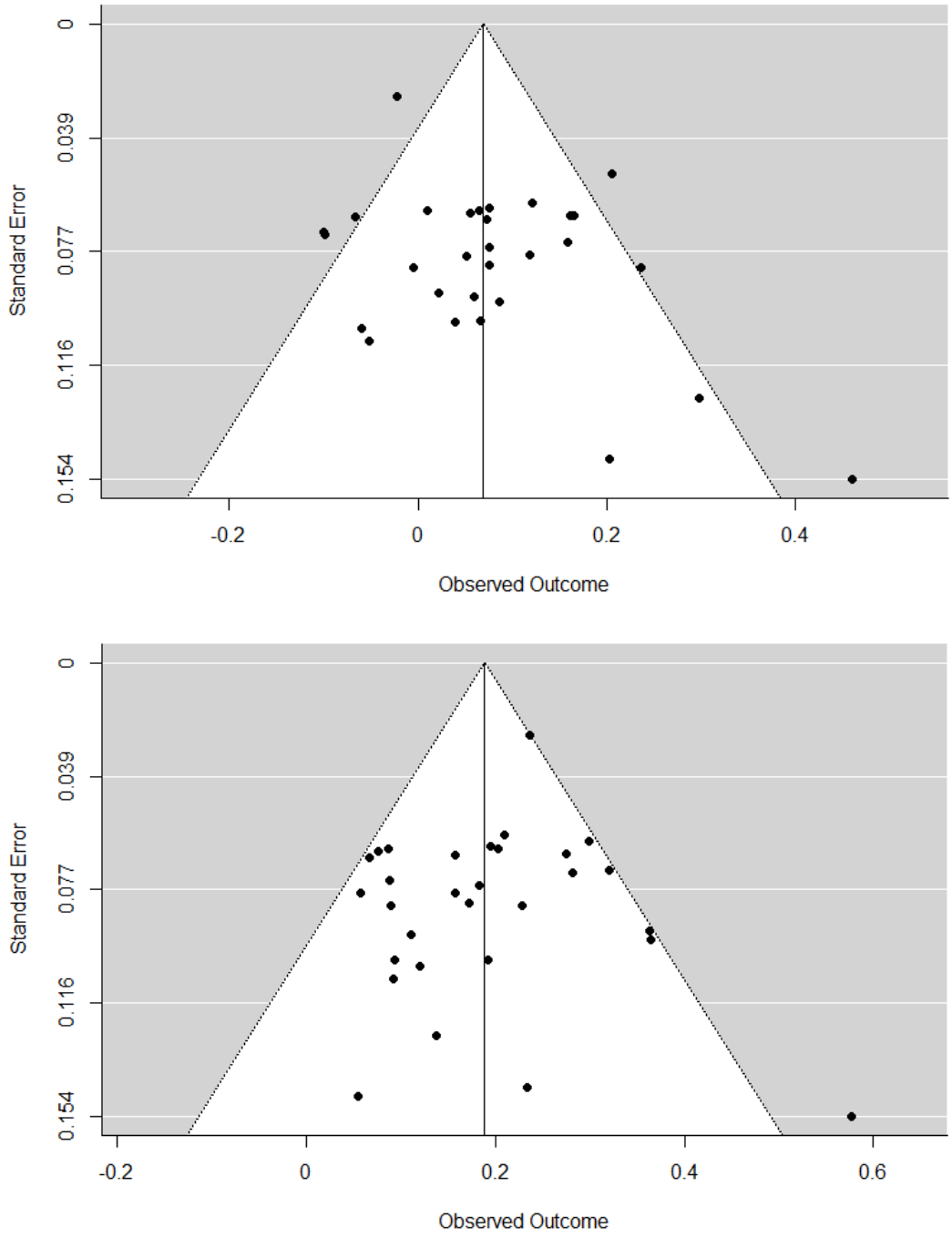

Figure 6. Funnel plot of each sample's mean weighted effect size by average variance to assess for publication bias for goal disengagement (upper panel) and goal reengagement (lower panel).

Preliminary descriptive analyses were conducted to examine sample demographics and determine the strength of the relation between goal disengagement and goal reengagement. Heterogeneity was assessed using the I^2 index, which is an indicator of the proportion of variance explained by heterogeneity (Higgins & Thompson, 2002). An I^2 index greater than 50% suggest a heterogeneous effect size distribution, which warrants additional moderator analyses. To complement the I^2 index, forest plots of the effect sizes were constructed and inspected to examine variability in the estimates.

Main analyses were stratified by goal adjustment capacities (i.e., separately for goal disengagement and goal reengagement). Overall effect sizes between goal adjustment capacities and quality of life were estimated. Next, separate analyses were conducted for *a priori* specified moderator variables including (a) quality of life type (*psychological well-bring* vs. *physical health*), (b) quality of life subtype for psychological well-being (indicators: *positive* vs. *negative*) and physical health (measurement type: *self-report* vs. *objective*); (c) depression risk status (*at-risk* vs. *not at-risk*), (d) sample characteristics (*sample size*, *age*, *sex*), and (e) timing (*cross-sectional* vs. *lagged*). Finally, exploratory analyses were conducted to quantify the association between goal adjustment capacities and specific quality of life constructs (e.g., *satisfaction with life, perceived stress*).

Two analytic methods were used to account for redundancy of effect sizes in the meta-analytic models. Predominantly, the robust variance estimation (RVE) method was used for models based on effect sizes derived from more than five samples. This method accounts for dependency among samples with multiple effect sizes by specifying the within-study correlation among effects (ρ). We utilized the default within-study correlation value of .80. Further, the small sample adjustment was used to correct for bias in *p*-values for analyses including less than 40 independent samples (Tanner-Smith, Tipton & Polanin, 2016). In addition, the basic random effects meta-analytic method was used for models based on effect sizes derived from five or fewer samples. Among analyses with few samples, the empirically calculated degrees of freedom can fall below four, rendering the estimated *p*-values inaccurate, or even further reduced when the predictor variables in question are markedly imbalanced (Tanner-Smith, Tipton & Polanin, 2016).

For all analyses, we initially tested the basic meta-regression model to estimate the mean effect size (i.e., intercept only, no predictors). Then, moderator analyses were conducted by

adding the moderator variable as a predictor in the meta-regression model. For continuous moderators, the coefficients can be interpreted as the amount of change expected in strength of the association (i.e., mean effect size Z') given a one unit increase in the moderator. For categorical moderators, dummy codes were used and thus, can be interpreted as the mean effect size difference between the groups. Analyses were conducted in R (version 3.5.1) using (i) *robumeta* package (Fisher & Tipton, 2014) for the RVE method to estimate mean effect sizes and meta-regression models, (ii) *clubSandwich* package (Pustejovsky, 2015) to estimate the multiparameter F-tests, and (iii) *metafor* package (Viechtbauer, 2010) to conduct the standard meta-analysis method that naïvely ignored data dependencies.

Results

Preliminary Analyses

An overview of the sample characteristics and effect sizes is presented in Table 8 and Table 9. Of the 31 included samples, the average sample contained 234 participants, with an average age of 38.09 years. Samples were 68.20% female and had an average study quality of 3.81 (range: 2 – 5). Further, 29 samples reported a correlation between goal disengagement and goal reengagement (1 effect size per sample). The average GAS scale reliability (Cronbach's α) was .76 for goal disengagement, and .86 for goal reengagement. Across these samples, the mean correlation was estimated at .17 (Z' = .17, SE = .04, p < .01), indicating a modest correlation between goal disengagement and goal reengagement capacities.

Heterogeneity of effect sizes. The present meta-analysis revealed that the proportion of total variation in the effect size estimates due to heterogeneity between studies was estimated at 71% and 73% for goal disengagement and goal reengagement, respectively. As an example, the variability among effect sizes is illustrated in Figure 7 for the associations between goal disengagement capacities and depressive symptoms for individuals at-risk, and not at-risk, for depression. Inspection of forest plots for other a-priory hypotheses also suggested considerable variability in the obtained estimates (Figures 8 and 9). Importantly, the focus of RVE analysis (and this meta-analysis) is the accurate estimation of mean effect sizes and meta-regression coefficients (Moeyaert et al., 2017; Tanner-Smith et al., 2016). Although heterogeneity parameters are provided, they are incidental to the analysis and may be imprecise, often estimated using simplistic methods (Cheung, 2014; Tanner-Smith et al., 2016). More specifically, Cheung (2014) noted that the estimated heterogeneity parameters are likely to be

Table 8.

Descriptive Characteristics and Frequencies of Included Studies

Characteristic	*j*[a]	*N*	*M (SD) or [%]*[b]
Sample Characteristics			
Sample Size	31	7241	233.58 (305.74)
Age (mean)	31	7241	38.09 (16.51)
Sex (% female)	31	7241	68.20 (22.42)
Study Quality	31	7241	3.81 (0.87)
Goal Adjustment Reliability (> .80)	22	5570	[70.97%]
Inclusion/Exclusion Criteria	21	3550	[67.74%]
Recruitment Methods	29	6835	[93.55%]
Missing Data/ Attrition	21	4158	[67.74%]
Sample >100	25	6828	[80.64%]
Goal Adjustment Capacity			
Goal Disengagement	30	7190	[96.77%]
Goal Reengagement	30	6999	[96.77%]
Quality of Life			
Psychological Well-Being	31	7241	[100.00%]
Positive	17	3121	[54.84%]
Negative	26	6353	[83.87%]
Physical Health	13	4211	[41.94%]
Self-Report	12	4121	[38.71%]
Objective Measures	3	651	[9.68%]

[a] Number of independent samples; [b] Percent of independent samples.

