Adaptive Self-Regulation across Older Adulthood: The Complementary Roles of Dispositional Optimism and Goal Disengagement

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A Thesis In

The Department of

Psychology

Presented in Partial Fulfillment of the Requirements for

the Degree of Doctor of Philosophy at Concordia

University

Montreal, Quebec, Canada

November 2016

CONCORDIA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis prepared

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Entitled: Adaptive Self-Regulation across Older Adulthood: The Complementary Roles of Dispositional Optimism and Goal Disengagement

and submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy (Psychology)

complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

Adaptive Self-Regulation across Older Adulthood: The Complementary Roles of Dispositional Optimism and Goal Disengagement

Current demographics are shifting rapidly and the proportion of older adults in the population is growing. In addition, older adulthood now spans more than 30 years of life (Oeppen & Vaupel, 2002). Old age is likely to be accompanied by increasing presence of age-related challenges along with diminishing opportunities to attain important life goals (Baltes & Smith, 2003; National Advisory Council on Aging, 2006). Such circumstances may trigger increased psychological stress in the short-term and may require long-term adaptations as important life goals become unattainable (Heckhausen, Wrosch, & Schulz, 2010). Two individual difference variables, dispositional optimism and goal disengagement have been found to be adaptive in the management of stressful life circumstances and may allow older adults to effectively negotiate changes in age-related opportunities and challenges (Scheier et al., 2010; Wrosch et al., 2013).

Study 1 investigated the role of optimism in the regulation of stress across 6 years in a sample of 135 community dwelling older adults. This study examined the relation between dispositional optimism, perceived stress and cortisol by modelling both, with-in person and between-person associations. Within-person results showed that under circumstances when individuals perceived higher than typical stress levels, optimism buffered against increases across most indicators of cortisol (except CAR). Conversely, between-person results showed that among individuals with higher perceived stress, optimism was associated with a lower CAR. Findings showed that optimism facilitated the physiological management of short-term stress by guarding against increases in cortisol in older adulthood.

Study 2 examined whether the emotional benefits of optimism vary across older

adulthood with declining opportunities to overcome stressors. A total of 171 older adults were assessed over a 6 year period to determine how optimism was related to changes in depressive symptoms and perceived stress across older adulthood. Results showed that dispositional optimism protected participants in early phases of older adulthood from exhibiting elevations in depressive symptoms over time, but had reduced benefits among those in advanced old age. The age-related association between optimism and depressive symptoms was most evident during times of stress. These results suggest that the adaptive effects of dispositional optimism become reduced in advanced old age.

Study 3 explored the age-related associations between goal disengagement capacities, emotional distress, and changes in disease severity across older adulthood. This study examined 131 older adults to determine whether goal disengagement capacities protect older adults particularly in advanced old age against experienced illness by preventing emotional distress. Results indicated that goal disengagement capacities protected against 6-year increases in older adults' self-reported cold symptoms, this effect was particularly pronounced among those in advanced old age. Changes in depressive symptoms were found to mediate the age-related association between goal disengagement and changes in cold symptoms. These findings suggest that as older adults advance in age, goal disengagement capacities may become increasingly important for protecting emotional well-being and physical health.

Overall, the findings outlined have important implications for research in the areas of personality, aging and health. Mechanisms through which dispositional optimism and goal disengagement facilitate the adaptive management of stress throughout older adulthood are highlighted. This research broadens existing life-span theories of motivation by integrating theories of personality with goal-specific processes and may reveal pathways to successful development in older adulthood. Limitations and future directions are discussed.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank Dr. Carsten Wrosch, for his guidance, knowledge, accessibility and reassurance. His mentorship throughout this process has been pivotal to the success of these research studies within the scientific community. I would also extend thank you to my committee members, Dr. Jean-Philippe Gouin, Dr. Jennifer McGrath, Dr. Lisa Kakinami who took time out of their busy schedules to read the document and providing insightful discussions around the subject matter. In addition, a special thank you extends to Dr. Dereck Isaacowitz who came from Boston to be present at the defense, his contributions were thought provoking and allowed me to experience the work from a different perspective. Finally, I would like to extend my utmost gratitude to the funding agencies who have supported this research. The research study has been funded primarily through *Canadian Institute for Health Research* while my funding for my training has come from *Social Sciences and Humanities Research Council* as well as the *Fonds de Recherche en Santé du Québec*. Finally, I want to extend appreciation for the wonderful university which provided the opportunity for me to follow my dreams. Concordia University provides a collaborative and accessible environment, with professors who believe in providing the best education by focusing on student learning. I have been lucky to have been lucky to call Concordia my school and "second home" as I progressed through two undergraduate degrees and two graduate degrees.

The path through a Ph.D. represents a time of invigorating discovery, being at the forefront of one's field but it is not without its challenges and tribulations. I want to take a moment to highlight some of the individuals who provided support, encouragement and all too needed humor during trying times. I have been so lucky to have had the unyielding support of friends and family. My parents always believed in me even when I was unsure of myself and

helped to push me towards the finish line. Both of them read the whole document and papers looking for typos, helped me re-write sentences and helped me clarify my ideas moving them from a working hypothesis to final completion. Dad always encouraged me to finish by withholding talks of future plans until after the Ph.D. My husband Jeff, you have been so great throughout this entire process. You have pulled me out when I got in too deep or hit roadblocks. You are my rock, who never stopped believing in me and helped me get through the rough patches. Without you, the road would have been far less pleasant. My friends and family, some of you have been with me since the very beginning; Jenny, Génévieve, Eva, Erika, Vicky and Stephanie. You've watched me throughout the entire process from undergraduate to Ph.D. You've been patient when I needed a shoulder to cry on, needed to just get out or when I just "could not" maintain my obligations because I was too tired, stressed, or generally overwhelmed. I also want to extend my thanks so friends within the program who have been such a support as we've gone through this journey; Sabrina, Jana, Caroline, Tomas, Danit, Gaëlle, Jamie, Erin and Sarah. You have been inspiring people to work alongside and I really don't think I could've made it through without you. Friends and family, whenever I faltered, became discouraged, I knew I had someone to turn to for encouragement, venting and emotional support. Thank you!

CONTRIBUTIONS OF AUTHORS

This dissertation is composed of three separate research papers culminating from data collected from the *Montreal Aging and Health Study.* As an undergraduate, I assisted with data collection for the second wave of this longitudinal study. As a doctoral student, I was involved with the selection of new study materials as the research evolved. Finally, in collaboration with Dr. Carsten Wrosch, I conducted all statistical analyses and prepared manuscripts for submission. Dr. Michael Scheier also collaborated on the preparation of manuscripts for Study 1 and Study 2. Funding for this research study was obtained by CIHR research grants awarded to Dr. Carsten Wrosch. In the completion of my dissertation and related research, I was supported by a SSHRC Joseph-Armand Bombardier Doctoral Scholarship, FRSQ Bourses de doctorat en recherche and the Concordia University Doctoral Award of Excellence. Edited versions of the three papers discussed within this dissertation have been published in *Health Psychology* (doi: 10.1037/a0032736), *Journal of Personality* (doi: 10.1111/jopy.1224) and *the International Journal of Behavioral Development* (doi: 10.1177/0165025415597549)*,* respectively. I declare that I am the sole author of the entire dissertation document below.

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CHAPTER 1:
GENERAL INTRODUCTION

Older adults represent a significant and growing segment of our population with those in advanced old age (Baltes & Smith, 2003) representing the most rapidly expanding group (Christensen, Doblhammer, Rau, & Vaupel, 2009; National Advisory Council on Aging, 2006). Individuals are living longer than ever before and older adulthood often spans over 30 years of life, representing a major portion of the human lifespan (Oppen & Vaupel, 2002).

Old age is accompanied by an onset of age-related challenges across different domains of life (e.g., functional limitations, loss of social roles, or bereavement; Baltes & Smith, 2003; Heckhausen, Wrosch, & Schulz, 2010). The controllability of and opportunities to overcome age-related challenges may differ substantially from the earlier to advanced phases of older adulthood, necessitating different self-regulation strategies to cope effectively (Baltes & Smith, 2003; National Advisory Council on Aging, 2006). The onset of age-related challenges may trigger increased psychological stress in the short-term and requires long-term adaptations as important life goals become unattainable (Heckhausen, Wrosch, & Schulz, 2010). Research focused on individual difference variables, such as dispositional optimism and goal disengagement, that allow older adults to manage age-related challenges and stress in different phases of old age will bring our understanding of successful aging in line with swiftly changing demographics.

Life-span development theories propose that individuals manage their development by orchestrating their goal pursuits over the course of their lives (Baltes & Baltes, 1990; Brandtstädter & Renner, 1990; Heckhausen, Wrosch, & Schulz, 2010). These theories highlight that at any developmental stage people prefer to direct their efforts toward the achievement of important and attainable life goals. However with increasing age, opportunities to achieve goals

typically decline and may even become absent in advanced old age (Smith & Baltes, 2003; Rothermund & Brandtstäedter, 2003). When people perceive a goal pursuit to be futile or too costly, a shift from persisting to letting go of unattainable life goals may be an adaptive process (Wrosch et al., 2003).

For these reasons, the influence of two individual difference variables, dispositional optimism and goal disengagement, were examined in this dissertation because these personality factors utilize complementary mechanisms to foster adaptive adjustment to challenging life circumstances (Wrosch & Scheier, 2003). Dispositional optimism relates to one's positive expectations for the future and typically results in persistent goal striving to overcome barriers (Scheier et al., 2010). Goal disengagement, by contrast, relates to one's ability to let go of unattainable goals, allowing the individual to protect their emotional well-being and conserve limited personal resources (Wrosch et al., 2003). Previous research demonstrates that both of these traits facilitate the maintenance of psychological and physical health under a variety of stressful life circumstances (Wrosch et al., 2013; Scheier et al., 2010).

To examine these possibilities empirically, age-related challenges and opportunities for attaining important life objectives were examined in this dissertation within the context of aging as proximal and distal stressors that could impact a person's emotional and physical well-being. In this way, stress was characterized in three different but related contexts. The first study examined how dispositional optimism facilitates management of stress on a day-to-day basis in older adults thus providing a developmental perspective on short-term variations of stress. In the two later studies, age was used as a proxy for age-related challenges that can become increasingly less controllable over time and was characterized as long-term developmental stress (Heckhausen, Wrosch, & Schulz, 2010). As such, the second study examined the influence of

dispositional optimism on longitudinal increases in depressive symptoms and perceived stress in early versus advanced old age. The third study examined the protective role of goal disengagement in the advanced versus earlier phases of older adulthood to determine individual differences in changes in emotional distress and associated physical health symptoms.

Personality Factors involved in the Self-Regulation of Stress

Personality factors generally determine how people appraise and cope with various life circumstances or stressors (Lazarus & Folkman, 1984; Wrosch & Scheier, 2003). Personality factors can be defined as individual difference variables that encompass an *endogenous* part of an individual's psychological structure that is relatively *stable* across situations and *consistent* over time (Wrosch & Scheier, 2003). Personality factors determine a constellation of thoughts, feelings and behaviours of an individual (Allport, 1961). Two complementary personality factors may help individuals cope with stress, notably dispositional optimism and goal disengagement capacities. Both of these individual difference variables have been found to foster health and well-being (Carver, Scheier, & Segerstrom, 2010; Wrosch et al., 2013). A major function of dispositional optimism relates to increased persistence in overcoming difficulties to attain important life objectives, while goal disengagement capacities promote giving up of effort and psychological commitment in order to let go of unattainable goals (Scheier, Carver, & Bridges, 1994; Wrosch et al., 2003b). This dissertation proposes that both of these personality factors result in adaptive outcomes in older adulthood, depending on the age-related controllability and opportunities to overcome emerging stressors.

Dispositional Optimism

Dispositional optimism is an individual difference variable that has been studied extensively over the past 30 years (Carver & Scheier, 2014). Optimism exists on a continuum where *optimists* represent one end of the spectrum and describes individuals who generally

expect positive future outcomes. The other end of the scale reflects *pessimists* who typically hold negative expectancies for the future across life domains. Since people's generalized future expectations tend to remain stable over time, optimism is considered to represent an integral part of an individual's personality (Scheier & Carver, 1985; Scheier, Carver & Bridges, 1994). This conceptualization of optimism differs from other forms of expectation, such as the belief that one can perform the necessary behaviors to attain performance objectives (i.e., self efficacy; Bandura, 1997). It is not to be confused with optimistic attributional style that is an explanatory approach related to how individuals make sense of past events that have occurred in their lives (Seligman, 1998). Dispositional optimism differs from such measures because it does not consider interpretation of past events or certain domain specific capacities and most importantly, because it focalizes directly on broad expectations for the future (Carver, Scheier & Segerstrom, 2010).

Optimists generally experience better psychological adjustment, increased social support, superior socioeconomic attainment and more positive physical health outcomes in a variety of contexts and in the face of diverse stressors (Carver et al., 2010; Solberg Nes, Evans & Segerstrom, 2009; Segerstrom, 2007; Rasmussen, Scheier, & Greenhouse, 2009). There has been extensive research on the impact of optimism on health, showing for the most part that optimism is a significant predictor of positive health outcomes and biological indicators of health (for a meta-analysis, see Rasmussen, Scheier, & Greenhouse, 2009). Optimist's positive outcomes have been attributed to their superior use of coping strategies but may also be attributed to their adaptive physiological responses (Nes & Segerstrom, 2006; Carver et al., 2010).

Goal Disengagement Capacities

Goal disengagement capacities have been conceptualized within the larger framework of *goal adjustment theory* (Mens et al., 2016; Wrosch et al., 2013) and reflect an individual difference variable defined as the ability to disengage from the pursuit of unattainable goals by withdrawing behavioral efforts and psychological commitment towards the goal (Wrosch et al., 2007). In other words, goal disengagement represents a personality dimension that measures people's general response to unattainable goals across life domains (Wrosch et al., 2007a). As some other personality constructs, goal disengagement capacities show long-term longitudinal changes across the lifespan and tend to increase as individuals age (Dunne, Wrosch, & Miller, 2011; Wrosch et al., 2013). Goal disengagement generally exerts a reasonable amount of stability over time (Mens et al., 2016) Goal disengagement has been shown to predict important outcomes over and above sociodemographic variables, dispositional optimism, and other personality factors such as the Big Five personality factors (Wrosch et al., 2003b). It should be noted that goal disengagement capacities is related to but distinct from Brandtstädter and Renner's (1990) concept of goal accommodation. *Goal accommodation* incorporates aspects from both, goal disengagement and goal reengagement capacities as well as aspects of coping (i.e., positive reappraisal, acceptance; Brandtstädter & Renner, 1990). Conversely, *goal adjustment capacities* (Wrosch et al., 2003a) view goal disengagement capacities as separate and orthogonal from goal reengagement capacities and coping strategies are conceptualized as mediators (Wrosch et al., 2011; Wrosch et al., 2013).

A substantial body of research shows the benefits of goal disengagement capacities. Goal disengagement capacities predict lower levels of distress, depressive symptoms, perceived stress, and intrusive thoughts (Wrosch et al., 2003a, 2007b). Individuals who can disengage from futile

goals also benefit from superior health such that they report fewer symptoms of acute illness (e.g., headaches, constipation, skin conditions), less sleep disturbances, and less systemic inflammation (Wrosch et al., 2007a).

Disengagement protects individuals from experiencing a variety of negative psychological and physical consequences because it allows individuals to avoid the negative consequences associated with failure to attain important life objectives. Furthermore, it enables individuals to preserve their limited resources so that they may direct them towards more viable opportunities (Wrosch et al., 2003a). Within a developmental perspective, goal disengagement can become increasing important for older adults to preserve limited resources that can be redirected or focalized on other meaningful life goals (Heckhause et al., 2010).

Developmental Perspective on Short-Term Fluctuations in Stress

When individuals encounter circumstances that overwhelm their capacities to cope they are likely to experience *stress* (Cohen, Tyrrell, & Smith, 1991; Lazarus & Folkman, 1984). Perceptions of stress generally activates a physiological pathway called the HPA axis (i.e., hypothalamic-pituitary-adrenal axis), which releases cortisol into the circulatory system (Cohen, Janicki-Deverts, & Miller, 2007). This hormone typically follows a diurnal rhythm across the day (peaking shortly after awakening and subsequently declining throughout the day, Van Cauter & Turek, 1994). However, high and sustained levels of cortisol may compromise long-term physical health (e.g., dysregulation of immune, metabolic, or nervous systems, Bjoerntorp & Rosmond, 1999; Cohen et al., 2007). Indeed, elevated cortisol secretion has been associated with physical health problems, aging and mortality (Otte, Hart, Neylan et al., 2005; Sephton, Sapolsky, Kraemer, & Spiegel, 2000; Wrosch, Miller, & Schulz, 2009). Alternatively, in cases of prolonged or chronic stress, cortisol may also become suppressed or blunted and this diurnal profile may also compromise physical health (Segerstrom & Miller, 2004).

People perceive changes in stress that fluctuate over the course of the day and from one day to the next. Such fluctuations are likely due to the onset of specific stressors (Lazarus & Folkman, 1984) and personal resources related to one's ability to cope with changes in external circumstances (Wrosch & Scheier, 2003). Since optimists expect positive future outcomes, they utilize coping strategies that are aimed at reducing, eliminating or managing the internal and external consequences of stressors. Conversely, pessimists typically expect negative outcomes and as a result tend to utilize coping strategies aimed at avoiding stressful circumstances altogether (Scheier & Carver, 1992; Solberg, Nes & Segerstrom, 2006). These divergent coping patterns may occur because optimists are more likely to perceive external stressors as being surmountable and so will persist in overcoming stressors. Pessimists, by contrast, are more doubtful and likely to avoid a problem by denying the problem or disengaging prematurely. Since optimists and pessimists cope differently when faced with stressors, it may be plausible that their physiological responses to stressors in their environment also differ.

Due to positive expectations, optimists generally perceive events as less stressful than their pessimistic counterpart (Endrighi, Hamer, & Steptoe, 2011; Räikkönen, Mathews, Flory et al., 1999; Carver, Scheier, & Segerstrom, 2010; Wrosch & Scheier, 2003). Intriguingly, although optimists and pessimists differ in their perceptions of stress, such differences have not been reliably shown in their physiological stress responses (i.e., cortisol levels). While some studies find optimism to be associated with reduced cortisol secretion (Endrighi, Hamer, & Steptoe, 2011; Lai, Evan, Ng et al., 2005; Brydon, Walker, Wawrzyniak et al., 2009), several other studies suggest that optimism is unrelated to cortisol level (Endrighi et al., 2011; Minton, Hertzhog, Barron et al., 2009 ; Taylor, Klein, Lewis et al., 2008).

One potential reason for this lack of consensus among researchers may result from the methodology utilized. To date, researchers examining inter-individual differences between optimists and pessimists have failed to find consistent differences in cortisol levels (Endrighi et al., 2011; Minton et al., 2009; Taylor et al., 2008). This may be the case because such a comparison fails to account for the process of habituation. *Stress habituation* has been documented in experimental stress research demonstrating that individuals show reduced elevations in cortisol after repeated exposure to events that were initially "stressful" (Pruessner, Gabb, Hellhammer et al., 1997; Schommer, Hellhammer, & Kirschbaum, 2003). Thus, given that pessimists tend to perceive higher levels of stress than their optimistic counterparts (Endrighi, et al., 2011) over their life course, pessimists may have become habituated to these elevated levels of stress. As a result, the amount of stress that pessimists need to perceive to display elevations in cortisol volume may differ from that of optimists. One way of controlling for such a habituation effect would be to examine fluctuations in stress within the same individual over a period of time (i.e., intra-individual differences). In this way, each individual would determine his or her own baseline and stress perceptions that deviate from habitual levels could then be distinguished to examine how optimists and pessimists differ in their physiological responses when facing relative increases or declines in stress perceptions.

Long-Term Developmental Changes in Stress

Long-term developmental stress may accumulate over longer periods of time as older adults face age-related challenges that may become more intractable over time (e.g., onset of chronic health conditions, death of a spouse; Wrosch et al., 2007b). From a developmental perspective, unrelenting age-related challenges are expected to amplify with increasing age while personal resources (e.g., physical abilities or cognitive capacities) are expected to decline (Baltes & Smith, 2003; Heckhausen, Wrosch & Schulz, 2010). Evidence shows that in the early phases

of older adulthood people are often able to overcome challenges and return to previous levels of functioning but this process of adjustment may be compromised in the later phases of older adulthood (Baltes & Smith, 2003). In advanced old age, opportunities to overcome obstacles may be constrained (i.e., declining physical and cognitive resources, time constraints, developmental stage) if not completely absent (i.e., regrets vis-a-vis a deceased spouse; Heckhausen, Wrosch & Schulz, 2010). As such, opportunities to achieve important life goals may be determined by age-related changes that occur and may become greatly reduced the later phases of life.

As opportunities evolve over the course of old age, processes that were once adaptive may become less effective in the face of unrelenting age-related challenges. Dispositional optimism is associated with persistent goal striving in the face of stressful circumstances and given that opportunities vary as a function of age, so could the emotional benefits of being optimistic. This theoretical idea suggests that dispositional optimism may result in different emotional consequences depending on an older adult's age. In the earlier phases of older adulthood, when people face relatively manageable age-related challenges (Heckhausen et al., 2010), being optimistic should enable people to persist in overcoming barriers and return to previous levels of functioning. In such cases, optimism may prevent the emotional distress associated with failure to overcome age-related challenges. However, in advanced old age, when opportunities are diminished (for a review, see Heckhausen et al., 2010), the persistence of optimists may no longer be of benefit as challenges may be too numerous or altogether intractable. As such, associations between dispositional optimism and emotional well-being may also become reduced as opportunities to overcome stressors decrease across older adulthood. In addition, such a process may occur particularly under highly stressful circumstances when

people are particularly vulnerable and confront the possibility of failing to overcome age-related challenges. In other words, the association between dispositional optimism and emotional well-being may become especially tenuous in the later phases of older adulthood when individuals face numerous age-related challenges and experience high levels of stress.

Research examining the age effects of dispositional optimism is sparse and allows for few conclusions to be made. One study showed that optimism buffered the association between stress perceptions and reduced life satisfaction among young, but not older, adults (Chang, 2002). While another cross sectional study failed to find an age effect of optimism on depressive symptoms and life satisfaction across young, middle and older adults on depressive symptoms (Issacowitz, 2005). Finally, one longitudinal study found that low pessimism predicted reduced mortality among relatively young adults who had a chronic disease, but was unrelated to mortality among their older counterparts (Schulz et al., 1996). While some of these studies suggest that there may be a reduction in the beneficial effects of dispositional optimism in later years, none of the studies examined whether such a process could evolve across older adults.

Managing the Accumulation of Developmental Stress in Advanced Old Age

Older adults' potential to manage developmental stressors and achieve important life goals may decrease with increasing age. In advanced old age, people are likely to be faced with numerous developmental stressors (i.e., chronic health conditions, diminishing social ties, isolation, etc.; Baltes & Smith, 2003, Heckhausen et al., 2010) that have accrued over time. As a result, individuals in advanced old age likely confront the greatest number of obstacles (i.e., functional limitations, cognitive decline, time constraints; Baltes & Smith, 2003) to achieving their goals. Failure to achieve important life objectives can lead to the experience of negative emotions (Wrosch et al., 2007a).

The emotional distress experienced as a result of age-related stressors can compromise older adults' physical health. Individuals who are distressed often exhibit health-compromising behaviours (i.e., lack of physical activity, poor hygiene; Wrosch et al., 2004) and can experience disruptions in their biological processes (i.e., immune function; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002). Older adults face age-related biological changes to the immune system that may increase susceptibility to infection (Graham, Christian & Kiecolt-Glaser, 2006). Those in advanced old age are likely to be at greater risk of infection as a result of pre-existing chronic health conditions (i.e., Alzeihmer's disease, osteoporosis, diabetes; Castle, 2000). Such factors are likely to increase susceptibility to and could increase the severity of experienced illness (e.g., the common cold; Cohen et al., 2007). Complications that result from the experience of a common cold can lead to more serious respiratory illness and can result in hospitalization and even mortality (Graham et al., 2006; Nichol, Wuorenma & von Sternberg, 1998; Falsey, Walsh, & Hayden, 2002).

Given that individuals in advanced old age are most susceptible to disease and disability, self-regulation processes that promote emotional well-being are likely to protect physical health (Christensen et al., 2009). Goal disengagement capacities have been found to be particularly important for health and well-being in older adulthood (Wrosch et al., 2007). Individuals who show high capacities to disengage are protected from experiencing negative affect, intrusive thoughts, and depressive symptoms when facing difficult life stressors (Wrosch et al., 2003, 2007; Wrosch & Sabiston, 2013). Furthermore, goal disengagement has been related to adaptive regulation of stress hormones (i.e., cortisol; Wrosch, Bauer, Miller & Lupien, 2007) and protective against markers of systemic inflammation (i.e., c-reactive protein; Miller & Wrosch, 2007). Although goal disengagement capacities are adaptive throughout older adulthood, it may

be increasingly important for those in advanced old age. Older adults in late life, as compared to earlier phases of old age, are likely to face an increase in intractable age-related stressors while also experiencing a decrease in personal resources (Heckhausen et al., 2010). As a result it may become increasingly difficult for older adults in later phases of life to attain important life objectives. By enabling individuals to let go from unattainable goals, goal disengagement can protect individuals from experiencing the distress associated with repeated failure experiences (Wrosch et al., 2003; 2007). As such, goal disengagement capacities may become increasingly important in advanced old age when people begin to face multiple, intractable, or insurmountable age-related challenges.

Limitations of Previous Research

The literature discussing changes in stress that occurs across old age highlight the importance of both dispositional optimism and goal disengagement in protecting emotional well-being and health. However, there are a few limitations in the literature that the current research aims to address:

1) *The link between dispositional optimism and the physiological regulation of stress remains tenuous with different studies demonstrating divergent findings. Research within this context typically examined inter-individual differences in stress and did not take into account the possibility of habituation to stress in pessimists and optimists.*
2) *Much of the research looking into the differential age effects of dispositional optimism is cross-sectional and does not distinguish individuals in early old age from their older counterparts. This makes it difficult, if not impossible to*

understand how dispositional optimism varies in function from earlier to advanced old age.

