Self-Perceptions of Aging and Health:

The Embodiment of Age Stereotypes

by

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DEDICATION

"Those who love deeply never grow old; they may die of old age, but they die young"

— Benjamin Franklin

To my parents who have shown me what it means to love unconditionally. To my Sam who fills my days with joy and laughter. There is no one else I'd rather grow old with, both objectively and subjectively.

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ABSTRACT

Age stereotypes are pervasive in contemporary American society. A growing body of research has shown that the internalization of societal age stereotypes can affect older adults' self-perceptions of aging (SPA), or attitudes towards their own aging process, in ways that can have significant implications for health and well-being. Based on Levy's stereotype embodiment theory, this dissertation used data from the Health and Retirement Study to examine the behavioral, biological, and psychological processes that potentially underlie the relationship between SPA and health among older US adults.

On a behavioral level, Study 1 found that, over a 1-year follow-up, individuals with negative SPA were more likely to delay necessary medical care and report more barriers to care, such as limited access to transportation and disliking going to the doctor. On a biological level, Study 2 considered the association between SPA, perceived discrimination, and changes in cystatin c (a biomarker of kidney function). Over the 4-year follow-up, having more negative SPA was associated with larger increases in cystatin c (e.g., worse kidney functioning) among those who reported being the target of discrimination. On a psychological level, Study 3 investigated the relationship between two different perceptions of the self, self-perceptions of grip strength and SPA, in predicting 4-year change in mobility limitations among adults over age 65. Individuals with more positive SPA had fewer mobility limitations four years later, even after adjusting for measured/perceived grip strength and other risk factors. Having more positive SPA, however, was only predictive of fewer mobility problems among respondents who also perceived

their grip strength to be strong, highlighting the importance of considering both domain-specific and domain-general self-perceptions when designing interventions to improve functional health.

Together, these studies extend the literature linking SPA and health by investigating proposals about three underlying processes. The final chapter discusses the implications of study findings, with a special focus on the design of interventions to promote more positive attitudes toward aging and the need to change age-related attitudes among health care professionals.

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CHAPTER I

Overview

From children's books and birthday cards to movies and advertisements, negative stereotypic portrayals of older adults can be found everywhere. The prevalence of negative age stereotypes in American society is contributing to the development of biased expectations of what it means to grow old. Through exposure to negative age-stereotypic messages across the life course, many individuals come to associate aging with a process of inevitable disease and decline rather than continued growth and development. Although older adulthood is typically characterized as a period in which losses exceed gains, a growing body of work shows that there are significant individual differences in how individuals interpret internal and external age-related cues as they transition from mid- to late-life, and the extent to which older adults accept or reject age stereotypes has important implications for health and well-being.

For this dissertation, I begin Chapter I by introducing two related but competing theoretical frameworks for understanding how age stereotypes influence health. Next, I summarize some of the different measures used to assess implicit and explicit age-related attitudes and narrow my focus to self-perceptions of aging (SPA), or subjective perceptions of one's own aging process. After summarizing the known sociodemographic, health-related, and psychosocial determinants of SPA, I use the framework of Levy's stereotype embodiment theory to create an overall conceptual model of the effects of SPA on different domains of health and the potential psychological, behavioral, and physiological/biological mediators of SPA and health. Using this conceptual model, I provide a preview of my three dissertation studies,

illustrating how each study emphasizes a different behavioral, biological, or psychological process through which SPA may influence health in old age.

From Age Stereotypes to Health: Theoretical Frameworks

Stereotype threat theory (Steele & Aronson, 1995) and stereotype embodiment theory (Levy, 2009) are two prominent theories with competing perspectives on how age stereotypes affect the cognition, behavior, and biology of older adults. These theories offer alternative views on how older adults process environmental age-related cues and propose different pathways through which age stereotypes affect health. While a handful of studies have attempted to identify the dominant process driving responses to age stereotypes (Hess, Hinson, & Statham, 2004; O'Brien & Hummert, 2006; Wheeler & Petty, 2001), stereotype threat and self-stereotyping likely both affect the way in which older adults react to age stereotypes, and the challenge lies in determining which process predominates in a given setting or with regards to a specific outcome. In the following section, I review the main assumptions of each theory and discuss how the two theories differ in their proposed mechanisms through which age stereotypes impact health.

Stereotype Threat Theory

Stereotype threat is a situationally-based phenomenon that occurs when negative stereotypes about an individual's group are made salient, triggering psychological and physiological responses that impede performance. In the classic experiment by Steele and Aronson (1995), African American students performed significantly worse than their White counterparts on questions from the verbal section of the Graduate Record Examination when they were told the test was diagnostic of intellectual ability, thereby activating stereotypes regarding racial/ethnic differences in intelligence. These differences, however, disappeared when

the test was framed as a non-diagnostic tool for understanding the psychological factors involved in problem-solving. Spencer, Steele, and Quinn (1999) observed a similar performance-depressing effect when women were led to believe that a math test was highly sensitive to gender differences, which played into the stereotype that women have lower math ability compared to men. While the effects of stereotype threat on performance have been most well-documented among African Americans, women, and other stigmatized groups, stereotype threat can lead to poor performance among members of any group when negative stereotypes against that group are actively elicited through social comparison or task framing.

Age stereotype threat, therefore, has been proposed to impair the performance of older adults when environmental cues activate negative aging expectations and prompt upward social comparisons to higher functioning younger adults. Given the prevalence of negative stereotypes about aging and memory in American society, age stereotype threat has been largely documented under conditions when cognitive abilities are made salient. Hess, Auman, Colcombe, and Rahhal (2003) found that older adults performed significantly worse on a memory task when they were presented with fabricated evidence supporting the validity of research showing the negative effects of aging on memory. Similar decreases in memory performance were found when Kang and Chasteen (2009) framed a reading comprehension task as a test of memory ability, and the researchers explicitly stated their interest in the participants' ability to remember details of a reading passage. The effects of stereotype threat have been shown to vary depending on degree of group identification, with those who most identify with the stereotyped group being most affected by negative comparisons (Kang & Chasteen, 2009; Schmader, 2002). Not all older adults, therefore, are equally susceptible to the effects of age stereotypes due to differences in the centrality of the stereotyped domain to the individual's identity and self-worth.

While the specific mechanisms linking stereotype threat to poor performance are still actively debated, increased anxiety, negative cognitions, lowered expectations, physiological arousal, reduced working memory capacity, and reduced motivation have all been proposed to play a role in explaining the tendency for group members to underperform in stereotype-threat conditions. Schmader, Johns, and Forbes (2008) proposed an integrated model that emphasizes the central role of working memory and three distinct but interrelated mechanisms through which stereotype threat impairs performance: 1) physiological stress arousal, 2) performance monitoring with the narrowing of attention, and 3) suppression of negative thoughts and emotions. Therefore, motivational, affective, physiological, and cognitive processes likely all interact to predict the task performance of individuals under stereotype threat.

Stereotype Embodiment Theory

Levy's stereotype embodiment theory (Levy, 2009) proposes that the assimilation of societal age-related beliefs alters self-perceptions of the aging process, which has significant implications for health and functioning in a variety of domains. Stereotype embodiment theory is built on four premises. The first premise is that individuals are exposed to age stereotypes across the lifespan, and the internalization of these stereotypes shapes individuals' evaluations of their own aging experience. Starting at a young age, individuals receive implicit and explicit messages about the aging process and acquire stereotypic beliefs about how the aging process will unfold. When individuals carry these expectations with them as they age and progress through the life course, they can have significant effects on health and well-being in older adulthood. Indeed, individuals who held more negative age stereotypes earlier in life (18-49 years) were more likely to experience a cardiovascular event over the next 38 years (Levy, Zonderman, Slade, &

Ferrucci, 2009). The early internalization of age stereotypes, therefore, can have far-reaching consequences beyond the immediate context and influence future health outcomes.

The second principle is that age stereotypes have the potential to influence behavior on an unconscious level without the explicit knowledge of the individual. Researchers have demonstrated that mere exposure to age-related words can activate age stereotypes and drive significant changes in behavior. Priming with age stereotypes has been shown to affect performance in a variety of domains including memory (Levy, 1996), gait speed (Hausdorff, Levy, & Wei, 1999), and hearing (Levy, Slade, & Gill, 2006). Given that the effects of negative primes have been shown to be significantly larger than those of positive ones (Meisner, 2012), older adults are more likely to experience decrements rather than boosts in performance from exposure to societal norms and expectations regarding the aging process.

The third assertion is that age stereotypes gain salience through self-relevance as individuals cross the socially constructed and/or self-defined boundary from middle to old age. While there have been some studies showing young adults to be susceptible to the effects of age stereotype primes (Bargh, Chen & Burrows, 1996), experiments that expose older and younger participants to the same age-related primes show that older adults tend to exhibit larger behavioral changes in response to stereotype activation (Hess et al., 2004; Levy, 1996). Given this initial invulnerability of young adults against age stereotypes, individuals are often unprepared to resist the damaging effects of age stereotypes when they reach the societally proscribed threshold of old age. As individuals become increasingly sensitized to environmental old-age cues and begin encountering more situations in which they are treated differently due to their age, they may have few coping strategies to deal with the attacks on their self-concept, leaving them vulnerable to the negative physical and psychological effects of age discrimination.

The final theoretical assumption is that older adults integrate positive or negative stereotypical information into their own self-views in an assimilative manner, and these views influence health and well-being through psychological, behavioral, and physiological pathways. Levy and colleagues have generated a significant body of work demonstrating the plausibility of each of these potential mechanisms in explaining the relationship between age stereotypes and health. At the psychological level, Levy and Leifheit-Limson (2009) observed a "stereotype-matching effect" in which age stereotype primes had the largest impact when the content of the stereotype (e.g., cognitive vs. physical) matched the experimental task (e.g., photo recall vs. timed chair stand), illustrating the power of self-fulfilling prophecy in driving behavior change. At the behavioral level, Levy and Myers (2004) found that individuals with more positive SPA were more likely to engage in preventive health behaviors, supporting the idea that older adults with more positive views are more proactive in protecting their health. At the physiological level, negative age stereotypes seem to "get under the skin" by eliciting a heightened cardiovascular response, suggesting one pathway through which chronic exposure to age discrimination can have long-term effects on cardiovascular functioning (Levy, Hausdorff, Hencke, & Wei, 2000).

Effects of Stereotype Threat vs. Self-Stereotyping Among Older Adults

In summary, stereotype threat theory suggests that stereotype activation must be conscious and explicit to modify behavior, but stereotype embodiment theory posits that age stereotypes can act below the level of awareness but also become explicitly incorporated into one's self-concept as self-perceptions of aging. Whereas stereotype threat usually results in performance impairment, stereotype embodiment can improve or worsen performance depending on the valence of the stereotype (e.g., positive versus negative). While the stereotype threat paradigm contends that the target does not need to endorse the stereotype in order to be affected

by it, stereotype embodiment is considered to be an assimilative process and often implies a deeper level of stereotype identification due to a lifetime of exposure to age stereotypes.

For the purposes of this dissertation, it is especially important to consider how stereotype threat theory and stereotype embodiment theory differ in their proposed mechanisms for how age stereotype exposure affects health outcomes. Given that stereotype threat is a situational reaction to the perception of being the target of a negative stereotype, it is typically assessed in an experimental setting and focuses on task performance rather than direct health outcomes. Figure 1.1 is an adaptation of the integrated process model of stereotype threat effects on performance proposed by Schmader et al. (2008).

While this model can account for the effects of age stereotypes on short-term changes on sensorimotor (e.g., gait speed) and/or cognitive (e.g., memory recall) task performance, it does not clearly delineate how negative age stereotypes may play a role in the development of chronic conditions or increase the risk for adverse events. Although one could imagine how chronic exposure to age stereotype threat could induce a pattern of behavior that leads to more enduring changes in functional or cognitive health, the pathway to long-term health outcomes is not explicitly acknowledged in the model. Due to the activation of "hot" motivational factors, individuals under stereotype threat may also experience feelings of anxiety and exhibit significant physiological stress arousal in the form of increased arterial blood pressure and/or increased levels of cortisol. In terms of health, frequent prolonged exposures to stress-inducing stereotype threat conditions could wreak havoc on the body, leading to irreversible damage to the heart and other organ systems.

Based on Levy's stereotype embodiment theory, Figure 1.2 depicts the psychological, behavioral, and physiological pathways through which age stereotypes are proposed to affect

health. Like stereotype threat theory, stereotype embodiment theory acknowledges the ability of age stereotypes to elicit heightened physiological stress responses. In this model, however, physiological reactions are a direct result of the internalization of age stereotypes, and conscious motivational processes like anxiety seem to play less of a mediating role in subsequent behavior. Rather, results from implicit priming experiments suggest that "cold" automatic processes are increasing the likelihood that an older adult will engage in age-stereotypic behaviors upon activation of a self-relevant stereotype schema.

Stereotype embodiment theory, however, goes beyond simple ideo-motor associations and has been used to understand how self-perceptions of aging can affect engagement in complex health-related behaviors. Individuals who have undergone the process of stereotype embodiment have internalized age stereotypes into their self-concept in a way that can have implications beyond the immediate context. Self-perceptions of aging can affect long-term goals and motivations in ways that increase or decrease the likelihood of aging well. Stereotype embodiment theory, therefore, also emphasizes the role of conscious psychological (e.g., self-efficacy) and behavioral (e.g., use of health care services) factors in understanding the role of SPA in late life health.

For this dissertation, I adopt Levy's stereotype embodiment theory as the overarching framework guiding my three proposed studies. In the context of health, stereotype embodiment theory offers a strong but flexible theoretical foundation upon which to test additional hypotheses on how age stereotypes can affect health. Stereotype embodiment theory describes stereotype internalization as a developmental process and allows researchers to approach the effects of age stereotypes from a lifespan perspective. While stereotype embodiment theory imposes a general outline regarding the types of mediating pathways, it does not specify the

particular psychological, behavioral, or physiological factors involved, allowing for a broad range of mediators of be examined within the confines of the established framework.

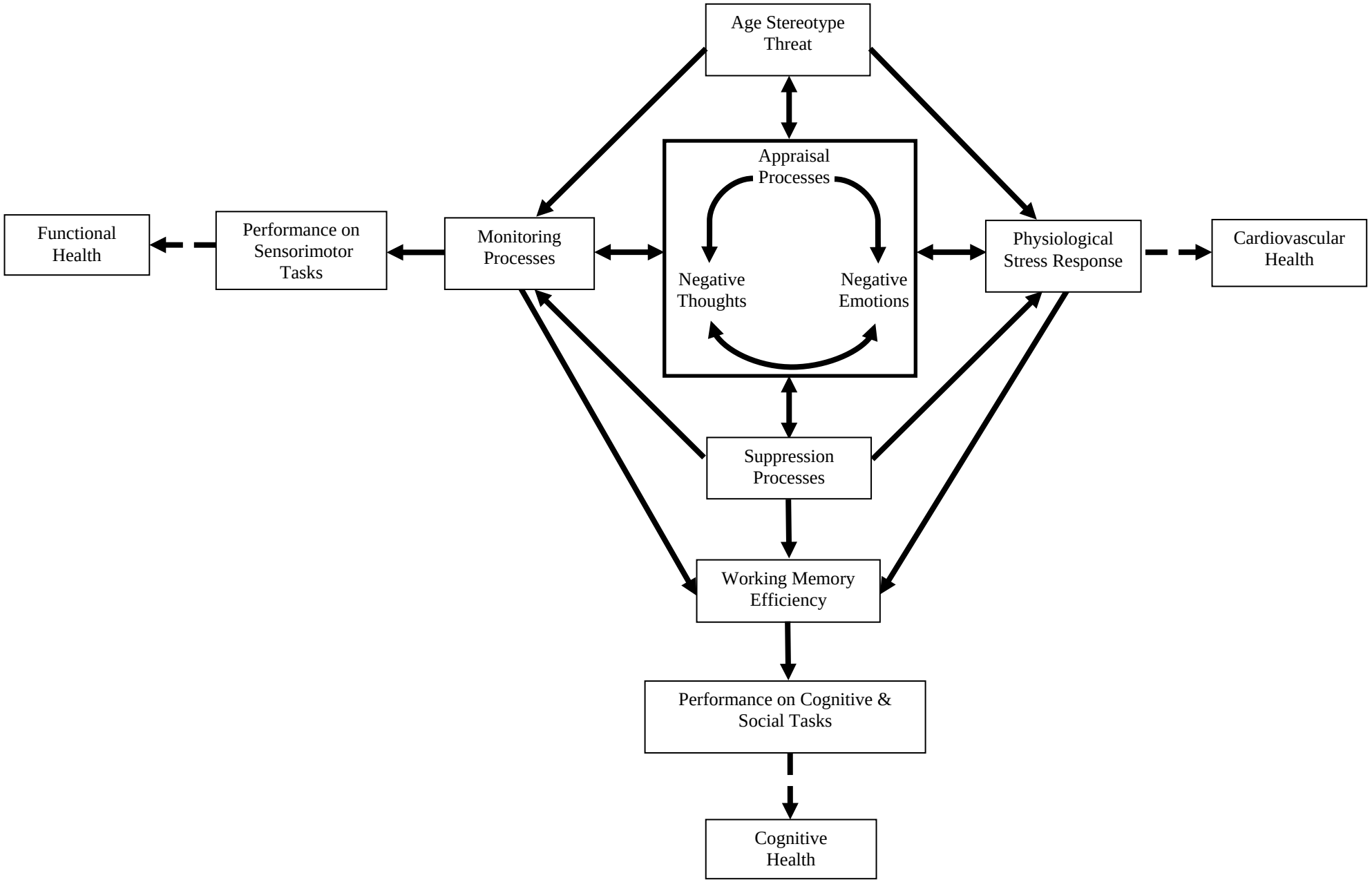


Figure 1.1 Mechanisms through which age stereotypes affect health based on stereotype threat theory. Adapted from Schmader, Johns, & Forbes (2008). Dotted lines indicate potential links to long-term health outcomes.