Table 9

Summary Table Including Cumulative Effects Sizes Between Goal Adjustment and Quality of Life by Sample

		Fisher's Z'					
	Article(s)	Goal Disengagement	Goal Reengagement	N	Age	% Female	Study Quality
1	Arends, Bode, Taal, and Van de Laar (2013); Kleinveld (2013)	0.08	0.18	305	62.25	62.00	4
2	Asano, Ishimura, and Kodama (2014)	-0.07	0.16	233	20.54	68.24	4
3	Barlow, Wrosch, and Hoppmann (2016)	0.07	0.07	228	48.25	50.00	5
4	Bauer (2004); Wrosch, Miller, Scheier, and Brun de Pontet (2007) S1	0.24	0.23	150	50.06	53.00	4
5	Boduszek & Dhingra (2016); Dhingra, Boduszek, and O'Connor (2016)	-0.02	0.24	1809	24.05	73.69	3
6	Burr (2006); Bye (2012)	0.21	0.21	385	59.18	43.80	5
7	Carver, Sinclair, and Johnson (2010)	-0.01	0.09	149	19.50	58.00	3
8	Castonguay, Wrosch, and Sabiston (2014); Castonguay, Wrosch, and Sabiston (2017); Wrosch and Sabiston (2013)	0.03	0.06	176	54.86	100.00	5
9	Dunne (2006); Dunne, Wrosch, and Miller (2011); Jobin and Wrosch (2016)	0.12	0.16	215	72.41	52.00	4
10	Eddington (2014)	0.07	0.09	388	18.80	74.00	4
11	Eddington, Silvia, Foxworth, Hoet, and Kwapil (2015)	0.20	0.06	49	37.88	83.67	4
12	Haase, Aviram, Wrosch, Silbereisen ,and Heckhausen (2013) S1	0.08	0.19	257	27.12	67.70	3
13	Haase, Aviram, Wrosch, Silbereisen, and Heckhausen (2013) S2	0.02	0.36	124	22.85	62.10	3

	Article(s)	*Fisher's Z'*		N	Age	% Female	Study Quality
		Goal Disengagement	Goal Reengagement				
14	Hrabliuk, Latham, and McCarthy (2012)	0.16	-	242	44.00	18.00	4
15	Janse, Sprangers, Ranchor, and Fleer (2015)	0.16	0.09	145	64.20	39.20	5
16	Lam et al. (2015)	0.08	0.17	172	51.97	100.00	5
17	Mens and Scheier (2015)	0.06	0.08	230	51.00	100.00	5
18	Messay (2014); Messay and Marsland (2015)	-0.05	0.09	90	19.24	59.30	3
19	Neely, Schallert, Mohammed, and Roberts (2009) S1	-0.10	0.32	203	22.00	30.54	3
20	Neely, Schallert, Mohammed, and Roberts (2009) S2	0.12	0.30	207	22.00	80.81	3
21	Neff and Faso (2015)	-	0.23	51	40.41	78.43	3
22	Neter, Litvak and Miller (2009)	0.04	0.09	101	41.21	96.00	5
23	O'Connor and Forgan (2007)	0.01	0.20	255	22.00	78.04	3
24	O'Connor et al., (2009)	-0.21	0.28	200	35.30	57.40	4
25	Thompson, Stanton, and Bower (2013)	0.07	0.19	114	57.20	100.00	4
26	Wrosch and Miller (2009)	-0.06	0.12	97	17.16	100.00	3
27	Wrosch, Miller, Scheier, and Brun de Pontet (2007) S2	0.30	0.14	81	22.11	83.95	4
28	Wrosch, Scheier, Miller, Schulz, and Carver (2003) S1	0.09	0.42	115	19.35	31.00	2
29	Wrosch, Scheier, Miller, Schulz, and Carver (2003) S2	0.06	0.11	120	45.28	56.00	3
30	Wrosch, Scheier, Miller, Schulz, and Carver (2003) S3	0.46	0.58	45	37.29	77.33	3
31	Zhu et al. (2015)	0.16	0.27	241	51.39	80.10	5

Note. Values in the table were left blank when the information was not provided in the article; S = Sample for multi-study papers.

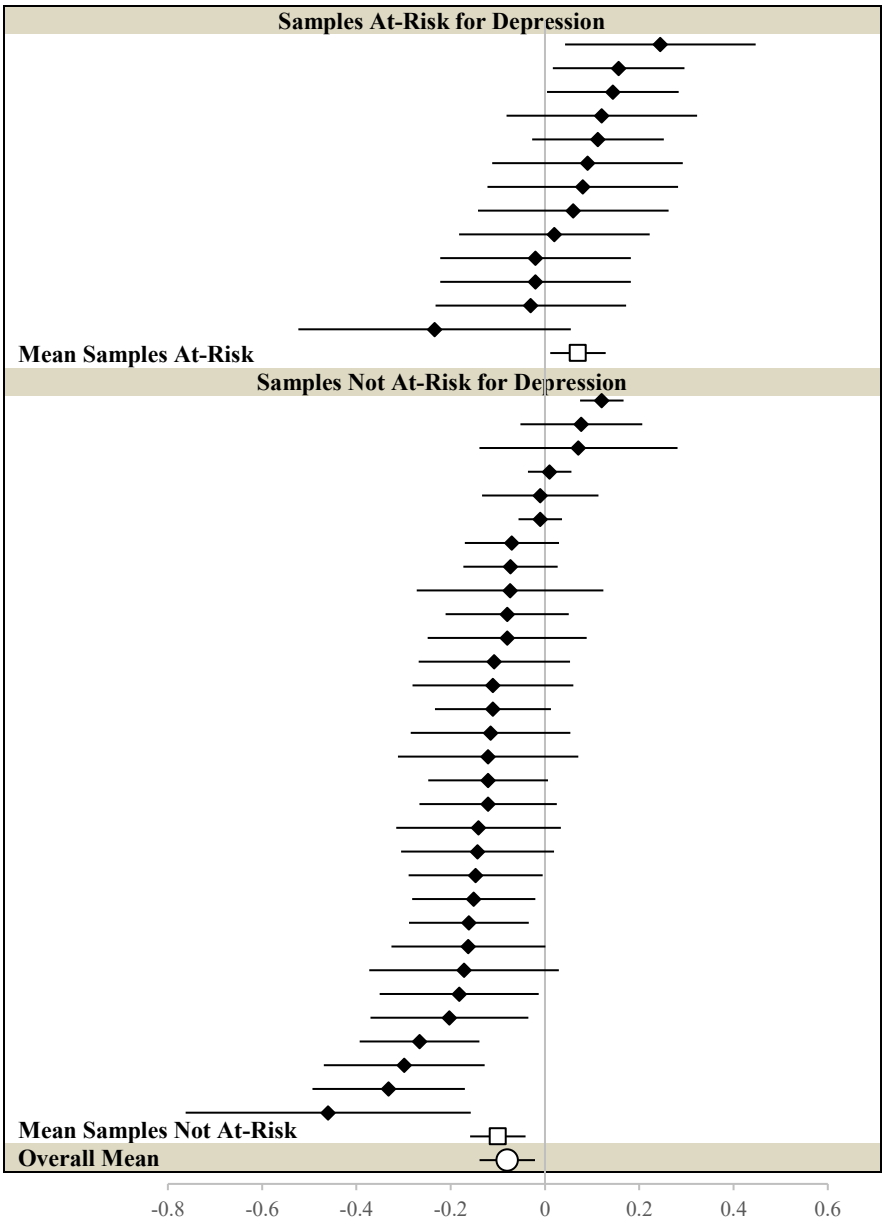

Figure 7. Forest plot of effect sizes for goal disengagement capacities and depressive symptoms, separately for samples at-risk, and not at-risk, for depression.

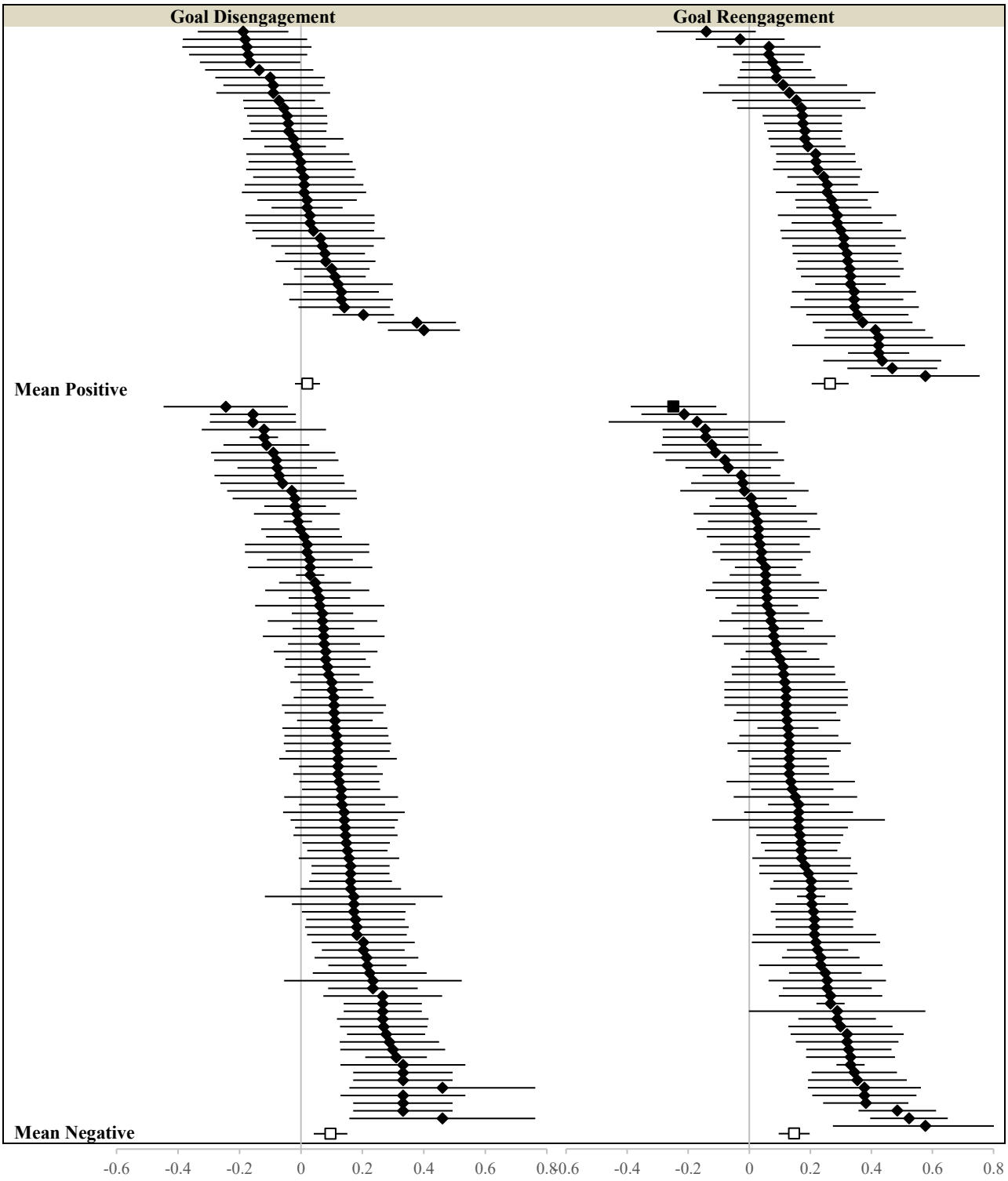

Figure 8. Forest plot of effect sizes for goal disengagement and reengagement capacities and psychological well-being, separately for positive, and negative, indicators.