3) *Goal disengagement has been extensively researched in older adults, but no studies have specifically parceled out young-old adults from older-old adults. Further research is required to understand how the protective effects of goal disengagement change from early to advanced old age.*

The Present Research

The present research aims to expand our current understanding of successful aging by addressing the limitations described in the extant literature. This dissertation incorporates three different studies that examine how two individual difference variables, dispositional optimism and goal disengagement capacities, influence adaptive self-regulation of stress within the developmental context of older adulthood. Most notably the aim of this dissertation is to clarify how these individual difference variables promote adaptation to stress and predict mental and physical health outcomes within changing developmental contexts (i.e., early versus advanced old age). The purpose of this research thesis is to examine interactions between age, dispositional optimism, goal disengagement, and perceptions of stress in predicting older adults' mood, biological indicators of stress (i.e., cortisol), and experienced illness.

Research Objectives:

Objective 1: To clarify our understanding of dispositional optimism in relation to the physiological mechanisms related to stress perceptions and biological stress regulation.

Objective 2: To expand our understanding of dispositional optimism on adaptive self-regulation within the developmental context older adulthood, where opportunities for goal pursuits are rapidly shifting.

Objective 3: To examine how goal disengagement capacities influence adaptive self-regulation and associated physical health in the late phases of life.

Each research objective of this dissertation is addressed by a separate study; objective one is addressed by Study 1, objective two is addressed by Study 2 and objective three is addressed by Study 3. All three studies are based on longitudinal data from the *Montreal Aging and Health* study. As such, all studies involve similar methodology and there is overlap in

analytical procedures. However, these studies (as described below) examine separate components of adaptation within a developmental context and each study offers a unique contribution to existing literature.

Study 1: Associations between Dispositional Optimism and Diurnal Cortisol in a Community Sample: When Stress is Perceived as Higher than Normal

This study examines associations between dispositional optimism, perceived stress, and cortisol secretion using longitudinal data from a community sample of older adults. The primary aim of this study is clarify the potential buffering effect of dispositional optimism on physiological stress regulation. This study expands upon previous research by utilizing analytical techniques that measure intra-individual (i.e., within-person) associations, which serve to clarify the interaction between dispositional optimism and perceived stress in predicting cortisol secretion. Furthermore, this study illustrates how previous research results may have confounded effects of perceived stress and optimism by contrasting intra-individual results to inter-individual (i.e., between-person) findings. The specific hypotheses for this study were:

> ***Hypothesis 1.1:*** *Older adults will exhibit higher levels of cortisol secretion on days they perceived higher, as compared to lower, stress.*
>
> ***Hypothesis 1.2:*** *Optimists, but not pessimists, will be protected from secreting higher levels of cortisol on days they experience higher than average levels of stress.*
>
> ***Hypothesis 1.3:*** *Replication using between-subject analyses will differ from the within-subject findings.*

Study 2: Do Emotional Benefits of Optimism Vary Across Older Adulthood? A Life Span Perspective

This second study examines longitudinal associations between age and dispositional optimism in a sample of community-dwelling older adults to predict changes in depressive symptoms and perceived stress over time. This study extends previous research by examining dispositional optimism within a life-span developmental context. By comparing older adults in the earlier and later phases of old age, the study examines whether declines in the developmental trajectory equate to diminishing benefits of optimism. Furthermore, it is examined whether this association is potentially moderated by periods of enhanced stress. Study 2 had the following hypotheses:

> ***Hypothesis 2.1:*** *Optimists, but not pessimists, in early old age will be protected from experiencing elevations in depressive symptoms over time. In advanced old age, optimists will experience diminishing benefits in guarding against elevations in depressive symptoms.*
>
> ***Hypothesis 2.2:*** *Age-related associations between dispositional optimism and depressive symptoms will be observed particularly when older adults perceive higher, as compared to lower, levels of stress.*

Study 3: Goal Disengagement Capacities and Severity of Disease Across Older Adulthood: The Sample Case of the Common Cold

In this third and final study, long-term associations between age and goal disengagement on changes in perception of illness were examined among older adults living within the community. Furthermore, it was investigated whether such associations between age and goal disengagement on perceived illness severity are mediated by changes in emotional well-being.

This research study along with Study 2 extends previous research by distinguishing individuals in early old age from individuals in advanced old age. The hypotheses for Study 3 were:

Hypothesis 3.1*: Goal disengagement capacities will predict reduced levels of older adults' cold symptoms, and this association will be pronounced in advanced old age.*

Hypothesis 3.2: *The age-related associations between goal disengagement and individuals' cold symptoms will be mediated by changes in depressive symptoms.*

CHAPTER 2:

Study 1

Associations between dispositional optimism and diurnal cortisol in a community sample: When stress is perceived as higher than normal

Note: Copy edited version of this study was published in the *Health Psychology,* April 2014

Abstract

Objectives. This study examined whether dispositional optimism would be associated with reduced levels of cortisol secretion among individuals who perceive stress levels that are either higher than their normal average (i.e., within-person associations) or higher than the stress levels of other individuals (i.e., between-person associations). **Methods.** Stress perceptions and four indicators of diurnal cortisol (AUC, awakening, afternoon/evening, and CAR levels) were assessed on 12 different days over six years in a sample of 135 community-dwelling older adults. **Results.** Hierarchical linear models showed that while pessimists secreted relatively elevated AUC, awakening, and afternoon/evening levels of cortisol (but not CAR) on days they perceived stress levels that were higher than their normal average, optimists were protected from these stress-related elevations in cortisol. However, when absolute stress levels were compared across participants, there was only a significant effect for predicting CAR (but not the other cortisol measures), indicating that optimism was associated particularly strongly with a reduced CAR among participants who experienced high levels of stress. **Conclusions.** Dispositional optimism can buffer the association between stress perceptions and elevated levels of diurnal cortisol when individuals perceive higher-than-normal levels of stress, and it may predict a reduced CAR among individuals who generally perceive high stress levels. Research should examine relative, in addition to absolute, levels of stress to identify the personality factors that help individuals adjust to psychological perceptions of stress.

Introduction

Research has shown that optimists are more likely than pessimists to adjust successfully to stressful life circumstances and maintain their physical health (Rasmussen, Scheier, & Greenhouse, 2009). Although such health benefits could occur, at least in part, because optimism ameliorates the secretion of cortisol, research has failed to show that optimism consistently modulates stress-related alterations in cortisol (e.g., Taylor, Burklund, Eisenberger et al., 2008). The available literature on optimism, however, has examined *inter-individual differences* in stress and cortisol. This approach is based on comparing a person's stress level to other individuals and thus leaves unexamined the possibility that optimism could prevent cortisol dysregulation in circumstances when individuals experience stress levels that are higher than their typical level of stress. To examine the latter possibility, within-person research is needed to assess stress levels over time and capture deviations from a person's typical level of stress. Such an approach may be particularly fruitful because it controls for each person's average level of stress and thus rules out the possibility that associations between stress and cortisol could be attenuated if cortisol secretion among some individuals have become habituated to high levels of stress (Miller, Chen, & Zhou, 2007). Here we test this hypothesis by examining the influence of dispositional optimism on the within-person and between-person associations of stress perceptions and diurnal cortisol in a community sample of older adults. We expected that optimism would be associated with a buffering of the stress-cortisol link and becomes paramount when individuals perceive stress that is higher than their normal average.

Optimism, Perceived Stress, and Diurnal Cortisol

Dispositional optimism is conceptualized as a relatively stable, continuous, and bipolar individual difference variable, reflecting a person's generalized expectations about future life events across different domains (Scheier & Carver, 1985). While optimists hold expectancies for positive outcomes, pessimists tend to expect negative outcomes. A large body of research has shown that

optimism ameliorates the adverse consequences of stressful life experiences on individuals' well-being and health. For example, optimists cope more effectively with stress and report higher levels of subjective well-being than pessimists (Carver, Scheier, & Segerstrom, 2010; Wrosch & Scheier, 2003). In addition, stress-related benefits of optimism have been associated with adaptive immune responses (Brydon, Walker, Wawrzyniak et al., 2009; Ironson et al., 2005; Segerstrom, Taylor, Kemeny, & Fahey, 1998)[1] and physical health outcomes (e.g., physical symptoms, cardiovascular incidents, or survival; Boehm & Kubzansky, 2012; Rasmussen, Scheier, & Greenhouse, 2009).

A biological mechanism that could be associated with these beneficial consequences of optimism is related to individuals' cortisol secretion. Cortisol is a hormone that is secreted by the HPA axis and follows a diurnal rhythm across the day (peaking shortly after awakening and subsequently declining until bedtime, Van Cauter & Turek, 1994). Research suggests that the psychological perception of stress and associated negative affect can release cortisol into the circulation (Cohen, Janicki-Deverts, & Miller, 2007).[2] While cortisol may facilitate the short-term management of stressful circumstances (Taylor et al., 2000), it also serves regulatory functions in different bodily systems and through these processes could compromise physical health (e.g., dysregulation of immune, metabolic, or nervous systems, Bjoerntorp & Rosmond, 1999; Cohen et al., 2007). In support of this possibility, increased cortisol output has been associated with aging, physical health problems, and mortality (Otte et al., 2005; Sephton, Sapolsky, Kraemer, & Spiegel, 2000; Wrosch, Miller, & Schulz, 2009), although both elevated and blunted forms of cortisol may

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[1] Some studies have found reversed associations among individuals who suffer from chronic or uncontrollable stressors, in that optimism was associated with decrements in immune function (Cohen et al., 1999; Segerstrom, 2005).

[2] Psychological theories emphasize that appraisals of life circumstances, rather than the circumstances per se, influence the biological consequences of stress (Lazarus & Folkman, 1984).

affect physical health (Segerstrom & Miller, 2004).

The previous discussion makes it likely that optimism is also associated with cortisol secretion. In particular, the behavioral and emotional benefits of optimism may prevent individuals who perceive high levels of psychological stress from exhibiting an elevated cortisol response. Surprisingly, however, research examining the role of dispositional optimism in the stress-cortisol link shows inconsistent results. While some studies found optimism to be associated with a lower cortisol awakening response (Endrighi, Hamer, & Steptoe, 2011; Lai, Evan, Ng et al., 2005) and reduced cortisol output after a stress induction (Brydon et al., 2009), several other studies suggest that optimism is unrelated to cortisol level across the day (Endrighi et al., 2011; Minton, Hertzhog, Barron et al., 2009), cortisol awakening levels (Ebrecht et al., 2004), and stress-induced cortisol response (Endrighi, et al., 2011; Taylor et al., 2008).

A review of the extant literature indicates that this research has relied on between-person designs. In particular, the studies examined how either *inter-individual differences* in levels of naturally occurring or experimentally induced stress are associated with cortisol output among optimists versus pessimists (e.g., Minton et al., 2009; Taylor et al., 2008). While this approach compares each individual's stress level to the mean of a sample of different individuals, it does not consider that optimism may protect individuals against elevations in cortisol when they are faced with stress that is higher than their personal average. To examine the latter possibility, however, within-person research is needed to measure perceptions of stress repeatedly over time.

We think that such an approach could contribute to a more comprehensive understanding of the role of dispositional optimism in the stress-cortisol link. Most importantly, a within-person approach would address a potential problem that may arise from the fact that pessimists typically perceive higher levels of stress than optimists (Carver et al., 2010). In this regard, these differences in absolute levels of perceived typical stress could attenuate a buffering effect of optimism on the

association between perceived stress and cortisol secretion. This could be the case because individuals' physiological system can habituate to stress over time and sustained exposure to severe stress may result in lower levels of cortisol (Miller et al., 2007; Wüst, Fedorenko, vanRossum et al., 2005). Thus, given that pessimists typically perceive higher levels of stress than optimists, pessimists may also be particularly likely to become physiologically habituated to their typically higher levels of stress, which may at times result in a relatively low secretion of cortisol. As a consequence, pessimists' stress-related cortisol responses might not always be distinguishable from their optimistic counterparts. We should be clear about what it is that we think habituates. Specifically, we believe that it is the response of the HPA axis to perceptions of stress, and not necessarily the perception of stress itself. Thus, pessimists might perceive higher levels of stress than optimists, but still not exhibit increased levels of cortisol.

Nonetheless, differences in cortisol output between optimists and pessimists may be reliably observed if perceptions of stress exceed individuals' typical stress levels. In such circumstances, pessimists are less likely to be habituated to the stress experienced and should exhibit an associated increase in their cortisol levels, while the beneficial behavioral and emotional effects of optimists' positive outcome expectancies may ameliorate stress-related cortisol output. Further, such differences in stress-related cortisol secretion between optimists and pessimists should be particularly evident in within-person research, as this approach accounts for habituation effects by examining deviations from a person's typical stress level.

The Present Study

We examined whether dispositional optimism would moderate the within-person and/or between-person associations of psychological perceptions of stress and four indicators of diurnal cortisol secretion (area-under-the-curve [AUC], awakening levels, afternoon/evening levels, and cortisol awakening response [CAR]). To this end, we analyzed data from a heterogeneous and

community-dwelling sample of older adults, which included measures of stress perceptions and diurnal cortisol secretion on twelve different days across six years of study. This normative study of older adults was particularly well-suited to test our hypothesis, as aging is commonly associated with both incidence of age-normative problems and dysregulation of cortisol (McEwen & Stellar, 1993; Wrosch & Schulz, 2008). We hypothesized that participants would exhibit higher levels of indicators of cortisol secretion on days they perceived higher, as compared to lower, stress. In addition, we hypothesized that this effect would appear only among pessimists, and not among optimists. Finally, we analyzed the same data points in between-person analyses by averaging the 12 daily measures of stress and cortisol. Given the aforementioned mixed literature, we explored whether optimism would also be associated with a buffering of the stress-cortisol link in between-person analyses (see Figure 1 for the conceptual framework that guides the research).

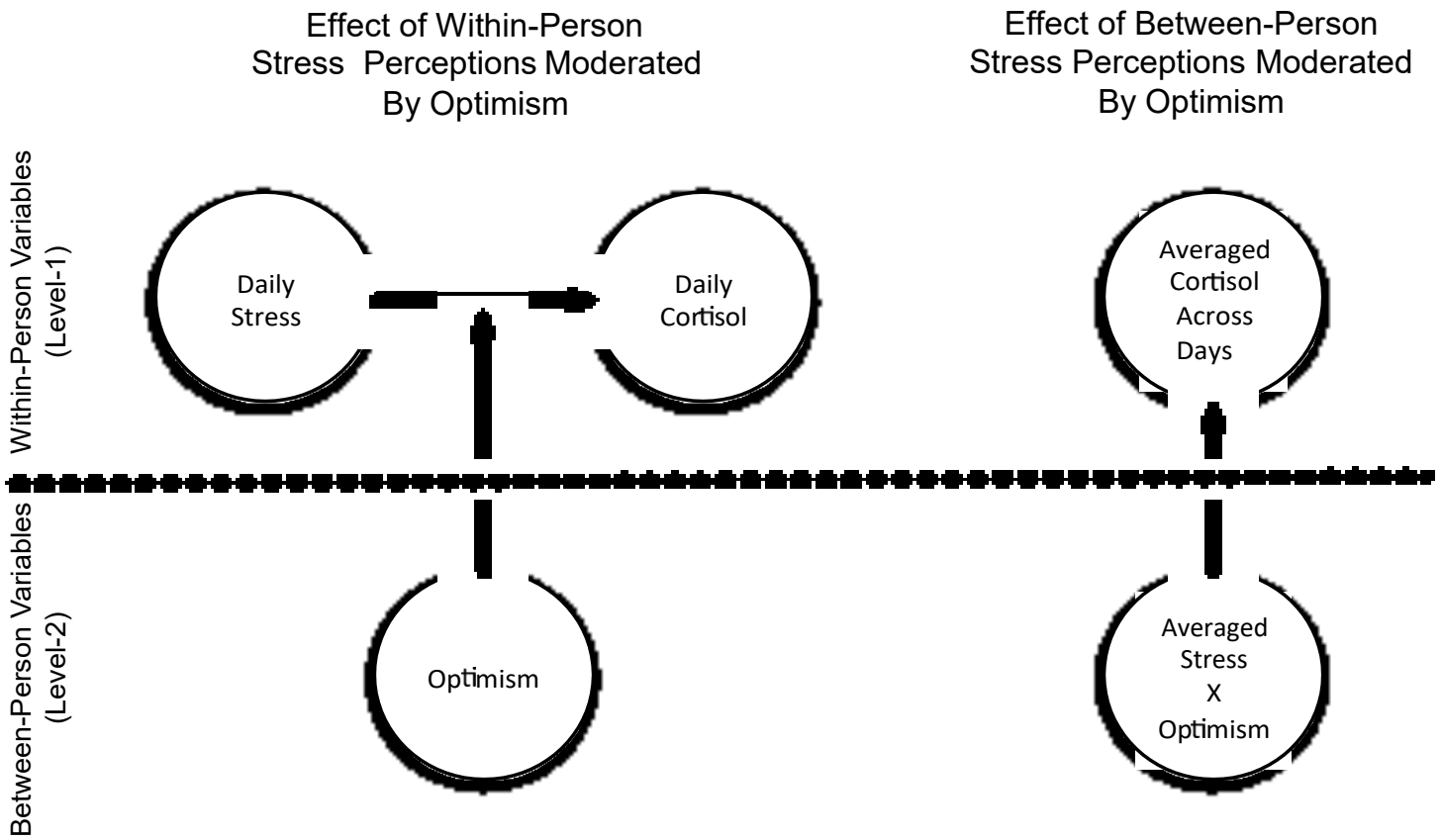

Figure 1. Graphical representation of the potential moderating role of dispositional optimism in the within-person and between-person associations between perceptions of stress and cortisol secretion. In the within-person analyses perceptions of stress was a Level-1 predictor, whereas in the between-person analyses perceptions of stress were aggregated across twelve measurement points and used as a Level-2 predictor.

Method

Participants

This study was based on a heterogeneous sample of community-dwelling older adults who participated in the *Montreal Aging and Health Study* (Wrosch, Schulz, Miller, Lupien, & Dunne, 2007). Following a baseline assessment in 2004 ($N = 215$), subsequent waves of the study were conducted approximately two years ($M = 1.89$, $SD = 0.08$, *range* = 1.72 to 2.13 years; $n = 184$), four years ($M = 3.78$, $SD = 0.24$, *range* = 3.28 to 4.77 years; $n = 164$) and six years after baseline ($M = 6.05$, $SD = 0.20$, *range* = 5.52 to 6.40 years; $n = 137$). Attrition over six years of study was associated with refusal to participate further ($n = 9$), inability to locate participants ($n = 19$), presence of other personal problems ($n = 27$), and death ($n = 23$). Participants who dropped out of the study were significantly older at baseline ($M = 73.82$, $SD = 6.78$) than those who remained in the study ($M = 71.61$, $SD = 5.21$; $t[129.14] = 2.49$, $p = 0.01$). Study attrition was not significantly associated with any of the other baseline variables used in this study or the earliest measure of dispositional optimism (i.e., 2-year follow-up). Two of those 137 subjects who participated in the 6-year follow-up were further excluded from the analyses because they provided cortisol samples on less than 50% of the sampling days, resulting in a final sample of 135 subjects.

Procedure

Participants were recruited through newspaper advertisements. In order to obtain a normative sample, the only inclusion criterion was that participants had to be older than 60 years (See Appendix A for consent form). In each wave of the study, they were either visited in their homes or invited to the laboratory and responded to a main questionnaire. On three non-consecutive and typical days during the week following the initial appointment, participants collected saliva (see Appendix E) and responded to daily questionnaires including perception of stress (see Appendix F). Across waves, this procedure resulted in twelve assessments of daily cortisol and stress perceptions

over six years of study.

Materials

Perceptions of stress were assessed in each wave over three days by asking participants at bedtime to rate how 1) *stressed* and 2) *overwhelmed* they felt during each of three days, using 5-point Likert-type scales (0 = *very slightly or not at all* to 4 = *extremely*; see Appendix F). For each day, we computed a sum score of the two items to obtain daily measures of stress perceptions (*r*s = .20 to .60, *p*s < .01; average *r* [based on z-transformation] = .44, *p* < .01). Because some subjects did not participate in all waves, 85 out of 1620 potential stress values (5.25%) were replaced with the respective sample mean[3]. Perceptions of stress showed some stability within waves (average *r* = .58, *p* < .01) and exerted an average 2-year stability across waves of *r* = .28, *p* < .01. We also computed an overall score of stress perceptions by averaging stress scores across all twelve assessments.

Diurnal cortisol secretion was also assessed across waves on three days. Participants used salivettes to collect five saliva samples throughout the day: at awakening, 30 minutes after awakening, 2 PM, 4 PM, and bedtime. They were instructed not to brush their teeth or eat thirty minutes prior to saliva collection to prevent contamination with food or blood. Participants took the first saliva sample when they awoke. To collect the second saliva sample thirty minutes after awakening, they were provided with a timer. Participants were contacted by phone to facilitate compliance with the afternoon saliva collection (i.e., at 2 PM and 4 PM). They collected the last saliva sample by themselves at the time they went to bed. The exact time of day of each sample collected was recorded by the participants (see Appendix E). Samples were stored in participants'

[3] The pattern of significant effects in the associations between perceived stress, optimism, and cortisol did not change if missing data were not replaced and addressed in the HLM analyses.

home refrigerators until they were returned to the lab 2-3 days after collection was completed, and they were frozen until completion of each wave. Cortisol analysis was performed at the University of Trier using a time-resolved fluorescence immunoassay with a cortisol-biotin conjugate as a tracer. The intra-assay coefficient of variation was less than 5%, and the inter-assay variability from cortisol analyses performed at the University of Trier has been found to be routinely below 10%.

We collected 7815 cortisol samples from the 135 participants (96.48% of possible samples). Ninety-four samples (1.2%) deviated 3 standard deviations or more from the mean cortisol level for a given time of day and were excluded from the analyses. To obtain a reliable CAR, 72 samples (4.67%) were further excluded because they deviated more than 10 minutes from 30-minutes after awakening, and thus could compromise and accurate measurement of CAR. We calculated cortisol indicators only for days during which participants provided at least four usable cortisol scores, resulting in cortisol scores for 95.19% of the 1620 sampled days. For days on which participants had one single cortisol score missing (8.95%), the missing value was replaced with the respective sample mean. Additional missing values for single days (4.81%) were also replaced by the respective sample mean. Across waves, samples were on average collected .51 (*SD* = .02), 7.04 (*SD* = .96), 9.11 (*SD* = .97), and 15.82 hours (*SD* = .94) after awaking. The cortisol scores were log-transformed to stabilize variance. They formed a typical diurnal rhythm, including high awakening levels (*M* = 1.06, *SD* = .15), increasing 30-minutes levels (*M* = 1.16, *SD* = .17), as well as declining levels at 2 PM (*M* = .76, *SD* = .12), 4 PM (*M* = .69, *SD* = .12), and bedtime (*M* = .54, *SD* = .14).

We calculated four different indicators of cortisol secretion for each assessment day. To examine overall cortisol volume, area-under-the-curve (AUC) across day was computed using the trapezoidal method based on hours after awakening. The 30-minutes measure was excluded from AUC because early morning increase of cortisol has been shown to be relatively independent from overall cortisol volume (Chida & Steptoe, 2009). In addition, we analyzed awakening levels (by

using the first measure of the day) and afternoon/evening levels of cortisol (by averaging the last three measures of the day) to explore whether differences in overall cortisol volume would relate to morning levels and/or later levels of cortisol secretion. Finally, we calculated the cortisol awakening response (CAR) by computing the difference between the 30-minutes and the awakening measures. All indicators of cortisol secretion showed some stability within waves (average *r*s = .26 to .56, *p*s < .01) and across waves (average 2-year stability: *r*s = .22 to .35, *p*s < .01).

Dispositional optimism was assessed in waves 2, 3, and 4, using the 6-item Life Orientation Test-Revised, which is a reliable and well-validated measure of dispositional optimism (LOT-R, Scheier, Carver, & Bridges, 1994; see Appendix D). Participants were asked to indicate their agreement with each of the six items, using 5-point Likert-type scales (0 = *strongly disagree,* to 4 = *strongly agree*). The LOT-R includes three optimism items (e.g., *I am always optimistic about my future*) and three pessimism items (e.g., *If something can go wrong for me, it will*). For each wave, we computed a sum score of the six items after reverse coding the pessimism items. Measures of optimism demonstrated good internal consistency (αs = .72 to .79), were correlated (average 2-yr stability: $r = .73$, $p < .01$), and did not change significantly across waves (F [1, 134] = 1.81, p = .18). The optimism scales were averaged across waves to obtain a reliable measure of dispositional optimism.

Sociodemographic and health-related covariates were included into the study to minimize the presence of spurious associations. Age and sex was assessed by self-report. Socioeconomic status was measured using three baseline variables (highest education, yearly family income, and perceived social status, α = .69) and averaged to obtain a reliable indicator of socioeconomic status (see in Appendix B). We coded participants as smokers if they smoked at any time during the study (average stability: $r = .67$, $p < .01$). Chronic illness was measured by assessing the presence of 17 different health problems (e.g., coronary heart disease, arthritis, or cancer) and averaged across

waves (average stability: $r = .75$, $p < .01$). Self-reported body-mass-index (BMI in kg/m^2) was calculated and averaged across waves (average stability: $r = .79$, $p < .01$). Finally, we calculated change scores of participants' chronic health problems and BMI across waves by predicting in regression analyses the wave 4 levels by the baseline levels and saving the standardized residuals for further analyses (see Appendix C for measures of health).

Data Analysis

Preliminary analyses were conducted in order to describe the sample (by calculating means and frequencies; see Table 12 and Table 13 in Appendix L) and the zero-order associations among main study variables (by calculating correlations; see Table 11 in Appendix K). In addition, we examined whether indicators of cortisol secretion and perceptions of stress would vary as a function of assessment day and/or wave (by using ANOVAs; see Table 14 in Appendix L) to assess whether these factors need to be included as covariates in subsequent analyses.

Next, we tested the study's hypotheses (see Figure 1) by performing two sets of hierarchical linear models, using HLM 7.0. In the Level-1 models of the first set of analyses, variability in the four different cortisol indicators (i.e., AUC, awakening level, afternoon/evening level, and CAR) across assessments was estimated as a function of person-centered scores of daily stress perceptions, person-centered time-related factors (that proved to be significant in the preliminary analyses), and a residual term. In these models, the intercepts represented participants' average cortisol levels across daily assessments, while the slopes for stress perceptions indicated whether deviations from a person's average level of stress perceptions were reliable predictors of variability in cortisol output. In the Level-2 models, we predicted all coefficients obtained in the Level-1 models by between-person differences in dispositional optimism and the covariates to examine the presence of significant cross-level interaction effects between optimism and intra-individual variability of stress perceptions in predicting particpants' cortisol secretion.