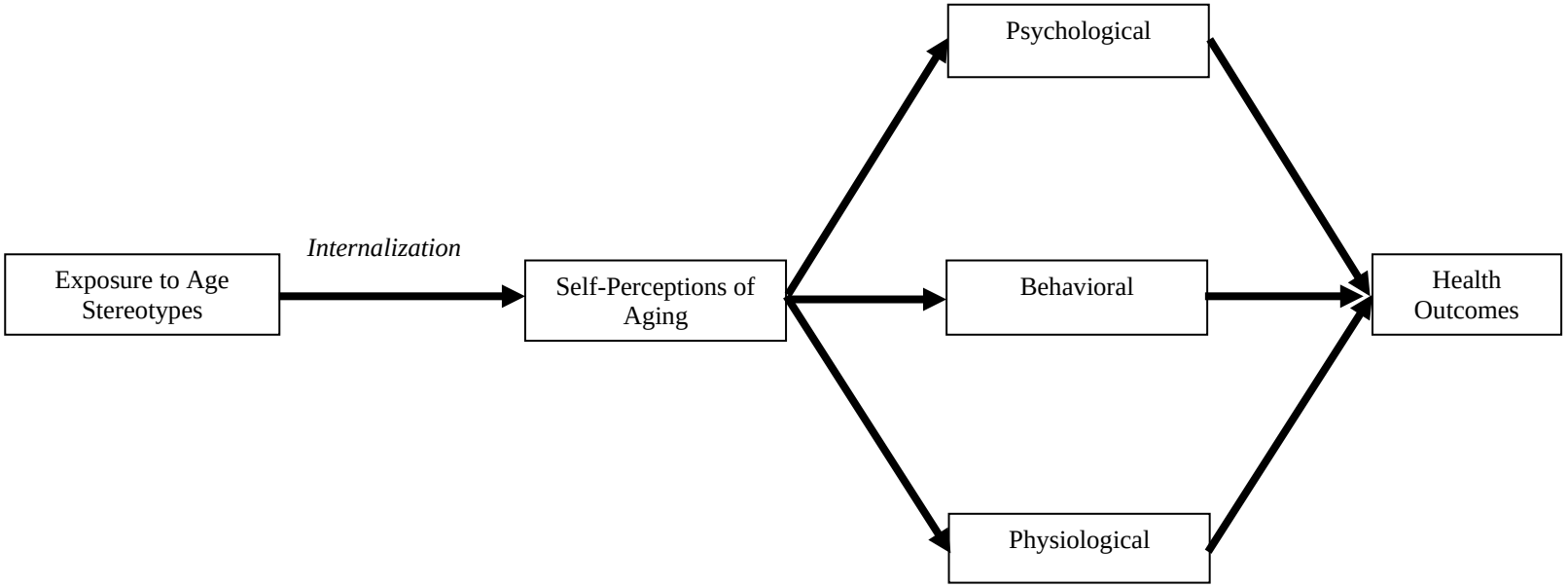


Figure 1.2. Mechanisms through which age stereotypes affect health based on stereotype embodiment theory. Adapted from Levy, 2009.

Measuring Implicit and Explicit Age-Related Attitudes

Researchers have developed various experimental methods and psychometric scales to understand the process through which age stereotypes are integrated into the self-concept. The following section offers a glimpse into the complexity involved in operationalizing older adults' perceptions about the aging process and deciphering the process through which age stereotypes affect health outcomes. Based on Levy's stereotype embodiment theory, I organize measures first based on whether they are implicit or explicit in nature. For explicit measures, I then provide illustrative examples of how different measures capture various stages of the internalization process from 1) the endorsement and validation of age stereotypes to 2) the development of personal attitudes towards aging/older adults to 3) the incorporation of age stereotypes into one's self-perceptions of age/aging. While measures do not necessarily fit into one of these three stages, Levy's stereotype embodiment theory provides a framework for organizing some of the existing measures of subjective age-related attitudes (Table 1.1).

Table 1.1 Measures of implicit and explicit age-related attitudes

Measure	Implicit/ Explicit	Classification	Description	Sample Item	Citation
Implicit Association Test (IAT)	Implicit	N/A	Reaction time task; strength of association between concepts and evaluations	Old and young faces paired with positive and negative words	Greenwald, McGhee, Schwartz, 1998
Priming	Implicit	N/A	Exposure to stimuli at a speed that allows for perception but not conscious processing	Senility-related (e.g, dementia) vs. wisdom-related (e.g., alert) words	Levy, 1996
Attitudes Toward Older People Scale	Explicit	Endorsement of age stereotypes	Endorsement of misconceptions and stereotypes about old people (Yes/No)	"Old people are helpless"	Tuckman & Lorge, 1953
Palmore's Facts on Aging	Explicit	Endorsement of age stereotypes	Knowledge about basic physical, mental, and social facts as well as common misconceptions about aging	"The majority of old people are senile"	Palmore, 1977; Palmore, 1980
Image of Aging Scale	Explicit	Attitudes toward aging	Extent to which one's image of aging corresponds to 9 conceptual categories	Activity (walks slowly vs. active)	Levy, Kasl, & Gill, 2004
Attitudes Toward Old People Scale	Explicit	Attitudes toward older adults	Paired positive/negative sentiments about older adults in various domains	"Most old people get set in their ways and are unable to change"	Kogan, 1961
Subjective Age	Explicit	Self-perceptions of age	How old one feels regardless of chronological age	"How old do you feel?"	Kastenbaum, Derbin, Sabatini, & Artt, 1972
Attitudes Toward Own Aging Subscale	Explicit	Self-perceptions of aging	Subjective evaluations of one's own aging experience	"The older I get, the more useless I feel"	Lawton, 1975; Liang & Bollen, 1983

Implicit Measures

Levy (2009) asserts that the internalization of age stereotypes is largely an unconscious process that occurs without the explicit awareness of the individual. Two of the most widely used methods for measuring implicit age attitudes has been through the Implicit Association Test (IAT) and priming (Greenwald et al., 1998; Levy & Banaji, 2002). Both priming and the IAT take advantage of the fact that individuals often hold implicit age biases that do not match their explicit beliefs (Nosek, Banaji, & Greenwald, 2002), and older adults who do not consciously endorse age stereotypes may nonetheless be affected by societal messages regarding the aging process. Measuring implicit age attitudes and stereotypes eliminates concerns about social desirability and paints a more realistic picture of how older adults unconsciously react to age-related cues during daily interactions.

Age IAT studies tend to focus on individual and group differences in unconscious age-related attitudes, with less emphasis on the associated behavioral outcomes. The implicit association test (IAT) pairs a target social category or concept (e.g., young vs. old) with an evaluative component (e.g., good vs. bad) and uses differences in response times for alternate pairings as a measure of implicit bias. On a computer, participants who take the age IAT on Harvard's Project Implicit website (https://implicit.harvard.edu/implicit/) may first be asked to press a left key in response to young faces and good words (e.g., happy, friend) and press a right key in response to old faces and bad words (e.g., awful, tragic). The pairings are then switched with the left key corresponding to young faces/bad words and the right key corresponding to old faces/good words. The age IAT, therefore, can be used to reveal the extent to which participants implicitly favor younger versus older adults. The implications of such biases for health and well-being can then be studied at the individual, institutional, and societal levels.

Studies that use age stereotype priming, on the other hand, tend to investigate the effects of implicit age stereotypes on cognitive, behavioral, and affective outcomes in an experimental setting. One popular priming paradigm has been to activate pre-existing age schemas by presenting positive or negative age-stereotypic words on a computer screen at a speed that allows for perception but not conscious awareness and then assessing how stereotype activation affects subsequent task performance. Levy (1996), for example, studied the memory effects of exposing older adults to senility-related (e.g, Alzheimer's, dementia) versus wisdom-related (e.g., alert, insightful) primes. The guiding assumption is that exposure to age stereotypes activates old age identities and affects behavior only if the target considers the stereotypes to be self-relevant.

Explicit Measures

Although Levy (2009) describes the internalization of age stereotypes as a largely unconscious process, explicit age-related attitudes are also important to understanding individual differences in how people consciously view and interpret the world around them. Implicit and explicit measures offer distinct but complementary perspectives on the aging process, and the development of survey-based measures of subjective aging has allowed researchers to ask targeted questions that focus on specific aspects of the aging experience.

Endorsement of age stereotypes. While Levy (2009) suggests that everyone is exposed to age stereotypes across the lifespan, there are individual differences in the extent to which each person detects and accepts these stereotypic messages as factual representations of the aging process. Some measures, therefore, directly measure the degree to which individuals endorse common stereotypes about aging. The Baltimore Longitudinal Study of Aging, for example, asks participants how much they agree or disagree with negative age-stereotypic statements (e.g., old people are helpless) derived from the Attitudes Toward Older People Scale (Tuckman & Lorge,

1953). Another commonly used measure, Palmore's Facts on Aging (Palmore, 1977; Palmore, 1980), is a true/false quiz that was developed to assess knowledge of basic physical, mental, and social facts as well as common misperceptions about aging. It has been adapted for research purposes and commonly used as an indicator of bias against older adults, based on the assumption that participants who endorse the validity of statements like "The majority of old people are senile" and "Old people usually take longer to learn something new" are more accepting of negative age stereotypes.

Attitudes toward aging/older adults. Through repeated exposure across the lifespan, Levy (2009) suggests that individuals develop biased attitudes toward aging early in life and carry these attitudes with them into older adulthood. Individuals develop a mental image of how the typical older adult looks and behaves, which not only colors their interactions with older adults in everyday settings but also shapes their own expectations of what old age will bring. Researchers have tried to measure conscious attitudes towards aging by asking individuals to describe their own views of older adults: "When you think of somebody old, what are the first five words that come to mind?" (Levy & Langer, 1994). Given the open-ended nature of the question, respondents are able to list words that most closely mirror their own ideas of aging in the absence of specific word prompts.

Unlike age stereotypes which are predominantly negative and give rise to prejudice and discrimination against older adults, aging attitudes can range from extremely positive to extremely negative depending on the domain in question. Therefore, some scales provide both positive and negative depictions of aging in various domains to gain a more complete and balanced picture of respondents' internal representations of aging. The Image of Aging Scale (Levy et al., 2004), for example, asks participants to rate the extent to which their image of aging

corresponds to words from 9 conceptual categories: activity (walks slowly, active), appearance (wrinkly, well-groomed), cognition (senile, wise), death (dying, full of life), dependence (helpless, capable), personality (grumpy, positive outlook), physical health (sick, healthy), relationships (lonely, family-oriented), and will to live (will to live, given up). In a similar manner, Kogan's Attitudes Toward Old People scale (Kogan, 1961) presents respondents with paired positive and negative sentiments about older adults with regards to residence, tension, homogeneity, intergenerational relations, dependence, cognitive style, personality, personal appearance, and power. For cognitive style, for example, respondents are asked to what extent they agree that "Most old people get set in their ways and are unable to change" versus "Most old people are capable of new adjustments when the situation demands it."

Self-perceptions of age/aging. Finally, Levy (2009) contends that age stereotypes gain salience through self-relevance. Upon reaching old age, age stereotypes become directed towards the self and serve as a benchmark against which to evaluate one's own aging experience. While the endorsement of age stereotypes and general attitudes towards older adults may indirectly reflect how older adults feel about their own aging, measures of self-perceptions of age/aging ask respondents to think about their own aging in the first person in order to directly assess the extent to which age stereotypes have been assimilated into their self-views.

Researchers often use chronological age as a proxy for understanding the development process. Chronological age, however, does not always correspond with subjective age, or the age individuals feel on the inside. Measures of subjective age or age identity assess self-perceptions of age by asking about the age a person feels regardless of their chronological age (Kastenbaum et al., 1972). While some researchers use subjective age at face value, others focus on the discrepancy between subjective and chronological age to quantify the extent to which individuals

feel older or younger than their calendar age (Rubin & Berntsen, 2006). The construct of subjective age has been further differentiated by some into perceived “mental age” and perceived “physical age” (Uotinen, Rantanen, & Suutama, 2005). “Felt age” has also been distinguished from “ideal age” due to their distinct associations with mental health and well-being (Kaufman & Elder, 2002; Keyes & Westerhof, 2012). Barak and Stern (1986) provides a review of different ways in which subjective age has been operationalized in the literature. These measures of self-perceptions of age, however, have been criticized for being devoid of context and vague regarding the relative contributions of personal experiences and normative age expectations to the formation of age-related self-views.

Other measures have attempted to probe deeper into the actual lived experience of growing older to measure individuals’ self-perceptions of the aging process. The Attitudes Towards Own Aging subscale of the Philadelphia Geriatric Center Morale scale is a commonly used measure that asks respondents to indicate the degree to which they endorse statements such as “Things keep getting worse as I get older” and “The older I get, the more useless I feel" (Lawton, 1975; Liang & Bollen, 1983). Although there are many other domain-general and domain-specific measures of SPA, the Attitudes Toward Own Aging subscale has been shown to be a reliable predictor of a wide range of important health outcomes.

A Focus on Self-Perceptions of Aging

For my three dissertation studies, I use an adapted measure of SPA from the Health and Retirement Study that includes five items from the Attitude Toward Own Aging subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975; Liang & Bollen, 1983) and an additional three items from the Berlin Aging Study (Baltes & Mayer, 2001). The HRS self-perceptions of aging scale includes a balance of both positively-worded (e.g., “So far, I am

satisfied with the way I am aging") and negatively-worded (e.g., "Getting older has brought with it many things that I do not like") items.

Among the explicit survey-based measures reviewed above, self-perceptions of age/aging are the among the most internalized form of age stereotypes and likely to be the strongest and most proximal predictor of health-related outcomes. Levy's stereotype embodiment theory, however, emphasizes self-perceptions of *aging* rather than self-perceptions of *age*. Although some researchers consider self-perceptions of aging to be synonymous with subjective age, I use the term self-perceptions of aging (SPA) in this dissertation to refer more specifically to attitudes towards one's own aging process. The remainder of this chapter will focus on 1) the individual-level predictors of SPA, 2) previous research on SPA and health, and 3) the mediators of SPA and health.

Individual-Level Predictors of Self-Perceptions of Aging

Levy's stereotype embodiment theory emphasizes age stereotypes as one of the driving forces behind older adults' perceptions of their own aging experience. Age stereotypes, despite their power, are not the only factors influencing how older adults perceive themselves as they age. Individual-level characteristics may influence self-perceptions of aging, independent of the effects of age stereotypes. Identifying individual factors that are amenable to change will guide our efforts to improve SPA and in turn, the health and well-being of the aging population. For the purposes of the current dissertation, understanding the individual-level predictors of SPA will be important for choosing relevant covariates and isolating the effects of SPA independent of other sociodemographic, health-related, and psychosocial factors.