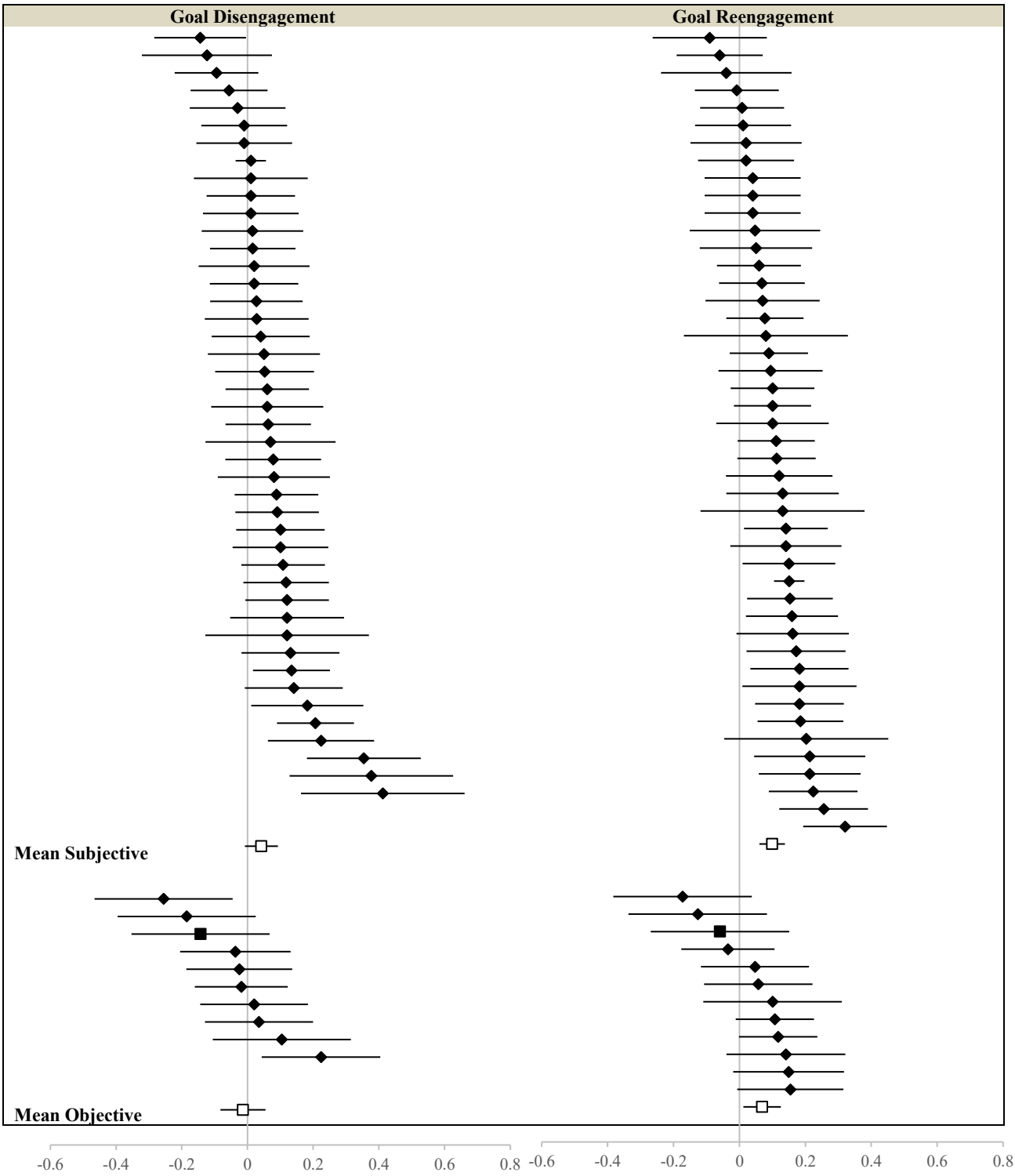

Figure 9. Forest plot of effect sizes for goal disengagement and reengagement capacities and physical health, separately for subjective, and objective, measurement types.

overestimated when using the RVE approach, as compared to the multi-level approach.

Main Analyses

Overall effect sizes. Overall, the cumulative effect size for goal disengagement (r = .08) and goal reengagement (r = .19) revealed positive associations with quality of life indicators, such that higher levels of goal adjustment capacities were associated with better well-being and physical health (refer to Table 10 for summary of the main analyses).

Quality of life type. The associations between goal adjustment and quality of life differed between psychological well-being and physical health for goal reengagement (B = 0.12, p < .01), but not goal disengagement (B = 0.01, p = .75). More specifically, goal reengagement was shown to be more strongly related to psychological well-being (r = .20), as compared to physical health (r = .09), while goal disengagement was found to be similarly linked to psychological well-being (r = .08) and physical health (r = .04), although the latter association was not statistically significant.

Psychological well-being subtype. The relations between goal adjustment capacities and psychological well-being differed between positive and negative indicators of psychological well-being for goal disengagement (B = -0.09, p = .02), but not goal reengagement (B = 0.06, p = .21; Figure 8). More specifically, the analyses revealed that goal disengagement was associated with lower levels of negative (r = -.12), but not positive (r = .02), indicators of psychological well-being. At the level of specific constructs, goal disengagement was associated with lower levels of depression (r = -.09), anxiety (r = -.12), intrusive thoughts (r = -.18), perceived stress (r = -.23), negative affect (r = -.14), and fatigue (r = -.09). Conversely, goal reengagement was similarly linked to higher levels of positive indicators (r = .24), and lower levels of negative indicators (r = -.17), of psychological well-being. In particular, goal reengagement was related to greater satisfaction with life (r = .27), purpose in life (r = .29), positive affect (r = .26), and less depression (r = -.20), anxiety (r = -.14), perceived stress (r = -.24), negative affect (r = -.13), and fatigue (r = -.11; refer to Table 11 for summary of effect sizes by constructs of interest). Further, supplemental moderator analyses demonstrated that as compared to goal disengagement, goal reengagement capacities were more strongly associated with positive (B = -0.24, SE = 0.04, p < .01), but not negative (B = -0.06, SE = 0.03, p = .054), indicators of psychological well-being.

Physical health measurement subtype. The associations between goal adjustment

Table 10.

Effects Sizes of Associations Between Goal Disengagement and Reengagement Capacities With Quality of Life Types, and Subtypes

	Goal Disengagement				Goal Reengagement			
Moderators	*j*[a]	*Number of Effect Sizes*	*Z' (SE)*	*p*	*j*[a]	*Number of Effect Sizes*	*Z' (SE)*	*p*
Overall	30	203	.08 (.02)	<.01	30	218	.19 (.02)	<.01
Quality of Life Type		B^b = 0.01, *SE* = 0.04, *p* = .75				B^a = 0.12, *SE* = 0.02, *p* < .01		
Psychological	29	143	.08 (.02)	<.01	29	154	.21 (.02)	<.01
Physical Health	12	54	.04 (.03)	.22	13	58	.09 (.02)	<.01
Psychological Subtype		B^c = -0.09, *SE* = 0.03, *p* = .02				B^b= 0.06, *SE* = 0.04, *p* = .21		
Positive	15	40	.02 (.02)	.37	15	46	.25 (.03)	<.01
Negative	24	90	-.12 (.03)	<.01	24	95	-.17 (.02)	<.01
Physical Subtype†		B^d = 0.09, *SE* = 0.04, *p* = .02				B^c = 0.05, *SE* = 0.03, *p* = .07		
Self-Report	11	44	.05 (.03)	.14	12	46	.10 (.02)	<.01
Objective†	2	10	-.02 (.04)	.60	3	12	.06 (.05)	.32
Depression Risk†		B^e = -0.17, *SE* = 0.04, *p* < .01				B^d = -0.02, *SE* = 0.04, *p* = .60		
At-Risk†	3	13	.08 (.03)	<.01	3	13	-.18 (.03)	<.01
Other samples	15	31	-.10 (.03)	.01	16	32	-.20 (.02)	<.01
Sample Age		*B* = 0.003, *SE* = 0.001, *p* < .01				*B* = -0.001, *SE* = 0.001, *p* = .16		
Sample Sex (% female)		*B* = -0.000, *SE* = 0.001, *p* = .82				*B*= -0.001, *SE* = 0.001, *p* = .20		
Study Quality		*B* = 0.037, *SE* = 0.017, *p* = .05				*B* = -0.052, *SE* = 0.019, *p* = .01		
Timing Type		B^f = -0.03, *SE* = 0.03, *p* = .0.33				B^f = 0.07, *SE* = 0.02; *p* < .01		
Cross-Sectional	29	116	.07 (.02)	<.01	29	128	.19 (.02)	<.01
Lagged	13	87	.09 (.03)	.01	13	90	.16 (.02)	<.01

Note. The signs of some of the reported effect sizes were flipped to intuitively match the moderator labels. †Estimated ignoring dependencies; [a] Number of independent samples; [b] psychological = 1, physical = 0; [c] positive = 1, negative = 0; [d] self-report = 1, objective = 0; [e] depression risk samples = 1, all samples = 0; [f] cross-sectional = 1, lagged = 0.

Table 11.