The second set of hierarchical models examined between-person associations among optimism, stress perceptions, and cortisol (see Figure 1). In contrast to the first set of analyses, the Level-1 models only included person-centered time-related factors and a residual term as predictors of variability in daily cortisol volume (and excluded person-centered stress perceptions). The coefficients of interest in these analyses were the intercepts, which represented participants' average cortisol levels across daily assessments. In the first step of the Level-2 models, we estimated the obtained variability in average cortisol output (and in the associations between time-related factors and cortisol) as a function of between-person differences in optimism, perceptions of stress, and the covariates. In a second step we tested whether the interaction between optimism and inter-individual variability of stress perceptions would significantly predict variability in participants' cortisol secretion. Both sets of hierarchical models were based on using restricted maximum likelihood estimation and robust standard errors. Level-2 predictors were standardized prior to conducting the analyses. Specifications of the models are reported in Table 9 and Table 10 of Appendix J.

Results

Preliminary Analyses

As reported in Table 1, approximately half of the sample was female and participants were on average 72 years old. They experienced an average of 2-3 chronic health problems and had an average BMI that was located at the cusp between normal weight and overweight. Less than 10% of the sample smoked and 37% of participants had obtained a graduate degree. Participants' income was quite heterogeneous and approximately half of the sample had an annual income between $17,000 and $51,000. The sample average for perceived social status was slightly above the midrange of the scale. The socio-demographic and health related characteristics of this sample were representative of community-dwelling older adults (National Advisory Council on Aging, 2006).

Table 1

Means, Standard Deviations and Frequencies of Variablesin Study 1 (N = 135)

Constructs	Mean (SD) or Percentage [a]
Average cortisol AUC (in log nmol/L x h)	12.00 (1.65)
Average cortisol awakening level (in log nmol/L)	1.05 (.14)
Average cortisol afternoon/evening level (in log nmol/L)	.66 (.10)
Average cortisol awakening response (in log nmol/L)	.11 (.12)
Average perceptions of stress	.79 (.71)
Dispositional optimism	16.65 (3.43)
Age	71.54 (5.20)
Female (%)	53%
Average number of chronic health problems	2.38 (1.59)
Average body-mass-index	25.75 (3.59)
Smoking (%)	7.4%
Education (%)	
None	3.8%
High School	29.2%
College/Trade	23.0%
Bachelor	24.6%
Masters/PhD	12.3%
Income	
Less than $17,000	21.4%
$17,001 – $34,000	37.3%
$34,001 – $51,000	19.0%
$51,001 – $68,000	15.1%
> $68,000	3.2%
Subjective social status	6.22 (1.85)

Note. [a] Mean (SD) are presented for continuous variables. For more specific cortisol and stress values across study waves and assessment days, see Table 12 and Table 13 in Appendix L.

Results from correlational analyses among the main between-person variables showed that optimism was significantly associated with lower perceptions of stress, $r = -.37$, $p < .01$ (for correlations among other study variables, including covariates, see Table 11 in Appendix K). Average AUC, awakening levels, and afternoon/evening levels of cortisol were positively correlated, rs > .31, ps < .01. CAR was not significantly associated with AUC or afternoon/evening levels of cortisol, but correlated with lower awakening levels, $r = -.33$, $p < .01$. There were no significant correlations between the averaged four indicators of cortisol secretion with dispositional optimism or averaged levels of stress.

To explore time-related changes in the four indicators of cortisol secretion and perceptions of stress, five separate repeated measurement ANOVAs were conducted including the within-subject factors *Wave* (4 levels) and *Day* (3 levels). These analyses are presented in Table 14 in Appendix L. The results showed significant linear effects of *Wave* for stress perceptions and all cortisol indicators, except CAR (see Table 14 of Appendix L). In addition, they indicated linear effects of *Day* for awakening and afternoon/evening levels of cortisol. Finally, Table 14 of Appendix L shows quadratic *Wave* and *Day* effects for some indicators of cortisol secretion, and a quadratic *Wave* effect for stress perceptions. Overall, the pattern of findings indicated that cortisol levels (except CAR) mostly increased over the first three waves and declined in the last wave (see Table 14). Stress perceptions, however, were higher in the last three waves, as compared to baseline (see Table 12 of Appendix L). With respect to *Day*, afternoon/evening levels of cortisol increased across days, and AUC and awakening levels peaked during the second assessment day, while CAR levels were comparably low during the second day (see Table 13 of Appendix L). These findings indicate that further hypotheses-related analyses should control for linear and quadratic effects of time since study entry and assessment day.

Predicting Within-Person Variation in Diurnal Cortisol Secretion

The analyses examining the within-person associations between perceptions of stress and the four indicators of cortisol predicted in separate Level-1 models variability in participants' cortisol secretion across 12 daily measures by person-centered scores of stress peceptions, linear and quadratic effects of years since study entry and assessment day, and a residual term. (for *df*s, see Tables 9 and 10 in Appendix J). The results of the analyses showed that average levels (i.e., intercepts) of AUC, $\beta = 12.00$, $SE = .14$, $p < .01$, awakening cortisol, $\beta = 1.05$, $SE = .01$, $p < .01$, afternoon/evening cortisol, $\beta = .66$, $SE = .01$, $p < .01$, and CAR, $\beta = .11$, $SE = .01$, $p < .01$, were significantly different from zero. In addition, person-centered stress perceptions (i.e., slope) significantly predicted variability of AUC, $\beta = .17$, $SE = .05$, $p < .01$, awakening level, $\beta = .02$, $SE = .01$, $p < .01$, and afternoon/evening level of cortisol secretion, $\beta = .01$, $SE = .00$, $p = .03$, but not CAR, $\beta = -.01$, $SE = .01$, $p = .17$. The latter findings indicate that participants secreted higher AUC, awakening, and afternoon/evening levels of cortisol on days during which they perceived high levels of stress as compared to days that involved comparatively lower stress levels. Finally, the results from the Level-1 models showed that there was considerable variability in the average levels of all cortisol indicators, $\chi 2$s = 1027.86 to 335.80, ps < .01, as well as in the within-person association between perceptions of stress and AUC, awakening levels, and afternoon/evening levels of cortisol, $\chi 2$s = 160.74 to 143.30, ps = .02 to .15. There was less variability in the associations between stress perceptions and CAR, $\chi 2 = 119.77$, $p > .50$.

In the Level-2 models, we attempted to explain the observed variability in participants' cortisol secretion and in their within-person associations between stress perceptions and cortisol by predicting all Level-1 coefficients by dispositional optimism and the covariates. The obtained results indicate that of the covariates only sex, average chronic illness, and increases in chronic

illness exerted significant effects on participants' average (i.e., intercept) AUC of cortisol. In addition, sex and age significantly predicted participants' average afternoon/evening levels of cortisol. Women had lower AUC, β = -.46, *SE* = .14, $p < .01$, and afternoon/evening levels of cortisol, β = -.03, *SE* = .01, $p < .01$, than men. Moreover, older, as compared with younger, participants had higher afternoon/evening levels of cortisol, β = .02, *SE* = .01, $p < .01$. Finally, while increases in chronic health problems were associated with a higher AUC of cortisol, β = .30, *SE* = .14, $p = .04$, high average levels of chronic health problems were associated with a lower AUC of cortisol, β = -.39, *SE* = .15, $p < .01$.[4] None of the remaining covariates or dispositional optimism predicted AUC or afternoon/evening levels of cortisol, and there were no significant effects on awakening levels or CAR.

With respect to the within-person associations between stress perceptions and the four indicators of cortisol, none of the covariates explained significant proportions of variance in these associations. However, dispositional optimism showed significant cross-level interaction effects on the associations between within-person perceptions of stress and AUC, β = -.19, *SE* = .04, $p < .01$, awakening levels, β = -.01, *SE* = .00, $p < .01$, and afternoon/evening levels, β = -.01, *SE* = .00, $p = .04$, of cortisol (but not CAR, β = .01, *SE* = .01, $p = .07$).[5]

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[4] Note that the health effects were based on some suppression associated with the remaining covariates. If only measures of chronic illness were included into the Level-2 model, increases in chronic illness, β = .37, *SE* = .16, $p = .02$, but not averaged levels of chronic illness, β = -.24, *SE* = .14, $p > .05$, were associated with higher AUC.

[5] The effects of optimism were also significant if Level-2 covariates were not included into the models, and therefore are not based on potential suppression effects.

To interpret the significant interactions, we plotted in Figure 2 the within-person associations between perceptions of stress and AUC (left panel), awakening levels (middle panel), and afternoon/evening levels (right panel) of cortisol, separately for optimists and pessimists, using the averaged upper and lower quartiles of the distributions of dispositional optimism and daily stress perceptions as reference points (Preacher, Curran, & Bauer, 2006). In support of our hypotheses, analyses of the simple slopes demonstrated that within-person perceptions of stress were significantly associated with elevated AUC, $\beta = .40$, $SE = .08$, $p < .01$, awakening levels, $\beta = .04$, $SE = .01$, $p < .01$, and afternoon/evening levels of cortisol, $\beta = .02$, $SE = .01$, $p < .01$, among pessimists, but not among optimists, $|\beta s| < .10$, $SEs < .07$, $ps > .05$. In addition, optimism was significantly associated with lower AUC, $\beta = -.42$, $SE = .17$, $p = .01$, awakening levels, $\beta = -.03$, $SE = .02$, $p = .05$, and afternoon/evening levels of cortisol, $\beta = -.02$, $SE = .01$, $p = .04$, on days when participants perceived higher-than-normal stress, but not on days that involved lower-than-normal level of stress, $|\beta s| < .08$, $SEs < .13$, $ps > .50$.

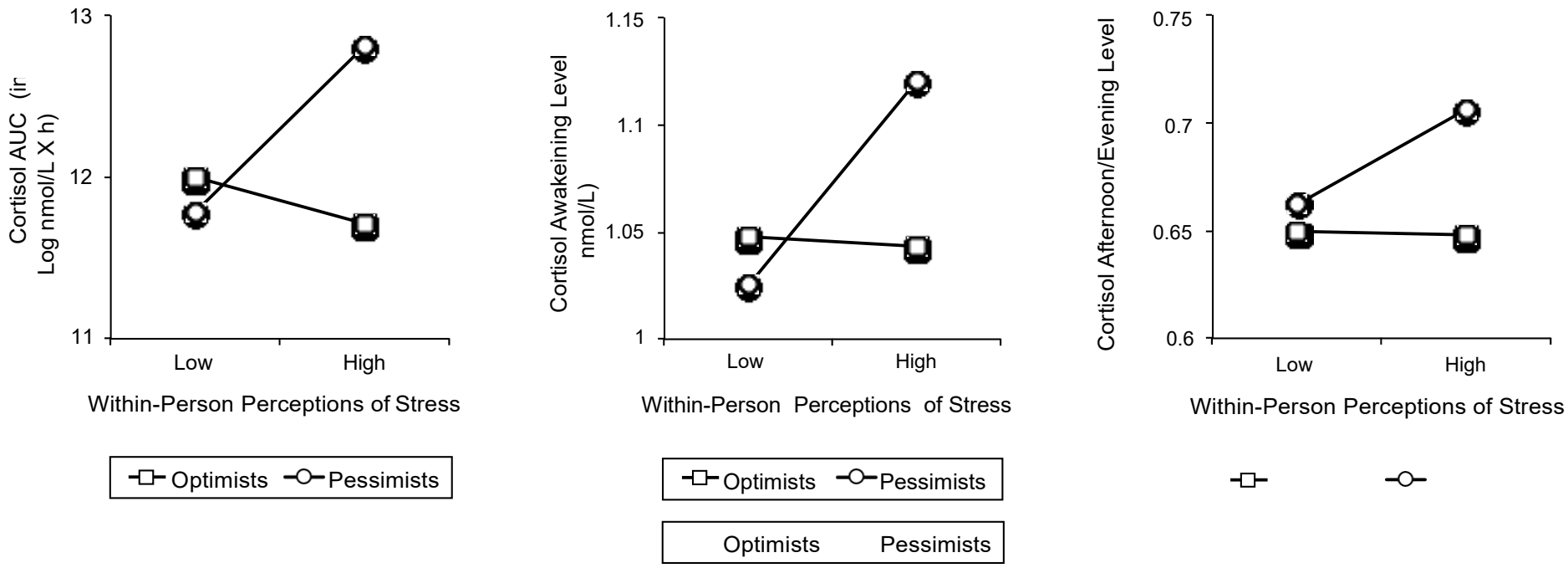

Figure 2. Within-person associations between stress perceptions and AUC (left panel), awakening level (middle panel), and afternoon/evening level (right panel) of cortisol secretion, separately for pessimists and optimists. Associations were plotted for the averaged upper and lower quartiles of the predictor variables.

Predicting Between-Person Variation in Diurnal Cortisol Secretion

To examine whether between-person differences in levels of stress perceptions and dispositional optimism would also be associated with participants' diurnal cortisol secretion, we repeated the previously reported Level-1 models by predicting the four indicators of cortisol secretion (and excluding person-centered scores of stress perceptions as a predictor from the Level-1 analyses). In the Level-2 models, we included between-person differences in perceptions of stress (averaged across 12 days), dispositional optimism, and the covariates as predictors of the Level-1 coefficients. In a final step, we tested the interaction term between perceptions of stress and dispositional optimism for significance.

The significance and direction of effects for the Level-1 models, and the Level-2 effects of the covariates and dispositional optimism on the Level-1 intercept were identical to the previously reported analyses, and are therefore not reported again. However, and in contrast to the reported within-person analyses, the Level-2 main effect of between-person differences in perceptions of stress did not significantly predict the average levels of any of the four indicators of cortisol secretion, $|\beta s| < .03$, $SEs < .12$, $ps > .32$. In addition, the subsequently tested interaction between perceptions of stress and dispositional optimism did not significantly predict AUC, awakening, or afternoon/evening levels of cortisol, $|\beta s| < .01$, $SEs < .10$, $ps > .26$ but did significantly predict CAR, $\beta = -.03$, $SE = .01$, $p < .01$.

The interaction involving between-person associations of stress perceptions and dispositional optimism in predicting average levels of CAR is illustrated in Figure 3 for the averaged upper and lower quartiles of the predictor variables. Follow-up analyses of the simple slopes suggested that similar to the previously reported interactions, pessimists who perceived high levels of stress across the study exhibited a larger CAR than their counterparts who

generally perceived lower levels of stress, β = .03, *SE* = .01, $p < .01$. In addition, among participants who perceived high levels of stress, optimism was significantly associated with lower CAR, β = -.04, *SE* = .01, $p < .01$. However, the obtained interaction was also somewhat different from the within-person results, in that optimists who perceived low levels of stress secreted relatively elevated levels of CAR, which were higher than CAR of pessimists who perceived low levels of stress, β = .03, *SE* = .01, $p < .01$, as well as higher than CAR of optimists who reported high levels of stress perceptions, β = -.04, *SE* = .01, $p < .01$.

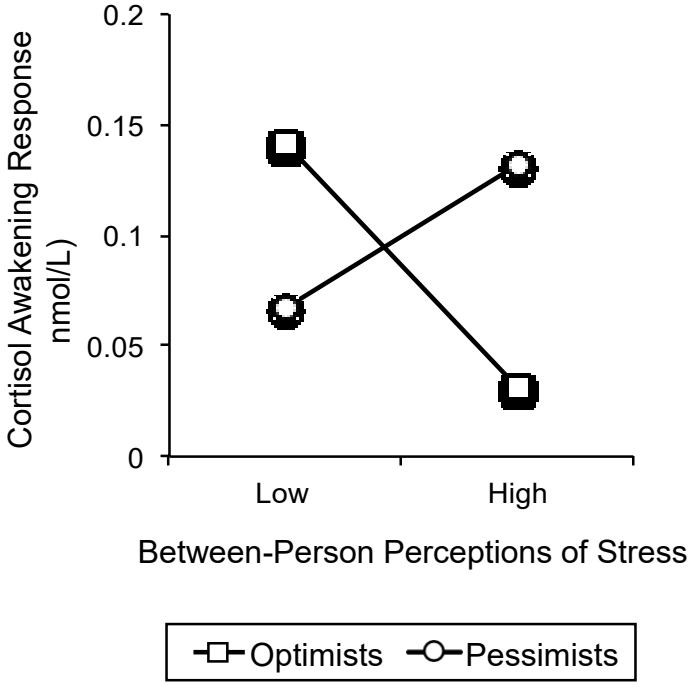

Figure 3. Between-person associations between stress perceptions and cortisol awakening response, separately for pessimists and optimists. Associations were plotted for the averaged upper and lower quartiles of the predictor variables.

Discussion

This study showed that dispositional optimism can moderate the associations between psychological perceptions of stress and increased cortisol secretion in a community sample of older adults. However, this association was obtained for most indicators of cortisol (except for CAR) only when stress perceptions were evaluated within each individual in comparison to each person's average level of stress (i.e., within-person associations) and not when participants' absolute stress perceptions were compared to the sample mean (i.e., between-person associations). In particular, higher-than-normal perceptions of stress were reliably associated with elevated AUC, awakening, and afternoon/evening levels of cortisol secretion among pessimists. Optimists, by contrast, were protected from exhibiting higher levels of cortisol secretion on days they perceived stress levels that were higher than their normal average.

We did not find the same associations for participants' absolute levels of stress perceptions. Here, pessimists who perceived relatively high levels of stress across the entire study period did not differ from optimists in their levels of AUC, awakening, or afternoon/evening levels of cortisol. To provide an explanation for this finding, we suggest that even though pessimists' absolute stress levels were higher than their optimistic counterparts', associations between *inter-individual differences* in stress perceptions and pessimists' cortisol secretion may not have been observed because pessimists had become physiologically habituated to their typical and high levels of stress (cf. Miller et al., 2007; Wüst et al., 2005). This conclusion is supported by the reported within-person analyses, which demonstrated that pessimists exhibited stress-related elevations of cortisol if habituation effects of typical levels of stress were controlled for.

The study's findings further showed that a general association between stress perceptions

and AUC, awakening, and afternoon/evening levels of cortisol was observed only if relative stress perceptions were compared within individuals. By contrast, and consistent with some other research (e.g., van Eck, Berkhof, Nicolson & Sulon, 1996), we did not obtain a significant association between *inter-individual differences* in stress perceptions and cortisol secretion. In this regard, we suspect that a similar habituation mechanism could underlie this pattern of findings. Consistent with this notion, perceptions of stress were significantly correlated across waves of assessment. Thus, there was some stability in stress ratings across time. This could set the stage for cortisol secretion to habituate to chronically high levels of stress. If so, links between stress and cortisol might emerge only when stress perceptions are higher than individuals' normal levels.

Of interest, our analyses did not confirm significant within-person associations between optimism, stress perceptions, and CAR. However, the interaction between optimism and averaged perceptions of stress significantly predicted CAR in the reported between-person analyses. The shape of this interaction suggests that dispositional optimism can buffer the association between absolute levels of stress perceptions and CAR. Absolute levels of stress perceptions were positively associated with a larger CAR among pessimists, and this association became increasingly negative among optimists. While we did not postulate a-priori that CAR would be associated with the interaction of stress and optimism in between-person analyses, previous research may provide an explanation for this effect. In this regard, it has been shown that CAR can be relatively independent from other aspects of the diurnal rhythm of cortisol (e.g., cortisol across day, Schmidt-Reinwald et al., 1999). In addition, a recent meta analysis indicated that CAR in particular is reliably associated with high levels of chronic life stress (Chida & Steptoe, 2009). Thus, it is possible that CAR is less suceptible to stress habituation than other

aspects of cortisol functioning, which could explain the significant effects of absolute levels of stress perceptions on CAR.

We acknowledge that the shape of the interaction effect for predicting CAR was not completely identical with the interactions obtained in the within-person analyses. In particular, optimists who generally perceived low stress exhibited a relatively elevated CAR (see Figures 2 and 3). In this regard, we note that other factors have been implicated in enhanced CAR, such as low depression or fatigue (Chida & Steptoe, 2009). Post-hoc analyses of our data showed that the significant association between optimism and CAR among participants who generally perceived low stress was rendered non-significant, $\beta = .02$, $SE = .01$, $p = .12$, if we additionally controlled the analysis for average levels of depressive symptoms.[6] Follow-up regression analyses further indicated that this reduction was based on associations between low depressive symptoms and high CAR, particularly so among optimists, $\beta = -.53$, $p < .01$ (versus pessimists: $\beta = .09$, $p = .51$), and participants who perceived low stress, $\beta = -.44$, $p < .01$ (versus high stress: $\beta = -.02$, $p = .87$). Given that depressive symptoms were also associated with low optimism, $\beta = -.37$, $p < .01$, and high stress, $\beta = .41$, $p < .01$, an implication of these findings is that optimism may prevent low mood and foster engagement with desired activities among individuals who generally perceive low stress, which could contribute to optimists' somewhat higher CAR in such circumstances.

Overall, the study's results may help reconcile some of the mixed findings in the literature on dispositional optimism, stress, and cortisol secretion. While a large body of research has documented stress-related benefits of dispositional optimism on effective coping, subjective

[6] All reported within-person interactions remained significant if the analyses were additionally controlled for depressive symptoms.

well-being, and physical health (Carver et al., 2010; Rasmussen et al., 2009), several studies examining inter-individual differences in stress levels failed to support that dispositional optimism also facilitates cortisol regulation (Ebrecht et al., 2004; Endrighi et al., 2011; Taylor et al., 2008). Contrary to these previous studies, our findings support the idea that optimism can ameliorate the association between stress perceptions and cortisol. However, for most indictators of cortisol secretion this association only emerged when participants perceived stress levels that were higher than their normal average, and not if stress levels were compared to the sample mean. As a consequence, our study suggests that it is advantageous to examine the associations between optimism, perceived stress, and cortisol using within-person designs. In particular, a within-person approach controls for habituation effects and is thus well-suited to uncover protective psychological factors that buffer the association between perceived stress and cortisol.

We note that this conclusion does not imply that stress-related effects of optimism (for habituation-susceptible indicators of cortisol) cannot be observed in between-person research. From our perspective, the occurrence of such effects may depend on the levels of stress that are perceived. Thus, if absolute stress levels are higher than individuals' typical levels in any particular study, between-person research may document a pattern of results that is similar to the within-person results reported here. However, given that such a discrepancy may not always occur and that it is difficult to determine whether inter-individual differences in actual stress deviate from individuals' typical stress levels, between-person studies may just be less likely to detect buffering effects of optimism on the stress-cortisol link.[7]

[7] Post-hoc analyses conducted for each wave separately showed that differences between pessimists and optimists arose in only one wave of data collection (i.e., wave 3). In that wave, and not in other waves, absolute levels of stress perceptions were associated with higher AUC

Limitations and Future Research Directions

There are some issues that need to be addressed in future research. First, we examined a sample of older adults, and future studies should extend this approach to studying younger indiviudals. Such a life-span approach may be important because it could illuminate age-related processes in the physiological habituation to psychological stress. Given that there is considerable time-related stability in stress perceptions, and that physiological habituations requires repeated exposure to stress over an extended period of time, with advancing age individuals may be more likely to show cortisol habituation to the perception of stress.

Second, our study focused on perceptions of stress, and some of the covariates (e.g., health problems or BMI) were assessed with bias-prone self-reports. While our hypotheses are based on theories that emphasize the psychological perception of stress (Lazarus & Folkman, 1984), we suggest that future studies should additionally assess actual stressors to examine the conditions under which the experience of stressors results in the perception of stress and influences cortisol secretion. In addition, such studies should include objective measures of physical health and BMI.

Third, mean levels differences in cortisol and perceived stress could have contributed to the obtained pattern of findings. In our study, stress perceptions increased over the first two years of study and remained stable in subsequent waves, while AUC, awakening, and afternoon/evening levels of cortisol mostly increased over the first four years and declined in the last wave. This divergence of cortisol and stress levels could imply that some participants'

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among pessimists, $\beta = .19$, $p = .05$, but not among optimists, $\beta = -.12$, $p = .45$; $F(1, 121) = 4.18$, $p = .04$. Further, in this wave, pessimists had significantly higher stress levels than optimists, after controlling for the stress levels of the other waves, $F(1, 120) = 4.17$, $\beta = -.21$, $p = .04$.

cortisol response habituated over time to increasing and high levels of stress. Alternatively, we note that cortisol assays of each wave of our study were performed in different batches, which could have attenuated the mean levels of cortisol across waves. Regardless of the reasons, we think that the observed mean levels differences across time are unlikely to compromise the overall interpretation of findings as our analyses controlled for linear and quadratic variation in the sampling of cortisol and stress perceptions over time. In support of this conclusion, we note that we would have observed a highly similar pattern of findings if time-related covariates were excluced from the analyses and if measures of cortisol secretion and stress were standardized for each day of assessment.

Fourth, although our study operationalized optimism on a continum from high pessimism to high optimism (Scheier & Carver, 1985), some research has analyzed the subscales of optimism and pessimism separately (Marshall, Wortman, Kusulas et al., 1992). To address this issue empricially, we performed separate follow-up analyses of the subscales of optimism and pessimism (see Tables 15 and 16 in Appendix M). The analyses showed that except for afternoon/evening levels of cortisol, all significant effects of dispositional optimism reported in this manuscript remained significant if the optimism and pessimism items of the LOT were analyzed separately. Nonetheless, the analyses also documented a trend in that the effects of optimism on the within-person associations of stress perceptions and cortisol secretion were somewhat stronger than the effects of pessimism. Thus, future research may examine whether the presence of optimism or the absence of pessimism can affect cortisol functioning among individuals who perceive high levels of stress.

Finally, the study's results may reveal a novel pathway through which dispositional optimism could protect individuals' immune function and physical health (Rasmussen et al.,

2009; Segerstrom et al., 1998). In particular, an accumulation of cortisol volume across circumstances that involve higher-than-normal perceptions of stress could compromise pessimists' immune function and increase their susceptibility for developing physical illness. However, given that cortisol can also serve adaptive anti-inflammatory function, it may require repeated exposure to elevated cortisol over a sustained period of time to render immune cells partially resistant to glucocorticoid inhibition and trigger mild, chronic inflammation (Segerstrom & Miller, 2004). In addition, we note that there could also be health-related consequences of increased levels of CAR among pessimists who generally perceive high levels of stress. We therefore suggest that future studies should examine whether effects of optimism on cortisol regulation can mediate subsequent biological and health-related outcomes. Research along these lines may uncover psychological factors that ameliorate the effects of psychological stress on biological and physical health problems.

CHAPTER 3:

Study 2

Do the emotional benefits of optimism vary across older adulthood?