Given that SPA is an age-related construct, it is not surprising that how people feel about their own aging depends on where they are in the life course. The relationship between chronological age and SPA, however, is not necessarily linear or constant in magnitude across the lifespan. Studies that examine how self-perceptions of aging change over time approximate the effects of age on SPA by comparing SPA among participants of different ages or tracking intra-individual changes in SPA during the transition from middle to old age. While there appears to be a general trend for self-perceptions of aging to become more negative later in life, some studies suggest that older adults may be able to maintain steady levels of SPA as they enter their later years. Wurm, Wolff, and Schüz (2014) found both age and age^2 to be significant predictors of SPA among a sample of adults aged 40-85 years from the German Aging Survey, suggesting that positive SPA may initially increase in midlife but then gradually decrease in older adulthood. Interestingly, Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, and Smith (2009) proposed that after the age of 70, changes in SPA may be more related to a sense an impending death rather than age-related changes or the general experience of growing older.

Other sociodemographic factors may also affect older adults' SPA. Gender and race, for example, may influence the frequency of exposure to age stereotypes, and certain groups may be disproportionately targeted by age stereotypic-messages. Research on sex-differences in SPA, however, have yielded inconsistent results, and it is unclear which sex views aging in a more positive light (Kim & Moen, 2002; Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008; Sun, Kim, & Smith, 2017). There are also relatively few studies that directly examine differences in SPA by race. Sun et al. (2017) found Black/African American respondents to have more positive SPA compared to their White counterparts after adjusting for other sociodemographic factors, but more studies are needed to understand the differences in the subjective experience of aging

among racial/ethnic minorities. Socioeconomically, individuals with more personal resources in the form of income and/or educational attainment tend to report more positive perceptions of their own aging process (Kwak, Ingersoll-Dayton, & Burgard, 2014; Wurm et al., 2014). Collectively, sociodemographic factors seem to have an inconsistent effect on SPA, suggesting that the sociodemographic factors may exert only a weak to moderate effect on self-directed aging attitudes depending on the sample and the other covariates included in the model.

The impact of health on SPA seems more clear-cut and well-established. Generally, individuals with more health problems (e.g., greater number of diseases, greater severity of disease, poor functional health, poor cognitive health) tend to perceive their aging more poorly (Kleinspehn-Ammerlahn et al., 2008; Kwak et al., 2014; Wurm et al., 2014). While many of these measures are based on self-report, performance-based measures and anthropomorphic assessments have also been linked to how older adults view their own age. After adjusting for sociodemographic factors, self-rated health, and depression, Stephan, Sutin, and Terracciano (2015) found that lower peak expiratory flow, lower grip strength, and higher waist circumference were all associated with older subjective age. Blood pressure and telomere length, on the other hand, were not related to subjective age.

Stephan and colleagues concluded that it is the more observable or perceptible biological cues that likely contribute to how old individuals feel independent of their chronological age. Although subjective age is distinct from attitudes towards one's own aging, they both capture subjective evaluations of the aging self and may share some common predictors. Older adults may be interpreting both internal and external cues about their health status as a reflection of their likelihood of aging successfully. Health status, therefore, is both an antecedent and a

consequence of older adults' views of aging, but the effects of SPA on health seem to be substantially larger than the reverse (Sargent-Cox, Anstey, & Luszcz, 2012).

Personality and other psychosocial factors have recently received more attention as predictors of SPA. Rigidity, or an intolerance for ambiguity, has been associated with more negative aging self-stereotypes over time, which, in turn, predict more negative aging self-perceptions over time (Levy, 2008). Individuals with more rigid personalities may more readily accept negative age stereotypes perpetuated in mainstream American culture, while individuals with more flexible personalities may question the veracity of such views and update their attitudes toward aging based on ongoing life experiences. Moor, Zimprich, Schmitt, and Kliegel (2006) offered an explanation for how neuroticism could act through age stereotypes to affect self-rated health. Older adults high in neuroticism tend to hold more negative aging self-stereotypes, and these negative views on aging appear to impact how individuals perceive their own health, independent of gender, objective health status, and depression. Among the other Big Five personality traits, agreeableness was also found to be a significant predictor of positive aging self-perceptions (Moor et al., 2006).

To determine the relative contribution of sociodemographic, health-related, and psychosocial variables in determining SPA, Jang, Poon, Kim, and Shin (2004) performed a hierarchical multiple regression analysis on a sample of 291 Korean community-dwelling older adults. Demographic variables (age, gender, marital status, education, perceived economic status) accounted for 15% of the variance in SPA. Older Korean adults with higher levels of education and higher perceived economic status had more positive SPA. Health-related variables explained an additional 17% of the variance in SPA (chronic conditions, functional disability, vision, hearing, number of sick days). More chronic conditions, greater disability, poorer vision,

and more sick days were associated with more negative SPA. Adding psychosocial factors (neuroticism, mastery, network with family, network with friends) contributed to another 12% of the variance, where individuals with higher levels of neuroticism and a lower sense of mastery tended to have more negative SPA. Finally, an additional 3% of the variance was attributed to self-rated health after accounting for all other covariates, and individuals with higher self-rated health reported more positive SPA.

Previous Research on Self-Perceptions of Aging and Health

While having a positive perception of one's own aging is desirable in its own right, self-perceptions of aging have also been associated with a range of important health outcomes. The degree to which older adults internalize age stereotypes and interpret environmental cues as signals of "old age" has been shown to affect functional, cardiovascular, cognitive, and psychological health. Health behaviors also been studied in relation to older adults' attitudes towards their own aging in hopes of uncovering if personal age-related beliefs predict engagement in protective and/or damaging lifestyle behaviors. Finally, adverse events, in the form of hospitalization and mortality, are important downstream outcomes that can be a consequence of negative self-directed age attitudes. In the following section, I review the literature on what is known regarding the relationship between SPA and each health outcome. While the focus of my dissertation is on self-perceptions of aging measured in a survey context, this review consolidates findings from both age stereotype priming experiments and longitudinal prospective studies to offer a more complete picture of the short- and long-term effects of internalized attitudes towards aging.

Functional Health

Functional health is important to the ability of older adults to maintain their independence and continue engaging in productive and meaningful activities as they enter their later years. Although cumulative wear and tear decreases the efficiency with which the body performs in old age, physical decline is not inevitable, and evidence suggests that having a positive mindset regarding one's own aging can have powerful effects on physical functioning. Self-perceptions of aging have been shown to be associated with a variety of functional health outcomes, including the risk of several adverse events related to functional decline. Findings from both experimental and observational studies have added to our understanding of how age stereotypes and our attitudes toward aging can shape late life functional trajectories.

While there have been some experimental studies showing an effect of old age stereotypes on the walking speed of younger adults (Bargh et al., 1996), age stereotypes seem to have a stronger effect on the physical functioning of older adults because of the increased salience and self-relevance of age stereotypes for this age group. After exposing older participants to positive age stereotypic words under the pretense of a computer game, Hausdorff et al. (1999) found that older adults experienced significant increases in gait speed and percent swing time (time spent with one foot off the floor during walking) compared to baseline. The content of age stereotypes, therefore, can have immediate, short-term effects on older adults' physical performance.

Longitudinal prospective studies have allowed researchers to track how self-perceptions of aging affect changes in physical functioning over the course of years. A significant number of studies have shown a relationship between SPA and self-reported functioning (Levy, Slade, & Kasl, 2002; Moser, Spagnoli, & Santos-Eggimann, 2011; Wurm & Benyamini, 2014). More positive SPA, for example, were associated with better self-reported functional health (e.g.,

ability to perform ordinary/heavy work around the house, work at full-time job, walk half a mile, visit friends or relatives, walk up and down stairs, etc.) over an 18-year period, over and above baseline measures of functional health, self-rated health, age, gender, race, and socioeconomic status (Levy, Slade, & Kasl, 2002). Attitudes towards one's own aging have also been linked to longitudinal changes in performance-based measures, such as walking speed (e.g., number of seconds needed to completed Timed Up-and-Go (TUG) task) two years later (Robertson, Savva, King-Kallimanis, & Kenny, 2015).

While many of these prospective studies control for physical functioning at baseline, there has been considerable debate over the directionality of the relationship between SPA and physical functioning in older adults. To more closely examine the temporal relationship between SPA and physical functioning, Sargent-Cox et al. (2012) collected measurements of both SPA and physical functioning (e.g., side-by-side stands, semi-tandem stands, full-tandem stands, chair rises, gait speed) over 5 waves (up to 16 years) for 1,212 older adults 65 years or older in the Australian Longitudinal Study of Aging. Using a bivariate dual change score model (BDCSM), Sargent-Cox et al. (2012) demonstrated that the model which allowed for cross-lagged effects of SPA to physical functioning with restrictions on effects from physical functioning to SPA resulted in the best fit for the data, suggesting that the effects of SPA on physical functioning are stronger than the reverse.

Unlike most studies that investigate the relationship between SPA and physical functioning in everyday contexts, some studies have explored how SPA affects physical recovery following an adverse health event. For example, among a sample of older patients who had experienced an acute myocardial infarction, individuals who endorsed more positive age stereotypes at baseline exhibited greater physical recovery 1 month and 7 months later (Levy &

Slade, May, & Caracciolo, 2006). In the context of a serious health event, research has shown that positive SPA can lead to short-term increases in negative affect but long-term improvements in functional health (Wolff, Schüz, Ziegelmann, Warner, & Wurm, 2015). Specifically, individuals with more negative SPA who perceive physical losses as an inevitable part of aging may be less surprised by sudden deteriorations in health, and therefore, less likely to respond with increases in negative affect. Their negative outlook on aging, however, may prevent them from engaging in health-promoting activities, leading to worse physical functioning over time. Individuals with more positive SPA, on the other hand, may invest significant cognitive and emotional resources in the short-term to cope with unexpected losses but incur health benefits in the long run from sustained efforts to engage in an active and healthy lifestyle.

Finally, having more positive SPA may reduce the risk for falls, which are especially devastating for the older adult population. Although falls are not a direct measure of functional status, falling is a serious adverse outcome for older adults experiencing deteriorating functional health. Studying the effect of psychosocial factors, such as SPA, on fall risk may be helpful in identifying modifiable risk factors. Based on data from 4,121 respondents in the Health and Retirement Study, participants with more positive SPA were 12% less likely to experience a fall over the next four years after adjustment for age, gender, education, ethnicity, medical status, functional status, cognitive functioning, walking speed, balance, vision, depressive symptoms, physical activities, and past falls. Mediation analyses suggested that self-perceptions of aging partially exerted their effects on fall risk through impacting levels of physical functioning (e.g., ADLs/IADLs). In other words, individuals who were more satisfied with their own aging experienced less physical impairment, which in turn, reduced their risk for falls (Ayalon, 2015). Moser et al. (2011) found a similar association between negative SPA and increased risk of falls,

but the strength of association fluctuated from the first to the third year of follow-up with a statistically significant relationship found in the second year only.

In general, the relationship between SPA and physical functioning appears robust, with strong evidence from both experimental and longitudinal, prospective studies supporting the theory that assimilation of negative age stereotypes increase the risk for functional decline. More studies are needed to understand the underlying processes leading to changes in functional health and whether negative aging self-perceptions are leading individuals to withdraw prematurely from activities and make unnecessary accommodations based on stereotypic expectations. If indeed older adults are changing their behavior based on perceived physical deficits, these subjective distortions may be contributing to the development of actual limitations through self-fulfilling prophecy.

Cardiovascular Health

While self-perceptions of aging have been shown to broadly affect health in multiple domains, SPA may act through specific physiological pathways that disproportionately impact some organ systems more than others. The cardiovascular system, in particular, seems to be sensitive to the effects of age stereotypes and exhibit exaggerated responses when participants perceive age-related threats to their self-concept. An experimental study by Levy et al. (2000) found that older adults exposed to negative age stereotypes experienced a significantly heightened cardiovascular response (e.g., systolic blood pressure, diastolic blood pressure, heart rate) immediately after priming with age-stereotypic words. Negative age stereotypes, therefore, may act as a direct physiological stressor and place undue strain on the cardiovascular system. Positive age stereotypes, on the other hand, seemed to have a protective effect against stress by preventing significant autonomic changes from baseline despite exposure to multiple challenges.

While the participants in the original experiment were predominantly White, the effect of age-stereotype primes on cardiovascular response during stress-inducing activities has also been replicated in a sample of older African American adults (Levy et al., 2008).

There may, however, be individual differences in how people react physiologically to threatening age-stereotypic information. Weiss (2016) proposed that essentialist beliefs about aging may moderate the effect of negative age stereotypes on overall systolic blood pressure reactivity. After being confronted with negative age stereotypes, older adults who viewed aging as a more fixed and inevitable process experienced greater cardiovascular reactivity in response to a memory test compared to older adults who believed aging to be more malleable and modifiable. Stronger endorsement of essentialist aging beliefs resulted in significantly higher systolic blood pressure reactivity in a negative stereotype condition compared to a neutral prime condition (Weiss, 2016). Consequently, self-perceptions of aging likely have both direct and indirect effects on cardiovascular health and interact with a range of psychological factors to determine the degree of cardiovascular stress reactivity.

While short-term fluctuations in blood pressure and heart rate may not have immediate health repercussions, frequent and sustained activation of the hypothalamic-pituitary-adrenal (HPA) axis and/or sympathetic nervous system in response to stressful situations (e.g., exposure to age stereotypes) could lead to an increased risk for adverse cardiovascular events. Indeed, individuals who held more negative age stereotypes in earlier in life (18-49 years) were more likely to experience a cardiovascular event over the next 38 years (Levy et al., 2009). Several recent meta-analyses have shown a longitudinal association between greater stress reactivity/impaired stress recovery and poor cardiovascular outcomes (Chida & Steptoe, 2010; Panaite, Salomon, Jin, & Rottenberg, 2015). Regular exposure to negative age stereotypes may

be one of the triggers that set older adults on a path to developing negative attitudes toward their own aging and increasing their risk for cardiovascular-related morbidity and mortality.

Cognitive Health

The predominance of negative age stereotypes in American society may be partially to blame for the rates of cognitive decline in the older adult population. Several experimental studies have shown the memory-depressing effects of exposure to negative age stereotypes. In one study, Levy (1996) implicitly activated age stereotypes regarding memory by exposing older adults to senility-related (e.g., Alzheimer's, decline, senile) or wisdom-related (e.g., wise, alert, insightful) words as part of a computer task. Participants who were exposed to positive age stereotypes tended to improve their memory performance while participants negative age stereotypes performed substantially worse. Interestingly, Hess et al. (2004) found similar effects of negative age stereotypes on memory when they were presented implicitly, but there was no overall effect of stereotype valence among older adults who were made explicitly aware of the age-related primes. Making participants aware of the primes eliminated the effects associated with the negative primes in the implicit condition, suggesting that older adults are sensitive to cultural messages regarding aging but able to counteract the negative effects of age stereotypes when they are made blatant.

Cross-cultural studies have also allowed researchers to better understand how cultural differences in the prevalence of negative age stereotypes can affect cognitive performance. A study by Levy and Langer (1994) examined the relationship between aging stereotypes and memory among both young and old participants from three different cultures: Chinese hearing, American deaf, and American hearing. Chinese hearing and American deaf individuals were hypothesized to hold more positive views of aging because they tend to hold their elders in high

esteem and are more isolated from the negative age stereotypes propagated in mainstream American culture. While the young participants from the three groups performed similarly, the older Chinese hearing and American deaf significantly outperformed the American hearing on the memory tasks (e.g., episodic recall tests of explicit memory). Thus, the culture in which one lives can have a substantial influence on one's late life cognitive functioning, and those cultures that embrace a more positive view of aging may create an environment that shields their members from the memory-damaging effects of negative age stereotypes.

While the general effects of age stereotypes on the cognitive functioning of older adults has been described previously (Levy, 1996), less is known about moderating factors and the specific conditions under which age stereotypes affect memory to a greater or lesser extent. Some research suggests that beliefs about aging and memory may play a role in predicting how older adults will respond to threatening information. Weiss (2016), for example, found that exposure to negative age stereotypes only impaired the performance of older adults who held strong beliefs about the inevitability of decline with aging. While participants with more essentialist age beliefs performed significantly worse on memory tasks after exposure to negative age stereotypes, older adults who had less deterministic and more flexible ideas about age-related changes actually performed marginally better in the negative compared to the neutral prime condition. Hess et al. (2003) found that the value that older adults place on their memory ability also affects how adults react to age stereotypes relevant to cognition.