Exploratory Analyses: Effects Sizes of Associations Between Goal Adjustment Capacities With Quality of Life Constructs

	Goal Disengagement				Goal Reengagement			
Constructs	*j*[a]	*Number of Effect Sizes*	*Z' (SE)*	*P*	*j*[a]	*Number of Effect Sizes*	*Z' (SE)*	*p*
Life satisfaction	5	6	.08 (.05)	.18	6	9	.27 (.06)	.01
Purpose in Life	7	11	-.03 (.02)	.19	6	10	.30 (.04)	<.01
Positive Affect	9	17	.06 (.04)	.17	9	20	.26 (.03)	<.01
Depression	18	44	-.09 (.03)	.01	19	45	-.21 (.02)	<.01
Anxiety	9	17	-.12 (.03)	.01	9	18	-.14 (.05)	.02
Intrusive Thoughts†	3	6	-.18 (.04)	<.01	3	6	-.03 (.07)	.62
Perceived Stress†	2	2	-.24 (.10)	.02	3	4	-.24 (.04)	<.01
Negative Affect	7	16	-.14 (.05)	.03	7	18	-.13 (.04)	.02
Fatigue†	3	6	-.09 (.03)	<.01	3	6	-.11 (.05)	.03
Physical Symptoms†	5	11	-.13 (.04)	<.01	5	11	-.13 (.03)	<.01
Chronic Illness†	3	9	-.05 (.03)	.11	4	11	-.09 (.02)	<.01
Physical Activity†	2	10	.02 (.02)	.50	2	10	.12 (.02)	<.01
Biomarkers†	2	10	-.02 (.04)	.60	2	10	.03 (.03)	.32
Sleep†	3	5	.11 (.04)	.01	3	5	.07 (.05)	.13

Note. The signs of some of the reported effect sizes were flipped to intuitively match the moderator labels. †Estimated ignoring dependencies; [a] Number of independent samples.

capacities and physical health varied between subjective and objectives measures for goal disengagement (B = 0.09, p = .02), but not goal reengagement (B = 0.05, p = .07; Figure 9). However, the physical health subtype analyses demonstrated that goal disengagement was not related to self-report (r = .05), or objective (r = -.02), measures of physical health, while goal reengagement was related to self-report (r = .10), but not objective (r = .06), measures of physical health. Nonetheless, the construct-specific analyses showed that, goal disengagement was associated with fewer physical symptoms (r = -.13), and better sleep (r = .11). Goal reengagement was related to fewer physical symptoms (r = -.13), less chronic illness (r = -.09), and greater physical activity (r = .12).

Depression risk samples. Depression risk status explained significant variability in the relation between goal disengagement and depressive symptoms (B = -0.17, p < .01), but not for the association between goal reengagement and depressive symptoms (B = -0.02, p = .60). Goal disengagement was associated with fewer depressive symptoms in samples not at risk for depression (r = -.11), but more depressive symptoms in samples at-risk for depression (r = .08; refer to Figure 7). The magnitude of the association between goal reengagement and depressive symptoms was nearly identical in depression risk samples (r = -.18) and all other samples (r = -.23).

Sample characteristics. Although the magnitude of the goal reengagement effect sizes was not associated with the mean age of the samples (B = -0.001, p = .16), the magnitude of the goal disengagement effect sizes significantly increased as the mean age of the samples increased (B = 0.003, p < .01). The sex distribution of the sample did not moderate the magnitude of the goal disengagement (B = -0.000, p = .82), or goal reengagement effect sizes (B = -0.001, p = .20). The magnitude of the goal disengagement effect sizes was larger in samples with higher overall study quality ratings (B = .037, p = .05), while the magnitude of the goal reengagement effect sizes was larger for samples with lower study quality ratings (B = -.052, p = .01). However, a multiple predictor meta-regression including all the separate study quality indicators simultaneously revealed no significant associations with goal disengagement (p > .30). Conversely, only the reliability indicator was negatively associated with the magnitude of the goal reengagement effect sizes (B = -0.06, SE = 0.03, p = .03). Of note, the moderator results for the sample and study characteristics replicated if tested simultaneously in a single multiple predictor meta-regression model for goal reengagement, but not for goal disengagement (B_{age} =

0.003, $p = .10$; $B_{quality} = -0.004$, $p = .89$).

Timing of effects. The analyses demonstrated that timing type moderated the association between goal reengagement and quality of life ($B = 0.07$, $p < .01$), but not goal disengagement and quality of life ($B = -0.33$, $p = .33$). More specifically, the cross-sectional effect sizes ($r = .19$) were larger than lagged effect sizes ($r = .16$) for goal reengagement.

Discussion

A growing body of research in personality and lifespan psychology has examined whether goal disengagement and goal reengagement processes support the adaptive management of unattainable goals (for reviews, see Heckhausen et al., 2010, 2019; Wrosch et al., 2011, 2013). When the pursuit of a desired goal is severely constrained and goal progress has become impossible, this line of work posits that individuals need to protect their quality of life by disengaging from the respective goal and pursuing other meaningful goals (Brandtstädter & Renner, 1990; Heckhausen et al., 2010; Wrosch et al., 2003a). In such circumstances, goal disengagement may reduce the distress associated with the pursuit of unattainable goals and related failure experiences, while the engagement in other valued goals may ensure that life continues with purpose (Wrosch et al., 2003b, 2007).

The present meta-analysis examined these assumptions from a personality perspective by focusing on inter-individual differences in individuals' capacities to disengage from unattainable goals and to reengage in other goals across situations, domains, and the lifespan. Consistent with conclusions from studies and narrative reviews (Wrosch et al., 2011, 2013), the results documented that both goal disengagement and goal reengagement capacities were associated with higher levels of psychological well-being and certain indicators of physical health. Using Cohen's effect size guidelines for Pearson correlation coefficients (Cohen, 1988), the reported overall quality of life effect sizes were generally small, while certain quality of life types and constructs ranged from small to medium, although these guidelines should be used with caution. Further, these associations were statistically significant for cross-sectional and lagged effect sizes. In fact, the timing moderator did not significantly alter the observed pattern for goal disengagement capacities, although associations between goal reengagement capacities and quality of life indicators were particularly strong for cross-sectional, compared to lagged effect sizes (although all were statistically significant; see Table 10). Of importance, our analysis did uncover a slight degree of publication bias in the aggregated effect sizes, such that goal

disengagement effect sizes may be slightly exaggerated, while goal reengagement effect sizes may be slightly understated. Given this slight bias, results should be interpreted with an appropriate amount of caution.

The study's findings showed a relatively modest, positive association between individuals' goal disengagement and goal reengagement capacities, which suggests that these capacities represent two independent constructs that could serve distinct functions in the self-regulation of behavior (Wrosch et al., 2003a; 2003b). The reported findings further support this conclusion by demonstrating differential associations of goal disengagement and goal reengagement capacities on positive, but not negative, indicators of psychological well-being. More specifically, goal disengagement capacities were associated with lower levels of negative indicators of well-being, but unrelated to positive indicators of well-being. The strongest associations of goal disengagement capacities were obtained with lower levels of perceived stress, intrusive thoughts, and negative affect. These findings support the theoretical claim that goal disengagement serves to protect individuals from the negative psychological states associated with the pursuit of unattainable goals and associated failure experiences (Wrosch et al., 2007). Conversely, individuals who are unable to disengage from unattainable goals may become overwhelmed with a lack of goal progress and perceive heightened levels of stress and intrusive thoughts (Carver & Scheier, 1990, 1999).

Goal reengagement capacities, by contrast, were associated with both higher levels of positive, and lower levels of negative, indicators of psychological well-being. In fact, as compared to goal disengagement capacities, the supplemental moderator analyses showed that goal reengagement exerted stronger effects of positive, but not negative, indicators of well-being. More specifically, the largest effect sizes were found with respect to predicting purpose in life, positive affect, and life satisfaction. These findings substantiate the theoretical premise that the pursuit of other or new goals can instill individuals' lives with purpose, and their attainment may elicit positive emotions and contribute to a person's life satisfaction (e.g., Wrosch et al., 2003a, 2007, 2013). Note that our findings also indicate substantial effect sizes for the association between goal reengagement capacities and reduced perceptions of stress and depressive symptoms (see Table 11). Interestingly, these results suggest it is possible that the positive psychological consequences of new goal pursuits could mitigate some of the negative psychological consequences of goal failure. In this regard, the purpose, positive emotions, and

life satisfaction deriving from new goal pursuits may reduce perceptions of stress and depressive symptoms by helping define an unattainable goal as not necessary for life (Sprangers & Schwartz, 1999), promoting a sense of coherence and control (Antonovsky, 1987; Kobasa, 1979; Ryff & Keyes, 1995), or instigate a shift of an individual's thought content away from the unattainable goal (e.g., Gollwitzer, Heckhausen, & Steller, 1990). These potential mechanisms are likely to contribute to our understanding of the motivational pathways that protect individuals' well-being in the context of unattainable goals and need to be substantiated in longitudinal and experimental research.

Furthermore, the study's results suggest that goal disengagement and goal reengagement capacities seemed to be associated with certain indicators of physical health. It is important to reiterate, however, that the moderation analyses supporting this conclusion were conducted ignoring dependencies due to the limited number of studies reporting effect sizes with different indicators of physical health. As such, our conclusions should be considered with caution and highlight the need for more research in this area to illuminate the true associations between goal adjustment capacities and different indicators of physical health. Keeping this limitation in mind, the analyses showed that goal disengagement capacities were not associated with overall physical health, or subjective and objective indicators of health, when analyzed separately. Nonetheless, the exploratory analyses indicated that goal disengagement capacities were associated with some health outcomes, including fewer physical symptoms and better sleep. Goal reengagement capacities were linked to self-report, but not objective measures, of physical health and also significantly predicted fewer physical symptoms. In addition, goal reengagement capacities were associated with less chronic illness and more physical activity (see Table 11). These findings represent an important step in clarifying how goal adjustment capacities could be conducive to physical health. It is plausible to assume that their positive health associations may occur, in part, via their associated benefits on positive and negative indicators of psychological well-being (for well-being and health, see Cohen, Janicki-Deverts & Miller, 2007; Pressman & Cohen, 2005; Watson, 1988; Watson & Pennebaker, 1989). In addition, goal reengagement may further facilitate physical health by encouraging individuals to adopt new goals which may keep them engaged in health-facilitating behaviors, such as physical activity (Wrosch & Sabiston, 2013).