A life-span perspective

Note: Copy edited version of this study was published in the *Journal of Personality,* March 2016

Abstract

Objective. This study examined whether the emotional benefits of dispositional optimism for managing stressful encounters decrease across older adulthood. Such an effect might emerge because age-related declines in opportunities for overcoming stressors could reduce the effectiveness of optimism. **Method**. This hypothesis was tested in a six-year longitudinal study of 171 community-dwelling older adults (age range = 64 to 90 years). **Results**. Hierarchical linear models showed that dispositional optimism protected relatively young participants from exhibiting elevations in depressive symptoms over time, but that these benefits became increasingly reduced among their older counterparts. Moreover, the findings showed that an age-related association between optimism and depressive symptoms was observed particularly during periods of enhanced, as compared to reduced, stress. **Conclusions**. These results suggest that dispositional optimism protects emotional well-being during the early phases of older adulthood, but that its effects are reduced in advanced old age.

Introduction

A large body of research suggests that optimists fare better in life than pessimists (Carver, Scheier, & Segerstrom, 2010; Mens, Scheier, & Carver, 2016).[8] Dispositional optimism is defined as individuals' generalized expectations about the extent to which positive versus negative events will occur in a person's future across life domains (Scheier & Carver, 1985). This definition makes it different from other forms of expectations that target, for example, individuals' future behaviors (e.g., self-efficacy, Bandura, 1997) or optimistic patterns of attributions (Seligman, 1991).

Theoretical accounts of why dispositional optimism benefits a person's quality of life stem from a tradition of expectancy-value models of motivation (Atkinson, 1964; Feather, 1982). Because optimists generally expect positive future outcomes, they continue to exert effort if they confront an important problem. Pessimists, by contrast, are generally more doubtful about their future and likely to withdraw effort from goal-related problems (Carver & Scheier, 1998; Scheier & Carver, 1985). Research supports this assumption by demonstrating particularly strong effects of dispositional optimism on problem-focused coping, which reflects approaching stressors head on (for a meta-analysis, see Nes & Segerstrom, 2006). In addition, optimists tend to engage more frequently in effective emotion-focused coping than pessimists (e.g., benefit finding, Helgeson et al., 2006), although the latter effect appears to be less pronounced than the former. Further, these divergent coping responses can mediate emotional outcomes, indicating that optimists are more likely than pessimists to prevent emotional problems because they strive towards overcoming stressors and regulate emotions more effectively (for reviews, see Mens et al., 2016; Rasmussen et

[8] We use the terms optimists versus pessimists for the purpose of communication of ideas and results, referring to individual differences in a bipolar and continuous distribution that ranges from high optimism to high pessimism (Scheier, Carver, & Bridges, 1994).

al. 2006; Wrosch & Scheier, 2003).

It is less known, however, whether the benefits of optimism could vary across different life circumstances. This possibility has been raised in a recent discussion of whether the adaptive value of dispositional optimism could, at times, be reduced (Carver & Scheier, 2014). In addition, this idea is consistent with life-span developmental theories, postulating that the effectiveness of self-regulation factors depends on an age-related configuration of opportunities and constraints for successful development. This line of work has documented that an age-related increase in the experience of uncontrollable stressors can constrain individuals' opportunities for overcoming problems and jeopardize their emotional well-being (Baltes & Baltes, 1990; Heckhausen et al., 2010).

Consistent with this argument, research has shown that, unlike adulthood and early old age, advanced old age in particular can be characterized by an enhanced susceptibility to chronic and irreversible problems, a reduction of personal resources, and associated increases in emotional problems (Baltes & Smith, 2003; Smith et al., 2002; Sutin et al., 2013). These age-related changes may require individuals to adjust their self-regulation processes to the controllability of problems. More specifically, life-span developmental research has demonstrated that strategies aimed at goal attainment facilitate emotional well-being particularly at younger ages when many individuals encounter favorable opportunities for overcoming stressors (e.g., persistence, Wrosch, Heckhausen, & Lachman, 2000). However, if such opportunities are absent or sharply reduced, as it is often the case during older adulthood, associations between goal striving and emotional well-being become considerably reduced (for a review, see Heckhausen et al., 2010).

The previous discussion makes it likely that the emotional consequences of dispositional optimism could also vary as a function of age, and that older adulthood may represent a sensitive period during which such differences evolve. To the extent that the benefits of optimism derive

from the tendency on the part of optimists to engage in persistent goal pursuits when stressors are encountered, differences in the ensuing emotional consequences experienced by optimists and pessimists could decrease in advanced old age. This may be the case because some of the benefits of optimism are reduced as occurring stressors become generally less controllable during the later phases of older adulthood. In the earlier phases of old age, by contrast, stressors are generally more likely to involve problems that can be resolved through persistent goal pursuits, and dispositional optimism should buffer stress-related increases in emotional problems. Note that such age differences in the adaptive value of optimism could become pronounced during particularly stressful periods, given that the influence of personal resources on emotional outcomes is paramount in such circumstances (Heckhausen & Wrosch, 2016; Lazarus & Folkman, 1984).

Empirical research examining the theoretical proposition of age effects of dispositional optimism, however, is scarce. One of the few cross-sectional studies shows that optimism buffered the association between stress perceptions and reduced life satisfaction among young, but not older, adults (Chang, 2002), while another cross-sectional study did not find age effects of dispositional optimism on life satisfaction or depressive symptoms if comparing young, middle-aged, and older adults (Isaacowitz, 2005). Moreover, longitudinal research documents that low pessimism predicted reduced mortality among relatively young adults who had a cancer, but was unrelated to mortality among their older counterparts (Schulz et al., 1996). Although this research suggests that some of the benefits of optimism could become smaller as a function of age, it is noteworthy that most of these studies did not examine emotional outcomes or, more importantly, whether such a process could evolve during older adulthood.

Here, we address this research question by examining changes in older adults' depressive symptoms as a function of age, dispositional optimism, and perceived stress. We hypothesized that among individuals in early old age, optimists (but not pessimists) would be protected from

experiencing increases in depressive symptoms over time. This beneficial effect of optimism, however, was expected to be smaller among their older counterparts. Moreover, we hypothesized that age effects of optimism would vary as a function of the level of stress experienced over time. To this end, we compared within-person assessments of depressive symptoms during times at which participants perceived higher versus lower levels of perceived stress. We expected that differences in an age-related association between dispositional optimism and depressive symptoms would be observed particularly in periods when older adults perceive higher (as compared to lower) levels of stress.

Method

Participants

Participants of this study were recruited from the community through newspaper advertisements targeted to older adults from Montreal (Montreal Aging and Health Study [MAHS]; Wrosch et al., 2007).[9] A normative sample of older adults was obtained by enrolling individuals who were older than 60 years (see Appendix A for consent form). At baseline (T1), a total of 215 participants were either visited in their homes or invited to the laboratory. At each follow-up wave, they responded to a self-report questionnaire as well as to a daily questionnaire over three non-consecutive days. Subsequent waves of the MAHS were conducted approximately two years (T2: M = 1.88, SD = 0.08, *range* = 1.72 to 2.13 years; n = 184), four years (T3: M = 3.78, SD = 0.23, *range* = 3.28 to 4.77 years; n = 164), and six years after baseline (T4: M = 6.05, SD = 0.18, *range* = 5.51 to 6.39 years; n = 137). Because we were interested in predicting changes in depressive symptoms, participants who did not provide data on the outcome variable in at least two waves of the study (n

[9] Data previously published from the MAHS have not examined (age-differential) effects of optimism on depressive symptoms (e.g., Jobin et al., 2014).

= 25) were excluded from the analyses. In addition, we excluded participants who were deceased (n = 19) because it is not common practice to estimate long-term trajectories of psychological constructs among deceased individuals. After the exclusion of these participants, the analytic sample consisted of 171 participants.[10] At baseline, excluded participants were older (t = 2.07, p = .04) and reported slightly higher levels of stress (t = 2.02, p = .05) than those who remained in the study. However, excluded participants did not differ from other subjects on any of the other baseline measures used in this study or the earliest measure of dispositional optimism (i.e., 2-year follow-up; |ts| < 1.35, ps > .18). The analytic sample exhibited demographic characteristics that are within the normative range of community-dwelling older adults (National Advisory Council on Aging, 2006). At baseline, participants were on average approximately 72 years old, 52% were female, 35% received a university education, and 40% had an income of more than $34,000 (see also Table 2).

Materials

The descriptive statistics for, and zero-order correlations among, the main study variables are reported in Table 2 and Table 3.

[10] Please note that our analyses involving optimism and age would have obtained the same significant effects, if deceased participants or only those who participated in at least 3 of the 4 waves were included into the analyses.

Table 2

Means, Standard Deviations, Frequencies, and Range for Variables in Study 2 (N = 171)

Constructs	*Mean* (*SD*) or *Percentage*	*Range*
Depressive Symptoms		
T1	5.81 (4.21)	0-18.00
T2	6.44 (5.20)	0-23.00
T3	7.10 (5.73)	0-28.00
T4	7.15 (5.27)	0-26.25
Perceived stress		
T1	1.75 (2.49)	0-11.00
T2	2.80 (3.51)	0-14.00
T3	2.80 (3.68)	0-19.00
T4	2.38 (2.89)	0-12.00
Dispositional optimism (*M*[T2, T3, T4])	16.46 (3.45)	7.67-24.00
Age (T1)	71.94 (5.54)	64-90
Female (%)	51.46%	
Education (%)		
None	3.70%	
High school	30.25%	
College/trade	31.48%	
Bachelor	24.07%	
Masters/PhD	10.49%	
Income		
Less than $17,000	22.78%	
$17,001 – $34,000	36.71%	
$34,001 – $51,000	20.25%	
$51,001 – $68,000	12.66%	
> $68,000	7.59%	
Subjective social status	6.11 (1.82)	0-10.00

Depressive symptoms were assessed in each wave, using the 10-item Center for Epidemiological Studies Depression Scale (Andresen et al., 1994; see Appendix G), which includes items assessing negative emotional states (e.g., "I felt depressed") and positive emotional states (e.g., "I was happy"). Participants were asked to indicate how often each statement applied to them during the past week on a 4-point Likert-type scale, (0= *rarely or none of the time* to 3 = *most or almost all of the time*). Sum scores of the 10 items were computed for each assessment, after reverse coding of the positively formulated items. Measures of depressive symptoms demonstrated appropriate internal consistency (αs = .70 to .83), were positively correlated across waves (*r*s = .56 to .66, *p*s < .01), and increased across assessments (ANOVA: $F = 4.92$, $p < .01$).

Perceived stress was assessed on three non-consecutive typical days at each of the four waves over a period of six years. Because we were interested in measuring age-normative stress experiences, we attempted to eliminate the influence of any unusual specific stressor by spacing out the assessment days and by asking participants to skip untypical days. At the end of each assessment day, participants were asked to rate how 1) *stressed* and 2) *overwhelmed* they felt during the day, using 5-point Likert-type scales (0 = *very slightly or not at all* to 4 = *extremely*; see Appendix F). Sum scores were computed across days to obtain a measure of perceived stress at each wave (αs = .75 to .84).Stress perceptions were positively correlated within waves (*r*s = .42 to .64, *p*s < .01), and across waves (*r*s = .25 to .44, *p*s < .01), and exhibited an increase across assessments (ANOVA: $F = 3.02$, $p = .03$).

Dispositional optimism was assessed at T2, T3, and T4, using the 6-item Life Orientation Test-Revised (Scheier, Carver, & Bridges, 1994; see Appendix D). This measure of dispositional optimism has generally been used as a bipolar construct, incorporating both optimistic and pessimistic outcome expectancies (but see Kubzansky et al., 2004; Marshall et al., 1992; Mroczek et al., 1993). Participants were asked to indicate their agreement with each of the six items, using 5-

point Likert-type scales (0 = *strongly disagree,* to 4 = *strongly agree*). The scale includes three positively formulated items (e.g., *I am always optimistic about my future*) and three negatively formulated items (e.g., *If something can go wrong for me, it will*). For each wave, the sum of the six items was computed to obtain a total optimism score, after the negatively formulated items were reverse coded. Measures of optimism demonstrated appropriate internal consistency (αs = .74 to .79), were correlated across waves (rs = .70 to .75, ps < .01), and did not linearly change across assessments (ANOVA: F = .64, p = .53). The optimism scores were averaged across waves to obtain the most reliable measure of dispositional optimism.

Table 3

Zero-Order Correlations of Main Study Variables for Study 2 (N = 171)

	1	2	3	4	5	6	7	8	9	10	11
1. Depressive symptoms $_{T1}$											
2. Depressive symptoms $_{T2}$	.59**										
3. Depressive symptoms $_{T3}$	.64**	.66**									
4. Depressive symptoms $_{T4}$	.56**	.65**	.58**								
5. Perceived stress $_{T1}$	.33**	.26**	.36**	.35**							
6. Perceived stress $_{T2}$	.12	.29**	.25**	.30**	.25**						
7. Perceived stress $_{T3}$	.37**	.41**	.61**	.37**	.36**	.32**					
8. Perceived stress $_{T4}$	.33**	.29**	.35**	.47**	.29**	.44**	.41**				
9. Dispositional optimism	-.58**	-.50**	-.53**	-.47**	-.25**	-.15	-.38**	-.29**			
10. Age	.02	.11	-.03	.10	-.09	-.04	-.05	.06	.04		
11. Socioeconomic Status	-.38**	-.25**	-.17*	-.22*	-.07	-.03	-.07	-.03	.27**	-.07	
12. Sex [a]	.13	.06	.08	.11	.05	.10	.11	.11	-.05	.02	-.15*

Note. [a] Higher values represent female participants.

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

Sociodemographic variables were included in the study either as predictors or covariates (see Appendix B). Age and sex were measured at baseline through self-report. Socioeconomic status (SES) was assessed at baseline using three variables; highest education completed, yearly family income, and perceived social status (Adler et al., 2000). All three SES measures were standardized and subsequently averaged to obtain a reliable indicator of SES (rs = .37 to .55, ps < .01; α = .70).

Data Analysis

We tested the study's hypotheses by performing two sets of hierarchical linear models, using HLM 7.0.[11] The first set examined the effects of optimism and age on longitudinal changes in depressive symptoms. This analysis predicted in a Level-1 model participants' depressive symptoms across waves by person-centered scores of years since study entry, an intercept, and a residual term. The intercept represented averaged levels of depressive symptoms across waves, and the slope referred to the amount of yearly change in depressive symptoms over six years of study. The subsequently conducted Level-2 model predicted the intercept and slope coefficients obtained in the Level-1 model by between-person differences in dispositional optimism, age, and the covariates (sex and SES). In a second step of the Level-2 model, we tested whether the additional inclusion of the interaction term involving dispositional optimism and age would significantly predict the intercept and slope coefficients of participant's depressive symptoms.

A second set of hierarchical linear models was conducted to examine whether age-related associations between dispositional optimism and depressive symptoms would be particularly strong

[11] Level-1 missing data were addressed in the HLM analyses (depression = 57 of 684; stress = 79 of 684), which calculated intercepts and slopes for each individual based on the number of available data points. There were no missing data for Level-2 variables.

during periods when individuals perceive enhanced levels of stress. In this analysis, the Level-1 model estimated variability in depressive symptoms across assessments by person-centered scores of perceived stress, an intercept, and a residual term. The model's intercept represented average levels of depressive symptoms across waves, and its slope indicated the extent to which deviations from a person's average level of perceived stress would be associated with changes in depressive symptoms across waves. We did not include years since study entry into the Level-1 model since perceptions of stress can be expected to increase over time, and controlling for time would thus attenuate some of the higher stress levels observed in the later waves of the study (but we address this possibility in supplemental analyses, reported in Footnote 12). The subsequently conducted Level-2 model estimated the intercept and slope coefficients obtained in the Level-1 model by between-person differences in dispositional optimism, age, and the covariates. In a final step, we tested whether the additional inclusion of the interaction between dispositional optimism and age would significantly predict the obtained intercept and slope coefficients. Level-2 predictors were standardized prior to the analyses, and the reported results are based on using restricted maximum likelihood estimation and robust standard errors.

Results

Longitudinal Changes in Depressive Symptoms

The results of the analysis examining the effects of optimism and age on longitudinal changes in depressive symptoms are reported in Table 4. The Level-1 model showed a significant effect for the intercept of depressive symptoms, indicating that participants' average levels of depressive symptoms were significantly different from zero. In addition, the Level-1 model demonstrated a significant slope effect for depressive symptoms, suggesting that levels of depressive symptoms linearly increased over time. Finally, the Level-1 model showed considerable variability in the intercept, $\chi 2 = 1146.08$, $p < .01$, and slope, $\chi 2 = 175.70$, $p = .37$, coefficients of participants' depressive symptoms, indicating the possible presence of individual differences in these estimates.

The subsequently conducted Level-2 models predicted variability in participants' average levels (i.e., intercepts) and longitudinal changes (i.e., slopes) in depressive symptoms by interindividual differences in dispositional optimism, age, and the covariates (sex and SES). The results of the Level-2 main effects showed that only dipositional optimism (but not age, sex, or SES) predicted the intercept (i.e., average levels) of depressive symptoms. Optimists reported lower levels of depressive symptoms than pessimists across the entire study period (see intercept values in Table 4). In addition, optimism, age, and sex did not exert significant effects on changes in depressive symptoms. However, SES positively predicted longitudinal changes in depressive symptoms, indicating that participants who had a higher SES experienced a steeper increase in depressive symptoms than their lower SES counterparts (see slope values in Table 4). In the final step, the inclusion of the interaction term between optimism and age showed that this interaction did not significantly predict average levels of depressive symptoms (see intercept values in Table 4), but (consistent with arguments presented in the introduction) was significantly associated with

Table 4

Results from HLM Analyses Examining Longitudinal Changes in Depressive Symptoms as a Function of Dispositional Optimism and Age (N = 171)

	Depressive Symptoms			
	Average level (Intercept)		Yearly change (Slope)	
	Coefficient (SE)	*T-Ratio*	*Coefficient (SE)*	*T-Ratio*
Level-1	6.60 (.33)	20.19**	.25 (.06)	4.27**
Level-2 main effects				
Sex [a]	.23 (.26)	.90	-.02 (.06)	-.40
Socioeconomic status	-.48 (.29)	-1.64	.14 (.06)	2.22*
Age	.25 (.26)	.96	.03 (.06)	.48
Dispositional optimism	-2.48 (.25)	-9.98**	-.08 (.07)	-1.17
Level-2 interaction effect				
Age X dispositional optimism	.40 (.27)	1.44	.16 (.07)	2.34*

Note. [a] Higher values represent female participants. The Level-1 model had 170 *dfs* and the Level-2 model had 165 *df*s.

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

changes in depressive symptoms (see slope values in Table 4). Above and beyond the main effects, the interaction effect explained 12.64% of additional variance in longitudinal changes of depressive symptoms (Kreft & De Leeuw, 1998).

To interpret the significant interaction effect, we plotted in Figure 4 the associations between optimism and 6-year changes in depressive symptoms separately for younger-old (left panel) and older-old participants (right panel). These associations were illustrated by using the averaged upper and lower quartiles of the continuous distributions of baseline age (lower quartile = 65.74 years; upper quartile = 80.30 years) and the averaged scores of dispositional optimism across waves (lower quartile = 11.73; upper quartile = 20.77) as reference points (Preacher, Curran, & Bauer, 2006). Simple slope analyses showed that among younger-old participants, optimists maintained relatively low and stable levels of depressive symptoms over time, $\beta = -.05$, $SE = .12$, $p = .67$, while pessimists' levels of depressive symptoms increased over time, $\beta = .50$, $SE = .17$, $p < .01$. Among older-old participants, by contrast, optimists' low baseline levels of depressive symptoms increased significantly over time, $\beta = .55$, $SE = .17$, $p < .01$, while pessimists' maintained relatively high and stable levels of depressive symptoms, $\beta = -.01$, $SE = .24$, $p = .98$.

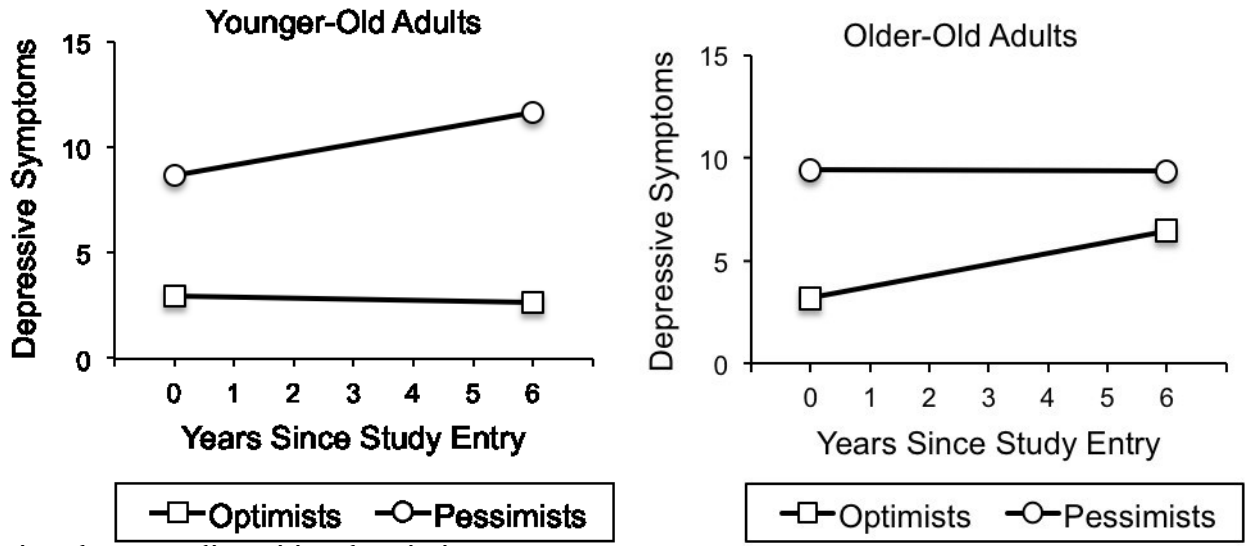


Figure 4. Associations between dispositional optimism and change in depressive symptoms over 6 years separately for younger-old adults (left panel) and older-old adults (right panel). Associations were plotted for the averaged upper and lower quartiles of the continuous predictor variables

Effects of Perceived Stress on Depressive Symptoms

The results of the analysis examining whether age effects of optimism on depression would occur particularly when older adults experience periods of enhanced (as compared to reduced) stress are reported in Table 5. Identical to the first set of analyses, the Level-1 model showed that average levels of depressive symptoms were significantly different from zero (see intercept values in Table 5). In addition, it documented a significant effect of within-person changes in perceived stress on depressive symptoms (see slope values in Table 5). Participants reported higher levels of depressive symptoms in waves in which they experienced higher, as compared with lower, levels of stress. Note that there was also considerable variability in the average levels of depressive symptoms, $\chi 2 = 1247.03$, $p < .01$, and in the within-person associations between perceived stress and depressive symptomatology, $\chi 2 = 191.94$, $p < .01$.

The subsequent Level-2 model attempted to explain variability in within-person associations between perceived stress and depressive symptoms by individual differences in age, dispositional optimism, and the covariates. The pattern of findings for average levels of depressive symptoms (i.e., intercept) was highly similar to the first set of analyses, suggesting that dispositional optimism (but not age, sex, or SES) was significantly associated with lower average levels of depressive symptoms across waves (see intercept values in Table 5). In addition, the Level-2 model showed that optimism, age, sex, and SES did not exert significant main effects on the within-person associations of perceived stress and depressive symptoms (see slope values in Table 5).

Table 5

Results from HLM Analyses Examining Within-Person Associations Between Perceived Stress and Depressive Symptoms as a Function of Dispositional Optimism and Age (N = 171)

	Depressive symptoms			
	Average levels (Intercept)		Effect of perceived stress (Slope)	
	Coefficient (SE)	*T-Ratio*	*Coefficient (SE)*	*T-Ratio*
Level-1	6.53 (.33)	20.03**	.26 (.07)	3.71**
Level-2 main effects				
Sex [a]	.22 (.26)	.85	.07 (.07)	.97
Socioeconomic status	-.51 (.29)	-1.78	-.01 (.08)	-.13
Age	.17 (.26)	.66	-.04 (.07)	-.60
Dispositional optimism	-2.46 (.25)	-10.00**	.04 (.06)	.71
Level-2 interaction effect				
Age X dispositional optimism	.35 (.26)	1.35	.15 (.05)	2.89**

Note. [a] Higher values represent female participants. The Level-1 model had 170 *df*s and the Level-2 model had 165 *df*s.

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

In the final step of the Level-2 model, the additional inclusion of the interaction term between age and optimism indicated that this interaction did not significantly predict average levels of depressive symptoms (see intercept values in Table 5). However, as suggested, a significant interaction effect between age and optimism in predicting the within-person associations between perceived stress and depressive symptoms was obtained (see slope values in Table 5). Above and beyond the main effects, the interaction explained 7.15% of additional variance in the association between intra-individual stress levels and depressive symptoms (Kreft & De Leeuw, 1998).[12]

To illustrate the significant interaction effect, we plotted in Figure 5 the within-person associations between perceived stress and depressive symptoms for optimistic and pessimistic younger-old participants (left panel) and for optimistic and pessimistic older-old participants (right panel). As in the first set of analyses, averaged upper and lower quartiles of the predictor variables were used as reference points. Simple slope analyses showed that among younger-old participants, optimists' levels of depressive symptoms remained low and stable, independent of within-person variation in perceived stress, $\beta = .17$, $SE = .14$, $p = .24$, while pessimists' levels of depressive symptoms were significantly enhanced in periods of high, as compared to low, stress, $\beta = .37$, $SE = .13$, $p < .01$. Among older-old participants, by contrast, optimists experienced significantly higher levels of depressive symptoms in periods of enhanced, as compared to reduced, stress, $\beta = .58$,

[12] We also conducted a supplemental analysis, which controlled the observed longitudinal changes in depressive symptoms for within-person variation in perceived stress. This analysis documented that the interaction effect between optimism and age on longitudinal changes in depressive symptoms was rendered non-significant, $t = 1.42$, $p = .16$, while the same interaction effect on the within-person association between stress perceptions and depressive symptoms remained significant, $t = 2.52$, $p = .01$.