In addition to studying moderating factors, some researchers have also worked to identify mediating factors and the intermediate pathways through which age stereotypes act to affect memory. Levy (1996) suggests that metamemory and views of aging likely mediate the relationship between age stereotype primes and memory performance. Age stereotypes may

indirectly affect memory capabilities by highlighting senility or wisdom self-schemas and/or influencing older adult's self-efficacy and judgments about their own cognitive abilities. In an experiment using an explicit false feedback design, Hess et al. (2003) found the effect of age stereotypes on memory performance to be partially mediated by strategy use. Individuals who read articles contradicting negative stereotypes about cognitive aging were more likely to use clustering of words in the same semantic category as a mnemonic strategy, which aided memory recall and boosted performance.

Emerging evidence, however, suggests that age stereotypes are not just influencing feelings of self-efficacy or the use of memory strategies but also shaping the brain at a biological level. In one study of older adults who were dementia-free at baseline, those who held more negative age stereotypes experienced significantly steeper hippocampal-volume loss on MRI and greater accumulation of neurofibrillary tangles and amyloid plaques on brain biopsy (Levy, Ferrucci, et al., 2016). Looking forward, more research is need to understand the relationship between endorsement of age stereotypes and cognition not only as it relates to normal cognitive functioning but also as it pertains to the development of pathologic states such as Alzheimer's disease. Research in this area has significant clinical implications and will help identify potential routes for intervention.

Psychological Health

There has been great interest in studying how older individuals can continue to function at a high level not just physically but also socially and psychologically. While some older adults view old age as a time of seclusion and despair, others perceive older adulthood as a time for continued growth and engagement in social and leisure activities. Differences in the internalization of negative age stereotypes may partially account for these differences in

perceptions of old age and explain variations in psychological well-being. Self-perceptions of aging act as a lens through which older adults perceive themselves and the world around them, and the attitudes they hold about their own aging experience have been shown to predict a variety of both positive and negative psychological health outcomes.

One of the common misconceptions about aging is that depression is an expected and normal part of aging. Consequently, older adults who hold this negative image of aging with regards to psychological health may be more prone to develop symptoms of depression as they age. Wurm and Benyamini (2014) found that individuals with more negative SPA reported a higher frequency of depressive symptoms over a 3-year period, after adjusting for baseline age, gender, education, place of residence, and number of illnesses. Older adults with negative SPA not only report more depressive symptoms but also may be less likely to seek out professional resources. Compared to depressed older adults who attributed their depression to illness, those who attributed depression to aging were less likely to believe in the importance of discussing their symptoms with their doctor (Sarkisian, Lee-Henderson, & Mangione, 2003).

Poor self-perceptions of aging may also be a risk factor for the development of psychiatric conditions among special high-risk populations. A cross-sectional study by Levy, Pilver, and Pietrzak (2014) found that that negative expectations regarding aging were related to the development of psychiatric disorders among older US veterans. Compared to veterans who were fully accepting of negative age stereotypes, veterans who were fully resistant to negative age stereotypes were less likely to meet screening criteria for suicidal ideation, anxiety, and PTSD, after adjusting for demographics, health, personality, and trauma/combat-related experiences. There was a graded association between degree of resistance to negative age stereotypes and prevalence of each psychiatric condition with greater levels of resistance

corresponding to lower prevalence rates. Interventions that target age stereotypes may be effective in not only reducing the prevalence of psychological disorders in the general population but also among vulnerable subpopulations at increased risk for poor psychological outcomes.

In addition to acting as an independent predictor, self-perceptions of aging also seem to mediate some of the effects of other factors on the risk for depression. While receipt of care is usually considered a positive contributor to health and well-being, it can, in some cases, increase the risk for depression among older adults by activating negative age stereotypes and solidifying the notion that aging is inexorably linked with increased dependence and functional limitations. Kwak et al. (2014) found that older adults who received greater amounts of assistance with ADLs and IADLs at baseline (Time 1) perceived their aging more negatively at 2 years (Time 2), and these negative aging self-perceptions, in turn, were related to more depressive symptoms 2 years later (Time 3). Practitioners and policymakers, thus, should consider how care-giving interventions may potentially negatively influence attitudes towards the aging self.

The absence of psychological dysfunction is not equivalent to the presence of psychological well-being, and self-perceptions of aging have also been associated with increased subjective well-being in a variety of domains. Wurm, Tomasik, and Tesch-Römer (2008), for example, found that positive views on aging predicted better life satisfaction after a six-year follow-up, independent of baseline life satisfaction, serious health events, age, gender, place of residence, living arrangement, socioeconomic status, physical health, and functional limitations. In addition to being more satisfied with their lives, older adults who have more positive attitudes towards their own aging also tend to be more socially engaged and more open to forming new relationships. In a sample of primarily older African American females from the Baltimore Experience Corps Trial, participants with more positive expectations regarding aging reported

making more new friends 2 years later, even after controlling for covariates likely to influence social behaviors (Menkin, Robles, Gruenewald, Tanner, & Seeman, 2016).

Subjective Health

While most of the research on SPA and health has focused on specific disease diagnoses and other objective indicators of health status, a significant literature has demonstrated that how individuals subjectively evaluate their health can predict the risk of mortality above and beyond traditional biomedical risk factors. Several studies, therefore, have examined the relationship between SPA and self-rated health, controlling for chronic disease status. Recent evidence suggests that positive self-perceptions of aging are prospectively associated with better self-rated health, even after adjusting for baseline sociodemographic and health-related factors (Beyer, Wolff, Warner, Schüz, & Wurm, 2015; Wurm & Benyamini, 2014). Although how individuals view their health and how individuals view their own aging process are clearly interconnected, additional studies are needed to more definitively establish the directionality of this relationship and the extent to which subjective health and subjective attitudes toward aging measure distinct constructs.

While self-rated health is usually measured globally without reference to a specific context, Wurm et al. (2008) considered the role of positive views of aging on subjective health in the setting of a serious health event. In line with previous findings about the general effects of SPA on self-rated health, positive views of one's own aging were associated with better subjective health ratings six years later, even after adjusting for baseline subjective health, serious health events, age, gender, place of residence, living arrangement, socioeconomic status, physical health, and functional limitations. Positive views regarding one's own aging experience, however, did not buffer the negative effect of a serious health event on subjective health, and

individuals who experienced a serious health event did not rate their health differently based on their personal views on aging.

Health Behaviors

Health behaviors are not only important as an intermediate pathway to downstream health conditions but are also an important outcome in their own right. Self-perceptions of aging have been associated with numerous health-related behaviors. Older adults with more positive views of their own aging are more likely to practice preventive health behaviors (e.g., alcohol consumption, diet, exercise, medication compliance, tobacco use, regular physical exam) (Levy & Myers, 2004) and get preventive health screenings (e.g., mammogram, pap smear, prostate exam, cholesterol test) (Kim, Moored, Giasson, & Smith, 2014). The effects of attitudes toward one's own aging and health behaviors seem to be far-reaching, with some studies showing SPA to affect health behaviors over a 20-year period (Levy & Myers, 2004).

There are many reasons why individuals with more negative SPA may be less inclined to engage in health-promoting activities. One possibility is that older adults with negative SPA do not see the benefits of actively maintaining their health because they are more likely to attribute their illness and/or disability to inevitable age-related decline. Indeed, Stewart, Chipperfield, Perry, and Weiner (2012) found that the more an individual attributed their illness to "old age," the less likely they were to engage in routine health maintenance activities such as eating a nutritious diet, exercising, and getting adequate sleep. Age stereotypes can have a profound effect on how older adults interpret and react to age-related changes, and inappropriate old age attributions may prevent older adults from seeing the advantages of living a healthy lifestyle.

Older adults with more negative views of aging may also have skewed beliefs about the common causes and treatments of age-related conditions. Those with negative aging attitudes

may defer preventive care services because they believe treatable conditions to be a simple product of aging. They, therefore, may not see the value of regular physician visits and/or screening tests if disease is unavoidable in old age. In one study of noninstitutionalized black, Hispanic, non-Hispanic white adults aged 75+, respondents who thought arthritis, heart disease, and sleep problems were a normal part of aging (e.g., fatalistic) were less likely to have received preventive care services (e.g., blood pressure measurement, screening for glaucoma, influenza vaccination, routine physical exam, mammogram, pelvic exam, rectal/prostate exam) in the previous year, and older adults who thought nothing could be done to treat these conditions (e.g., nihilistic) were significantly less likely to have a regular physician (Goodwin, Black, & Satish, 1999).

Hospitalization

Hospitalization is a severe adverse event for older adults, and accumulating evidence suggests that attitudes towards one's own aging may be increasing the risk for hospitalization among the older adult population. Moser et al. (2011) investigated the relationship between SPA and adverse events among a sample of 1,422 older adults aged 65-70 from Lausanne, Switzerland. While they found an association between SPA and risk of hospitalization, it was not apparent beyond the first year of follow-up. Adding in previous history of hospitalization in a model that accounted for sex, age, depressive feelings, chronic conditions, and living arrangement caused the relationship between SPA and hospitalization to become non-significant. This study, however, included respondents within a relatively narrow age range and a limited geographic area, and therefore, may not generalize to older adults over age 70 or those living in other countries.

In a recent study, we re-examined the association between SPA and the rate of hospitalization using a larger, nationally representative sample of older U.S. adults from the Health and Retirement Study with a wide age range (53-96 years). We found that positive self-perceptions of aging were linked to lower rates of hospitalization over four years even after adjusting for sociodemographic factors, baseline health, and health behaviors (Sun et al., 2017). Unlike Moser and colleagues (2011), the association between SPA and rate of hospitalization remained significant after accounting for previous rates of hospitalization and persisted across all four years of follow-up.

Levy, Slade, Chung, and Gill (2015) also found negative age stereotypes to be associated with an increased risk of hospitalization in a sample of adults over age 70. Specifically, individuals who scored above the median in terms of negative age stereotypes were 50% more likely to be hospitalized over the next 10 years compared to their more positive counterparts, even after accounting for age, sex, race, years of education, MMSE score, CESD symptoms, and physical frailty. This study was unique in demonstrating the resiliency of older adults' age stereotypes after stressful events and provided more evidence for the directionality of the relationship between SPA and hospitalization. By measuring endorsement of age stereotypes about older adults ten years apart and monitoring the occurrence of intervening stressful events, they showed that personally-held age stereotypes were relatively unperturbed by the occurrence of overnight hospitalizations between the two measurement points.

Mortality/Longevity

Several longitudinal prospective studies have shown a relationship between baseline SPA and risk of all-cause mortality among older adults. Among a sample of U.S. adults aged 50 and over from the Ohio Longitudinal Study of Aging and Retirement, those who had more positive

SPA lived, on average, 7.6 years longer than their more negative counterparts (median survival: 22.6 vs. 15 years) (Levy, Slade, Kunkel, & Kasl, 2002). The association persisted even after controlling for age, gender, SES, loneliness, and functional health, suggesting that self-perceptions of aging have an independent effect on mortality above and beyond known sociodemographic and health-related risk factors.

The link between positive SPA and lower risk of mortality has also been observed in other national samples of older adults outside of the U.S. In Australian Longitudinal Study of Aging, baseline SPA was a significant predictor of mortality over 16 years. A one-point increase in positive SPA increased the risk of mortality by 12% in the fully-adjusted model that accounted for demographics, physical health, cognitive functioning, and well-being (Sargent-Cox, Anstey, & Luszcz, 2014). Participants in the Berlin Aging Study were also followed for a 16-year period, and individuals who were more satisfied with their own aging lived approximately 2 years longer than those with low aging satisfaction regardless of baseline sociodemographic, health-related, or cognitive factors (Kotter-Grühn et al., 2009).

While the association between baseline SPA and mortality has been replicated in multiple samples, the relationship between changes in SPA and mortality seems to be less straightforward. In the Berlin Aging Study, decreases in aging satisfaction over a four-year period was associated with an increased risk of mortality, above and beyond baseline levels. These results remained significant even after adjusting for chronological age, gender, SES, comorbidity, and dementia (Kotter-Grühn et al., 2009). The Australian Longitudinal Study of Aging, however, found that while decline in SPA increased the risk of mortality in an unadjusted model, the relationship was no longer significant after adjusting for demographics, physical health, cognitive functioning, and well-being (Sargent-Cox et al., 2014). Given the increasing

number of interventions being developed to improve attitudes toward aging, more research is needed to explore whether it is absolute or relative SPA that is more important when it comes to matters of health. Some studies show that older adults perceive their aging more negatively over time, and thus, the implications of changes in SPA may be particularly meaningful for the aging population.

Although most prospective studies have looked at all-cause mortality, a few studies have also investigated whether self-perceptions of aging influence disease-specific mortality. After adjusting for age, gender, marital status, functional health, self-rated health, SES, and loneliness, more positive self-perceptions of aging were associated with a lower risk of dying from respiratory causes as defined by the ICD-9 (Levy & Myers, 2005). While specific mechanisms were not formally explored, the researchers hypothesized that negative SPA could result in suppression of the immune system and increase susceptibility to respiratory infections such as pneumonia or induce a chronic inflammatory state that contributes to the pathogenesis of chronic obstructive pulmonary disease (COPD).

In conclusion, the long follow-up periods and comprehensive adjustment for covariates common to most of the prospective studies in the literature make a compelling case for an effect of baseline SPA on all-cause mortality risk. Significant questions remain, however, about 1) the exact magnitude of the effect of SPA on mortality, 2) the effect of changes in SPA on mortality, 3) the role of SPA in disease-specific mortality, and 4) the specific mechanisms connecting SPA to mortality.

Mediators of Self-Perceptions of Aging and Health

As evidenced by the representative number of studies on SPA and health reviewed above, there is no shortage of research demonstrating an association between personal age-related

attitudes and health. Studies that examine the mechanisms linking SPA to health, however, are relatively rare, and most proposed pathways are based on speculation or are inferred through studies that control for possible mediating factors as covariates. Studying mediating pathways is not just important on a theoretical level but can also guide the development of future interventions through the identification of intermediate targets that may be amenable to change. This section, therefore, is dedicated to reviewing potential mediators of the relationship between SPA and health and identifying areas for future research.

According to Levy's stereotype embodiment theory (Levy, 2009), age stereotypes act through psychological, behavioral, and physiological pathways to exert their effects on long-term health. At a psychological level, will to live, or the judgment that perceived benefits of one's life outweigh the perceived hardships, seems to partially mediate the relationship between SPA and longevity (Levy, Slade, Kunkel, et al., 2002). Compared to older adults exposed to positive age stereotypes, those primed with negative age stereotypes were less likely to accept medical treatment in a hypothetical situation in which they were diagnosed with a terminal illness. In a similar study, the relationship between stereotype valence and will to live persisted even after older adult subjects performed an intervening distraction task for 180 seconds, suggesting that age stereotypes may have more enduring effects beyond the immediate context (Marques, Lima, Abrams, & Swift, 2014). Expectations regarding aging has also been shown to affect how long people wanted to live among a sample of young and middle-aged respondents (Bowen & Skirbekk, 2016). Holding fewer positive expectations of old age was associated with wanting to live a relatively short life compared to the national average. Age expectations may influence preferred life expectancy, which then lead to changes in health behaviors that ultimately increase or decrease longevity.

The link between negative SPA and poor health may also be partially explained by lower use of selection-optimization-compensation (SOC) strategies (Baltes & Baltes, 1990). Specifically, negative SPA may prevent older adults from engaging in adaptive responses to age-related losses, resulting in self-fulfilling prophecies regarding physical and psychological deterioration with age. SPA may be particularly important in understanding the use of coping strategies in response to a serious health event. Wurm, Warner, Ziegelmann, Wolff, and Schüz (2013) found that individuals who experienced a serious health event were more likely to use SOC strategies. This effect, however, was most pronounced among those who had less negative aging expectations regarding physical losses. Furthermore, SOC strategies acted as a mediator between negative SPA and several indicators of health and well-being. Negative SPA after a serious health event were associated with lower self-rated health and lower life satisfaction through lower SOC strategy use. The use of adaptive self-regulation techniques, therefore, may be an important pathway through which SPA influences health outcomes later in life.