Our findings also elucidate the complexities of the associations between goal

disengagement and depressive symptomatology. Again, it is important to consider that these moderation analyses ignored dependencies due to the limited number of depression risk samples, and the conclusions need to be substantiated in future research. However, consistent with past research demonstrating different and reciprocal associations between goal disengagement and depressive symptoms (Wrosch & Miller, 2009), the present study revealed that while goal disengagement capacities were generally linked to lower levels of depressive symptoms across samples not at-risk for depression, this association was reversed in samples at-risk for depression (see Table 10). Such reversed associations among individuals who are likely to experience depressive symptoms may be observed because depressive symptoms could make it easier to disengage from unattainable goals (Koppe & Rothermund, 2017; Wrosch & Miller, 2009). As such, it is plausible that the typically observed association between depression and disengagement failure can be reversed, if states of depressive symptoms facilitate a person's disengagement capacity. This conclusion is consistent with arguments derived from evolutionary and personality psychology, suggesting that depressive mood has evolved in humans to facilitate goal disengagement in circumstances that involve threat, waste of resources, or insurmountable problems (e.g., Klinger, 1975; Nesse, 2000). It further highlights the need for more process-oriented research on the antecedents and consequences of goal disengagement capacities, since opposing and reversed functional associations between depressive symptoms and goal disengagement may blur the magnitude of the true effect size of goal disengagement capacities on individuals' well-being.

Finally, our results documented that the adaptive value of goal disengagement capacities varied as a function of age, such that the beneficial effects of goal disengagement on well-being and health were greater in older, as compared to younger, samples. We feel that the latter result has important implications for lifespan developmental theory and research. This body of work has postulated that age-related changes in personal resources and external constraints can reduce individuals' opportunities for goal attainment as they advance in age (Baltes, 1987; Carstensen, Isaacowitz, & Charles, 1999; Heckhausen et al., 2010; Schulz & Heckhausen, 1996). As a consequence, older adults should be particularly likely to confront unattainable goals. To this end, our findings suggest that goal disengagement capacities may exert the largest impact on quality of life when people frequently experience unattainable goals, such as in older adulthood. These capacities may help older adults to prevent the adverse psychological consequences of

irreversible losses and repeated failure experiences and allow them to conserve their limited resources for the pursuit of other meaningful and still attainable goals (Heckhausen et al., 2010). Thus, the obtained results may foster much needed intervention research aimed at protecting well-being and health in vulnerable populations by facilitating the adjustment of unattainable goals (for preliminary intervention work, see Wrosch et al., 2007).

Limitations and Future Directions

Although this meta-analysis contributes to the literature by clarifying important questions regarding general associations (e.g., well-being and health) and differential psychological outcomes of individuals' goal adjustment capacities (e.g., positive versus negative aspects of well-being) as well as circumstances that can alter these associations (e.g., aging or depression risk status), it is not without limitations. There are relevant issues remaining that could not be addressed in this study.

First, certain estimates in the present meta-analysis were calculated from a relatively small number of effect sizes, limiting the power and increasing the uncertainty surrounding some of these estimates (e.g., perceived stress, see Table 11). Further, some of the moderator analyses (i.e., depression risk status and physical health subtype) and single estimates were computed ignoring the dependency among effect sizes due to a low number of effect sizes. In this regard, we note that in order to maximize the number of samples and avoid biases, we had searched for unpublished data in respective databases and by contacting authors. Even though these strategies resulted in the addition of samples, we cannot exclude the possibility that some unpublished research was not considered by this meta-analysis. As such, some of the reported results must be interpreted with caution, and research should focus on these factors to estimate their true effect sizes and clarify their associations with individuals' goal disengagement and goal reengagement capacities.

Second, the reported results were based on studies that allowed us to empirically distinguish goal disengagement from goal reengagement capacities. This approach was chosen because a major aim of our project was to identify different psychological outcomes that can be uniquely related to one of these two self-regulation capacities (cf. Brandstätter & Herrmann, 2017). As a consequence, we did not include studies that measured conceptually related constructs, but combined goal disengagement and goal reengagement processes into a single construct (e.g., goal accommodation or secondary control strategies, Brandtstädter & Renner,

1990; Heckhausen & Schulz, 1995). However, we would assume that other, related constructs could similarly show positive associations with indicators of well-being and health, although they may not be able to identify some specific psychological consequences of different goal adjustment processes or circumstances in which their associations are reversed. Future research may therefore consider conducting additional meta-analytic reviews with these predictor variables to substantiate some of the conclusions of our study.

Finally, we note that the theoretical concepts underlying this meta-analysis would assume that goal adjustment capacities become particularly important during life circumstances that involve the actual experience of unattainable goals, but may be less influential in circumstances that involve no or only minor goal constraints (Wrosch et al., 2013). This possibility, in turn, could have attenuated some of the observed effect sizes. As a consequence, we suggest that more theoretical and empirical work is needed to identify the most important goal-related stressors and examine how the associations of goal adjustment capacities change as a function of encountering such stressors. Our theoretical framework would expect that the general associations of individuals' goal adjustment capacities reported in this meta-analysis could substantially increase if research is capable of capturing the specific life circumstances that render important goals unattainable and require individuals to protect their quality of life by engaging in effective goal adjustment processes.

Conclusions

This meta-analysis supports the theoretical proposition that goal disengagement and goal reengagement capacities exert adaptive functions when individuals confront unattainable goals. Results showed that goal disengagement and goal reengagement capacities were associated with higher levels of psychological well-being and certain indicators physical health. In addition, they indicated that goal disengagement capacities were associated with lower levels of negative, but not higher levels of positive, indicators of well-being. Goal reengagement capacities, by contrast, were associated with both, lower levels of negative, and higher levels of positive, indicators of well-being. Further, this meta-analysis showed that the association between goal disengagement capacities and reduced levels of depressive symptoms was reversed in samples at risk for depression, and that the beneficial associations of goal disengagement capacities on indicators of quality of life were stronger in samples of older, as compared to younger, samples. Together, these results point to the adaptive value of individuals' capacities to adjust to unattainable goals.

In addition, they clarify some of the distinct quality of life concomitants of goal disengagement and goal reengagement capacities and identify specific circumstances that are likely to alter associations between goal adjustment capacities and indicators of quality of life.

CHAPTER 6:
GENERAL DISCUSSION

The aim of this dissertation was to expand existing developmental and functional accounts of emotion by investigating and qualifying the different functions and adaptive values of discrete negative emotions. More specifically, it sought to examine moderating factors of the associations of anger and sadness with emotional well-being, physical health, and motivational processes. To accomplish this aim, three studies were presented. Study 1 (Chapter 3) examined the age-related associations between older adults' daily experiences of anger and sadness with indicators of chronic low-grade inflammation and chronic illness in a sample of community-dwelling older adults. This study also attempted to elucidate the pathways by which negative emotions may influence physical health in older adulthood, by exploring whether the age-related impacts of these emotions on chronic illness were mediated by the emotions' age-related inflammatory effects. Study 2 (Chapter 4) explored the associations of sadness and anger, with goal disengagement capacities in older adults, and the moderating role of stress experiences. Further, this study investigated the adaptive value of the sadness-disengagement process for buffering older adults' emotional well-being when faced with stressful life circumstances. Finally, Study 3 (Chapter 5) sought to demonstrate the adaptive value of goal disengagement capacities and differentiate the sadness-disengagement process from maladaptive processes typically associated with depression (e.g., learned helplessness; Seligman, 1975) using meta-analytic techniques.

Summary of Research Findings

Overall, the presented studies provided substantial insight and made significant contributions towards accomplishing the outlined objectives. The first objective of this dissertation was to investigate the differential adaptive value of anger and sadness for emotional well-being and physical health in older adulthood. Study 1 demonstrated that anger, but not sadness, was associated with higher levels of chronic inflammation and chronic illness among old-old, but not young-old, adults. Study 1 also suggested that this age-related association between anger and chronic illness may, at least in part, be due to the elevated markers of chronic low-grade inflammation in old-old adults who experience high levels of anger. Said differently, old-old adults who experience high levels of anger may be at increased risk of developing chronic illness due to the associated elevation in inflammatory markers. Additionally, Study 2

demonstrated that older individuals who were more likely to disengage from unattainable goals when they experienced sadness were buffered from the adverse consequences of higher-than-average stress (daily cortisol, but not perceived stress) on emotional well-being (positive, but not negative, affect). No anger effects emerged. Together these studies support the notion that distinct discrete negative emotions may serve different adaptive functions in older adulthood by demonstrating differential effects of processes associated anger and sadness on emotional well-being and physical health.

Second, this research attempted to explore the moderating role of age and stress experiences on the differential functions of anger and sadness. Study 1 demonstrated that the associations between anger and both chronic inflammation and illness were moderated by age. More specifically, anger was found to be associated with elevated chronic inflammation and a greater number of chronic illnesses among old-old, but not young-old, adults. In addition, Study 2 demonstrated that both the function and the adaptive value of sadness were moderated by older adults' biological stress markers. More specifically, Study 2 demonstrated a positive within-person association between sadness and goal disengagement capacities, but only among older adults who generally secreted higher levels of cortisol. Further, individuals who were able to disengage from unattainable goals when they experienced sadness were found to be protected from the adverse consequences of higher-than-average daily cortisol levels on positive affect. Together, these findings are consistent with the hypotheses as they suggest that the functions and adaptive values of different negative emotions may vary depending on an individual's developmental context, operationalized in terms of age or stress.

Third, this dissertation sought to examine the differential associations of anger and sadness with goal disengagement capacities in older adulthood. Study 2 demonstrated that sadness, but not anger, was associated with improved goal disengagement capacities among older adults with generally elevated levels of biological stress. More specifically, the within-person association between sadness, but not anger, and goal disengagement capacities was found to be moderated by between-person levels of diurnal cortisol, but not perceived stress. These findings highlight that anger and sadness are differentially associated with individual differences in older adults' motivational processes.