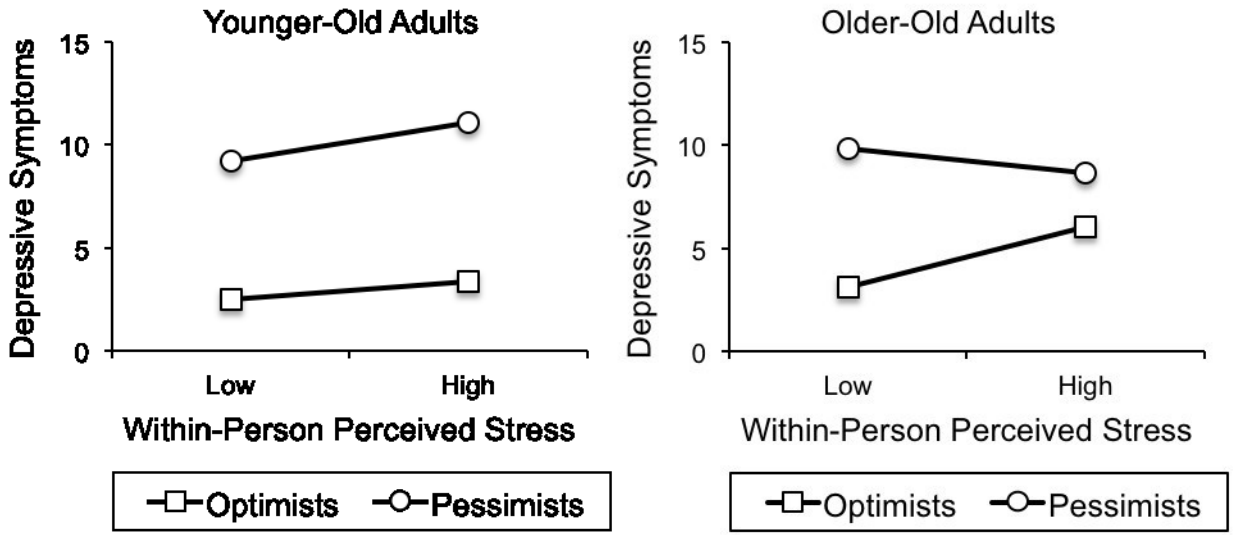


Figure 5. Within-Person associations between perceived stress and depressive symptoms separately for younger-old adults (left panel) and older-old adults (right panel). Associations were plotted for the averaged upper and lower quartiles of the continuous predictor variables.

SE = .15, $p < .01$, while pessimists maintained high and relatively stable levels of depressive symptoms, independent of within-person variation in perceived stress, β = -.23, *SE* = .20, $p = .24$.

Discussion

This study showed in a sample of community-dwelling older adults that the emotional benefits of dispositional optimism can vary as a function of age. While optimism buffered longitudinal increases in depressive symptoms in early old age, these beneficial consequences of optimism were reduced in advanced older adulthood. This pattern of findings supports our hypothesis that an age-related configuration of opportunities and constraints for overcoming stressors and attaining personal goals (Baltes & Baltes, 1990; Heckhausen et al., 2010) could determine the adaptive value of dispositional optimism. During the earlier phases of older adulthood, when individuals typically confront stressors that can be overcome through active goal pursuits (Baltes & Smith, 2003), optimists may be more likely than pessimists to resolve their problems and prevent the experience of depressive symptoms. In the later phases of old age, however, when many individuals experience a larger number of uncontrollable stressors, even optimists may may have difficulties overcoming the problems they face and experience an increase in depressive symptoms as a result. Note that pessimists' levels of depressive symptoms did not further increase in advanced old age, which could imply that their emotional distress had already reached a ceiling. Alternatively, pessimists' emotional well-being may have been protected in advanced old age by their observation that most age peers also fail in overcoming problems (cf. Festinger, 1954).

The study's results further documented that intra-individual variability in levels of perceived stress play a role in the age-related functions of dispositional optimism. Here, optimism buffered the association between enhanced stress and depressive symptoms in early old age, but this effect was reduced in advanced old age. These findings suggest that age effects of optimism on older adults'

depressive symptoms become apparent particularly during periods of enhanced stress.

In addition, the findings indicate that within-person increases in perceived stress could explain the observed age effects of older adults' optimism on longitudinal increases in depressive symptoms. We suggest that such a process could take place if the age-related associations between optimism and depressive symptoms, obtained under conditions of higher-than-average stress, occurred to a larger extent in the later waves of our study. This may be the case because older adults can be expected to experience an increase of age-related stressors over time (Baltes & Baltes, 1990; Heckhausen et al., 2010).

Consistent with this possibility, the reported data showed that levels of stress increased after baseline (see Method Section). Moreover, our supplemental analyses support this conclusion by showing that the interaction effect between optimism and age on longitudinal changes in depressive symptoms was rendered non-significant if the analysis controlled for within-person differences in perceived stress. By constrast, the same interaction effect on the within-person association between stress perceptions and depressive symptoms remained significant if the analysis controlled for time in study (see Footnote 12). These results suggest that longitudinal changes in older adults' depressive symptoms may have been shaped, over time, by within-person increases in perceived stress.

Note that the effect sizes of the obtained associations were substantial. The observed interaction effects between age and optimism explained 12.64% of the variability in longitudinal changes in depressive symptoms, and 7.50% of the variability in the associations between perceived stress and depressive symptoms. Put differently, over 6 years of study, young-old pessimists' and older-old optimists' levels of depressive symptoms increased between .72 and .78 standard deviations, respectively (using the *SD* of baseline depression scores as a reference). In a similar vein, young-old pessimists' and older-old optimists' levels of depressive symptoms increased as a

function of variation in perceived stress between .43 and .70 standard deviations, respectively. Of note, levels of depressive symptoms among pessimists in early old age reached the clinical cut-off for mild depression (CES-D10 ≥ 10; Andresen et al., 1994) after 6 years of study as well as in the context of high stress perceptions (see Figure 4 and Figure 5).

Finally, we note that the reported findings were statistically independent of socio-demographic variation in sex and socioeconomic status (SES). It is noteworthy, however, that an independent, significant effect of SES was found on changes in depressive symptoms over time, indicating that participants with a *higher* SES experienced a steeper increase in depressive symptoms over time than their lower SES counterparts. To explain this counterintuitive finding, it is important to recognize that SES was associated with lower levels of depressive symptoms across all study waves (see Table 3). Thus, the emotional advantage that high SES individuals held at baseline over their lower SES counterparts became smaller during the study period. This pattern is conceptually similar to the results found for dispositional optimism, in that in both cases the benefits of a positive personal resource became less impactful over time. Perhaps personal resources, such as education and income, also render less effective as older adults advance in age; a possibility that should be addressed more comprehensively in future research.

Overall, the reported research contributes to the literature on dispositional optimism. Although optimism is widely considered an adaptive personality trait, recent work has discussed the possibility that the adaptive value of optimism may be reduced, and possibly reversed, in certain contexts (Carver & Scheier, 2014). Our theoretical rationale did not expect pessimistic (relative to optimistic) outcome expectancies to become more adaptive at any point in a person's life since the vast majority of studies did not reported benefits deriving from dispositional pessimism (Carver & Scheier, 2014).

In support of this assumption, the reported study showed that while the gap between the

levels of depressive symptoms among optimists and pessimists became smaller as a function of age, even in advanced old age, optimists still had an emotional advantage over their pessimistic counterparts. This pattern may have emerged because optimists, as compared to pessimists, do not only use problem-focused coping more frequently, but also tend to engage more often in effective emotion-focused coping (irrespective of the controllability of life circumstances, Scheier et al., 1986). As such, the benefits deriving from emotion-focused coping could have partially compensated for losses in the effectiveness of problem-focused strategies among older-old optimists, enabling them to maintain an emotional advantage. Thus, dispositional optimism may not reverse its function entirely and may not become maladaptive. Instead, the benefits of optimism might vary depending on an individual's developmental context. In life circumstances for which an optimist's propensity for effective problem-focused coping is paramount, optimism should have a robust association with emotional well-being. By contrast, if individuals confront life circumstances for which the behavioral consequences of optimism are less effective, the emotional benefits deriving from those concomitants of optimism may also be reduced.

This study further advances theory and research on successful aging. During the past decade, evidence for substantial declines across different aspects of psychological functioning has accumulated in samples including older-old adults (Baird et al., 2010; Gerstorf et al., 2010; Sutin et al., 2013). To this end, our study demonstrates that as individuals enter advanced old age, enhanced emotional distress can be related to reductions in the effectiveness of intrapersonal resources, such as dispositional optimism. Note, however, that our analysis used age as a proxy to operationalize declines in individuals' opportunities for overcoming goal-related problems (Heckhausen et al., 2010). The underlying factors driving these age effects, however, likely relate to a loss of specific resources (e.g., reduction of energy, health problems, or death of a spouse), which different individuals encounter at somewhat different ages. In addition, opportunity structures for goal

pursuits undergo historical changes as cultures develop new means for supporting successful aging (Baltes, 1997). Thus, the specific ages at which the adaptive value of dispositional optimism becomes reduced in older adulthood may vary across individuals and are likely to change as a function of historical time.

Finally, the reported results may broaden extant life-span theories of motivation, which have proposed that successful development requires individuals to adjust their goal-specific processes to age-related declines in the controllability of life circumstances (Heckhausen et al., 2010). In this regard, our findings may facilitate an integration of theories on the role of personality dimensions and goal-specific processes. Considering that dispositional optimism reliably predicts persistent goal pursuits, it is likely to represent an underlying factor that influences individuals' specific responses to threatened goals and through this process could trigger age-related changes in emotional well-being (Heckhausen & Wrosch, 2016).

Limitations and Future Directions

There are limitations of the present research. First, the study's results are based on a relatively small longitudinal sample of older adults. This methodology limits the generalizability of findings and prevents us from drawing causal conclusions. Second, our study did not measure the specific coping tactics that could mediate the observed age effects of dispositional optimism on depressive symptoms (e.g., problem and emotion-focused coping, Carver Scheier, & Weintraub, 1989). Third, we acknowledge that our measure of perceived stress was quite brief and did not tap into the type and nature of stress that individuals experience. Fourth, our analyses did not examine the specific factors that could determine opportunity declines in overcoming goal-related stressors (e.g., onset of health problems or loss of a spouse). This limitation prevents us from excluding the possibility that some participants may have experienced problems with overcoming goal-related stressors earlier than others, which could provide an alternative explanation for the observed

increases in depressive symptoms among young-old pessimists and older-old optimists. Finally, this study did not examine whether age effects of optimism could further contribute to older adults' health-related problems, which represents a plausible possibility given the adverse effects of depressive symptomatology on mortality (Schulz et al., 2000).

Future research should address these limitations by conducting long-term longitudinal studies in large representative samples. Such research should assess a wide array of psychological resources (e.g., SES, control beliefs, coping, and other traits) and measure specific life events (e.g., death of spouse or onset of severe health problems). Finally, health-related outcomes (e.g., immune function and clinical disease) should be included with more psychological outcomes to illuminate the psychological mechanisms that result in pathways to successful development.

CHAPTER 4:

Study 3

Goal disengagement capacities and susceptibility to disease across older adulthood: The sample case of the common cold

Note: Copy edited version of this study was published in the *International Journal of Behavioral Development,* March 2016

Abstract

Objectives. This study examined age-related associations between goal disengagement capacities, emotional distress, and susceptibility to disease across older adulthood. Given that an age-related increase in the experience of stressors might render important goals unattainable, we expected that goal disengagement capacities would reduce susceptibility to disease (i.e., the common cold) by preventing emotional distress (i.e., depressive symptoms), particularly so among individuals in advanced (as compared to early) old age. **Methods.** This hypothesis was tested in a 6-year longitudinal study of 131 older adults (age range = 64 to 90). **Results.** Regression analyses showed that goal disengagement capacities buffered 6-year increases in older adults' cold symptoms, and that this effect was significantly pronounced among older-old participants. Mediation analyses further indicated that changes in depressive symptoms exerted an indirect effect on the age-related association between goal disengagement and changes in cold symptoms. **Conclusions.** The study's findings suggest that goal disengagement capacities become increasingly important for protecting emotional well-being and physical health as older adults advance in age.

Introduction

Across older adulthood many individuals experience a sharp decline in different areas of function, leaving in particular older-old adults susceptible to the development of disease (Baltes & Smith, 2003). Such physical health problems may occur, in part, because as older adults advance in age, they face an increasing number of age-related stressors that can render important goals unattainable and trigger health-compromising emotional distress (Cohen et al., 2007; Wrosch et al., 2006). A psychological construct that could protect older adults' physical health in the context of stress and unattainable goals relates to individual differences in goal disengagement capacities (Wrosch, Scheier, & Miller, 2013). However, little is known about potential changes in the adaptive value of these self-regulation capacities across older adulthood. Here, we address this possibility by examining age effects of goal disengagement capacities on susceptibility to disease (by predicting the common cold) and emotional distress (by predicting depressive symptoms) in a sample of elderly individuals. Considering that stressors and goal constraints typically increase across older adulthood, we hypothesized that goal disengagement capacities would buffer against increases in cold symptoms particularly among individuals in advanced, as compared to early, old age. In addition, we expected that this age effect of goal disengagement capacities could be mediated by depressive symptomatology.

Age-Related Stressors and Susceptibility to Disease Across Older Adulthood

Older adulthood often consists an accumulation of uncontrollable and at times inevitable challenges across different domains of life (e.g., functional limitations, loss of social roles, or bereavement; Baltes & Smith, 2003; Heckhausen, Wrosch, & Schulz, 2010). Since stress can produce a variety of negative consequences, the occurrence of age-related stressors may compromise older adults' psychological and physical health (Cohen et al., 2007). Older adults who face an increasing number of stressors may feel overwhelmed by their inability to achieve

important life goals and as a result, experience emotional distress (Wrosch et al., 2006). Stress-related emotional problems, in turn, may prompt health-compromising behaviors or disturb health-relevant biological processes (e.g., physical activity or immune function), which could increase susceptibility to infectious diseases (e.g., the common cold; Cohen et al., 2007). This process could play a further role in the development of other age-related conditions (e.g., Alzheimer's disease, diabetes, or osteoporosis; El-Sahly et al., 2000; Graham et al., 2006).

The influence of age-related stressors on physical health may increase across older adulthood. To date, older adulthood can span more than 30 years of life (Oeppen & Vaupel, 2002) and the severity and controllability of stressors exert substantial changes across older adulthood. As compared to early old age, advanced old age is often characterized by the experience of multiple and often irreversible losses as well as increases in emotional distress (Baltes & Smith, 2003; Gerstorf et al., 2010; Smith et al., 2002; Sutin et al., 2013). In addition, older-old adults frequently experience declines in personal resources (e.g., cognitive function or social networks), which may further constrain their opportunities to overcome age-related stressors. Young-old adults, by contrast, are generally better able to adapt to age-related challenges and return to previous levels of functioning (Baltes & Smith, 2003). Thus, given that older-old adults are particularly likely to experience uncontrollable stressors and losses, they may also be at greatest risk of encountering emotional distress and susceptibility to disease (Cohen et al., 2007). This process may set in motion an adverse cascade, characterized by the occurrence of age-related stressors and subsequent psychological and physical health problems.

The Role of Goal Adjustment Capacities

Given the adverse health effects of stressors and unattainable goals, it would be important to identify factors that could protect older adults' quality of life in such circumstances. From our perspective, this function could be served by adaptive self-regulation processes that enable older

adults to maintain their well-being and health by adjusting behavior to occurring challenges and associated goal constraints (Brandtstädter, & Renner, 1990; Heckhausen et al., 2010).

Our approach is based on goal adjustment theory (Mens, Wrosch, & Scheier, in press; Wrosch et al., 2013). This theory proposes that goal adjustment capacities reflect individual difference variables that operate across different life domains and facilitate two self-regulation processes: goal disengagement and goal reengagement (Wrosch et al., 2013). *Goal disengagement capacities* correspond to an individual's tendency to withdraw behavioral efforts and psychological commitment from the pursuit of an unattainable goal. *Goal reengagement capacities* refer to the tendency to identify, commit to, and pursue other goals. The two goal adjustment capacities represent independent constructs that are only small to moderately associated with each other and exert different functions (Wrosch et al., 2013). In the context of unattainable goals, goal disengagement should prevent repeated failure and associated emotional distress. Goal reengagement, by contrast, is thought to provide new purpose in life and enhance positive emotional states. Since emotions play an important role in the development of disease (Cohen et al., 2007), both goal adjustment capacities may also be implicated in physical health.

Research suggests that goal disengagement and goal reengagement capacities can increase from adolescence to old age (Wrosch et al., 2013). These age-related improvements could enable some older adults to successfully manage the occurrence of age-related stressors. A substantial number of studies, including samples of older adults, support this assumption by demonstrating that *goal disengagement capacities* ameliorate negative emotional states (e.g., depressive symptoms), biological dysregulation (e.g., diurnal cortisol or systemic inflammation), and physical health problems (e.g., eczema or constipation; Wrosch et al., 2003, 2007, 2013). Thus, goal disengagement capacities could also reduce older adults' susceptibility to disease by buffering stress-related emotional problems, particularly in advanced old age.

The role of goal reengagement in the adjustment to stress, however, appears to be more complex. Although goal reengagement capacities are often related to improved levels of positive emotional states, they rarely prevent distress or benefit biological and physical health (Wrosch et al, 2013).[13] In addition, goal reengagement can at times adversely affect subjective well-being (e.g., caregiving, Wrosch et al., 2011). Such detrimental effects may occur when individuals stretch their resources too thin by engaging in too many goals and become unable to effectively manage pressing life demands (Wrosch et al., 2013). As a consequence of these opposing effects, it seems rather unlikely that goal reengagement capacities directly protect older adults from enhanced susceptibility to disease or underlying emotional distress.

In sum, the discussed literature suggests that in particular goal disengagement capacities could become increasingly important for protecting physical health as older adults advance in age. However, there is a paucity of age-comparative research on the adaptive value of these capacities across older adulthood. To address this gap in the literature, we examined the age-related effects of goal adjustment capacities on emotional distress and susceptibility to disease in an age-heterogeneous and longitudinal sample of older adults. As markers of emotional distress and susceptibility to disease, we assessed depressive symptoms and cold symptoms, respectively. We hypothesized that goal disengagement capacities would predict reduced levels of older adults' cold symptoms, and that this association would be pronounced among individuals in advanced (as compared to early) old age. In addition, we reasoned that the hypothesized age effect on changes in cold symptoms could be mediated by depressive symptomatology. We did not expect the same effects to occur as a function of older adults' goal reengagement capacities,

[13] Goal reengagement capacities may benefit physical health, however, if they directly trigger salubrious behaviors (e.g., exercise, Wrosch et al., 2013).

since goal reengagement has been shown to produce mixed effects in previous research (Wrosch et al., 2013). Nonetheless, we included goal reengagement capacities into our analysis to provide evidence for discriminant validity of different self-regulation capacities.

Method

Participants

This study was based on the *Montreal Aging and Health Study* (MAHS; Wrosch et al., 2007). Participants were recruited through newspaper advertisements targeted at older adults within the Montreal area (see Appendix A for Consent Form). The only inclusion requirement was that participants should be over 60 years of age to facilitate the collection of a normative sample. A total of 215 older adult participants were recruited at baseline. They were visited in their homes or invited to the laboratory and were asked to respond to a self-report questionnaire among other measures. Follow-up data for this study were obtained every two years. Here, we report analyses using baseline data and the 6-year follow-up of the MAHS (M = 6.05, SD = 0.18, *range* = 5.51 to 6.39 years; n = 137).[14] Attrition over six years of study was associated with refusal to participate further (n = 9), inability to locate participants (n =19), presence of other personal problems (n = 27), and death (n = 23). Attrition was not associated with any baseline variable, except for age. Excluded participants were significantly older at baseline (M = 73.65, SD = 6.75) than those who remained in the study (M = 71.94, SD = 5.54; t[144.79] = 2.04, p =

[14] Note that data from the MAHS have been reported in previous research, including results on goal adjustment capacities or depressive symptoms (e.g., Dunne et al., 2011). However, none of these studies examined age-effects of goal adjustment capacities across older adulthood or predicted participants' cold symptoms.

0.02). Six of the remaining 137 subjects were further excluded from the analyses because of missing data necessary to compute predictor or outcome variables. The final analytic sample consisted of 131 participants.

Materials

Cold symptoms were assessed at baseline and 6-year follow-up, using an 8-symptom checklist (e.g., *cough, runny nose, feeling under the weather*; Hamrick et al., 2002; see Appendix H). Participants reported how severely they experienced the eight cold symptoms over the past two weeks on a 5-point Likert-type scale (0 = *none* to 4 = *very severe*). A measure of cold symptoms was obtained by calculating the average symptom severity at both assessments (αs > .71). To operationalize 6-year change in cold symptoms, a regression analysis was conducted, predicting follow-up cold symptoms by baseline cold symptoms, and saving the standardized residuals for future analysis.

Depressive symptoms were assessed at baseline and follow-up, using the 10-item Center for Epidemiological Studies Depression Scale (CES–D; Andresen et al., 1994; see Appendix G). Participants were asked to rate how often each of the ten items applied to them during the previous week (e.g., *I felt depressed* or *I was bothered by things that usually don't bother me*). Responses were measured on a 4-point Likert-type scale (0 = *rarely or none of the time* to 3 = *most or almost all of the time*). Depressive symptoms were calculated by computing a sum score of the 10 items (αs > .71). A measure of 6-year changes in depressive symptoms was obtained in a regression analysis, predicting follow-up levels of depressive symptoms by baseline levels of depressive symptoms, and saving the standardized residual for future analysis.

Goal adjustment capacities were measured at baseline using the Goal Adjustment Scales (GAS, Wrosch et al., 2003; see Appendix I). This self-report questionnaire assesses general tendencies to disengage from unattainable goals and to reengage in other goals when

unattainable goals are encountered. Four items measured goal disengagement capacities (e.g., *It's easy for me to stop thinking about the goal and let it go*), and six items measured goal reengagement capacities (e.g., *I start working on other new goals to pursue*). Responses were measured on 5-point Likert-type scales, ranging from 1 = *strongly disagree*, to 5 = *strongly agree*. A principal component factor analysis confirmed that the goal disengagement (loadings = .64 to .79) and goal reengagement (loadings = .68 to .78) items loaded on two different factors, explaining 67% of the variance. Accordingly, mean scores were computed for both goal disengagement ($\alpha = .57$) and goal reengagement ($\alpha = .85$) capacities.

Sociodemographic variables were included in the study as predictors or covariates. Age and sex were measured at baseline through self-report. Socioeconomic status (SES) was assessed using three variables at baseline: highest education completed (0 = *none* to 4= *graduate degree*), yearly family income (0 = *Less than $17,000* to 4 = *More than $68,000*), and perceived social status (visual ladder with 1 being the lowest rung and 10 being the highest; Adler et al., 2000). The three SES measures were postively correlated (rs > .40, ps < .001) and their standardized scores were averaged to obtain a reliable indicator of SES (see Appendix B for socio-demographic measures). The number of chronic illnesses was measured at baseline by asking participants to report whether they had experienced any of the 17 different health problems over the past year (e.g., coronary heart disease, cancer, high blood pressure, or arthritis; see Appendix C).

Data Analyses

Results are reported in three sections. First, we conducted preliminary analyses to describe the sample (by calculating means, standard deviations, and percentages), explore longitudinal changes in cold symptoms and depressive symptoms over time (by conducting ANOVAs), and report associations between the main variables (by computing zero-order

correlations). Second, we conducted a hierarchical regression analysis, predicting changes in cold symptoms (residualized scores) by levels of goal disengagement and goal reengagement capacities, age, sex, SES, and chronic illness. In a second step, we tested the interaction terms of age and goal disengagement capacities (and goal reengagement capacities) separately for significance. Third, we examined whether depressive symptoms would mediate the age-related association between goal adjustment capacities and changes in cold symptoms by calculating indirect effects (95% BCI) in bootstrap analyses (using 5000 bootstraps; Preacher & Hayes, 2008). Since baseline levels and changes in depressive symptoms could equally qualify as potential mediators, both constructs were simultaneously included into the mediation analysis.

Results

Preliminary Analyses

Participants were on average 72 years old, approximately half of them were female, and they reported on average approximately 2 chronic health problems (see Table 6). The sample incoporated heterogeneous socioeconmic backgrounds with approximatedly 60% of participants receiving less than $34,000 in income per year, and 34% of sample obtained an undergraduate degree or higher. The perceived social status was slightly above the midrange of the scale. The socio-demographic and health characteristics for this sample were within the normative range of community-dwelling older adults (National Advisory Council on Aging, 2006).

Repeated-measurement ANOVAs showed no significant within-person effect (TIME) for participants' cold symptoms, $F(1, 130) = 2.43$, $p = .12$, indicating that levels of cold symptoms remained relatively stable in the entire sample. With respect to participants' depressive symptoms, however, a significant TIME effect was obtained, $F(1, 130) = 9.55$, $p = .002$, suggesting that levels of depressive symptoms increased over time (see Table 6).

Table 6

Means, Standard Deviations and Frequencies of measures for Study 3 (N = 131)

Constructs	Mean (SD) or Percentage [a]
Cold symptoms	
Baseline	1.34 (0.34)
6-year	1.41 (0.48)
Depressive symptoms	
Baseline	5.91 (4.31)
6-year	7.15 (5.37)
Goal disengagement capacities	3.06 (0.70)
Goal reengagement capacities	3.70 (0.60)
Age	72 (5.19)
Female (%)	54%
Chronic illness	2.19 (1.52)
Education (%)	
None	4.0%
High school	29.4%
College/trade	28.6%
Bachelor	26.2%
Masters/PhD	11.9%
Income	
Less than $17,000	23%
$17,001 – $34,000	36.9%
$34,001 – $51,000	18%
$51,001 – $68,000	15.6%
> $68,000	6.6%
Subjective social status	6.23 (1.87)

Note.[a] Mean (SD) are presented for continuous variables.

Zero-order correlations showed that baseline levels of cold and depressive symptoms were positively associated with their respective follow-up levels, indicating some stability in these variables (see Table 7). In addition, baseline and follow-up levels of depressive symptoms were correlated with lower levels of goal disengagement, goal reengagement capacities, and SES. Follow-up levels of cold symptoms were positive related to follow-up levels of depressive symptoms, and negatively associated with participants' goal disengagement capacities. Women, as compared to men, were less likely to report cold symptoms at follow-up, experienced higher baseline levels of depressive symptoms, and reported a lower SES. Finally, baseline levels of chronic illness were associated with lower level of goal reengagement capacities and higher baseline levels of cold symptoms and depressive symptoms.