A variety of other psychological constructs have also been implicated in the pathway from SPA to health, and each has been studied with regards to a specific health outcome. Self-efficacy has been proposed as a potential mediator of the link between negative SPA and increased stress reactivity, a risk factor for several chronic diseases (Levy et al., 2000). Exposure to negative age stereotypes may activate negative SPA in a way that reduces self-efficacy, which then acts through self-fulfilling prophecy to induce poor performance and elevated levels of stress. In a related manner, negative views of aging have also been shown to influence memory and auditory performance through self-perceived abilities (Chasteen, Pichora-Fuller, Dupuis, Smith & Singh, 2015). Subjective well-being (e.g, positive affect) has been found to partially mediate the relationship between positive views on aging and subjective health, suggesting that

individuals with more positive views on aging experience more positive affect, which results in better evaluations of their health status (Hicks & Siedlecki, 2017). Westerhof and Wurm (2015) outline a heuristic model that synthesizes research on how subjective age constructs can help build psychological resources to improve health outcomes and increase longevity. So far, the psychological pathway has been the most studied in relation to self-perceptions of aging and health, but much more work is needed to clarify whether different subjective age constructs act through the same mediators and whether the mediators are disease- or domain-specific.

At a behavioral level, older adults with more positive attitudes toward their own aging tend to practice better health behaviors and be more proactive in seeking preventive care services (Levy & Myers, 2004; Kim et al., 2014). Only a few studies, however, have conducted formal mediation analyses of health behaviors as mediating factors between self-perceptions of aging and health. Among those that have, physical activity seems to be the most promising factor in explaining why older adults with optimistic views of aging derive more health benefits. Beyer et al. (2015) identified physical activity as a partial mediator of the longitudinal relationship between self-perceptions of aging and self-rated health. Among a sample of German community-dwelling older adults with two or more chronic conditions, positive self-perceptions of aging were associated with increases in physical activity at six months, which in turn, predicted better self-rated health 2.5 years after baseline. A similar effect was found among a convenience sample of community-residing older adults in Korea: health-promoting behavior partially mediated the relationship between expectations regarding aging and better physical and mental health (Kim, 2009), further supporting the presence of a behavioral pathway between attitudes towards aging and health. In a related manner, leisure activity engagement has been found to

partially mediate the relationship between positive views on aging and both subjective health and physical limitations among middle-aged and older adults (Hicks & Siedlecki, 2017).

Of the three proposed processes, the physiological/biological pathways between self-perceptions of aging and health have been the least explored. There, however, have been several studies that have shown a connection between SPA and changes occurring at the biological level. Systemic inflammation, for example, has been implicated as one of the biological processes linking negative age perceptions to poor health outcomes. A recent study by Levy and Bavishi (2016) found that c-reactive protein mediated the association between self-perceptions of aging and longevity. Positive SPA at baseline predicted lower c-reactive protein levels four years later, which increased the likelihood of survival two years after c-reactive protein measurement.

Activation of the sympathetic nervous system and/or hypothalamic-adrenal-pituitary axis may be another means by which exposure to age stereotypes can lead to negative health outcomes. Negative age stereotypes have been shown to elicit elevated cardiovascular responses to stress (Levy et al., 2000), and prolonged and chronic increases in blood pressure can lead to circulatory dysfunction and increase the risk for cardiovascular disease. Holding more positive age self-stereotypes, however, seems to act as a buffer against cumulative stress (Levy, Moffat, Resnick, Slade, & Ferruci, 2016). Over a 30-year follow-up, older adults with more positive age stereotypic views exhibited non-significant changes in cortisol from baseline while those with more negative age stereotypic views showed a 44% increase in cortisol levels from baseline. At a biological/physiological level, the self-perceptions of aging, therefore, may affect how the body reacts to environmental stressors by exacerbating or buffering the effects of the inciting stressor.

Current Conceptual Model

The culmination of this chapter is the formation a conceptual model (Figure 1.3) that synthesizes the existing findings regarding the effects of self-perceptions of aging on health. After a brief review of the literature, I build upon the basic framework of Levy's stereotype embodiment theory by 1) specifying the individual-level predictors of self-perceptions of aging (*See section on Individual-Level Predictors of Self-Perceptions of Aging*), 2) identifying specific domains of health and adverse outcomes affected by SPA (*See section on Previous Research on Self-Perceptions of Aging and Health*), 2) proposing potential psychological, behavioral, physiological/biological mediating factors (*See section on Mediators of Self-Perceptions of Aging and Health*).

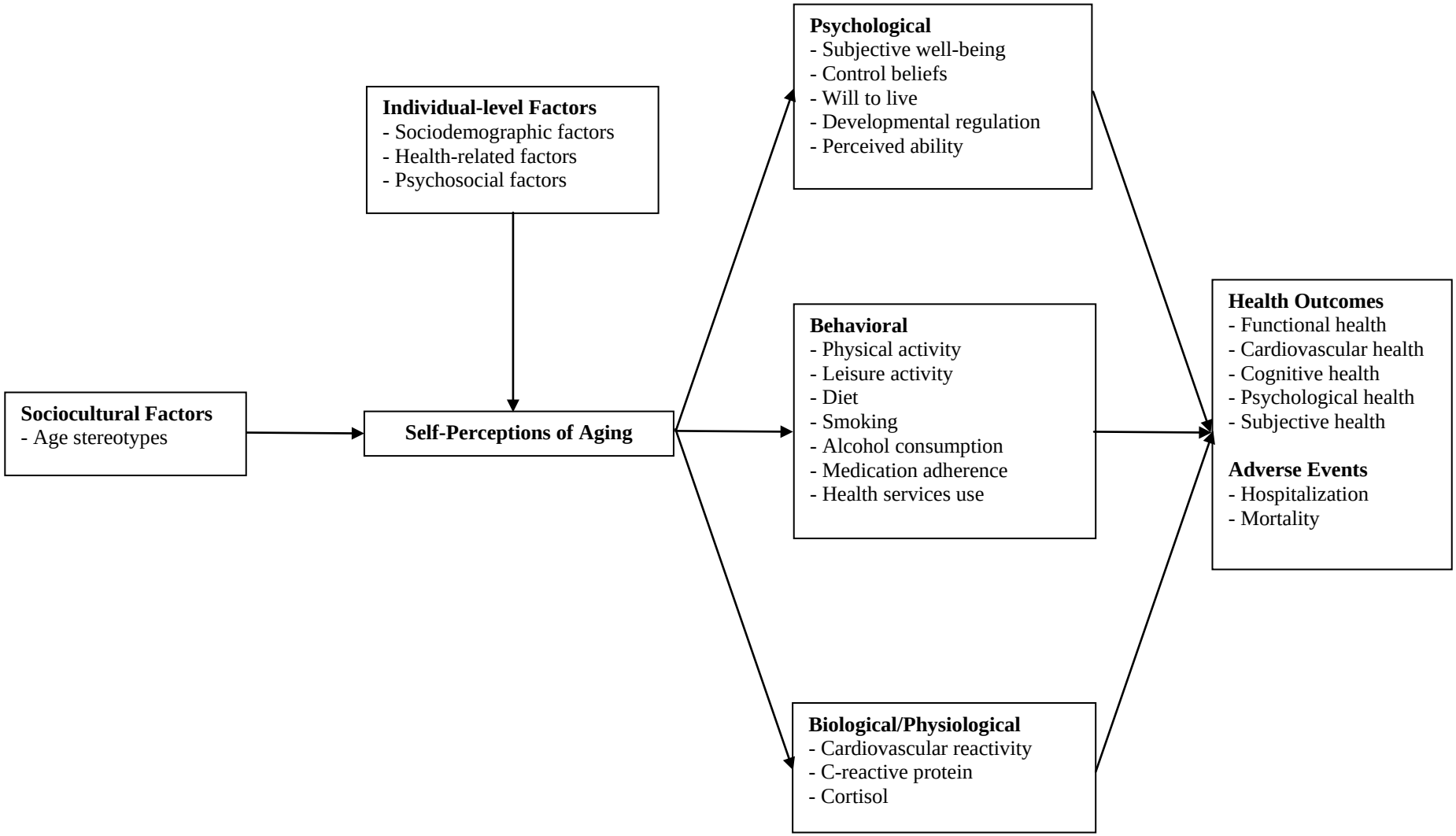
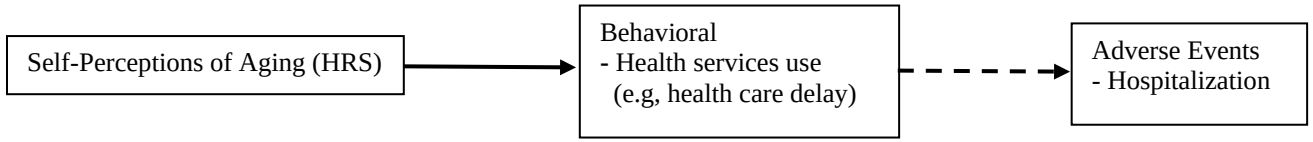


Figure 1.3. Conceptual model of pathways linking self-perceptions of aging to health outcomes and adverse events. Adapted from on Levy (2009) and Westerhof & Wurm (2013).

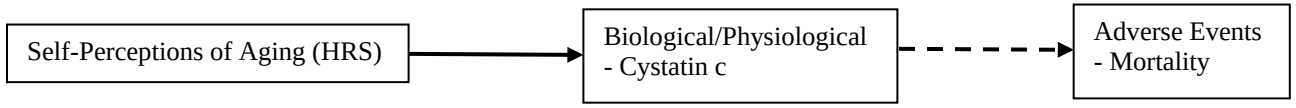
Preview of Studies

Based on conceptual model described above (Figure 1.3), the three studies in this dissertation examine the potential behavioral, biological/physiological, and psychological processes linking self-perceptions of aging (SPA) and health (Figure 1.4). At a behavioral level, Study 1 examines the association between SPA and health care delay, focusing not only on how SPA predicts the likelihood of delay but also the specific reasons given for delay. At a biological/physiological level, Study 2 examines the association between SPA, perceived discrimination, and changes in cystatin c to understand how SPA may get "under the skin" to affect kidney functioning. At a psychological level, Study 3 examines how two different psychological perceptions of the self, self-perceptions of grip strength and self-perceptions of aging, interact to predict changes in mobility limitations over four years. Together, the three studies in this dissertation support the idea that SPA act through multiple pathways to affect health, and a multi-faceted approach is needed prevent the detrimental effects of negative age stereotypes on health in older adulthood.

Study 1:



Study 2:



Study 3:

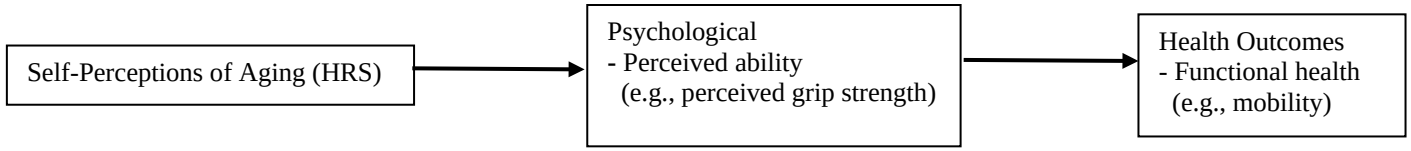


Figure 1.4: Conceptual pathways from the Health and Retirement Study (HRS) measure of self-perceptions of aging to health outcomes/adverse events for each dissertation study.

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CHAPTER II

Self-Perceptions of Aging and Perceived Barriers to Care: Reasons for Health Care Delay

(Adapted from a manuscript in press at *The Gerontologist*)

Introduction

Self-perceptions of aging (SPA), or subjective evaluations of one's own aging experience, have wide-reaching implications for the health of the aging population. According to Levy's stereotype embodiment theory (Levy, 2009), individuals are exposed to age stereotypes across the lifespan, and the internalization of these stereotypes as SPA influences health through physiological (Levy, Hausdorff, Hencke, & Wei, 2000), psychological (Levy & Leifheit-Limson, 2009), and behavioral (Levy & Myers, 2004) pathways. Previous research has shown that compared with their more positive counterparts, older adults with more negative SPA tend to have shorter lives (Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Levy, Slade, Kunkel, & Kasl, 2002), suffer from more functional limitations (Levy, Slade, & Kasl, 2002; Sargent-Cox, Anstey, & Luszcz, 2012), and are less likely to recover from disability (Levy, Slade, Murphy, & Gill, 2012).

How older adults view the aging process affects not only their health status but also their use of health care resources. Evidence from multiple studies of middle-aged and older adults show that individuals with more negative aging self-views are less likely to seek preventive health services (Kim, Moored, Giasson, & Smith, 2014) but more likely to require intensive or emergent care such as hospitalization (Stephan, Sutin, & Terracciano, 2016; Sun, Kim, & Smith, 2017). One explanation for these findings is that older adults with more negative SPA are

delaying necessary medical care and suffering from more serious downstream consequences. Few studies, however, have investigated if aging self-perceptions influence the likelihood of health care delay and perceived barriers to timely medical care. The purpose of the present study is to examine the association between negative SPA and health care delay as a possible behavioral link between SPA and health services use.

Andersen's Behavioral Model of Health Services Use

Barriers to primary care are associated with an increased risk of using emergency services, highlighting the importance of timely medical care in reducing the occurrence of serious adverse events (Rust et al., 2008). Andersen's Behavioral Model of Health Services Use provides a useful framework for studying factors that influence access to care (Andersen, 1995). Predisposing factors (e.g., sociodemographic factors, health beliefs) influence an individual's propensity to use health care services. Enabling factors (e.g., income, health insurance, regular source of care) are resources that enable or facilitate access to care. Need factors (e.g., disease burden, depressive symptoms) capture how perceived or evaluated health status dictates the use of medical services. Although many studies that use Andersen's model as a conceptual framework examine factors that increase the likelihood of health care use, the present study uses this theoretical structure for understanding how aging self-perceptions affect short-term health care delay and decrease the likelihood of health care use due to perceived barriers to care. We are interested in the effects of SPA on health care delay above and beyond the influence of known predisposing, enabling, and need predictors of health care utilization.

Within the framework of Andersen's model, negative SPA may be associated with an increased likelihood to delay care due to a) lower predisposition to seek care, b) lack of enabling resources, and c) lower perceived need for care. As a predisposing factor, SPA may affect older

adults' health beliefs regarding age-related conditions. Goodwin, Black, and Satish (1999) found that individuals who considered arthritis, heart disease, and sleep problems to be a normal part of aging were less likely to receive preventive care services. Negative SPA, therefore, may lower an individual's propensity to proactively protect their health. Older adults with negative SPA may also lack important enabling resources that facilitate access to care. In one study, older adults who believed nothing could be done to treat age-related conditions were significantly less likely to have a regular physician (Goodwin et al., 1999). Older adults with more negative SPA have also been shown to be less likely to financially plan for retirement (Heraty & McCarthy, 2015). Finally, SPA could be conceptualized as a need factor that affects older adults' judgments of whether their health problems are of sufficient importance to seek help. In a study of community-dwelling older adults, those who held more negative views of aging were less likely to believe in the importance of discussing age-related issues (e.g., depression, arthritis, memory impairment) with their doctors (Sarkisian, Hays, & Mangione, 2002).

Current Study

In the present study, we use data from the Health and Retirement Study (HRS) to examine whether aging self-perceptions are associated the likelihood of delaying medical care over the next 12 months. HRS collected mail surveys about delay of medical care from two independent subsamples. The first sample completed an in-person HRS interview in 2010 and the Health Care Mail Survey (HCMS) in 2011. The second sample completed an in-person HRS interview in 2012 and the Health Care and Nutrition Study (HCNS) in 2013. We analyzed these two samples separately, performing initial analyses using the 2011 HCMS sample and then replicating our results in the 2013 HCNS sample. We hypothesize that individuals with more

negative SPA will be more likely to delay care and report more perceived barriers to care, after adjusting for predisposing, enabling, and need factors.

We also explore the relationship between SPA and the specific reasons for delaying care. While accessibility issues (e.g., not being able get an appointment soon enough, not having transportation) are important problems to address, we also consider the role of psychosocial factors (e.g., disliking going to the doctor, being afraid of what one might find out) in the decision to postpone care. Previous studies suggest that psychosocial concerns such as physicians' perceived lack of responsiveness may be a greater disincentive to seeking care than more tangible or practical factors such as medical bills or transportation (Fitzpatrick, Powe, Cooper, Ives, & Robbins, 2004).