The fourth objective of this dissertation was to use meta-analytic techniques to demonstrate the adaptive value of goal disengagement capacities and identify key moderating

variables. Study 3 demonstrated that goal disengagement capacities were associated with improved quality of life. Further, the association between goal disengagement capacities and quality of life was found to be moderated by age, such that the association was greater in older samples. These results were in line with existing theoretical and empirical work highlighting the benefit of letting go of unattainable goals, particularly among individuals whose opportunities for overcoming stressors are constrained (for review, see Wrosch & Scheier, 2019). Accordingly, these findings highlight the importance of goal disengagement capacities for maintaining psychological well-being and physical health into older adulthood.

The fifth and final objective of this dissertation was to elucidate the association between depressive symptoms and goal disengagement capacities in normative samples, and samples at-risk for depression. Study 3 demonstrated that the association between depressive symptoms, and goal disengagement capacities was reversed in samples at-risk for depression, as compared to normative samples. More specifically, while goal disengagement capacities were found to be associated with fewer depressive symptoms in normative samples, this association was reversed and positive in samples at-risk for depression. These findings add to the extant literature by differentiating the proposed adaptive sadness-disengagement process from maladaptive concepts such as learned helplessness (Seligman, 1975). Consistently, Study 2 revealed that older adults who disengaged from unattainable goals when they experienced sadness were protected from declines in positive affect when their cortisol was elevated. Together, these findings are in line with the notion that sadness, and related constructs, can serve adaptive functions by eliciting motivational processes, such as goal disengagement capacities.

Contributions to Theory and Research

The results from the presented studies have several implications for theory, research, and practice. First, the presented findings add to the extant literature on emotions, by providing support for functional approaches to emotion. The reported results support the notion that sadness and anger may serve different functions, by demonstrating the divergent effects of these emotions on motivational processes (i.e., goal disengagement capacities). More specifically, the reported findings suggest that older adults who generally experienced elevated levels of diurnal cortisol were found to disengage more easily in response to sadness, but not anger. These findings are consistent with theory and research suggesting that sadness may generally be experienced in response to irreversible losses (e.g., Cole & Dendukuri, 2003; Kunzmann &

Grühn, 2005; Kunzmann et al., 2017), and can enable the reprioritization of goals and the pursuit of realistic plans (Heckhausen, Wrosch, & Schulz, 2019; Klinger, 1975; Nesse, 2000; Wrosch & Miller, 2009), and facilitate disengagement from unattainable goals (Klinger, 1975; Lazarus, 1991; Nesse, 2000; Wrosch & Miller, 2009). In contrast, anger is thought to represent an approach-oriented affect that can be triggered by obstacles to goal pursuit (Carver & Harmon-Jones, 2009; Lazarus, 1991), and can support persistence in overcoming goal blockages or reversing injustice (e.g., Frijda et al., 1989; Keltner & Gross, 1999; Kunzmann, Rohr, Wieck, & Wrosch, 2017). Accordingly, the differential effects of anger and sadness on goal disengagement processes reported in this dissertation are in line with propositions of functional accounts of emotion highlighting the distinct motivational functions of discrete negative emotions.

Second, the reported studies provide important insight into pathways to successful aging by demonstrating the effects of anger and sadness on emotional well-being (i.e. positive affect) and physical health (i.e. chronic inflammation and illness) in older adults. In doing so, the present dissertation expands the existing empirical work stemming from the DEA by moving beyond the examination of differences in salience of anger and sadness in older adulthood and exploring the impact of these discrete negative emotions on well-being. The reported findings suggest that sadness and goal disengagement processes may represent important psychological factors that may help older adults maintain their emotional well-being. More specifically, the reported findings suggest that old adults who disengaged more in response to sadness were buffered from the declines in positive affect associated with elevated levels of daily cortisol. Given the age-related declines in biological, social, and motivational resources (Baltes, 1987; Heckhausen et al., 2010; Heckhausen & Schulz, 1995), these findings are in line with the notion that the experience of sadness should become particularly adaptive for emotional well-being in old age if it facilitates the effective adjustment of unattainable goals via goal disengagement processes in response to increasing age-related stress (Kunzmann et al., 2014; Nesse, 2000; Wrosch & Miller, 2009).

The importance of the sadness-disengagement process in the context of increasing developmental constraints in older adulthood is further supported by the meta-analytic finding that the adaptive value of goal disengagement capacities for well-being and health was greater in older, as compared to younger, samples. This finding represents an important contribution to lifespan developmental theory and research in that lifespan theory has postulated that age-related

changes in opportunities and constraints for goal pursuit reduce individuals' opportunities for goal attainment in old age (Baltes, 1987; Carstensen, Isaacowitz, & Charles, 1999; Heckhausen et al., 2010; Schulz & Heckhausen, 1996), resulting in an increased likelihood for older adults to experience unattainable goals. To this end, our findings suggest that goal disengagement capacities, potentially facilitated by the experience of sadness, may become paramount in older adulthood, when people most frequently experience unattainable goals.

The reported results also point to the adverse consequences of anger in older adulthood. More specifically, the findings of this dissertation suggest that anger can be particularly maladaptive for older adults' physical health towards the end of life, potentially resulting in higher levels of chronic inflammation and chronic illness. These findings are also consistent with theory and research which highlight that the motivational and behavioral concomitants of anger may become less adaptive in older adulthood if anger facilitates attempts at overcoming insurmountable goal obstacles (Kunzmann et al., 2014). Accordingly, the age-related declines in opportunities and increases in constraints could render anger particularly maladaptive during old age if it triggers futile pursuit of unattainable goals resulting in repeated failure experiences and wasted resources (Kunzmann et al., 2014). Further, the reported results also add to the existing literature by providing a theory-based investigation of the divergent age-related effects of anger and sadness on a major physiological pathway to chronic illness. More specifically, it may be the case that the higher levels of anger in old-old adults results in higher levels of chronic illness via the associated elevated chronic inflammation. Altogether, the reported results extend the limited literature examining whether different negative emotions can exert differential effects on physical health outcomes, which often lacks a solid theoretical foundation (Suls, 2018; Kunzmann & Wrosch, 2018).

In addition, the reported studies support the proposition of the discrete theory of affective aging (Kunzmann et al., 2014) that the adaptive value of different discrete emotions depends on the extent to which they facilitate, or hinder, adaptive opportunity-adjusted motivational processes. More specifically, the results demonstrate that the functions and consequences of negative emotions may be moderated by an individual's developmental context. More specifically, the findings of the studies in this thesis demonstrated that the association between anger and chronic inflammation and illness was moderated by age, whereas the association between individuals' tendency to disengage more in response to sadness and positive affect was

moderated by diurnal cortisol levels. This dissertation also extended past work by moving beyond using only age as a proxy for individuals' developmental context and demonstrating the moderating role of biological indicators of stress. These findings acknowledge the notion that although older adulthood is typically characterized by increasing irreversible losses and developmental constraints, and reductions in personal resources, aging is a heterogeneous process (Baltes & Smith, 2003). Therefore, these findings complement and clarify propositions of the DEA (Kunzmann et al., 2014) by illuminating contextual factors which influence the potential adaptive values of anger and sadness within older adulthood. Therefore, within older adulthood sadness may be relatively more adaptive in old-old age, or when older adults are confronted with relatively uncontrollable or severe stressors, while anger may be relatively more adaptive in young-old age, or when older adults are confronted with relatively more controllable or surmountable goal obstacles.

Third, the findings from this dissertation also have important implications for the fields of self-regulation and personality. The reported findings support the adaptive value of goal adjustment capacities for quality of life more broadly, and point to several important contextual factors that may moderate their adaptive value. Importantly, the results challenge theoretical accounts that have conceptualized goal disengagement as a maladaptive consequence of goal failure, and linked goal disengagement to helplessness (Seligman, 1975; Wortman & Brehm, 1975). Contrary to this view, the present dissertation reaffirms and quantifies the potential benefits of individual differences in goal disengagement, as well as goal reengagement, capacities on different facets of individuals' quality of life. While both goal disengagement and reengagement processes may be associated with quality of life, the strength and direction of these associations diverge depending on the type, subtype or construct of interest. This work clarifies the existing body of theory and research outlining the general adaptive value of these processes, provides insight into areas lacking research (e.g., biological markers), and points to contextual factors that may alter their adaptive value (e.g., age).

Further, the presented studies complement existing work exploring personality change in older adulthood (e.g., Neugarten, 1973; Roberts & Mroczek, 2008), and highlight the potential impact of these changes for psychological well-being. More specifically, the present dissertation points to potential factors that may influence changes in individual differences in self-regulatory processes across development. In line with past work in adolescent females at risk of developing

depression (Wrosch & Miller, 2009), the presented findings highlight the potential roles of sadness and depressive symptoms in facilitating the improved goal disengagement capacities. In this way, the presented research also adds to the literature by supporting the notion that discrete negative emotions can facilitate not only situation-specific, but also individual differences in, indicators of self-regulatory processes. In addition, the presented findings suggest that individuals may be able to protect their well-being in old age if they are able to adapt to changing developmental contexts by aligning their self-regulation strategies with recurrent situational demands.

Moreover, these findings are conceptually consistent with previously discussed work linking depressive mood with goal disengagement capacities (Koppe & Rothermund, 2017; Wrosch & Miller, 2009). Accordingly, the present dissertation provides support for arguments from evolutionary psychiatry which suggest that depressive mood may have evolved in humans to enable goal disengagement in circumstances that involve threat, waste of resources, or insoluble problems (e.g., Klinger, 1975; Nesse, 2000). In fact, the presented results highlight that sadness and depressive mood may at times serve an adaptive function by facilitating a person's capacity to disengage from unattainable goals (Klinger, 1975; Koppe & Rothermund, 2016; Nesse, 2000; Wrosch & Miller, 2009).

Finally, the reported findings have practical implications, particularly for clinicians who work with older adults. The results of this dissertation highlight the potential advantage of considering the divergent functions, consequences, and triggers of different negative emotions in older adulthood. Insight may also be drawn from taking an individuals' developmental context into account. Such an approach may allow older adults to maintain or enhance their emotional well-being and physical health by promoting changes in adaptive self-regulatory processes. In addition, this research points to the potential benefits of intervention research targeted at protecting the psychological and physical well-being of older adults by facilitating the adjustment of unattainable goals (for preliminary intervention work, see Wrosch et al., 2007).