Table 7

Zero-Order Correlations of Main Study Variables for Study 3 (N = 131)

	1	2	3	4	5	6	7	8	9
1. Baseline cold symptoms									
2. 6-year cold symptoms	.18*								
3. Baseline depressive symptoms	.14	.12							
4. 6-year depressive symptoms	.07	.32**	.57**						
5. Goal disengagement capacities	-.01	-.34**	-.16*	-.39**					
6. Goal reengagement capacities	.09	-.07	-.31**	-.29**	.12				
7. Age	-.13	.10	.06	.11	-.16	-.04			
8. Sex [a]	-.02	-.19*	.17*	.11	.08	.06	.07		
9. Chronic illness	.36**	.16	.17*	.12	-.12	-.18*	-.05	-.17	
10. Socioeconomic status	-.01	.06	-.43**	-.21*	.08	.10	-.14	-.21*	-.07

Note. [a] Higher values represent female participants.

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

Age Effects of Goal Adjustment Capacities on Changes in Cold Symptoms

Results from a hierarchical regression analysis showed that the included covariates, age, and the main effect of goal reengagement capacities were not significantly associated with changes in participants' cold symptoms, |*B*s| < .14, |*SE*s| > .08, *p*s >.05 (see Table 8). The main effect of goal disengagement capacities, however, significantly predicted changes in cold symptoms, $F(1, 124) = 13.23$, $p < .001$. Higher baseline levels of goal disengagement capacities were associated with fewer increases in cold symptoms, $B = -.32$, $SE = .09$, $p < .001$. The second step of the regression analysis confirmed a significant interaction effect between age and goal disengagement in predicting changes in cold symptoms, $F(1, 124) = 4.19$, $p = .04$. The interaction between age and goal reengagement capacities was not significant.

Table 8

Regression Analysis Examining Age Effects of Goal Adjustment Capacities on 6-year Changes in Cold Symptoms (N = 131)

	6-year changes in cold symptoms		
	R^2	*B*	*SE*
Main Effects			
Goal disengagement capacities (GD)	.09**	-.32**	.09
Goal reengagement capacities (GR)	.00	-.04	.09
Age	.01	.11	.10
Sex [a]	.02	-.14	.09
Socioeconomic status	.01	.08	.08
Chronic illness	.00	.05	.09
Interaction Effects			
Age X GD	.03*	-.23*	.11
Age X GR	.00	.06	.12

Note. [a] Higher values represent female participants.

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

Figure 6 illustrates the associations between age and changes in participants' cold symptoms one standard deviation above and below the mean of the goal disengagement scale. The obtained pattern suggests that increases in cold symptoms were observed particularly among older-old adults who reported low levels of goal disengagement capacities. By contrast, increases in cold symptoms were considerably lower among younger-old adults who reported low levels of goal disengagement capacities, and these changes were almost as low as the scores of their counterparts who were better able to disengage from unattainable goals (independent of age). Analyses of the simple slopes (Aiken & West, 1991) supported this interpretation by showing that age significantly predicted increases in cold symptoms among participants who reported low (-1 *SD*: $B = .29$, $SE = .13$, $p < .05$), but not high (+1 *SD*: $B = -.16$, $SE = .16$, $p > .05$), levels of goal disengagement capacities. Conversely, goal disengagement capacities significantly predicted fewer increases in cold symptoms among older-old adults (estimated for age 85: $B = -.96$, $SE = .32$, $p = .004$), but not among younger-old adults (estimated for age 65: $B = -.09$, $SE = .15$, $p > .05$).

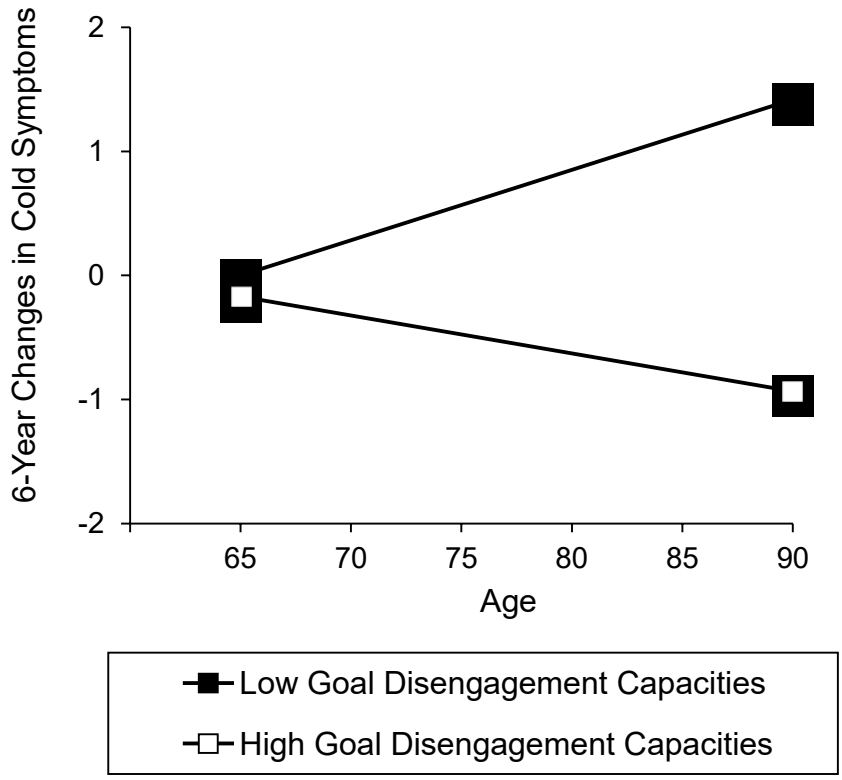


Figure 6. Associations between age and 6-year changes in cold symptoms among participants with low (-1 *SD*) and high (+1 *SD*) baseline levels of goal disengagement capacities.

The Mediating Role of Depressive Symptomatology

The mediation analysis showed that the significant direct effect of the interaction between age and goal disengagement capacities on changes in participants' cold symptoms was rendered non-significant when baseline levels and changes in depressive symptoms were controlled simultaneously for, B = -.19, SE = .11, p > .05 (see Figure 7). Bootstrap analysis clarified that changes in depressive symptoms (95% BCI [-.1664, -.0023]), but not baseline levels of depressive symptoms (95% BCI [-.0105, .0790]) exerted a significant indirect effect on the interaction effect between age and goal disengagement on changes in cold symptoms.

Figure 7 further shows that only increases in depressive symptoms (but not baseline levels of depressive symptoms, B = .04, SE = .02, p > .05), were positively associated with increases in cold symptoms, B = .19, SE = .09, p = .03. In addition, it demonstrates that the interaction between age and goal disengagement capacities also predicted changes in depressive symptoms, $F(1, 124) = 6.21$, p = .01 (but not baseline levels of depressive symptoms, $F[1, 124] = .88$, p > .05). Subsequently conducted simple slopes analyses confirmed that the pattern of interaction effect on changes in depressive symptoms was similar to the previously reported effect on changes in cold symptoms. That is, age was significantly associated with increases in depressive symptoms among participants with low (-1 *SD*: B = .25, SE = .13, p = .05), but not high (+1 *SD*: B = -.29, SE = .16, p > .05), levels of goal disengagement. Conversely, goal disengagement capacities were significantly associated with fewer increases in depressive symptoms among older-old adults (estimated for age 85: B = -1.15, SE = .32, p < .05), but not among younger-old adults (estimated for age 65: B = -.10, SE = .14, p > .05).

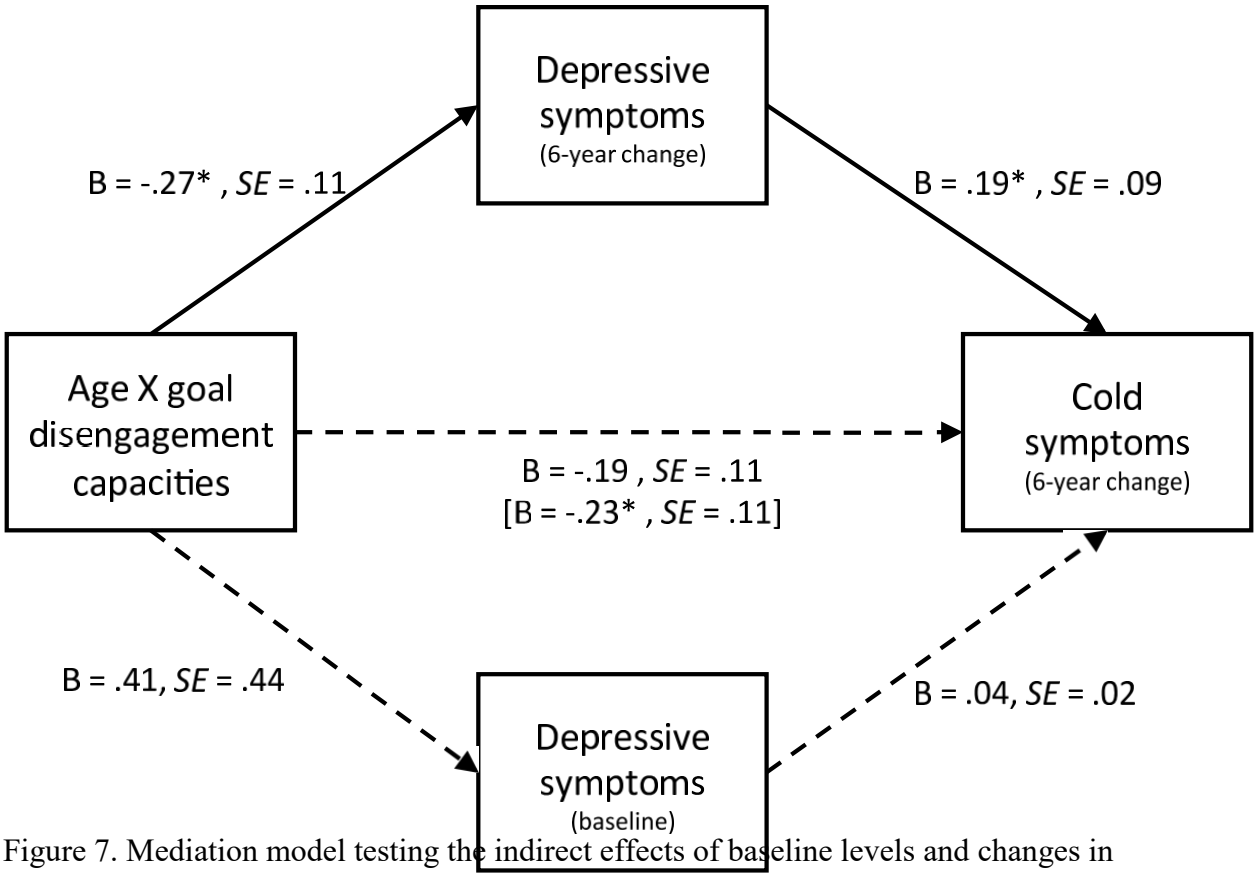


Figure 7. Mediation model testing the indirect effects of baseline levels and changes in depressive symptoms on the age-related association between goal disengagement capacities and changes in cold symptoms.

Discussion

This longitudinal study of community-dwelling older adults showed that goal disengagement capacities buffered against 6-year increases in participants' cold symptoms. In addition, it demonstrated that this protective effect was enhanced among individuals in advanced, as compared to early, old age. Finally, the age-related association between goal disengagment capacities and changes in cold symptoms was statistically mediated by a reduction of depressive symptoms. These effects were independent of sex, SES, and chronic illness.

The obtained association between individuals' capacity to disengage from unattainable goals and fewer longitudinal increases in cold symptoms is consistent with research, documenting the physical health benefits of goal disengagement capacities (Wrosch et al., 2007). Such a process may occur because goal disengagement can prevent repeated failure experiences and reduce associated emotional distress, which may ameliorate susceptibility to physical disease (Cohen et al., 2007; Wrosch et al., 2013). Further, the observed health benefits were specific to participants' goal disengagement capacities and did not emerge as a function of their goal reengagement capacities. The frequent absence of longitudinal health effects of goal reengagement capacities has been discussed previously by addressing that goal reengagement rarely reduces psychological distress and at times can also forecast emotional problems (e.g., if individuals deplete their resources, Wrosch et al., 2011, 2013)

Of importance, the buffering effect of goal disengagement capacities on changes in cold symptoms became paramount among individuals in advanced, as compared to early, old age. This implies that goal disengagement is particularly important for reducing susceptibility to disease as older adults advance in age. We think that such an age-related increase in the adaptive value of goal disengagement capacities occurs because individuals in advanced old age are particularly likely to experience multiple and often uncontrollable stressors and losses, while

simultaneously encountering a reduction in resources needed for overcoming these problems (Baltes & Smith, 2003; Heckhausen et al., 2010). Individuals in early old age, by contrast, typically have more resources and opportunities available to overcome stressors and goal-related problems, which may make goal disengagement a less needed behavioural response.

Finally, the study's results demonstrated that the age effect of goal disengagement capacities on reduced levels of cold symptoms was statistically mediated by changes in depressive symptomatology. In particular among participants in advanced old age, goal disengagement capacities were associated with a reduction of depressive symptoms, which exerted an indirect effect on the age-related association between goal disengagement and reduced levels of cold symptoms. This mediation effect documents a psychological process that links adaptive goal disengagement with beneficial health outcomes. Considering the well-documented associations between distress, biological disturbances, and health (Cohen et al., 2007), it seems likely that this mediation effect could have occurred because reduced levels of depressive symptoms prevented a dysregulation of participants' immune function (for goal disengagement and systemic inflammation, see Wrosch et al., 2013).

Overall, the reported findings have important implications for lifespan developmental research and theory. While advanced old age has been described as a widely understudied area (Baltes, 1998), more recent research has documented significant declines in older-old adults' emotional, psychological, and physical functioning (e.g., Baltes & Smith, 2003; Gerstorf et al., 2010; Sutin et al., 2013). The psychological processes that accelerate, or delay, psychological and physical decline in advanced old age, however, are not well understood. To this end, our results suggest that some of these declines may be prevented if individuals are capable of disengaging from unattainable goals. The identification of this process may curb an adverse cascade in advanced old age, in which age-related challenges trigger emotional distress and

subsequent physical health problems.

In addition, the findings lend support to theories of adaptive self-regulation. Although a substantial body of research has documented that disengagement can benefit well-being and health if individuals encounter unattainable goals (Brandtstädter & Renner, 1990; Heckhausen, et al., 2010; Wrosch et al., 2013), extant work did not examine age-differences in the influence of these self-regulation processes across older adulthood. In this regard, our study demonstrates that goal disengagement processes become paramount when older individuals enter a life phase that is characterized by an increasing number of challenges and a reduction of opportunities for overcoming problems (Baltes & Smith, 2003). The reported study thus supports the theoretical claim that it is especially in such low opportunity circumstances that individuals need to abandon unfeasible goals to protect their quality of life (Heckhausen et al., 2010).

Finally, this study may contribute to health research by documenting a psychological mechanism that could protect older adults' physical health. Our findings suggest that the stress-related incidence of infectious disease, such as the common cold, may be triggered by emotional distress if older-old adults are unable to disengage from unattainable goals. Given that susceptibility to infectious disease (and a potentially underlying dysregulation of immune function) could contribute to subsequent and serious health conditions (e.g., Alzheimer's disease, diabetes, or osteoporosis, El-Sahly et al., 2000; Graham et al., 2006), the identification of goal disengagement capacities as a protective process may be important to a variety of researchers who work with the elderly population. Note, however, that our findings showed that levels of goal disengagement capacities did not further increase across older adulthood (see Table 7), potentially leaving individuals who enter old age with a low capacity for goal disengagement most vulnerable to the experience of emotional distress and physical health problems. An implication of the latter argument would be that older adults with poor goal disengagement

capacities could be targeted to receive interventions on how to manage specific goal constraints which could improve their quality of life.

Limitations and Future Directions

This research is not without limitations. First, the reported results are based on a small longitudinal sample, and future research should examine their generalizability by replicating them in larger and representative samples of older adults.

Second, participants' cold symptoms were assessed via self-reports, which could be affected by a number of biases or individual difference variables (e.g., neuroticism). Although our analysis predicted changes in cold symptoms, which is likely to reduce biases as a function of other individual difference variables, future studies should incorporate measures of physician-verified cold symptoms.

Third, changes in depressive and cold symptoms were both measured over the same 6-year time interval, which makes it possible that reversed associations between variables are possible too. Note, however, that our hypotheses were based on experimental research, demonstrating that distress can cause the incidence of the common cold if participants were infected with the cold virus (Cohen, 1996). Nonetheless, future research should conduct fine-grained studies to further explore directional associations between distress and cold symptoms.

Fourth, the reliability of the goal disengagement scale was only modest in this study. Although low reliability has not been a problem in much of the research using this scale (Mens et al., in press), it may at times be observed for instruments incorporating only few items (i.e., four). Given that factor analysis confirmed that the items of the two subscales of the GAS (disengagement and reengagement) loaded on two separate factors (see Methods), we feel that this issue does not seriously compromise the interpretation of our findings.

Finally, our theoretical model would suggest that the observed process could be

associated with the prospective development of severe health problems in participants' future. We therefore suggest that subsequent waves of our study should address this possibility by assessing changes in a variety of chronic health conditions. Research along these lines may further illuminate how elderly individuals can manage the occurrence of stressors across older adulthood and protect their psychological and physical health.

CHAPTER 5:
GENERAL DISCUSSION

The aim of this dissertation was to expand our current understanding of successful aging by addressing the limitations of extant literature to reflect the changing demographics in older adulthood. This was accomplished by examining how dispositional optimism and goal disengagement capacities influence the self-regulation of stress within the context of older adulthood. Study 1 demonstrated how dispositional optimism moderated associations between perceived stress and cortisol secretion in a community sample of older adults on 12 different days across 6 years. This study showed how dispositional optimism facilitated the physiological management of short-term stress and guarded against increases in cortisol in older adulthood. Study 2 examined associations between age and dispositional optimism to predict longitudinal changes in depressive symptoms and perceived stress over 6 years. Results from this study demonstrated how age-graded opportunities for goal pursuits influence the adaptive value of dispositional optimism in the maintenance of psychological health. Specifically, optimism facilitated adaptive self-regulation in early phases of older adulthood but had reduced effectiveness in advanced old age. Finally, Study 3 investigated long-term associations between age and goal disengagement on 6-year changes in perception of illness among older adults mediated by changes in emotional distress. This study demonstrated how goal disengagement sustained physical health across older adulthood by preventing increases in emotional distress, and became particularly important for those in advanced old age.

Summary of Research Findings

The first objective of the research was to clarify the association between dispositional optimism, stress perceptions and physiological stress regulation. The results of Study 1 demonstrated that dispositional optimism moderated the within-person associations between

perceived stress and increased cortisol secretion in a community sample of older adults. Specifically, when older adults experienced stress perceptions that were higher than their typical levels of stress (i.e., within-person associations), optimists were protected from exhibiting enhanced levels of cortisol on most indicators (with the exception of CAR). Conversely, when participants' absolute stress perceptions were compared to the sample mean (i.e., between-person associations), pessimists and optimists did not differ on most indicators of cortisol with the exception of CAR. Specifically, among participants who experienced higher levels of stress on average, dispositional optimism was associated with a reduced CAR. This study clarified the association between dispositional optimism, stress and cortisol providing evidence for the beneficial impact of optimism on stress regulation while also explaining the discordance found in previous research.

The second objective was to examine the effect dispositional optimism on adaptive self-regulation as opportunities for goal pursuits diminish across older adulthood. Study 2 showed that the emotional benefits of dispositional optimism can vary as a function of long-term developmental stress. While optimism buffered longitudinal increases in depressive symptoms in early phases of older adulthood this effect became reduced in advanced old age. This pattern of findings suggests that the adaptive value of dispositional optimism is likely determined by the age-related configuration of opportunities and constraints for overcoming stressors and attaining personal goals (Baltes & Baltes, 1990; Heckhausen et al., 2010). Results also showed that the age-related association between optimism and depressive symptoms was particularly evident under conditions of higher stress. Such findings indicate that increases in perceived stress were associated with increases in depressive symptoms for dispositional optimists in advanced old age. This study suggests that the adaptiveness of dispositional optimism may become reduced under conditions of long-term developmental stress.

Finally the third objective was to explore the effect of a personality dimension that could support quality of life in advanced old age. To this end, goal disengagement capacities were expected to exert an increased influence on adaptive self-regulation and associated physical health across old age. Findings from Study 3 demonstrated that goal disengagement capacities buffered against 6-year increases in participants' self-reported cold symptoms. Although goal disengagement capacities benefited all older adults, the protective effect was particularly pronounced among individuals in advanced old age. These findings suggest that goal disengagement capacities become increasingly important in reducing susceptibility to disease with increasing age. Finally, the age-related association between goal disengagment capacities and changes in cold symptoms was mediated by changes in emotional distress. By being capable of letting go, those in advanced old age are likely to avoid the distress associated with repeated failure experiences, reducing their susceptibility to illness (Cohen et al., 2007, Wrosch et al., 2013). This mediation effect demonstrates a psychological pathway by which goal disengagement leads to beneficial health outcomes. Together, findings demonstrate that goal disengagement may become increasingly important in advanced old age for the management of emotional and physical health.

Theoretical Implications for Research on Dispositional Optimism

A substantial body of evidence shows that dispositional optimism is related to physical health outcomes from markers of immune function to survival (Rasmussen et al., 2009). While researchers have identified an array of behavioral mechanisms by which optimists adapt (i.e., use of coping strategies such as persistent goal striving, problem focused coping, positive reappraisal, Nes & Segerstrom, 2006), fewer studies have attempted to understand the physiological mechanism by which optimism impacts health (Rasmussen et al., 2009). The findings from this research suggests that the physiological stress response may be one

mechanism by which optimism can influence physical health outcomes. Dispositional optimism was found to downregulate the physiological stress response when people face higher than typical levels of stress. In this way, optimism may protect physical health by preventing individuals from experiencing sustained elevated levels of circulating cortisol. By effectively regulating cortisol, optimism is likely to protect individuals from experiencing the adverse health effects associated with elevated cortisol secretion, from short-term impairments in cognitive functioning (i.e., declarative memory, spatial thinking; Kirschbaum, Wolf, May et al., 1996) to lowered immune function (Vedhara, Cox, Wilcock et al., 1999; Segerstrom & Miller, 2004) and associated mortality (Schoorlemmer, Peeters, van Schoor & Lips, 2009). In this way, dispositional optimism facilitates the management of stress and may protect people from physiological dysregulation which can in turn protect their overall health.

The findings contribute to the literature on dispositional optimism by suggesting that the benefits of optimism might vary depending on an individual's developmental context. In early older adulthood as compared to advanced old age, individuals are much more likely to overcome obstacles and return to previous levels of functioning (Baltes & Smith, 2003). Under life circumstances when individuals can overcome obstacles, optimism protects emotional well-being. By contrast, as age-graded opportunities for goal attainment diminish, dispositional optimism may prove less effective in promoting emotional well-being. Results showed that the gap in depressive symptoms between optimists and pessimists became smaller with increasing age, suggesting the optimism may become less beneficial in advanced old age. The findings from this research suggest that an accumulation of developmental stress in advanced old age may challenge the goal striving capacities of optimists. However, a caveat to this remains that even in advanced old age, optimists continue to exhibit an emotional advantage over their pessimistic counterparts. This remaining benefit could be attributed to diverse coping strategies used by

optimists, which not only include problem-focused coping but also effective emotion-focused coping (i.e., acceptance, positive reinterpretation, cognitive restructuring; Nes & Segerstrom, 2006). Thus, while persistent goal pursuit may become less effective in advanced old age, optimists may still benefit from other coping strategies. These findings suggest that the developmental context is likely influence the effectiveness of dispositional optimism.

Theoretical Implications for Research on Health

The research has strong implications for research on physical health, particularly with respect to considering optimal methodologies and research designs. Health researchers should consider the use of within subjects design as a complement to the use of between subjects design when examining individual differences in health-relevant biomarkers. Findings from Study 1 demonstrated important differences based on whether inter-individual (i.e., between-persons) or intra-individual (i.e., within-persons) designs were used. More specifically, inter-individual analyses failed to find numerous associations between dispositional optimism and cortisol or between stress perceptions and cortisol. Conversely, the intra-individual analyses clearly depicted the associations between perceived stress, optimism and cortisol, as this design could account for the potential confound between stress perceptions and optimism. Biomarkers offer the advantage of being precise, valid and objective measures of health-relevant processes, but in many cases do not have established norms (Mayeux, 2004). Intra-individual designs may facilitate research involving physiological biomarkers because it allows for norms to be established within the individual. In the case of cortisol where both elevated and low levels are considered to exert adverse physical consequences (Miller, Chen, & Zhou, 2007; Mayeux, 2004), this research method can be particularly beneficial as it allows variability to be established from an individual's own personal norm. Such research designs may be particularly sensitive to physiological changes as it allows investigators to capture variability within each individual

while also controlling for other potential confounding factors.

Cortisol secretion is a widely used physiological measure of stress but some mechanisms related to cortisol remain unclear. Until recently, only experimental paradigms documented *habituation effects,* suggesting that individuals displayed decreased cortisol reactivity after repeated exposure to a "stressful stimuli" (Pruessner et al., 1997; Schoemer, Hellhammer, & Kirschbaum, 2003). The findings from this dissertation extend the notion of stress habituation from the laboratory to a more naturalistic setting, such that individuals can become physiologically habituated to their own typical levels of stress perceptions or their general levels of pessimism. Researchers should consider the possibility of potential confounds between psychological phenomena and biological mechanisms. However, it should be stipulated that not all components of the diurnal rhythm (i.e., CAR) were necessarily as sensitive to the process of habituation. The distinction between CAR and other components of the diurnal rhythm suggest that while some indicators of cortisol may be sensitive to physiological process of habituation, others may be less so. Taken together, these findings suggest that future research utilizing cortisol should consider the possible habituation effects while also considering the distinction between different components of the diurnal rhythm. These conclusions may also extend more broadly to other biological processes, which may also be sensitive to the process of habituation.