Although reporting to be too busy to see the doctor may be related to logistical or scheduling conflicts, it may also serve as an excuse to avoid addressing underlying psychosocial concerns. By shifting causal attributions from an internal stable source (e.g., I do not like going to the doctor) to a more external situational factor (e.g., I am too busy), excuses allow individuals to maintain a positive personal image and a sense of control (Snyder & Higgins, 1988). We, therefore, hypothesize that being too busy will be more closely related to psychosocial rather than access-related reasons for delay.

Rather than analyze each reason for delay independently, we use latent class analysis to identify unmeasured subgroup membership. We describe the characteristics of each subgroup and then examine if, compared with the no delay group, SPA predicts membership in the delay subgroups. We hypothesize that there will be two distinct delay subgroups: Individuals who delay care due to a) limited health care access and b) psychosocial concerns. We predict that

SPA will be associated only with membership in the psychosocial subgroup after adjusting for predisposing, enabling, and need factors.

Method

Participants

The HRS is a nationally representative biennial panel study of US adults aged 51 and older (Sonnega et al., 2014). Respondents who completed an in-person HRS interview also received a self-administered Psychosocial and Lifestyle Leave-Behind Questionnaire that assessed multiple domains of psychosocial functioning, including SPA. The 2011 HCMS and 2013 HCNS examined issues of health care access, including health care delay in the past 12 months. Response rates were 75% and 65% for the HCMS and HCNS, respectively. The final analytic sample size was 2,866 for the 2011 HCMS sample and 2,474 for the 2013 HCNS sample. For a detailed description of the inclusion criteria for both analytic samples, see Figures 2.1 and 2.2. The HRS protocols are approved by the University of Michigan Health Services Institutional Review Board. The present study was exempted from review because it uses de-identified and publicly available data.

Measures

Self-perceptions of aging. In the HRS Psychosocial and Lifestyle Questionnaire, SPA were measured in 2010 and 2012 using an eight-item scale derived from the Philadelphia Morale Scale (Lawton, 1975) and the Berlin Aging Study (http://www.base-berlin.mpg.de/en). On a scale from 1 (*strongly disagree*) to 6 (*strongly agree*), respondents indicated the degree to which they endorsed statements such as “Things keep getting worse as I get older” and “So far, I am satisfied with the way I am aging.” Positively worded items were reverse coded, and all items were averaged so that higher scores corresponded to more negative SPA. The final score was set

to missing if there were more than four items with missing values. Cronbach's alpha for the overall scale was 0.82 in 2010 and 0.81 in 2012. For analyses, scores were standardized *($\mu=0$, $\sigma=1$)* to facilitate interpretation and comparison of effect size with other studies of SPA.

Health care delay. In the 2011 HCMS and 2013 HCNS, respondents were asked whether they had delayed getting medical care in the last 12 months for any of the following reasons (mark all that apply): a) I could not get through on the telephone, b) I could not get an appointment soon enough, c) Once I get there, I have to wait too long to see the doctor, d) The clinic/doctor's office wasn't open when I could get there, e) I did not have transportation, f) I am too busy to go to the doctor, g) I am afraid of what I might find out, h) I do not believe in going to doctors, i) I do not like going to the doctor, j) I have not delayed getting medical care in the last twelve months. We expected reasons a-e to be related to issues of health care access and reasons f-j to reflect psychosocial concerns. In the 2013 HCNS, additional responses in the "other (specify)" category were coded into existing coding frames or excluded to allow for more direct comparison with the 2011 HCMS. In the 2011 HCMS only, respondents who endorsed delaying care were also asked to mark all types of care delayed: a) major surgery that would have required a hospital stay of one or more nights, b) outpatient surgery, c) seeing the doctor about a symptom or a problem, d) getting a check-up, e) routine screening, like a colonoscopy, f) filling a prescription, g) other, specify. Responses in the "other (specify)" category were coded into existing coding frames or excluded from analyses.

Covariates. Covariates from the 2010/2012 in-person interview were included in blocks based on Andersen's Behavioral Model. Predisposing covariates included sociodemographic variables such as age, gender, race/ethnicity, educational attainment, and living arrangement. Enabling covariates included economic factors such as total household income and health

insurance status. Need covariates included health-related factors such as 1) an index of eight chronic conditions (Fisher, Faul, Weir & Wallace, 2005), 2) an index of eight depressive symptoms, and 3) the number of activities of daily living (ADLs) performed with difficulty (Fonda & Herzog, 2004).

Analysis Strategy

We employed three analytic steps. First, we used logistic regression in Stata 14.0 to examine the association between negative SPA and the likelihood of delaying health care for any of the provided reasons. Respondents were assigned a score of 0 if they marked only the option "I have not delayed getting medical care in the last 12 months" and a score of 1 if they marked at least one of the reasons for delaying medical care. Respondents who indicated that they had not delayed seeking care but also marked one or more reasons for delaying care were excluded due to their conflicting responses (Figures 2.1 & 2.2). Negative binomial regression was also performed to examine the relationship between negative SPA and the number of reasons given for delaying care. Coefficients were converted to odds ratios (OR) or incidence rate ratios (IRR) for ease of interpretation.

Second, we used MPlus version 7.4 to perform latent class analysis on the subsample of respondents who delayed care to identify subgroups who endorsed similar reasons for postponing care. Binary scores were created to indicate whether respondents did (1) or did not (0) delay care for each reason. Based on a priori hypotheses, one-, two-, and three-class models were tested. Model fit was determined using a combination of information criteria, entropy measures, and likelihood ratio tests.

Third, respondents were assigned to a delay subgroup based on their highest posterior probability of belonging, and the resulting group memberships were exported to Stata. Using

multinomial logistic regression with the no delay group serving as the reference category, we then examined if SPA predicted the likelihood of membership in the three different delay subgroups, after adjusting for blocks of predisposing, enabling, and need factors. Coefficients were converted to relative risk ratios (RRR) for ease of interpretation.

For the logistic, negative binomial, and multinomial logistic regression analyses described previously, we started with an unadjusted model (Model 1) and then created a minimally adjusted model with age and gender (Model 2). Next, we generated models to explore the degree to which additional blocks of predisposing, enabling, and need factors explained the link between SPA and health care delay over and above age and gender. Model 3 included age, gender, and other predisposing variables (race/ethnicity, educational attainment, living arrangement). Model 4 included age, gender, and enabling factors (total household income, health insurance status). Model 5 included age, gender, and need factors (chronic conditions, depressive symptoms, ADL limitations). Finally, Model 6 included all covariates.

Results

Descriptive Analyses

Table 2.1 shows the descriptive statistics for the 2011 HCMS and 2013 HCNS samples. Both samples were comparable in terms of gender, race, education, health insurance status, and number of depressive symptoms. Respondents in the 2013 HCNS sample, however, were slightly older, had a lower household income, had more chronic conditions, and were more likely to live alone. Over the 1-year follow-up, slightly more respondents in the 2013 HCNS sample reported delaying medical care. In both samples, the most common reasons for delaying care were disliking going to the doctor, being unable to get an appointment soon enough, and being too busy to see the doctor.

SPA and Health Care Delay

After adjusting for age, gender, and other predisposing factors (Model 3), each standard deviation (*SD*) increase in negative SPA was associated with a 49% higher likelihood of health care delay in the 2011 sample and a 57% higher likelihood of health care delay in the 2013 sample (Table 2.2). Individuals with more negative SPA were not only more likely to delay care overall but also reported more reasons for delay. Although the effect size was somewhat diminished with each block of covariates, the association between SPA and health care delay remained significant across all models. Compared with the minimally adjusted model with age and gender (Model 2), the largest incremental decrease in OR/IRR occurred after adding need factors in Model 5.

Latent Class Analyses

Latent class analysis was used to identify unobservable subgroups in our sample. The reason "I do not believing in going to doctors" was excluded from latent class analyses due to low endorsement (Table 1). Latent class analyses revealed a three-class model to be the best fit to the data among the three models tested (Table 2.3). Figure 2.3 shows the pattern of endorsement for each of the eight delay reasons by latent subgroup.

The characteristics of the three subgroups were remarkably similar between the two HRS samples. The largest subgroup (>50% of respondents) consisted of individuals who delayed care primarily due to limited health care access. Although each of the five access-related issues were reported by some members of the "limited-access" subgroup, inability to get appointments soon enough and lack of transportation were the most prominent reasons for delay in this subgroup. The other subgroups were predominantly characterized by a single reason for delay. In the "busy" subgroup, all respondents reported being too busy to see the doctor, and all respondents

in the “dislike” subgroup reported disliking going to the doctor. These two subgroups were comparable in size, each consisting of roughly 20% of respondents. Interestingly, “being afraid of what I might find out” was similarly endorsed by all three subgroups.

Descriptive Statistics for Subgroups of Delay

Table 2.4 describes the characteristics of the no delay group and the three delay subgroups. Compared with the no delay group, all three delay subgroups were significantly younger. Respondents in the limited-access subgroup were worse off in almost all respects: more negative SPA, lower household income, lower educational attainment, more chronic conditions, more depressive symptoms, more ADL limitations, and more likely to be uninsured. In terms of race/ethnicity, a larger proportion of minority respondents belonged to the limited-access subgroup. Respondents in the busy subgroup had a wealthier and healthier profile: higher household income, higher educational attainment, and fewer chronic conditions. The busy subgroup, however, was more likely to be uninsured in the 2011 sample. The busy subgroup was the only subgroup with similar levels of SPA compared with the no delay group. Finally, the dislike subgroup differed from the no delay group at a psychological level: more negative SPA and more depressive symptoms. However, the dislike subgroup had fewer chronic conditions in the 2011 sample and was more likely to be uninsured in the 2013 sample.

In the 2011 HCMS, respondents who endorsed delaying care in the past 12 months were also asked about the types of care delayed. The most common types of care delayed were seeing the doctor for a symptom or problem (52.13%), getting a check-up (28.80%), and getting routine screening (21.70%). In comparing the three subgroups, the busy subgroup was significantly more likely than the limited-access subgroup to delay preventative care services such as check-ups (40.19% vs. 24.48%) and routine screenings (30.84% vs. 17.48%) (Figure 2.4).

SPA and Delay Subgroup Membership

Table 2.5 presents the association between negative SPA and delay subgroup membership by model. In the unadjusted model, respondents with more negative SPA were more likely to belong to the limited-access subgroup compared with the no delay group in both the 2011 (*RRR* = 1.49, 95% CI = 1.32-1.69, $p < .001$) and 2013 (*RRR* = 1.61, 95% CI = 1.42-1.83, $p < .001$) samples. The association between SPA and access-related delay remained significant in all models, including the final model where each *SD* increase in negative SPA increased the likelihood of belonging to the limited-access subgroup by 18% in 2011 and 36% in 2013.

In the unadjusted model, there was no significant association between negative SPA and belonging to the busy subgroup compared with the no delay group, likely due to the relatively similar levels of SPA between the two groups. After adjusting for age, gender, and predisposing factors (Model 3) or enabling factors (Model 4), the relationship between SPA and busy subgroup membership became significant, suggesting the presence of suppression effects. Despite fluctuations in significance across models, the point estimates are relatively similar in magnitude for Models 2-6. A larger sample size may be needed to reveal the degree to which negative SPA is consistently related to busy delay subgroup membership.

Individuals with more negative SPA were more likely to belong to the dislike subgroup in all models. Although there were slight fluctuations in effect size after adjusting for different blocks of covariates, the relationship between SPA and dislike subgroup membership remained robust. After adjusting for all covariates, every *SD* increase in negative SPA increased the likelihood of belonging to the dislike subgroup by 55% in the 2011 sample and 67% in the 2013 sample.

Discussion

Based on Levy's stereotype embodiment theory, we explored health care delay as a behavioral explanation for why older adults with more negative aging attitudes experience worse health outcomes. Previous research suggests that total patient delay can be broken down into a series of conceptually distinct stages with unique predictors of delay at each point (Safer, Tharps, Jackson, & Leventhal, 1979). Although SPA may affect earlier stages of delay such as the initial detection of unexplained signs/symptoms to disease inference (e.g., appraisal delay) and disease inference to the decision to seek medical help (e.g., illness delay), the present study examined the association between SPA and utilization delay, or delays in seeing the doctor after determining the need to seek medical attention. Consistent with our hypothesis, individuals with more negative SPA were not only more likely to delay care but also cited more reasons for delaying care, even after adjusting for predisposing, enabling, and need factors based on Andersen's Behavioral Model of Health Services Use.

We then used a person-centered approach to identify latent subgroups of delay and examined if SPA scores predicted subgroup membership. As hypothesized, one of the subgroups was characterized by limited health care access. Older adults with more negative SPA were more likely to belong to the limited-access subgroup, whose members tended to be more socioeconomically disadvantaged and in poorer health. Although we did not expect SPA to influence the perception of practical barriers to care, it is plausible that individuals with negative SPA are less likely to persevere in the face of daily inconveniences. Endorsement of negative age stereotypes has been associated with the belief that health outcomes are in the control of powerful others or up to chance (Sargent-Cox & Anstey, 2015), and external factors such as prolonged wait times may be a sufficient deterrent for seeking care among those who are

nihilistic or fatalistic in their views of aging. Conversely, those with more positive SPA may be more persistent in their efforts and seek additional resources to get their health care needs met.

Counter to expectations, the busy delay subgroup was distinct from both the dislike and limited-access delay subgroups. Although we hypothesized that being too busy served as a psychosocial excuse for delaying care, being busy may not entail an active avoidance of health care encounters but rather a prioritization of other commitments. Individuals may report being too busy to seek care because they perceive an incompatibility between their own availability and the availability of potential sources of health care. A glimpse at the descriptive statistics provides some insight into the characteristics of individuals who say they are too busy to seek care. Although the busy subgroup had similar levels of SPA compared with the no delay group, respondents in the busy subgroup were younger and had higher household incomes, higher educational attainment, and fewer chronic conditions. The busy subgroup may represent older adults who are still functioning at a high level and delaying care because they are actively engaged in work or community activities. Indeed, a significantly larger percentage of respondents in the busy subgroup reported not being retired compared with the other delay subgroups. For these individuals, SPA may only matter in select circumstances and/or play only a small role in their decision-making process regarding whether to seek care.

Finally, older adults with more negative SPA were more likely to belong to the subgroup who disliked going to the doctor. Although only approximately 20% of respondents belonged to the dislike subgroup, disliking going to the doctor was the most cited reason for delaying care among all respondents. The Communication Predicament of Aging Model (Ryan, Giles, Bartolucci, & Henwood, 1986) depicts how negative age stereotypes can influence the quality of interactions between older adults and health professionals, causing older adults to evaluate their

health care experience more negatively. Physicians may adopt over-accommodating patterns of speech, sometimes referred to as patronizing communication (Ryan, Hummert, & Boich, 1995) or elderspeak (Kemper, 1994), based on stereotyped expectations about the aging process. Older adults with negative SPA may then embody negative age stereotypes by acting in a dependent manner and inadvertently contribute to the paternalistic behavior displayed by health care professionals. These well-intentioned but overly supportive patterns of speech and behavior by formal/informal care providers can negatively affect the psychological well-being of older adults by activating negative age stereotypes and solidifying the notion that aging is inexorably linked with increased dependence and functional limitations (Kwak, Ingersoll-Dayton, & Burgard, 2014; Williams, Kemper, & Hummert, 2004).

For all three subgroups in the 2011 sample, the most common type of care delayed was seeing the doctor for a symptom or problem. As older adults begin experiencing more age-related declines, they may find it more difficult to distinguish symptoms of "old age" from more worrisome symptoms that may be indicative of serious health conditions. Prior research found that older adults who attributed a recent heart attack/stroke to “old age” were less likely to make lifestyle changes and had higher rates of health care utilization (e.g., hospitalization) over follow-up (Stewart, Chipperfield, Perry, & Hamm, 2016). Promoting more positive aging self-perceptions may help older adults counter automatic old age attributions and take time to more critically evaluate their symptoms. Consequently, older adults with more positive views on aging may interpret new bodily discomforts as cues for seeking medical attention rather than inevitable products of the aging process.