Limitations and Future Directions

Despite the contributions of the present dissertation, it is not without limitations. First, the results from Study 1 and 2 used self-report measures of anger and sadness that asked participants to report their daily emotions at the end of three non-consecutive days during one week. Future research should replicate the presented findings implementing designs with more fine-grained

time scales and ecological momentary assessment of emotions (Shiffman, Stone, & Hufford, 2008). Further, future research should extend research examining the prepositions of the outlined theoretical model by utilizing objective measures of emotion, exploring the role of other emotion response systems (e.g., emotional expression and physiology; Levenson, 2000), and examining the role of trait-level emotions.

Second, the presented findings largely stem from a relatively small longitudinal sample of community-dwelling older adults, limiting the generalizability of the findings and ability to draw causal inferences. Therefore, future research should aim to replicate the reported findings using experimental methods and larger samples. In this regard, although the present dissertation focused on older adulthood, future research should also aim to explore the associations between emotions, motivational processes, and well-being, across the entire lifespan. Given the normative trajectories in constraints, opportunities, and personal resources (Heckhausen, 1999; Heckhausen & Schulz, 1995; Heckhausen et al., 2010; Schulz & Heckhausen, 1996), such research could help enlighten the function and adaptive value of discrete negative emotions from young adulthood into old age. For example, given that young adulthood is typically characterized by ample opportunities for overcoming goal-related obstacles and limited constraints for achieving developmental tasks (Baltes, 1987; Heckhausen et al., 2010), it may be that the motivational processes associated with anger elicit relatively more adaptive effects for well-being in younger adults (Kunzmann et al., 2014).

Third, although the presented findings point to the influence of contextual factors (e.g., daily cortisol levels) that could underlie the age-related functions and adaptive values of anger and sadness, more work is needed to replicate and extend these findings. Although the presented findings suggest that sadness may be particularly adaptive when individuals are faced with stressful life circumstances, future research should examine the role of several stressor characteristics (i.e. intensity, opportunities, constraints) to elucidate the underlying mechanisms of the proposed, and presented, age-related effects. Such work would also provide future insight into the discrepant findings with daily cortisol levels and perceived stress.

Fourth, the present dissertation focused on emotional constructs related to anger and sadness. This focus was rooted in the strong theoretical grounding for age-related effects of these emotions (Kunzmann et al., 2014). However, given that past work has identified numerous discrete emotions (Roseman, Wiest, & Swartz, 1994), more research is warranted. Other

negative (and positive) emotions may also serve distinct age-related functions. Therefore, future theoretical and empirical work should aim to illuminate the effects of a variety of discrete emotions on motivational process, emotional well-being, and physical health across the lifespan. Such research has the potential to reveal other emotions which may protect (or harm) older adults' well-being by promoting different motivational processes.

Fifth, although the present dissertation explored the adaptive value of disengagement processes associated with sadness and depressive mood, and highlighted that this process can be protective for emotional well-being in times of stress, depression has also been associated with detrimental health outcomes (e.g., Cohen et al., 2007). Therefore, future research should aim to improve the measurement of these constructs, allowing research to distinguish ordinary sadness from chronic sadness. Such research may clarify the different relations between sadness and depressive mood with physical health. It may be that the severe and chronic experience of negative emotions associated with clinical depression could counteract the potentially adaptive functions of sadness (Wrosch & Miller, 2009). This may be the case as while situation-specific sadness may serve an adaptive function by enabling individuals to adapt to their current context, chronic sadness or depressive mood may be more likely to be decoupled from the individual's context, and potentially indicative of a failure to effectively adjust to their environment. However, future research is needed to determine what characteristics of sadness and depressive mood may be responsible for its adaptive, and maladaptive, health outcomes.

Finally, although theory and research highlight that discrete negative emotions can serve adaptive functions by triggering distinct motivational processes, additional process-oriented work is needed to clarify these associations. For example, different individuals may vary in their ability to respond to different negative emotions with the appropriate motivational strategy. In particular, insight can be drawn from work documenting that the adaptive value of cognitive reappraisals in stressful circumstances is dependent not only on the frequency of use, but also the individual's skill at implementing the strategy (Ford, Karnilowicz & Mauss. 2017; Ford & Troy, 2019; Troy, Wilhelm, Shallcross & Mauss, 2010). Therefore, it may be the case that the adaptive value of discrete emotions depends not only on the extent to which the emotion theoretically facilitates an opportunity-adjusted motivational strategy, but also the extent to which the individual is able to respond appropriately to different negative emotions and implement the associated motivational strategy. Such research may help clarify associations between discrete

negative emotions, motivational processes, emotional well-being, and physical health.

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APPENDIX A

Consent Form – Montreal Aging and Health Study

CONSENT FORM TO PARTICIPATE IN RESEARCH

This is to state that I agree to participate in a program of research being conducted by Dr. Carsten Wrosch of the Psychology Department of Concordia University.

A. PURPOSE

I have been informed that the purpose of the research is to study older adults' goal management, well-being, and health.

B. PROCEDURES

This research will involve a questionnaire and 15 salivary cortisol samples collected over the course of three typical days. It also involves collecting some blood drops. A research assistant will go to the participant's home to administer part of a questionnaire on goal management, well-being and health, explain the saliva collection procedure, and collect the blood drops. The rest of the questionnaire will be filled in by the participant while alone and should take approximately one hour to complete. The saliva collection will involve chewing a provided cotton swab for one minute before placing it in its salivette. The saliva collection will be performed five times a day at specific times. The participant will receive phone calls from the research assistant to remind him/her to take a salivary cortisol sample. The blood drops will be collected by the trained research assistant using a finger-prick with a small lancet. The participant will receive $70 for participating in the study.

There should be no risks or discomfort involved in answering the questions or collecting the salivary cortisol samples. Collection of the blood drops should also involve no risk and should not be painful. The participant's name will not be attached to the questionnaire, although the signatures and names on the consent forms will be collected and stored separately by the supervising professor. The participant is free to refuse to participate in any portion of the study or to answer any question that makes him or her uncomfortable.

C. CONDITIONS OF PARTICIPATION

• I understand that I am free to withdraw my consent and discontinue my participation at anytime without negative consequences. Even if I discontinue my participation, I will receive $70.

• I understand that my participation in this study is CONFIDENTIAL (i.e., the researcher will know, but will not disclose my identity)

• I understand that the data from this study might be published.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print) _____

SIGNATURE _____

WITNESS SIGNATURE _____ DATE _____

APPENDIX B

Assessment of Sociodemographic Variables

Personal information

1. **Sex :** ☐ Female ☐ Male

2. **Age** ☐ yrs.

3. **Family Status?**
   - ☐ married
   - ☐ live with partner but not married
   - ☐ single
   - ☐ divorced; please indicate since when _____
   - ☐ widowed; please indicate since when _____

4. **Working status:** ☐ Retired ☐ Still working ☐ Never worked outside the house

5. **Profession (before retirement)** _____

6. **Current Family income (per year):**

   ☐ Less than 17 000$ ☐ 17 001$ - 34 000$ ☐ 34 001$ - 51 000$
   ☐ 51 001$ - 68 000$ ☐ 68 001$ - 85 000$ ☐ more than 85 000$

7. **Height:** _____

8. **Body weight:** _____

9.

10. **What language do you consider your dominant language?** ☐ English ☐ French ☐ Other

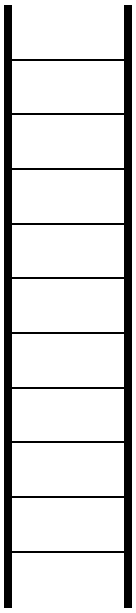
11. **Please rate your level of ability for each of the four skills listed below by using the following rating scheme and circling the appropriate number in the boxes below:**

1 = no ability at all **2** = very little **3** = moderate **4** = very good **5** = fluent ability

Language	Speaking	Reading	Writing	Listening
English	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
French	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

SES and Finances

1. **Think of this ladder as representing where people stand in our society. At the top of the ladder are the people who are the best off, those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off, those who have the least money, least education, and worst jobs or no job. Please, place an X on the rung that best represents where you think you stand on the ladder.**



APPENDIX C

Assessment of Chronic Illness

Physical Health

Please answer the following questions about your physical health.

	NO	YES	NOT SURE
1. Do you currently have high blood pressure?			
2. Do you currently have problems with an irregular heartbeat or chest pain?			
3. Have you ever been told that you have coronary heart disease or coronary artery disease?			
4. Have you ever had a heart attack?			
5. Have you ever been treated for congestive heart failure?			
6. Have you ever had major surgery?			
7. Have you ever had a stroke?			
8. Do you currently have osteoarthritis, fibromyalgia, osteoporosis, or any other serious muscular or bone problem?			
9. Do you currently have asthma, emphysema, chronic bronchitis, chronic obstructive lung disease, or any other serious respiratory problems?			
10. Do you currently have stomach ulcers, irritable bowel syndrome, or any other serious problems with your stomach or bowels?			
11. Do you have diabetes?			
12. Do you currently have problems with your kidneys?			
13. Do you have cirrhosis or any other serious liver problems?			
14. Do you currently have cancer?			
15. Do you currently have rheumatoid arthritis, lupus, acquired immune deficiency syndrome, multiple sclerosis, scleroderma, or any other autoimmune problem?			
16. Do you currently have problems with blood circulation in your legs, hemophilia, or any other blood-related problems?			
17. Do you have epilepsy or any other neurological problems?			