Previous research has demonstrated the importance of personality dimensions in the management of health (Scheier et al., 2010; Wrosch et al., 2013). In this regard, the findings from this dissertation suggest that one mechanism by which this is accomplished is through the management of both distal and proximal stressors. Results from Study 1 and Study 3 demonstrated how dispositional optimism and goal disengagement help to maintain physical health through the adaptive management of short-term or long-term stressors (i.e., age-related challenges). The results suggest that personality dimensions are physically adaptive in as much

as these tendencies match the controllability and length of stressors. Under conditions of short-term stress (i.e., increased daily stress) processes that facilitate problem-solving and persistent goal striving such as those associated with dispositional optimism can lead to superior health outcomes. Conversely, under conditions where stressors become more chronic, intractable and begin to accumulate, processes that preserve resources and prevent emotional distress such as those associated with goal disengagement may lower an individual's susceptibility to illness. These findings suggest that certain personality factors can be adaptive for physical health in so far as the underlying behavioral processes are appropriate for the type of stressors individuals face.

Theoretical Implications in the Study of Aging

This research further advances theory on aging by conceptualizing stress and adaptation within a developmental context. Older adults are expected to experience an increase of age-related challenges over time, especially as they enter the later phases of life (Baltes & Baltes, 1990; Heckhausen et al., 2010). The findings from this research substantiate the notion that increases in age-related stressors over time will shape and influence the mental and physical health of older adults. Specifically, the age effects found within this research suggests that an increasing uncontrollability of age-related challenges may culminate in sustained increases in distress unless effectively managed. Age-related challenges that become uncontrollable may result in long-term developmental stress and trigger emotional problems that may in turn contribute to subsequent physical health problems. While the concept of developmental stress has typically been reserved for early childhood adversity (Frodl & O'Keane, 2013), this concept applied to older adulthood provides a novel manner of understanding developmental forces that can adversely impact aging populations. This concept integrates both accumulating age-related challenges combined with the diminishing opportunities that occur as a result of declining

overall personal resources (i.e., loss of personal capacities or resources lost due to the management of other age-related stressors; Wrosch et al., 2006). The research highlights the adverse effect that long-term developmental stress can have on the capacity of older adults to self-regulate and maintain mental and physical health.

Older adulthood describes a large proportion of the life span with significant developmental changes to occur across old age. While it is known that adults in advanced old age face substantial declines across different aspects of psychological functioning (Baird et al., 2010; Gerstorf et al., 2010; Sutin et al., 2013), the psychological processes that influence decline in advanced old age are not well understood. The findings from this dissertation suggest that reductions in the effectiveness of personal resources such as dispositional optimism may occur in later years and trigger emotional distress. However, our results also suggest that some of these declines may be prevented if individuals are capable of disengaging from unattainable goals. Goal disengagement capacities may be an increasingly important resource as individuals move into advanced old age. Our findings show evidence that the same personality dimension has differential outcomes on older adults in early versus advanced old age and suggests that these could be distinct developmental stages (see Baltes & Smith, 2003). Taken together, these findings suggest that the current classification of older adulthood as one broad category spanning over 30 years disregards the considerable developmental changes that occur from early to advanced phases of older adulthood.

Finally, this research may broaden existing life-span theories of motivation by integrating theories of personality with goal-specific processes to explain successful development. Life-span developmental theories propose that individuals should adjust their goal-specific processes to declines in the controllability of particular life circumstances that occur with increasing age (Heckhausen et al., 2010). Dispositional optimism promotes persistent goal striving in the face of

threatened goals and facilitates well-being when older adults have favorable opportunities to overcome challenges. Conversely, goal disengagement allows older adults to preserve finite personal resources for only their most important life goals, and becomes increasingly adaptive as resources decline with increasing age (Baltes & Smith, 2003). In this regard, these personality dimensions could trigger variability in goal-specific regulation processes and contribute to patterns of successful development. It appears that advanced old age becomes a pivotal point in development where individuals transition from persistently overcoming challenges to preserving limited personal resources if they are to maintain emotional and physical health. The findings suggest that as dispositional optimism begins to lose some of its adaptive function, goal disengagement may become increasingly adaptive. Advanced old age may represent a challenging developmental period, in which goal disengagement may become essential and complementary to dispositional optimism in promoting emotional and physical health.

Limitations and Futures Directions

First, the results of this dissertation are based on a relatively small longitudinal sample of older adults and all three studies examined older adults living in the community. Future research should seek to replicate these findings in other older adult populations (i.e., those hospitalized or living in retirement facilities). While the majority of older adults (i.e., 92% of those 65 years and older) live in private dwellings within the community, those in advanced old age are more likely to live in special care facilities (i.e., 30% seniors over 85 years of age; Milan, Bohnert, LaVasseur, & Page, 2012). As such, it may be that our studies selected for the healthiest and most resilient of those in advanced old age. Thus future research should aim to include those living in nursing homes, chronic care or long-term care hospitals.

Second, the measure of perceived stress was a brief self-report and did not tap into the type and nature of stress that individuals experience. However, the benefit of using such a general subjective measure of stress is that it captures the extent to which a person experiences life as stressful, independent of the specific life challenge experienced, which ultimately determines the impact on the individual (Lavoie & Douglas, 2012). Furthermore, our hypotheses were based on theories that focus on psychological perception of stress (Lazarus & Folkman, 1984). However, future studies should assess specific stressors and other age-related challenges to identify the conditions under which stress perceptions are increased and elevate cortisol or depressive symptomatology.

Third, our study did not measure the specific coping tactics that could mediate the observed age effects of dispositional optimism (e.g., problem and emotion-focused coping, Carver Scheier, & Weintraub, 1989) or goal disengagement capacities (e.g., conservation of personal resources; Wrosch et al., 2013) on cortisol regulation, depressive symptoms or susceptibility to illness. In addition, while optimists may be more likely to engage in persistent goal striving, this research did not assess specific measures for goal striving. While the reported studies identified different pathways leading to adaptive outcomes in early versus advanced old age, future research should delve further to identify the specific behavioural copings mechanisms that could explain the results found in the reported research.

Finally, our research used age as a proxy for declines in older adults' opportunities for overcoming goal-related problems (Heckhausen et al., 2010). The underlying factors driving these age effects remain undetermined but are likely to be attributed to a broad loss of resources across domains of life (e.g., loss of energy, chronic health conditions, or death of a spouse; Baltes & Smith, 2003), which older adults may encounter as they advance in age. Future research

should seek to identify the specific circumstances that could drive the obtained age effects, as it would be plausible that some losses (i.e., loss of functional mobility or hearing) may have greater impact than others (i.e., fatiguability). Research along these lines has the potential of revealing additional mechanims that may lead to successful development, especially in advanced stages of life.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions.* Thousand Oaks, CA: Sage

Adler, N. E., Epel, E., Castellazzo, G., & Ickovics, J. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy white women. *Health Psychology, 19,* 586–592. doi: 10.1037/0278-6133.19.6.586

Allport, G. W. (1961). *Pattern and growth in personality.* Oxford, England: Holt, Reinhart & Wilson.

Anderson, E. M., Malmgren, J. A., Carter, W. B., Patrick, D. L. (1994). Screening for depression in well older adults: evaluation of a short form of the CES-D. *Amercian Journal of Preventive Medicine, 10*, 77-84.

Atkinson, J. W. (1964). *An introduction to motivation*. Princeton, NJ: Van Nostrand.

Baird, B. M., Lucas, R. E., & Donnellan, M. B. (2010). Life satisfaction across the lifespan: Findings from two nationally representative panel studies. *Social Indicators Research*, *99*, 183-203. doi: 10.1007/s11205-010-9584-9

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Baltes, M. M. (1998). The psychology of the oldest-old. *Current Opinion in Psychiatry, 11*, 411-415. doi: 10.1097/00001504-199807000-00009

Baltes, P. B. (1997). On the incomplete architecture of human ontogeny: Selection, optimization, and compensation as foundation of developmental theory. *American Psychologist*, *52*, 366-380. doi: 10.1037/0003-066X.52.4.366

Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 1–34). New York, NY: Cambridge University Press. doi: 10.1017/CBO9780511665684

Baltes, P. B. & Smith, J. (2003). New frontiers in the future of aging: from successful aging of the young old to the dilemmas of the fourth age. *Gerontology, 49*, 123-135. doi: 10.1159/000067946

Bjoerntorp, P., & Rosmond, R. (1999). Hypothalamic origin of the metabolic Syndrome X. *Annals of the New York Academy of Science, 892*, 297-307. doi: 10.1111/j.1749-6632.1999.tb07803.x

Boehm, J. K., & Kubzansky, L. D. (2012, April 16). The heart's content: The association between positive psychological well-being and cardiovascular health. *Psychological Bulletin*. Advance online publication. doi: 10.1037/a0027448

Brandtstädter, J., & Renner, G. (1990). Tenacious goal pursuit and flexible goal adjustment: Explication and age-related analysis of assimilative and accommodative strategies of coping. *Psychology and Aging, 5*, 58-67. doi: 10.1037/0882-7974.5.1.58

Brydon, L., Walker, C., Wawrzyniak, A. J., Chart, H., & Steptoe, A. (2009). Dispositional optimisim and stress-induced changes in immunity and negative mood. *Brain, Behavior, and Immunity, 23*, 810-816. doi: 10.1016/j.bbi.2009.02.018

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior.* New York, NY: Cambridge University Press. doi: 10.1017/CBO9781139174794

Carver, C. S., & Scheier, M. F. (2014). Dispositional optimism. *Trends in Cognitive Sciences, 18*, 293-299. doi: 10.1016/j.tics.2014.02.003

Carver, C. S., Scheier, M. F., & Segerstrom, S. C. (2010). Optimism. *Clinical Psychology Review, 30,* 879-889. doi: 10.1016/j.cpr. 2010.01.006

Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology*, *56*, 267-283. doi: 10.1037/0022-3514.56.2.267

Castle, S. C. (2000). Clinical relevance of age-related immune dysfunction.*Clinical Infectious Diseases*, *31*(2), 578-585. doi: 10.1086/313947

Chang, E. C. (2002). Optimism-pessimism and stress appraisal: testing a cognitive interactive model of psychological adjustment in adults. *Cognitive Therapy and Research, 26*, 675-690. doi: 10.1023/A:1020313427884.

Chida, Y., & Steptoe, A. (2009). Cortisol awakening response and psychosocial factors: A systematic review and meta-analysis. *Biological Psychology, 80*, 265-278. doi:10.1016/j.biopsycho.2008.10.004

Christensen, K., Doblhammer, G., Rau, R., & Vaupel, J. W. (2009). Ageing populations: the challenges ahead. *The lancet*, *374*(9696), 1196-1208. doi: 10.1016/S0140-6736(09)61460-4

Cohen, S. (1996). Psychological stress, immunity, and upper respiratory infections. *Current Directions in Psychological Science*, 86-90. doi: 10.1111/1467-8721.ep10772808

Cohen, F., Kearney, K. A., Zegans, L. S., Kemeny, M. E., Neuhaus, J. M., & Stites, D. P. (1999). Differential immune system changes with acute and persistent stressors for optimists vs pessimists. *Brain, Behavior, and Immunity, 13*, 155-174. doi: 10.1006/brbi.1998.0531

Cohen, S., Janicki-Deverts, D., & Miller, G. E. (2007). Psychological stress and disease. *Journal of the American Medical Association, 298*, 1685-1687. doi: 10.1001/jama.298.14.1685

Cohen, S., Tyrrell, D. A., & Smith, A. P. (1991). Psychological stress and susceptibility to the

common cold. *New England Journal of Medicine*, *325*, 606-612. doi: 10.1056/nejm199108293250903

Dunne, E., Wrosch, C., & Miller, G. E. (2011). Goal disengagement, functional disability, and depressive symptoms in old age. *Health Psychology*, *30*, 763-770. doi: 10.1037/a0024019

Ebrecht, M., Hextall, J., Kirtley, L.-G., Taylor, A., Dyson, M., & Weinman, J. (2004). Perceived stress and cortisol levels predict speed of wound in healthy male adults. *Psychoneuroendocrinology, 29*, 798-809. doi: 10.1016/S0306-4530(03)00144-6

El-Sahly, H. M., Atmar, R. L., Glezen, W. P., & Greenberg, S. B. (2000). Spectrum of clinical illness in hospitalized patients with "common cold" virus infections. *Clinical Infectious Diseases*, *31*, 96-100. Doi: 10.1086/313937

Endrighi, R., Hamer, M., & Steptoe, A. (2011). Associations of trait optimism with diurnal neuroendocrine activity, cortisol responses to mental stress, and subjective stress in healthy men and women. *Psychosomatic Medicine, 73*, 672-678. doi: 10.1097/PSY.0b013e31822f9cd7

Falsey, A. R., Walsh, E. E., & Hayden, F. G. (2002). Rhinovirus and coronavirus infection-associated hospitalizations among older adults. *Journal of Infectious Diseases*, *185*(9), 1338-1341. doi: 10.1086/339881

Feather, N. T. (1982). *Expectations and actions: Expectancy-value models in psychology*. Hillsdale, NJ: Erlbaum.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, *7*, 117-140. doi: 10.1177/001872675400700202

Gerstorf, D., Ram, N., Mayrz, G., Hidajat, M., Lindenberger, U., Wagner, G. G., Schupp, J. (2010). Late-life decline in well-being across adulthood in Germany, the United Kingdom, and the United States: something is seriously wrong at the end of life. *Psychology and Aging, 25,* 477–485. doi: 10.1037/a0017543

Graham, J. E., Christian, L. M., & Kiecolt-Glaser, J. K. (2006). Stress, age, and immune function: toward a lifespan approach. *Journal of Behavioral Medicine*, *29*, 389-400. Doi: 10.1007/s10865-006-9057-4

Hamrick, N., Cohen, S., & Rodriguez, M. S. (2002). Being popular can be healthy or unhealthy: stress, social network diversity, and incidence of upper respiratory infection. *Health Psychology*, *21*, 294-298. doi: 10.1037/0278-6133.21.3.294

Heckhausen, J., & Wrosch, C. (2016). Challenges to developmental regulation across the life course: What are they and which individual differences matter? *International Journal of Behavioral Development, 40,* 145-150. doi: 10.1177/0165025415588796

Heckhausen, J., Wrosch, C., & Schulz, R. (2010). The motivational theory of life-span

development. *Psychological Review, 117*, 32-60. doi: 10.1037/a0017668

Helgeson, V. S., Reynolds, K. A., & Tomich, P. L. (2006). A meta-analytic review of benefit finding and growth. *Journal of Consulting and Clinical Psychology*, *74*, 797-816. doi: 10.1037/0022-006X.74.5.797

Isaacowitz, D. M. (2005). Correlates of well-being in adulthood and old age: A tale of two optimisms. *Journal of Research in Personality, 39*, 224-244. doi:10.1016/j.jrp.2004.02.003

Ironson, G., Balbin, E., Stuetzle, R., Fletcher, M. A., O'Cleirigh, C., Laurenceau, J. P., Schneiderman, N., & Solomon, G. (2005). Dispositional optimism and the mechanisms by which it predicts slower disease progression in HIV: proactive behavior, avoidant coping, and depression. *International Journal of Behavioral Medicine, 12*, 86-97. doi: 10.1207/s15327558ijbm1202_6

Jobin, J., Wrosch, C., & Scheier, M. F. (2014). Associations between dispositional optimism and diurnal cortisol in a community sample: When stress is perceived as higher than normal. *Health Psychology, 33*, 382-391. doi: 10.1037/a0032736

Kiecolt-Glaser, J. K., McGuire, L., Robles, T. F., & Glaser, R. (2002). Emotions, morbidity, and mortality: new perspectives from psychoneuroimmunology. *Annual review of psychology*, *53*(1), 83-107. doi: 10.1146/annurev.psych.53.100901.135217

Kirschbaum, C., Wolf, O. T., May, M., Wippich, W., & Hellhammer, D. H. (1996). Stress-and treatment-induced elevations of cortisol levels associated with impaired declarative memory in healthy adults. *Life sciences*, *58*(17), 1475-1483. Doi: 10.1016/0024-3205(96)00118-x

Kreft, I., De Leeuw, J. (1998). *Introducing Multilevel Modeling*. London: Sage Publications. doi: 10.4135/9781849209366

Kubzansky, L. D., Kubzansky, P. E., & Maselko, J. (2004). Optimism and pessimism in the context of health: bipolar opposites or separate constructs? *Personality and Social Psychology Bulletin*, *30*, 943-956. doi: 10.1177/0146167203262086

Lai, J. C., Evans, P. D., Ng, S. H., Chong, A. M. L., Siu, O. T., Chan, C. L. W., … Chan, C. C. (2005). Optimism, positive affectivity, and salivary cortisol. *British Journal of Health Psychology, 10*, 467-484. doi:10.1348/135910705X26083

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping.* New York: Springer Publications.

Marshall, G. N., Wortman, C. B., Kusulas, J. W., Hervig, L. K., & Vickers, R. R. (1992). Distinguishing optimism form pessimism: Relations to fundamental dimensions of mood and personality. Journal of Personality and Social Psychology, 62, 1067-1074. doi:10.1037/0022-3514.62.6.1067

Mayeux, R. (2004). Biomarkers: potential uses and limitations. *NeuroRx*,*1*(2), 182-188. doi:

10.1602/neurorx.1.2.182

McEwen, B. S., & Stellar, E. (1993). Stress and the individual: mechanisms leading to disease. *Archives of Internal Medicine, 153*, 2093-2101. doi: 10.1001/archinte.1993.00410180039004

Marshall, G. N., Wortman, C. B., Kusulas, J. W., Hervig, L. K., & Vickers, R. R. (1992). Distinguishing optimism form pessimism: Relations to fundamental dimensions of mood and personality. *Journal of Personality and Social Psychology, 62,* 1067–1074. doi:10.1037/0022-3514.62.6 .1067

Mens, M. G., Scheier, M. F., & Carver, C. S. (2016). Optimism. In S. J. Lopez, L. M. Edwards, & S. C. Marques (Eds.), *Handbook of positive psychology* (3rd ed.), New York: Oxford University Press. doi: 10.1093/oxfordhb/9780199396511.013.24

.

Mens, M. G., Wrosch, C., & Scheier, M. F. (2015). Goal adjustment theory. In S. K. Whitbourne (Ed.), *The Wiley-Blackwell Encyclopedia of Adult Development and Aging*. Wiley-Blackwell. doi: 10.1002/9781118521373.wbeaa192

Milan, A., Bohnert, N., LaVasseur, S., Page, F. (2012). Living arrangements of seniors : Families, households and marital status, structural types of dwelling and collectives, 2011 census of population. *Census in Brief,* Statistics Canada (Ottawa).

Miller, G. E., Chen, E., & Zhou, E. S. (2007). If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychological Bulletin, 133*, 25-45. doi: 10.1037/0033-2909.133.1.25

Minton, M. E., Hertzhog, M., Barron, C. R., French, J. A., Reiter-Palmon, R. (2009). The first anniversary: Stress, well-being, and optimism in older widows. *Western Journal of Nursing Research, 31*, 1035-1056. doi: 0.1177/0193945909339497

Mroczek, D. K., Spiro, A., Aldwin, C. M., Ozer, D. J., & Bossé, R. (1993). Construct validation of optimism and pessimism in older men: Findings from the normative aging study. *Health Psychology*, *12*, 406-409. doi: 10.1037/0278-6133.12.5.406

National Advisory Council on Aging (NACA). (2006). *Seniors in Canada 2006: A report card.* Ottawa: NACA.

Nes, L. S., & Segerstrom, S. C. (2006). Dispositional optimism and coping: A meta-analytic review. *Personality and Social Psychology Review*, *10*, 235-251. doi: 10.1207/s15327957pspr1003_3

Nichol, K. L., Wuorenma, J., & Von Sternberg, T. (1998). Benefits of influenza vaccination for low-, intermediate-, and high-risk senior citizens. Archives of Internal Medicine, 158(16), 1769-1776. doi: 10.1001/archinte.158.16.1769

Oeppen, J., & Vaupel, J. W. (2002). Broken limits to life expectancy. *Science, 296*, 1029-1031. doi: 10.1126/science.1069675

Otte, C., Hart, S., Neylan, T.C., Marmar, C.R., Yaffe, K., Mohr, D.C. (2005). A meta-analysis of cortisol response to challenge in human aging: importance of gender. *Psychoneuroendocrinology 30*, 80-91. doi: 10.1016/j.psyneuen.2004.06.002

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational & Behavioral Statistics, 31*, 437-448. doi: 10.3102/10769986031004437

Preacher, K. J., & Hayes, A. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediation models. *Behavior Research Methods, 49*, 879-891. doi: 10.3758/brm.40.3.879

Pruessner, J. C., Gaab, J., Hellhammer, D. H., Lintz, D., Schommer, N., & Kirschbaum, C. (1997). Increasing correlations between personality traits and cortisol stress responses obtained by data aggregation. *Psychoneuroendocrinology, 22*(8), 615-625. doi: 10.1016/S0306-4530(97)00072-3

Räikkönen, K., Matthews, K. A., Flory, J. D., Owens, J. F., & Gump, B. B. (1999). Effects of optimism, pessimism, and trait anxiety on ambulatory blood pressure and mood during everyday life. *Journal of personality and social psychology*, *76*(1), 104. doi: 10.1037/0022-3514.76.1.104

Rasmussen, H. N., Scheier, M. F., & Greenhouse, J. B. (2009). Optimism and physical health: A meta-analytic review. *Annals of Behavioral Medicine, 37*, 239-256. doi: 10.1007/s12160-009-9111-x.

Rasmussen, H. N., Wrosch, C., Scheier, M. F., & Carver, C. S. (2006). Self-regulation processes and health: The importance of optimism and goal adjustment. *Journal of Personality, 74*, 1721-1748. doi : 10.1111/j.1467-6494.2006.00426.x

Rothermund, K., & Brandstädter, J. (2003). Coping with deficits and losses in later life: from compensatory action to accommodation. *Psychology and aging*, *18*(4), 896. doi: 10.1037/0882-7974.18.4.896

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology, 4*, 219-247. doi: 10.1037/0278-6133.4.3.219

Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self mastery, and self-esteem): A re-evaluation of the life orientation test. *Journal of Personality and Social Psychology, 67*, 1063-1078. doi: 10.1037/0022-3514.67.6.1063

Scheier, M. F., Weintraub, J. K., & Carver, C. S. (1986). Coping with stress: Divergent strategies of optimists and pessimists. *Journal of Personality and Social Psychology, 51*, 1257-1264. doi: 10.1037/0022-3514.51.6.1257

Schommer, N. C., Hellhammer, D. H., & Kirschbaum, C. (2003). Dissociation between reactivity of the hypothalamus-pituitary-adrenal axis and the sympathetic-adrenal-medullary system to repeated psychosocial stress.*Psychosomatic medicine*, *65*(3), 450-460. doi: 10.1097/01.PSY.0000035721.12441.17

Schulz, R., Beach, S. R., Ives, D. G., Martire, L. M., Ariyo, A. A., & Kop, W. J. (2000). Association between depression and mortality in older adults: The Cardiovascular Health Study. *Archives of Internal Medicine*, *160*, 1761-1768. doi: 10.1001/archinte.160.12.1761

Schulz, R., Bookwala, J., Knapp, J. E., Scheier, M. F., & Williamson, G. M. (1996). Pessimism, age, and cancer mortality. *Psychology and Aging, 11*, 304-309. doi: 10.1037/0882-7974.11.2.304

Schmidt-Reinwald, A., Pruessner, J. C., Hellhammer, D. H., Federenko, I., Rohleder, N., Schurmeyer, T. H., Kirschbaum, C., (1999). The cortisol response to awakening in relation to different challenge tests and a 12-hour cortisol rhythm. *Life Science, 64*, 1653–1660. doi: 10.1016/s0024-3205(99)00103-4

Schoorlemmer, R. M. M., G. M. E. E. Peeters, N. M. Van Schoor, and P. T. A. M. Lips. (2009). Relationships between cortisol level, mortality and chronic diseases in older persons. *Clinical endocrinology, 71*(6), 779-786. doi: 10.1111/j.1365-2265.2009.03552.x

Segerstrom, S. C. (2005). Optimism and immunity: Do positive thoughts always lead to positive effects? *Brain, Behavior, and Immunity, 19*, 195-200. doi: 10.1016/j.bbi.2004.08.003

Segerstrom, S. C., Taylor, S. E., Kemeny, M. E., Fahey, J. L. (1998). Optimism is associated with mood, coping, and immune changes in response to stress. *Journal of Personality and Social Psychology, 74*, 1646-1655. doi: 10.1037/0022-3514.74.6.1646

Segerstrom, S. C., & Miller, G. E. (2004). Psychological stress and the human immune system: A meta-analytic study of 30 years of inquiry. *Psychological Bulletin, 130*, 601-630. doi: 10.1037/0033-2909.130.4.601

Seligman, M. E. P. (1991). *Learned optimism*. New York, New York: Knopf.