There are several limitations to the present study that should be addressed. First, we used a select sample of respondents who met specific inclusion criteria. HRS does not provide weights

for respondents who complete both the Psychosocial and Lifestyle Questionnaire and an off-year study. Although we were unable to weight our analytic samples to represent the US population aged 51 and over, we replicated our results in two distinct samples of older adults, increasing confidence in the robustness of our findings. In predicting delay subgroup membership, we assigned respondents to the subgroup to which they had the highest posterior probability of belonging. Although we did not explicitly account for uncertainty of group membership in our analyses, the average probability of membership was greater than .85 for all groups. Additionally, our measure of health care delay was based on self-report, and thus, may reflect subjective rather than objective assessments of barriers to health care. Perceived barriers to care, however, may be just as important as actual barriers in predicting care-seeking behaviors. Finally, the reasons for delay did not capture all possible barriers to seeking medical care, and future work should examine a broader range of social, psychological, and cognitive factors as contributors to delay.

Despite these limitations, the present study adds to the literature on SPA and health by delving deeper into how aging attitudes affect perceived barriers to timely medical care. On a theoretical level, we emphasize the importance of studying not only the behavior of interest (e.g., health care delay) but also the underlying cognitive and emotional processes that guide health care decision-making. We highlight the role of psychosocial reasons in determining health care delay and draw attention to the fact disliking going to the doctor ranks highly among older adults as a justification for postponing care. Understanding the extent to which age stereotypes serve as a basis for these negative feelings toward care providers and/or the health care system will further inform efforts on how to improve doctor-patient communication and prevent the undertreatment or overtreatment of age-related conditions.

From a methodological perspective, the present study measured SPA prior to asking about health care delay and controlled for a comprehensive list of covariates. Many studies interview patients about the timing and reasons for delay after the occurrence of a serious health event such as hospitalization (Weissman, Stern, Fielding, & Epstein, 1991). These negative health events, however, may color how older adults remember the decisions and behaviors that contributed to their current state. By using a prospective design with a 1-year follow-up, we were able to ask about delay in the context of everyday life and infer how SPA affects short-term health care decisions.

The pervasiveness of age stereotypes in contemporary American society is shaping the way in which individuals think, feel, and behave as they enter their later years. With the unprecedented number of Baby Boomers reaching old age, ensuring that the aging population has access to the resources they need to maintain high levels of physical, psychological, and social functioning has become a top priority. Although the current study focuses on the effect of older adults' aging attitudes on health care use, it is also important to consider how clinicians' views on aging and ageism within the health care system may interact with older adults' self-views to influence the delivery of high-quality health care (Davis, Bond, Howard & Sarkisian, 2011; Meisner, 2012; Ouchida & Lachs, 2015). To help older adults view aging in a more positive light and more effectively manage their own health, policymakers and practitioners must take a multi-faceted approach and address the issue of age stereotypes and health care delay from individual, institutional, and societal levels.

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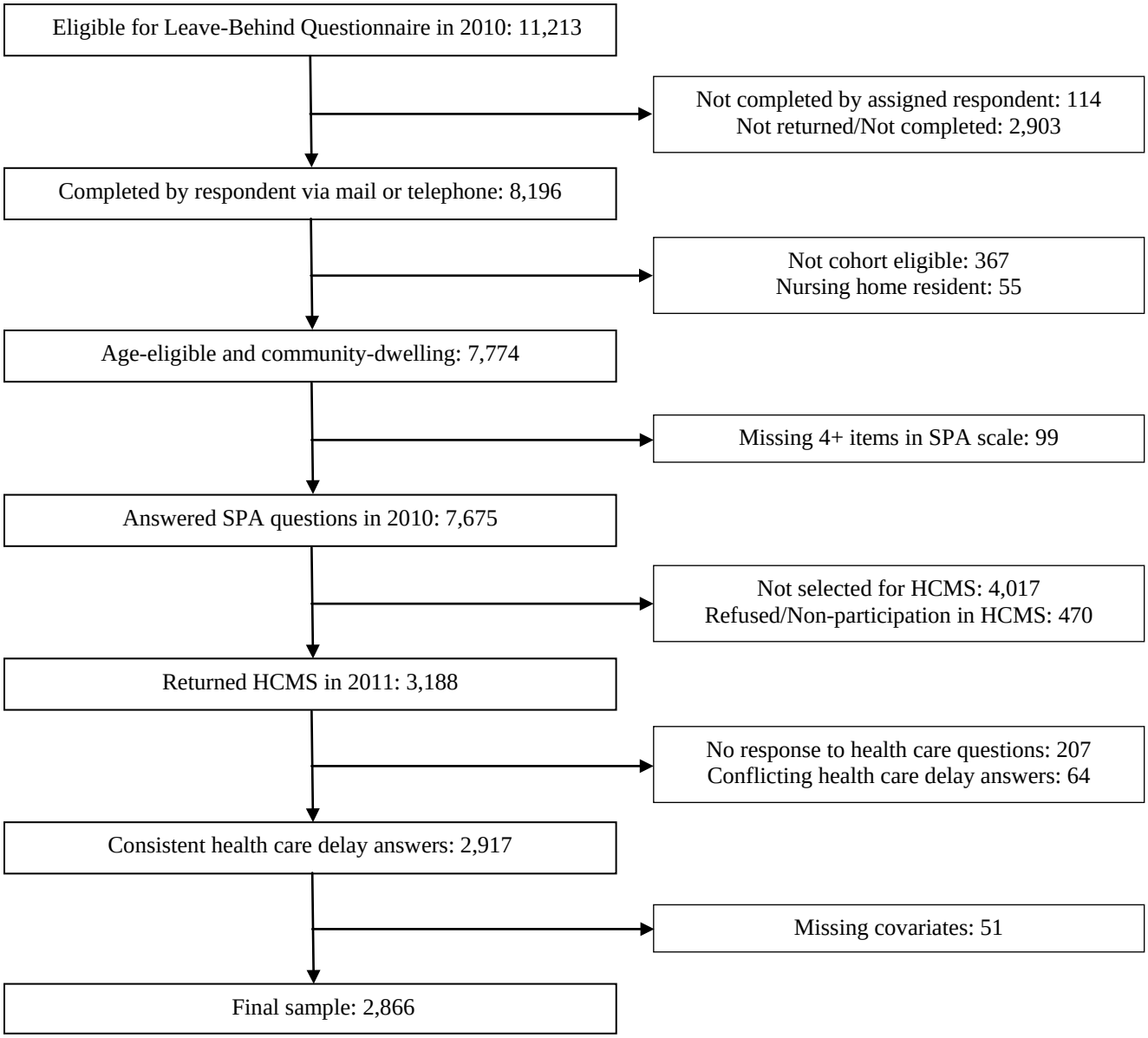


Figure 2.1. Sample inclusion criteria for 2011 Health Care Mail Survey (HCMS) analytic sample. In a rotating design, a random 50% of the Health and Retirement Study (HRS) longitudinal panel is selected for an in-person interview to collect physical measures, biomarkers, and psychosocial data. Participants are given the Psychosocial and Lifestyle Leave-Behind Questionnaire at the end of the interview to complete and mail back to the study offices. The Leave-Behind Questionnaire asks respondents about their self-perceptions of aging (SPA) as well as their evaluations of life circumstances, subjective well-being, and lifestyle choices. The HCMS was mailed to a subsample of HRS respondents in 2011 and asked about reasons for delaying health care as well as other issues regarding health care access, health policy, long-term care, use of senior services, and veterans' issues.

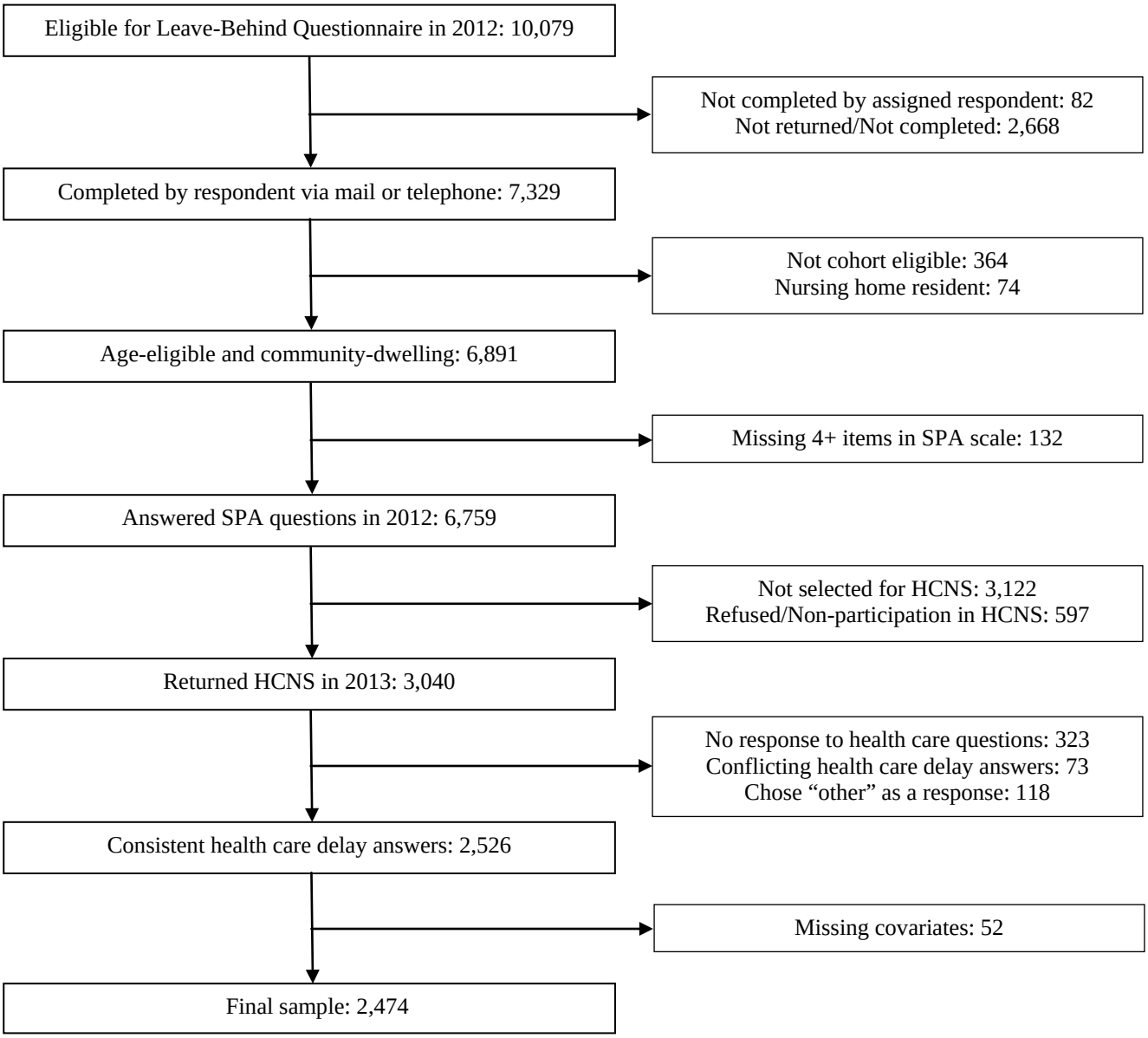


Figure 2.2. Sample inclusion criteria for 2013 Health Care and Nutrition Study (HCNS) analytic sample. In a rotating design, a random 50% of the Health and Retirement Study (HRS) longitudinal panel is selected for an in-person interview to collect physical measures, biomarkers, and psychosocial data. Participants are given the Psychosocial and Lifestyle Leave-Behind Questionnaire at the end of the interview to complete and mail back to the study offices. The Leave-Behind Questionnaire asks respondents about their self-perceptions of aging (SPA) as well as their evaluations of life circumstances, subjective well-being, and lifestyle choices. The HCNS was mailed to a subsample of HRS respondents in 2013 and asked about reasons for delaying health care as well as other issues regarding health care access, food purchases/consumption, and nutrition

Table 2.1

Descriptive Statistics from the 2011 HCMS and 2013 HCNS Analytic Study Samples[a]

Study Variables	2011 HCMS (*N* = 2,866)	2013 HCNS (*N* = 2,474)
Negative SPA, *M (SD)*	3.05 (1.04)	3.13 (1.02)
Age, *M (SD)*	67.34 (10.32)	68.18 (9.77)
Female, %	57.92	59.50
Race/ethnicity, %		
White	75.26	72.51
Black	14.03	14.92
Hispanic	8.16	9.58
Other	2.55	2.99
Educational attainment, %[b]		
<High school	13.22	14.96
High school	57.26	54.61
≥ College	29.52	30.44
Living alone, %	19.99	22.43
Total household income (in thousands), *M (SD)*	66.99 (75.01)	61.50 (87.22)
Uninsured, %	6.07	7.28
Chronic illnesses, *M (SD)*	2.10 (1.44)	2.28 (1.48)
Depressive symptoms, *M (SD)*	1.21 (1.81)	1.26 (1.85)
ADL limitations, *M (SD)*	0.25 (0.75)	0.24 (0.72)
Delay for any reason, %	17.20	19.52
I do not like going to the doctor, %	29.21	28.57
I could not get an appointment soon enough, %	23.53	26.71
I am too busy to go to the doctor, %	22.52	23.60
Once I get there, I have to wait too long to see the doctor, %	18.05	15.32
I did not have transportation, %	15.62	13.66
I am afraid of what I might find out, %	14.20	14.49
I could not get through on the telephone, %	11.16	7.45
The clinic/doctor's office was not open when I could get there, %	7.91	6.83
I do not believe in going to doctors, %	3.85	1.86

Note. ADL = activities of daily living; HCMS = Health Care Mail Survey; HCNS = Health Care and Nutrition Study; SPA = self-perceptions of aging.
[a] Unweighted sample data. [b] Percentages may not sum to 100% due to rounding.

Table 2.2

Negative Self-Perceptions of Aging and OR for Health Care Delay and IRR for Number of Reasons for Delay for 2011 HCMS and 2013 HCNS Samples

		2011 (*N* = 2,866)		2013 (*N* = 2,474)	
		Delay (yes/no)	Number of reasons	Delay (yes/no)	Number of reasons
Model	Covariates	OR (95% CI)	IRR (95% CI)	OR (95% CI)	IRR (95% CI)
1	Unadjusted	1.36 (1.24-1.50)	1.40 (1.28-1.54)	1.47 (1.33-1.63)	1.41 (1.29-1.55)
2	Age + gender	1.49 (1.35-1.65)	1.50 (1.37-1.65)	1.60 (1.44-1.78)	1.47 (1.34-1.60)
3	Age + gender + predisposing[a]	1.49 (1.34-1.65)	1.50 (1.37-1.65)	1.57 (1.41-1.75)	1.45 (1.33-1.59)
4	Age + gender + enabling[b]	1.47 (1.32-1.63)	1.47 (1.33-1.61)	1.58 (1.42-1.76)	1.46 (1.34-1.60)
5	Age + gender + need[c]	1.25 (1.11-1.41)	1.30 (1.17-1.45)	1.41 (1.25-1.60)	1.33 (1.21-1.48)
6	All covariates[d]	1.25 (1.11-1.42)	1.31 (1.17-1.46)	1.40 (1.24-1.59)	1.33 (1.20-1.47)

Note. ADL = activities of daily living; CI = confidence interval; HCMS = Health Care Mail Survey; HCNS = Health Care and Nutrition Study; *OR* = odds ratio; *IRR* = incidence rate ratio. $p < .001$ for all analyses.
[a]Predisposing: race/ethnicity, educational attainment, living arrangement. [b]Enabling: total household income, health insurance status. [c]Need: chronic illnesses, depressive symptoms, ADL limitations. [d]All covariates: age, gender, race/ethnicity, educational attainment, living arrangement, total household income, health insurance status, chronic illnesses, depressive symptoms, ADL limitations.

Table 2.3

Fit Statistics for One-, Two-, and Three-Latent Class Models of Reasons for Delaying Care for 2011 HCMS and 2013 HCNS Samples

	2011 HCMS Sample			2013 HCNS Sample		
Fit statistic	1 class	2 classes	3 classes	1 class	2 classes	3 classes
AIC	3588.624	3499.576	3440.801	3378.087	3302.838	3241.899
BIC	3622.228	3570.985	3550.014	3411.527	3373.898	3350.579
Adjusted BIC	3596.836	3517.027	3467.49	3386.136	3319.941	3268.057
Entropy	1.00	0.56	0.91	1.00	0.85	0.85
Lo-Mendell-Rubin LRT	N/A	p <.001	p <.001	N/A	p <.001	p <.001

Note. For Akaike information criterion (AIC), Bayesian information criterion (BIC), and adjusted BIC, a smaller value suggests a better model fit. The Lo-Mendell-Rubin likelihood ratio test (LRT) uses the adjusted asymptotic distribution of the likelihood ratio statistics to compare models with *k* and *k-1* classes. Entropy values range from zero to one, with values closer to one indicating clearer delineation of latent classes.