APPENDIX D

Assessment of Daily Anger, Sadness and Perceived Stress

DAY 1

To what extent did you experience each of the following emotions today? Check the appropriate box next to the emotion.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Lonely					
2. Stressed					
3. Proud					
4. Sad					
5. Upset					
6. Excited					
7. Hostile					
8. Isolated					
9. Satisfied					
10. Overwhelmed					
11. Unhappy					
12. Calm					
13. Angry					
14. Bitter					
15. Resentful					
16. Regretful					

DAY 2

To what extent did you experience each of the following emotions today? Check the appropriate box next to the emotion.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Lonely					
2. Stressed					
3. Proud					
4. Sad					
5. Upset					
6. Excited					
7. Hostile					
8. Isolated					
9. Satisfied					
10. Overwhelmed					
11. Unhappy					
12. Calm					
13. Angry					
14. Bitter					
15. Resentful					
16. Regretful					

DAY 3

To what extent did you experience each of the following emotions today? Check the appropriate box next to the emotion.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Lonely					
2. Stressed					
3. Proud					
4. Sad					
5. Upset					
6. Excited					
7. Hostile					
8. Isolated					
9. Satisfied					
10. Overwhelmed					
11. Unhappy					
12. Calm					
13. Angry					
14. Bitter					
15. Resentful					
16. Regretful					

APPENDIX E

Assessment of Goal Disengagement Capacities: Goal Adjustment Scale

Goal Adjustment

During their lives people cannot always attain what they want and are sometimes forced to stop pursuing the goals they have set. We are interested in understanding how you usually react when this happens to you. Please indicate the extent to which you agree or disagree with each of the following statements, as it usually applies to you.

If I have to stop pursuing an important goal in my life…	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. It's easy for me to reduce my effort towards the goal.					
2. I convince myself that I have other meaningful goals to pursue.					
3. I stay committed to the goal for a long time; I can't let it go.					
4. I start working on other new goals.					
5. I think about other new goals to pursue					
6. I find it difficult to stop trying to achieve the goal.					
7. I seek other meaningful goals.					
8. It's easy for me to stop thinking about the goal and let it go.					
9. I tell myself that I have a number of other new goals to draw upon.					
10. I put effort toward other meaningful goals.					

APPENDIX F

Assessment of Positive and Negative Affect: Positive and Negative Affect Schedule (20-item)

Well-Being

This scale consists of a number of words that describe different feelings and emotions. Read each item and indicate to what extent you experienced the following emotions **during the past year**.

	Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
17. Interested					
18. Distressed					
19. Excited					
20. Upset					
21. Strong					
22. Guilty					
23. Scared					
24. Hostile					
25. Enthusiastic					
26. Proud					
27. Irritable					
28. Alert					
29. Ashamed					
30. Inspired					
31. Nervous					
32. Determined					
33. Attentive					
34. Jittery					
35. Active					
36. Afraid					

APPENDIX G

Cortisol Saliva Collection Times

DAY 1

Date: _____

Please record the exact time when you took your saliva sample.

1st Saliva Sample: ***(Label: Day 1-1)***   I woke up at _____ h _____ min
2nd Saliva Sample: ***(Label: Day 1-2)***   Exact time : _____ h _____ min
3rd Saliva Sample: ***(Label: Day 1-3)***   Exact time : _____ h _____ min
4th Saliva Sample: ***(Label: Day 1-4)***   Exact time : _____ h _____ min
5th Saliva Sample: ***(Label: Day 1-5)***   Exact time : _____ h _____ min

After the last saliva sample of the day, please respond to the questions on the back of this page.

DAY 2

Date: _____

Please record the exact time when you took your saliva sample.

1st Saliva Sample: ***(Label: Day 1-1)***   I woke up at _____ h _____ min
2nd Saliva Sample: ***(Label: Day 1-2)***   Exact time : _____ h _____ min
3rd Saliva Sample: ***(Label: Day 1-3)***   Exact time : _____ h _____ min
4th Saliva Sample: ***(Label: Day 1-4)***   Exact time : _____ h _____ min
5th Saliva Sample: ***(Label: Day 1-5)***   Exact time : _____ h _____ min

After the last saliva sample of the day, please respond to the questions on the back of this page.

DAY 3

Date: _____

Please record the exact time when you took your saliva sample.

1st Saliva Sample: ***(Label: Day 1-1)***   I woke up at _____ h _____ min
2nd Saliva Sample: ***(Label: Day 1-2)***   Exact time : _____ h _____ min
3rd Saliva Sample: ***(Label: Day 1-3)***   Exact time : _____ h _____ min
4th Saliva Sample: ***(Label: Day 1-4)***   Exact time : _____ h _____ min
5th Saliva Sample: ***(Label: Day 1-5)***   Exact time : _____ h _____ min

After the last saliva sample of the day, please respond to the questions on the back of this page.

APPENDIX H

Meta-Analysis Coding Sheet

Study ID: _____ Study Code: _____ Coder Initials: _____

Section 1: Study Demographics

Study Title:

_____

_____

Author(s):

_____

_____

Year of Publication: _____

Type of publication:	□ Journal Article □ Book Chapter □ Other, specify: _____	Multiple studies? □ Yes □ No How many? _____ Study #: _____ Study Descriptor: _____
Exclusion criteria: **Retained?** □ Yes □ No	□ Theoretical □ Goal adjustment not measured □ Outcome measure not measured □ Foreign language □ Previously included results □ Experimental – no baseline □ Other, specify: _____	Notes: _____ _____ _____ _____ _____ _____
Study design:	□ Cross-sectional □ Longitudinal ▪ Time lag between time points: _____ days ▪ # time points? _____ □ Experimental (w/ baseline)	
GA measure:	□ Goal Adjustment Scale □ Goal Disengagement (GD) □ Goal Reengagement (GR) □ Flexible Goal Adjustment □ Goal Obstruction Scale □ Goal Disengagement (GD) □ Goal Reengagement (GR)	Scale altered? _____ If yes, how? _____ _____ _____ _____ _____

GA construct:	□ GD	M = _____	SD = _____	N = _____	α = _____
	□ GR	M = _____	SD = _____	N = _____	α = _____
	□ Comp	M = _____	SD = _____	N = _____	α = _____

Section 2: Well-Being Measures					
Type:	**□ Psychological well-being**		**Positive**	**Negative**	**Neither**
	□ Depressive symptoms			X	
	□ Anxiety			X	
	□ Negative Affect			X	
	□ Positive Affect		X		
	□ SWLS		X		
	□ Other 1, specify: _____				
	□ Other 2, specify: _____				
	□ Other 3, specify: _____				
	□ Other 4, specify: _____				
	□ Other 5, specify: _____				
	□ Other 6, specify: _____				
	□ Physical well-being	**Indicate all that apply:**			
	□ Chronic Illness	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Functional Limitations	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Functional Disability	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Physical Health Symptoms	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Other 1, specify: _____	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Other 2, specify: _____	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Other 3, specify: _____	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Other 4, specify: _____	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Other 5, specify: _____	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Other 6, specify: _____	□ Self-report □ Other-report	□ Checklist □ Scale	□ Medical test □ Physician Dx	
	□ Biological well-being				
	□ Cortisol □ CRP □ Other 1, specify: _____ □ Other 2, specify: _____ □ Other 3, specify: _____				
Overall:	**Total number of outcomes**:	_____			
	▪ Psychological: ▪ Physical ▪ Biological	_____ _____ _____			

Section 3: Sample Demographics

Sample Size (N): _____ **# of Covariates: _____**	**Different Group?** □ No □Yes	**If yes, specify:** **How? _____** **How many? _____**

Type of population: □ Normative
□ Clinical, specify: _____

Covariates: # of Covariates: _____

Age: Range: _____ - _____ □ Not Available	M = _____	SD = _____
Gender (% Female): □ Not Available	N = _____	% = _____
Education (in years): □ Not Available	M = _____	SD = _____
SES (specify):_____ □ Not Available	M = _____	SD = _____
Other 1: _____	M(N) = _____	SD(%) = _____
Other 2: _____	M(N) = _____	SD(%) = _____
Other 3: _____	M(N) = _____	SD(%) = _____
Other 4: _____	M(N) = _____	SD(%) = _____
Other 5: _____	M(N) = _____	SD(%) = _____

Study Quality (Check/fill all that apply)

Sample type:
□ Random sample
□ Convenience sample
□ National sample
□ Probability sample
□ Not reported
□ Other: _____

Recruitment Method:
□ No information reported
□ Newspaper ad/flyers
□ Specialty clinic/Doctor office
□ Other 1: _____
□ Other 2: _____
□ Other 3: _____

Missing data (%): _____
□ Not discussed
□ Mean replace
□ Multiple imputation
□ Do not replace/exclude
□ Other 1: _____
□ Other 2: _____

Assumptions:
□ Not discussed
□ Normality
□ Outlier
□ Variance
□ Other 1: _____
□ Other 2: _____

Inclusion:
□ Age range: _____
□ Diagnosis: _____
□ Other 1: _____
□ Other 2: _____
□ Other 3: _____
□ Other 4: _____

Attrition (%): _____

Study Location:
City: _____
Province/State: _____
Country: _____

Section 4: Effect Size Information

Total # Effect Sizes: _____	**GA # Effect Sizes: _____**	**WB # Effect Sizes: _____**

Goal Adjustment Effect Sizes

	GD_GAS	GR_GAS	GD_GOS	GR_GOS
GR_GAS	Type: _____ Value: _____ P Level: _____ N: _____			
GD_GOS	Type: _____ Value: _____ P Level: _____ N: _____	Type: _____ Value: _____ P Level: _____ N: _____		
GR_GOS	Type: _____ Value: _____ P Level: _____ N: _____	Type: _____ Value: _____ P Level: _____ N: _____	Type: _____ Value: _____ P Level: _____ N: _____	
FGA	Type: _____ Value: _____ P Level: _____ N: _____	Type: _____ Value: _____ P Level: _____ N: _____	Type: _____ Value: _____ P Level: _____ N: _____	Type: _____ Value: _____ P Level: _____ N: _____

Well-Being Effect Size #1

GA Measure: □ Goal Adjustment Scale □ Flexible Goal Adjustment □ Goal Obstruction Scale

GA Construct: □ Goal Disengagement □ Goal Reengagement □ Composite

WB measure: _____

WB construct: _____

Type: □ Psychological well-being □ Pos □ Neg □ N/A □ Physical well-being □ Biological well-being

Time lapse: _____ days

Reliability: Type: _____ Value: _____

Previously validated: □ Yes □ No □ N/A

Descriptives:	M = _____	SD = _____	Range = __/__	N = _____
Effect size #1:	Type = _____	Value = _____	P level = _____	N = _____
Effect size #2:	Type = _____	Value = _____	P level = _____	N = _____
Effect size #3:	Type = _____	Value = _____	P level = _____	N = _____
Effect size #4:	Type = _____	Value = _____	P level = _____	N = _____