Sephton, S. E., Sapolsky, R. M., Kraemer, H. C., & Spiegel, D. (2000). Diurnal cortisol rhythm as a predictor of breast cancer survival. *Journal of the National Cancer Institute, 92,* 994–1000. doi: 10.1093/jnci/92.12.994

Smith, J., Borchelt, M., Maier, H., Jopp, D. (2002). Health and well-being in the young old and oldest old. *Journal of Social Issues, 58*, 715-732. doi: 10.1111/1540-4560.00286

Smith, J., & Baltes, P. B. (1997). Profiles of psychological functioning in the old and oldest old. *Psychology and Aging, 12*, 458-472. doi: 10.1037/0882-7974.12.3.458

Solberg Nes, L., Evans, D. R., & Segerstrom, S. C. (2009). Optimism and college retention: mediation by motivation, performance, and adjustment. *Journal of Applied Social*

Psychology, *39*(8), 1887-1912. doi: 10.1111/j.1559-1816.2009.00508.x

Sutin, A. R., Terracciano, A., Milaneschi, Y, An, Y., Ferrucci, L., & Zonderman, A. B. (2013). The trajectory of depressive symptoms across the adult life span. *JAMA Psychiatry, 70*, 803-811. doi: 10.1001/jamapsychiatry.2013.193

Taylor, S. E., Burklund, L. J., Eisenberger, N. I., Lehman, B. J., Hilmert, C. J., & Lieberman, M. D. (2008). Neural bases of moderation of cortisol stress responses by psychological resources. *Journal of Personality and Social Psychology, 95*, 197-211. doi: 10.1037/0022-3514.95.1.197

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A., & Updegraff, J. A. (2000). Biobehavioral responses to stress in females: Tend-and-Befriend, not Fight-or-Flight. *Psychological Review, 107* (3), 411-429. doi: 10.1037/0033-295x.107.3.411

van Cauter, E., & Turek, F. W. (1994). Endocrine and other biological rhythms. In L. J. DeGroot, (Ed.), *Endocrinology* (pp. 2487-2548). W. B. Saunders: Philadelphia.

van Eck, M., Berkhof, H., Nicolson, N. & Sulon, J (1996). The effects of perceived stress, traits, mood states, and stressful daily events on salivary cortisol. *Psychosomatic Medicine, 58*(5), 447-458. doi: 10.1097/00006842-199609000-00007

Vedhara, K., Cox, N. K., Wilcock, G. K., Perks, P., Hunt, M., Anderson, S., ... & Shanks, N. M. (1999). Chronic stress in elderly carers of dementia patients and antibody response to influenza vaccination. *The Lancet*, *353*(9153), 627-631. doi: 10.1016/s0140-6736(98)06098-x

Wrosch, C., Amir, E., & Miller, G. E. (2011). Goal adjustment capacities, coping, and subjective well-being: The sample case of caregiving for a family member with mental illness. *Journal of Personality and Social Psychology*, *100* (5), 934-946. doi: 10.1037/a0022873

Wrosch, C., Dunne, E., Scheier, M. F., & Schulz, R. (2006). Self-regulation of common age-related challenges: Benefits for older adults' psychological and physical health. *Journal of Behavioral Medicine*, *29* (3), 299-306. doi: 10.1007/s10865-006-9051-x

Wrosch, C., & Heckhausen, J. (2016). Introduction to the special section on motivational self-regulation across the lifespan. *International Journal of Behavioral Development*, *40*(2), 97-99. doi: 10.1177/0165025415603826

Wrosch, C., Heckhausen, J., & Lachman, M. E. (2000). Primary and secondary control strategies for managing health and financial stress across adulthood. *Psychology and Aging, 15*, 387–399. doi: 10.1037/0882-7974.15.3.387

Wrosch, C., Miller, G. E., Scheier, M. F., & Brun de Pontet, S. (2007a). Giving up on unattainable goals: Benefits for health? *Personality and Social Psychology Bulletin, 33*(2), 251-265. doi: 10.1177/0146167206294905

Wrosch, C., Miller, G. E., & Schulz, R. (2009). Cortisol secretion and functional disabilities in old age: Importance of using adaptive control strategies. *Psychosomatic Medicine, 71*(9),

996-1003. doi: 10.1097/psy.0b013e3181ba6cd1

Wrosch, C., & Scheier, M. F. (2003). Personality and quality of life: The importance of optimism and goal adjustment. *Quality of Life Research, 12*, 59-73. doi: 10.1023/A:1023529606137

Wrosch, C., Scheier, M. F., Carver, C. S., & Schulz, R. (2003b). The importance of goal disengagement in adaptive self-regulation: When giving up is beneficial. *Self and Identity, 2*, 1-20. doi: 10.1080/15298860309021

Wrosch, C., Scheier, M. F., & Miller, G. E. (2013). Goal adjustment capacities, subjective well-being, and physical health. *Social and Personality Psychology Compass*, *7*(12), 847-860. doi: 10.1111/spc3.12074

Wrosch, C., Scheier, M. F., Miller, G. E., Schulz, R., & Carver, C. S. (2003a). Adaptive self-regulation of unattainable goals: Goal disengagement, goal reengagement, and subjective well-being. *Personality and Social Psychology Bulletin, 29*(12), 1494-1508. doi: 10.1177 /0146167203256921

Wrosch, C., & Schulz, R. (2008). Health engagement control strategies and 2-year changes in older adults' physical health. *Psychological Science, 19*, 537-541. doi: 10.1111/j.1467-9280.2008.02120.x

Wrosch, C., Schulz, R., Miller, G. E., Lupien, S., & Dunne, E. (2007b). Physical health problems, depressive mood, and cortisol secretion in old age: Buffer effects of health engagement control strategies. *Health Psychology, 26,* 341-349. doi: 10.1037/0278-6133.26.3.341

Wüst, S., Fedorenko, I. S., vanRossum, E. F. C., Koper, J. W., & Hellhammer, D. H. (2005). Habituation of cortisol responses to repeated psychological stress – further characterization and impact of genetic factors. *Psychoneuroendocrinology, 30*, 199-211. doi: 10.1016 /j.psyneuen.2004.07.002

APPENDIX A

Consent Form

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 Basic Socio-demographics Characteristics

Personal information

1. **Sex** ☐ Female ☐ Male

2. **Age**_____yrs.

3. **First Language** ☐ English ☐ French ☐ Other_____

4. **Family Status?**

   ☐ married
   ☐ live with partner but not married
   ☐ single
   ☐ divorced; please indicate since when _____
   ☐ widowed; please indicate since when _____

5. **Highest Level of Education Completed**

   ☐ None
   ☐ High School
   ☐ Collegial or Trade School
   ☐ Bachelor's Degree
   ☐ Masters or Doctorate Degree

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

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

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

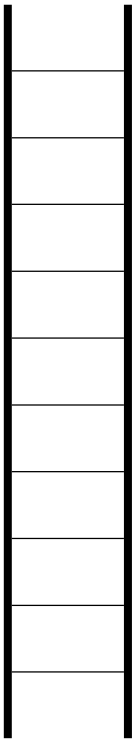
   ☐ Less than 17 000$ ☐ 17 001$ - 34 000$ ☐ 34 001$ - 51 000$
   ☐ 51 001$ - 68 000$ ☐ 68 001$ - 85 000$ ☐ more than 85 000$

9. Height: _____

10. Body weight: _____

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 and Tobacco Use

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? (IF YES:) What? _____			
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? (IF YES:) What type? _____			
15. Do you currently have rheumatoid arthritis, lupus, acquired immune deficiency syndrome, multiple sclerosis, scleroderma, or any other autoimmune problem?			

Physical Health (cont'd)

	NO	YES	NOT SURE
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?			
18. Do you currently have an overactive or underactive thyroid, or any other thyroid problems?			
19. Do you currently have any problems with your vision or hearing?			
20. Do you currently have asthma, bronchitis, or emphysema?			
21. Do you currently have persistent skin trouble (e.g., eczema)?			
22. Do you currently have recurring stomach trouble, indigestion, or diarrhea?			
23. Do you currently have migraine headaches?			
24. Are you constipated all or most of the time?			
25. Do you have chronic sleeping problems?			
26. Do you currently have any other health problems that I have not asked you about? (IF YES:) What? _____			

Tobacco Use

	YES	NO
1. Do you smoke cigarettes, cigars, or pipes daily?		
1a. On average how many of each do you smoke daily?_____cigarettes _____cigars _____pipes		

	YES	NO	I still smoke
2. Did you ever smoke cigarettes, cigars, or a pipe daily?			
2a. If yes, when did you quit smoking on a daily basis ?_____Month and year			

APPENDIX D

Assessment of Dispositional Optimism

Life Orientation Test - Revised

Describe Yourself

Please answer the following questions about yourself by indicating the extent of your agreement using the following scale: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree. Be as honest as you can throughout, and try not to let your response to one question influence your response to other questions. There are no right or wrong answers.

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. In uncertain times, I usually expect the best.					
2. If something can go wrong for me, it will.					
3. I'm always optimistic about my future.					
4. I hardly ever expect things to go my way.					
5. I rarely count on good things happening to me.					
6. Overall, I expect more good things to happen to me than bad.					

APPENDIX E

Cortisol Saliva Collection Times

DAY 1

Date: _____

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

1st Saliva Sample: ***(Label: 1-1)***   I woke up at_____h_____min
2nd Saliva Sample: ***(Label: 1-2)***   Exact time :_____h_____min
3rd Saliva Sample: ***(Label: 1-3)***   Exact time :_____h_____min
4th Saliva Sample: ***(Label: 1-4)***   Exact time :_____h_____min
5th Saliva Sample: ***(Label: 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: 2-1)***   I woke up at_____h_____min
2nd Saliva Sample: ***(Label: 2-2)***   Exact time :_____h_____min
3rd Saliva Sample: ***(Label: 2-3)***   Exact time :_____h_____min
4th Saliva Sample: ***(Label: 2-4)***   Exact time :_____h_____min
5th Saliva Sample: ***(Label: 2-5)***   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: 3-1)***   I woke up at_____h_____min
2nd Saliva Sample: ***(Label: 3-2)***   Exact time :_____h_____min
3rd Saliva Sample: ***(Label: 3-3)***   Exact time :_____h_____min
4th Saliva Sample: ***(Label: 3-4)***   Exact time :_____h_____min
5th Saliva Sample: ***(Label: 3-5)***   Exact time :_____h_____min

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

APPENDIX F

Assessment of Perceptions of Stress

DAY 1 (cont'd)

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. Stressed					
2. Overwhelmed					

DAY 2 (cont'd)

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. Stressed					
2. Overwhelmed					

DAY 3 (cont'd)

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. Stressed					
2. Overwhelmed					

APPENDIX G

Assessment of Depressive Symptoms

Center for Epidemiological Studies Depression Scale - 10-item

Well-Being

Below is a list of the ways you might have felt or behaved. Please indicate by a check how often you have felt this way **during the past week** using the following scale.

Rarely or None of the Time = Less than 1 Day
Some or a Little of the Time = 1 – 2 Days
Occasionally or a Moderate Amount of the Time =3 - 4 Days
Most or All of the Time = 5 - 7 Days

During the past week ….	**Less than 1 Day**	**1 – 2 Days**	**3 – 4 Days**	**5 – 7 Days**
1. I was bothered by things that usually don't bother me.				
2. I had trouble keeping my mind on what I was doing.				
3. I felt depressed.				
4. I felt that everything I did was an effort.				
5. I felt hopeful about the future.				
6. I felt fearful.				
7. My sleep was restless.				
8. I was happy.				
9. I felt lonely.				
10. I could not get "going."				

APPENDIX H:

Assessment of Cold Symptoms

Please indicate by checking the appropriate box, to what extent you have experienced any of the following cold symptoms during the past couple of weeks.

	None	**Mild**	**Moderately**	**Severe**	**Very severe**
Nasal congestion					
Sneezing					
Runny nose					
Cough					
Feeling under the weather					
Scratchy/sore throat					
Headaches					
Fever					

APPENDIX I

Assessment of Goal Disengagement

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 J

Specification of Within-Person and Between-Person HLM Models

Table 9

Specification of HLM Models Examining Within-Person Associations Between Daily Perceptions of Stress and Indicators of Diurnal Cortisol Secretion Across 12 Days of Assessment

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Level-1:

$$\text{Cortisol} = \beta_{0j} + \beta_{1j}(\text{Perceived Stress}) + \beta_{2j}(\text{Time}) + \beta_{3j}(\text{Time Squared}) + \beta_{4j}(\text{Day}) + \beta_{5j}(\text{Day Squared}) + r_{ij}$$

Level-2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Age}) + \gamma_{02}(\text{Sex}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{Smoking}) + \gamma_{05}(\text{Average Chronic Illness}) + \gamma_{06}(\text{Change in Chronic Illness}) + \gamma_{07}(\text{Average BMI}) + \gamma_{08}(\text{Change in BMI}) + \gamma_{09}(\text{Dispositional Optimism}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Age}) + \gamma_{12}(\text{Sex}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{Smoking}) + \gamma_{15}(\text{Average Chronic Illness}) + \gamma_{16}(\text{Change in Chronic Illness}) + \gamma_{17}(\text{Average BMI}) + \gamma_{18}(\text{Change in BMI}) + \gamma_{19}(\text{Dispositional Optimism}) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{Age}) + \gamma_{22}(\text{Sex}) + \gamma_{23}(\text{SES}) + \gamma_{24}(\text{Smoking}) + \gamma_{25}(\text{Average Chronic Illness}) + \gamma_{26}(\text{Change in Chronic Illness}) + \gamma_{27}(\text{Average BMI}) + \gamma_{28}(\text{Change in BMI}) + \gamma_{29}(\text{Dispositional Optimism}) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{Age}) + \gamma_{32}(\text{Sex}) + \gamma_{33}(\text{SES}) + \gamma_{34}(\text{Smoking}) + \gamma_{35}(\text{Average Chronic Illness}) + \gamma_{36}(\text{Change in Chronic Illness}) + \gamma_{37}(\text{Average BMI}) + \gamma_{38}(\text{Change in BMI}) + \gamma_{39}(\text{Dispositional Optimism}) + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{Age}) + \gamma_{42}(\text{Sex}) + \gamma_{43}(\text{SES}) + \gamma_{44}(\text{Smoking}) + \gamma_{45}(\text{Average Chronic Illness}) + \gamma_{46}(\text{Change in Chronic Illness}) + \gamma_{47}(\text{Average BMI}) + \gamma_{48}(\text{Change in BMI}) + \gamma_{49}(\text{Dispositional Optimism}) + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51}(\text{Age}) + \gamma_{52}(\text{Sex}) + \gamma_{53}(\text{SES}) + \gamma_{54}(\text{Smoking}) + \gamma_{55}(\text{Average Chronic Illness}) + \gamma_{56}(\text{Change in Chronic Illness}) + \gamma_{57}(\text{Average BMI}) + \gamma_{58}(\text{Change in BMI}) + \gamma_{59}(\text{Dispositional Optimism}) + u_{5j}$$

Note. The analyses were conducted for AUC, awakening, afternoon/evening, and CAR levels of cortisol. All Level-1 predictors were person-centered. Time represented years since study entry. SES = socioeconomic status. BMI = Body mass index. The Level-1 models had 134 *df*s and the Level-2 models had 125 *df*s.

Table 10

Specification of HLM Models Examining Between-Person Associations Between Daily Perceptions of Stress and Indicators of Diurnal Cortisol Secretion Across 12 Days of Assessment

Level-1:

$$\text{Cortisol} = \beta_{0j} + \beta_{1j}(\text{Time}) + \beta_{2j}(\text{Time Squared}) + \beta_{3j}(\text{Day}) + \beta_{4j}(\text{Day Squared}) + r_{ij}$$

Level-2 main effects:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Age}) + \gamma_{02}(\text{Sex}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{Smoking}) + \gamma_{05}(\text{Average Chronic Illness}) + \gamma_{06}(\text{Change in Chronic Illness}) + \gamma_{07}(\text{Average BMI}) + \gamma_{08}(\text{Change in BMI}) + \gamma_{09}(\text{Perceived Stress}) + \gamma_{010}(\text{Dispositional Optimism}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Age}) + \gamma_{12}(\text{Sex}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{Smoking}) + \gamma_{15}(\text{Average Chronic Illness}) + \gamma_{16}(\text{Change in Chronic Illness}) + \gamma_{17}(\text{Average BMI}) + \gamma_{18}(\text{Change in BMI}) + \gamma_{19}(\text{Perceived Stress}) + \gamma_{110}(\text{Dispositional Optimism}) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{Age}) + \gamma_{22}(\text{Sex}) + \gamma_{23}(\text{SES}) + \gamma_{24}(\text{Smoking}) + \gamma_{25}(\text{Average Chronic Illness}) + \gamma_{26}(\text{Change in Chronic Illness}) + \gamma_{27}(\text{Average BMI}) + \gamma_{28}(\text{Change in BMI}) + \gamma_{29}(\text{Perceived Stress}) + \gamma_{210}(\text{Dispositional Optimism}) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{Age}) + \gamma_{32}(\text{Sex}) + \gamma_{33}(\text{SES}) + \gamma_{34}(\text{Smoking}) + \gamma_{35}(\text{Average Chronic Illness}) + \gamma_{36}(\text{Change in Chronic Illness}) + \gamma_{37}(\text{Average BMI}) + \gamma_{38}(\text{Change in BMI}) + \gamma_{39}(\text{Perceived Stress}) + \gamma_{310}(\text{Dispositional Optimism}) + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{Age}) + \gamma_{42}(\text{Sex}) + \gamma_{43}(\text{SES}) + \gamma_{44}(\text{Smoking}) + \gamma_{45}(\text{Average Chronic Illness}) + \gamma_{46}(\text{Change in Chronic Illness}) + \gamma_{47}(\text{Average BMI}) + \gamma_{48}(\text{Change in BMI}) + \gamma_{49}(\text{Perceived Stress}) + \gamma_{410}(\text{Dispositional Optimism}) + u_{4j}$$

Level-2 interaction effects:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{Age}) + \gamma_{02}(\text{Sex}) + \gamma_{03}(\text{SES}) + \gamma_{04}(\text{Smoking}) + \gamma_{05}(\text{Average Chronic Illness}) + \gamma_{06}(\text{Change in Chronic Illness}) + \gamma_{07}(\text{Average BMI}) + \gamma_{08}(\text{Change in BMI}) + \gamma_{09}(\text{Perceived Stress}) + \gamma_{010}(\text{Dispositional Optimism}) + \gamma_{011}(\text{Perceives Stress X Dispositional Optimism}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{Age}) + \gamma_{12}(\text{Sex}) + \gamma_{13}(\text{SES}) + \gamma_{14}(\text{Smoking}) + \gamma_{15}(\text{Average Chronic Illness}) + \gamma_{16}(\text{Change in Chronic Illness}) + \gamma_{17}(\text{Average BMI}) + \gamma_{18}(\text{Change in BMI}) + \gamma_{19}(\text{Perceived Stress}) + \gamma_{110}(\text{Dispositional Optimism}) + \gamma_{111}(\text{Perceives Stress X Dispositional Optimism}) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{Age}) + \gamma_{22}(\text{Sex}) + \gamma_{23}(\text{SES}) + \gamma_{24}(\text{Smoking}) + \gamma_{25}(\text{Average Chronic Illness}) + \gamma_{26}(\text{Change in Chronic Illness}) + \gamma_{27}(\text{Average BMI}) + \gamma_{28}(\text{Change in BMI}) + \gamma_{29}(\text{Perceived Stress}) + \gamma_{210}(\text{Dispositional Optimism}) + \gamma_{211}(\text{Perceives Stress X Dispositional Optimism}) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{Age}) + \gamma_{32}(\text{Sex}) + \gamma_{33}(\text{SES}) + \gamma_{34}(\text{Smoking}) + \gamma_{35}(\text{Average Chronic Illness}) + \gamma_{36}(\text{Change in Chronic Illness}) + \gamma_{37}(\text{Average BMI}) + \gamma_{38}(\text{Change in BMI}) + \gamma_{39}(\text{Perceived Stress}) + \gamma_{310}(\text{Dispositional Optimism}) + \gamma_{311}(\text{Perceives Stress X Dispositional Optimism}) + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{Age}) + \gamma_{42}(\text{Sex}) + \gamma_{43}(\text{SES}) + \gamma_{44}(\text{Smoking}) + \gamma_{45}(\text{Average Chronic Illness}) + \gamma_{46}(\text{Change in Chronic Illness}) + \gamma_{47}(\text{Average BMI}) + \gamma_{48}(\text{Change in BMI}) + \gamma_{49}(\text{Perceived Stress}) + \gamma_{410}(\text{Dispositional Optimism}) + \gamma_{411}(\text{Perceives Stress X Dispositional Optimism}) + u_{4j}$$

Note. The analyses were conducted for AUC, awakening, afternoon/evening, and CAR levels of cortisol. All Level-1 predictors were person-centered. Time represented years since study entry. SES = socioeconomic status. BMI = Body mass index. The Level-1 models had 134 *df*s and the Level-2 models had 124 and 123 *df*s.

APPENDIX K

Correlation Table for Between Subjects Variables for Study 1

Table 11

Zero-Order Correlations Among Between Subjects Variables for Study 1

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Cortisol AUC across day													
2. Cortisol awakening level	.50**												
3. Cortisol afternoon/evening level	.86**	.32**											
4. Cortisol awakening response	.04	-.33**	.11										
5. Dispositional optimism	.02	.04	-.04	-.03									
6. Perceptions of stress	-.05	-.10	-.03	.02	-.37**								
7. Age	.10	-.06	.18*	-.06	-.02	.04							
8. Sex [a]	-.29**	-.11	-.30**	.12	-.11	.17*	.05						
9. Socioeconomic status	.12	.12	.10	-.02	.27**	-.07	-.13	-.21**					
10. Smoking	.17 [t]	.06	.18*	.04	-.02	-.04	-.11	-.13	-.08				
11. Average chronic illness	-.06	-.06	.01	-.12	-.17*	.16 [t]	.04	-.18*	-.04	.17*			
12. Δ chronic illness	.17 [t]	.05	.09	.05	-.07	.17*	.09	-.08	.10	.15 [t]	.38**		
13. Average BMI	.06	-.05	.06	.06	-.18*	.08	-.14	-.14	-.11	.08	.24**	.03	
14. Δ BMI	.09	-.02	.05	.04	-.15 [t]	.08	-.03	-.20*	-.04	-.04	.04	.05	.30**

Note. Measures of cortisol and average chronic illness and BMI represent constructs averaged across assessments. [a] Higher values represent female participants. [t] $p < .10$; * $p < .05$; ** $p < .01$.

APPENDIX L

Descriptive Tables and Repeated Measures ANOVA for

Indicators of Cortisol and Stress Perceptions

Table 12

Means (and Standard Deviations) of Indicators of Diurnal Cortisol Secretion And Stress Perceptions Across Waves of Study (Averaged Across Assessment Days)

	Wave of Study			
	Baseline	2-Year	4-Year	6-Year
Cortisol AUC across day	12.31 (2.46)$_a$	12.79 (2.20)$_b$	12.86 (2.45)$_b$	10.03 (2.48)$_c$
Cortisol awakening level	1.07 (0.20)$_a$	1.12 (0.16)$_b$	1.09 (0.19)$_{a, b}$	0.92 (0.23)$_c$
Cortisol afternoon/evening level	0.69 (0.14)$_a$	0.70 (0.14)$_{a, b}$	0.72 (0.14)$_b$	0.54 (0.16)$_c$
Cortisol awakening response	0.11 (0.19)	0.08 (0.20)	0.12 (0.16)	0.10 (0.19)
Perceptions of stress	0.56 (0.81)$_a$	0.94 (1.16)$_b$	0.85 (1.13)$_b$	0.79 (0.93)$_b$

Note. Means with different subscript differ significantly from each other at a level of $p < .05$. Post-hoc analyses were conducted with *t*-tests.

Table 13

Means (and Standard Deviations) of Indicators of Diurnal Cortisol Secretion And Stress Perceptions Across Assessment Days (Averaged Across Study Waves)

	Assessment Day		
	Day 1	Day 2	Day 3
Cortisol AUC across day	11.82 (1.78)$_a$	12.13 (1.82)$_b$	12.05 (1.90)
Cortisol awakening level	1.02 (0.16)$_a$	1.07 (0.16)$_b$	1.05 (0.16)$_b$
Cortisol afternoon/evening level	0.65 (0.11)$_a$	0.66 (0.11)	0.67 (0.12)$_b$
Cortisol awakening response	0.12 (0.16)$_a$	0.08 (0.18)$_b$	0.11 (0.16)
Perceptions of stress	0.80 (0.75)	0.76 (0.78)	0.80 (0.85)

Note. Means with different subscript differ significantly from each other at a level of $p < .05$. Post-hoc analyses were conducted with *t*-tests.

Table 14

F-Values of Repeated Measurement ANOVAs of Indicators of Diurnal Cortisol Secretion And Stress Perceptions for Linear and Quadratic Effects of Study Wave and Assessment Day

	Wave of Study			
	Wave (linear)	Day (linear)	Wave (quadratic)	Day (quadratic)
Cortisol AUC across day	70.40**	3.51	76.25**	4.02*
Cortisol awakening level	50.62***	5.73*	52.86**	11.38**
Cortisol afternoon/evening level	66.76**	6.10*	69.43**	0.41
Cortisol awakening response	0.00	0.03	0.11	4.56*
Perceptions of stress	4.50*	0.02	9.66**	0.66

Note. *df*s = 1, 134; * $p < .05$, ** $p < .01$.

APPENDIX M

Within-Person and Between-Person HLM analyses separating

Optimistic and Pessimistic Items of the LOT-R

Table 15

Results from HLM Analyses Examining Within-Person Associations Between Daily Perceptions of Stress and Indicators of Diurnal Cortisol Secretion (AUC, Awakening Level, Afternoon/Evening level, CAR) Across 12 Days of Assessment, Separately for the Optimism and Pessimism Items of the LOT-R

	AUC		Awakening		Afternoon/evening		CAR	
	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope
	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Level 1	12.00 (.14)**	.17 (.05)**	1.05 (.01)**	.02 (.01)**	.66 (.01)**	.01 (.00)*	.11 (.01)**	-.01 (.01)
Level 2								
Optimism items	-.27(.13)*	-.22 (.04)**	-.01 (.01)	-.01 (.00)**	-.01 (.01)*	-.01 (.00)**	-.00 (.01)	.01 (.01)
Level 2								
Pessimism items	-.18 (.14)	.13 (.06)*	-.01 (.01)	.01 (.01)*	.00 (.01)	.00 (.00)	.00 (.01)	-.01 (.01)*

Note. The intercepts represent participants' average levels of cortisol across days, and the slopes represent person-centered effects of stress perceptions on cortisol. All estimates were controlled for linear and quadratic effects of assessment day and time since study entry. In addition, effects of the optimism and pessimism items were controlled for the covariates reported in the manuscript. * $p < .05$; ** $p < .01$.

Table 16

Results from HLM Analyses Examining Between-Person Associations Between Daily Perceptions of Stress and Indicators of Diurnal Cortisol Secretion (AUC, Awakening Level, Afternoon/Evening level, Awakening CAR) Across 12 Days of Assessment, Separately for the Optimism and Pessimism Items of the LOT-R

	AUC	Awakening	Afternoon /evening	CAR
	Intercept	Intercept	Intercept	Intercept
	β (*SE*)	β (*SE*)	β (*SE*)	β (*SE*)
Level 1	12.00 (.14)**	1.05 (.01)**	.66 (.01)**	.10 (.01)**
Level 2				
Stress perceptions (S)	-.11 (.13)	-.01 (.01)	-.00 (.01)	-.01 (.01)
Optimism items (O)	-.31 (.13)*	-.01 (.01)	-.02 (.01)*	-.00 (.01)
S X O	.01 (.10)	.01 (.01)	-.00 (.01)	-.03 (.01)**
Level 2				
Stress perceptions (S)	.03 (.12)	-.01 (.01)	.00 (.01)	-.01 (.01)
Pessimism items (P)	-.19 (.15)	-.00 (.02)	.00 (.01)	-.00 (.01)
S X P	.02 (.12)	-.01 (.01)	.00 (.01)	.03 (.01)**

Note. The intercepts represent participants' average levels of cortisol across days. All estimates were controlled for linear and quadratic effects of assessment day and time since study entry. In addition, effects of stress perceptions and the optimism/pessimism items were controlled for the covariates reported in the manuscript. * $p < .05$; ** $p < .01$.