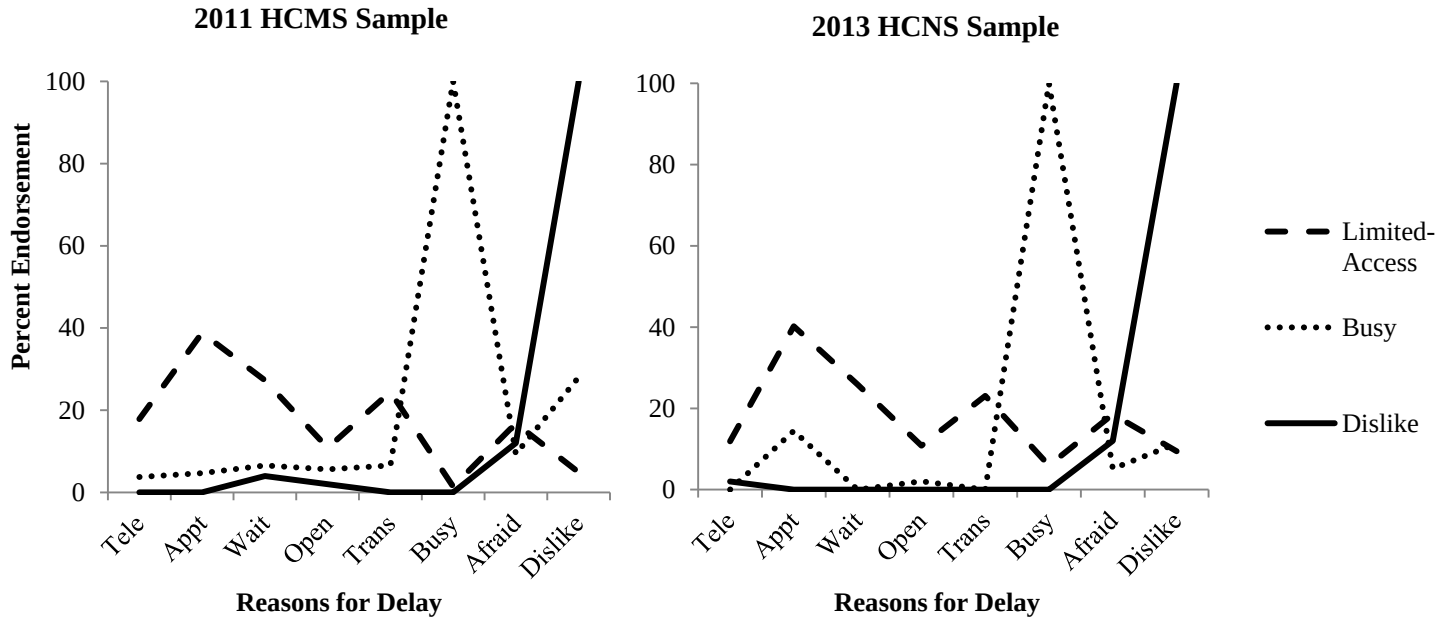


Figure 2.3. Percent endorsement of each reason for delay by latent subgroup for the 2011 Health Care Mail Survey (HCMS) and the 2013 Health Care and Nutrition Study (HCNS) samples. Tele = I could not get through on the telephone; Appt = I could not get an appointment soon enough; Wait = Once I get there, I have to wait too long to see the doctor; Open = The clinic/doctor's office was not open when I could get there; Trans = I did not have transportation; Busy = I am too busy to go to the doctor; Afraid = I am afraid of what I might find out; Dislike = I do not like going to the doctor. Busy = latent subgroup defined primarily by delay due to being too busy to go to the doctor; dislike = latent subgroup defined primarily by delay due to disliking going to the doctor; limited-access = latent subgroup defined primarily by delay due limited health care access.

Table 2.4

Descriptive Statistics for Latent Subgroups of Delay in the 2011 HCMS and 2013 HCNS Samples [a]

	2011 HCMS sample				2013 HCNS sample			
Covariates	No delay (n = 2,373)	Limited-access (n = 286)	Busy (n = 107)	Dislike (n = 100)	No delay (n = 1,991)	Limited-access (n = 286)	Busy (n = 97)	Dislike (n = 100)
Negative SPA, *M (SD)*	2.99 (1.02)	3.41 (1.03)	3.02 (1.08)	3.36 (1.05)	3.05 (1.00)	3.54 (1.03)	3.11 (0.99)	3.51 (1.08)
Age, *M (SD)*	68.38 (10.14)	63.31 (10.42)	59.71 (7.97)	62.56 (9.01)	69.30 (9.61)	64.18 (9.38)	60.03 (7.30)	65.20 (8.87)
Female, %	57.61	60.14	64.49	52.00	59.02	60.84	63.92	61.00
Race/Ethnicity, % [b]								
White	76.86	59.44	74.77	83.00	74.38	56.29	78.35	76.00
Black	13.70	20.28	9.35	9.00	14.41	21.33	10.31	11.00
Hispanic	6.78	18.18	13.08	7.00	8.49	17.13	7.22	12.00
Other	2.65	2.10	2.80	1.00	2.71	5.24	4.12	1.00
Educational attainment, % [b]								
<High school	12.52	20.63	8.41	14.00	14.21	24.13	3.09	15.00
High school	57.99	54.90	43.93	61.00	55.20	49.30	46.39	66.00
≥ College	29.50	24.48	47.66	25.00	30.59	26.57	50.52	19.00
Living alone, %	20.56	19.93	12.15	15.00	21.60	27.97	21.65	24.00
Total household income (in thousands), *M (SD)*	67.45 (74.16)	49.33 (65.99)	100.80 (98.79)	70.57 (76.92)	62.90 (90.75)	43.83 (50.44)	102.67 (114.56)	44.17 (38.79)
Uninsured, %	4.89	13.29	10.28	9.00	5.17	17.48	9.28	18.00
Chronic illnesses, *M (SD)*	2.10 (1.42)	2.34 (1.52)	1.70 (1.30)	1.69 (1.53)	2.29 (1.45)	2.58 (1.58)	1.58 (1.53)	1.99 (1.44)
Depressive symptoms, *M (SD)*	1.05 (1.66)	2.31 (2.36)	1.31 (1.87)	1.66 (2.18)	1.09 (1.71)	2.33 (2.38)	1.33 (1.59)	1.66 (2.06)
ADL limitations, *M (SD)*	0.23 (0.71)	0.49 (1.04)	0.12 (0.56)	0.21 (0.70)	0.22 (0.68)	0.46 (1.00)	0.13 (0.61)	0.21 (0.46)

Note. ADL = activities of daily living; HCMS = Health Care Mail Survey; HCNS = Health Care and Nutrition Study; SPA = self-perceptions of aging. Busy = latent subgroup defined primarily by delay due to being too busy to go to the doctor; dislike = latent subgroup defined primarily by delay due to disliking going to the doctor; limited-access = latent subgroup defined primarily by delay due limited health care access.
[a] Unweighted sample data. [b] Percentages may not sum to 100% due to rounding.

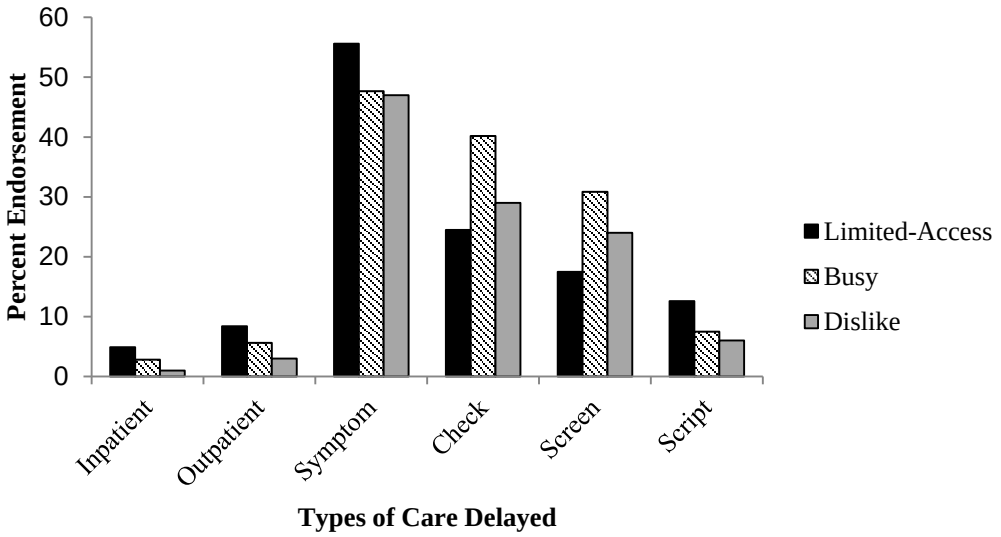


Figure 2.4. Percent endorsement of each type of care delayed for the 2011 Health Care Mail Survey sample. Inpatient = major surgery that would have required a hospital stay of one or more nights; Outpatient = outpatient surgery; Symptom = seeing the doctor about a symptom or a problem; Check = getting a check-up. Screen = routine screening, like a colonoscopy; Script = filling a prescription. Limited-Access = latent subgroup defined primarily by delay due limited health care access; Busy = latent subgroup defined primarily by delay due to being too busy to go to the doctor; Dislike = latent subgroup defined primarily by delay due to disliking going to the doctor.

Table 2.5

Negative Self-Perceptions of Aging and RRR of Membership into Latent Subgroups of Delay for 2011 HCMS and 2013 HCNS Samples

		2011 HCMS sample			2013 HCNS sample		
		Limited-access (n = 286)	Busy (n = 107)	Dislike (n = 100)	Limited-access (n = 286)	Busy (n = 97)	Dislike (n = 100)
Model	Covariates	RRR (95% CI)			RRR (95% CI)		
1	Unadjusted	1.49 (1.32-1.69)**	1.02 (0.84-1.24)	1.43 (1.17-1.74)**	1.61 (1.42-1.83)**	1.05 (0.86-1.30)	1.57 (1.29-1.92)**
2	Age + gender	1.61 (1.42-1.82)**	1.16 (0.96-1.42)	1.55 (1.27-1.89)**	1.73 (1.52-1.97)**	1.20 (0.97-1.47)	1.68 (1.37-2.05)**
3	Age + gender + predisposing[a]	1.58 (1.39-1.79)**	1.24 (1.02-1.51)*	1.52 (1.24-1.86)**	1.67 (1.46-1.90)**	1.27 (1.03-1.58)*	1.61 (1.31-1.98)**
4	Age + gender + enabling[b]	1.50 (1.32-1.71)**	1.24 (1.01-1.52)*	1.56 (1.27-1.90)**	1.65 (1.45-1.88)**	1.26 (1.02-1.56)*	1.61 (1.31-1.97)**
5	Age + gender + need[c]	1.18 (1.02-1.38)*	1.17 (0.93-1.48)	1.59 (1.25-2.01)**	1.37 (1.18-1.59)**	1.27 (1.00-1.61)	1.75 (1.38-2.21)**
6	All covariates[d]	1.18 (1.01-1.37)*	1.23 (0.97-1.56)	1.55 (1.22-1.97)**	1.36 (1.17-1.58)**	1.33 (1.04-1.70)*	1.67 (1.32-2.12)**

Note. ADL = activities of daily living; CI = confidence interval; HCMS = Health Care Mail Survey; HCNS = Health Care and Nutrition Study; RRR = relative risk ratio; busy = latent subgroup defined primarily by delay due to being too busy to go to the doctor; dislike = latent subgroup defined primarily by delay due to disliking going to the doctor; limited-access = latent subgroup defined primarily by delay due limited health care access; reference group = no delay group. [a]Predisposing: race/ethnicity, educational attainment, living arrangement. [b]Enabling: total household income, health insurance status. [c]Need: chronic illnesses, depressive symptoms, ADL limitations. [d]All covariates: age, gender, race/ethnicity, educational attainment, living arrangement, total household income, health insurance status, chronic illnesses, depressive symptoms, ADL limitations.
*$p < .05$, **$p < .001$

CHAPTER III

Self-Perceptions of Aging and Changes in Cystatin C in the Setting of Perceived Discrimination

Introduction

While some associate aging with a period of inevitable loss and decline, others consider old age as a time for continued growth and exploration. A significant body of work suggests that these individual differences in subjective evaluations of the aging process contribute to not only an individual's sense of self but also his/her risk of disease and disability in old age. Self-perceptions of aging (SPA), or attitudes toward one's own aging experience, have been associated with a variety of functional (Levy, Slade, & Kasl, 2002; Sargent-Cox, Anstey, & Luszcz, 2012), cognitive (Levy, 1996; Levy, Ferrucci, et al., 2016), and psychological (Wurm & Benyamini, 2014; Wurm, Tomasik, & Tesch-Römer, 2008) health outcomes among older adults, even after accounting for many traditional physical and behavioral risk factors.

According to Levy's stereotype embodiment theory (Levy, 2009), individuals are exposed to age stereotypes across the life course, and the embodiment of societal age stereotypes into the self-concept can influence late life health through multiple pathways. Previous studies have explored the role of psychological processes such as self-fulfilling prophecy (Levy & Leifheit-Limson, 2009; Robertson, Savva, King-Kallimanis, & Kenny, 2015; Wurm, Warner, Ziegelmann, Wolff, & Schüz, 2013) and behavioral pathways such as health behaviors (Levy & Myers, 2004; Kim, Moored, Giasson, & Smith, 2014) as possible mechanisms through which SPA may influence health outcomes among the older adult population. Recent evidence,

however, suggests that subjective aging experiences may also "get under the skin" and affect the way our bodies respond to environmental stressors at a biological or physiological level.

SPA and Physiological/Biological Stress Responses

Activation of the sympathetic nervous system and/or hypothalamic-adrenal-pituitary axis seems to be one means by which exposure to age stereotypes may impact health outcomes. In an experimental study, Levy, Hausdorff, Hencke, and Wei (2000) found that individuals exposed to negative age stereotypes experienced a significantly heightened cardiovascular response (e.g., systolic blood pressure, diastolic blood pressure, heart rate) immediately after being primed with age-stereotypic words. These authors suggest that negative age stereotypes activate negative age-related cognitive schemas about one's own aging and act as a physiological stressor on the cardiovascular system. Over the long term, the chronic stress of frequent and prolonged exposure to negative age stereotypes may place individuals with negative SPA at particularly high risk of experiencing poor health outcomes.

Exposure to positive age stereotypes and the activation of more positive self-perceptions of aging, on the other hand, seem to have a protective effect against stress by preventing significant autonomic changes from baseline despite exposure to multiple challenges (Levy et al., 2000). Holding more positive age self-stereotypes may also act as a buffer against long-term stress (Levy, Moffat, Resnick, Slade, & Ferruci, 2016). Over a 30-year follow-up, older adults with more positive age stereotypic views exhibited non-significant changes in cortisol from baseline while those with more negative age stereotypic views showed a 44% increase in cortisol levels from baseline. Additionally, individuals with more positive SPA have lower levels of inflammatory biomarkers such as c-reactive protein, which has been shown to partially mediate the association between positive SPA and mortality (Levy & Bavishi, 2016). Individuals who

hold more optimistic views about their aging process, therefore, may use these positive self-views as a buffer against attacks on their sense of self, preventing the cumulative effects of stress on the body.

Perceived Discrimination as an Environmental Stressor

In experimental settings, researchers have been able to elicit a stress response by simply exposing older participants to negative age stereotype primes at an unconscious level. Older adults in everyday contexts may be exposed to not only subliminal age-stereotypic messages but also to more overt and direct forms of discrimination. Being the target of discrimination is an uncontrollable, and often unpredictable, experience, making it a particularly potent environmental stressor. Perceived discrimination has been associated with multiple markers of stress, including elevated inflammatory markers such as c-reactive protein (Lewis, Aiello, Leurgans, Kelly, & Barnes, 2010), increased ambulatory blood pressure (Smart Richman, Pek, Pascoe, & Bauer, 2010), and increased allostatic load (Upchurch et al., 2015). Individuals who regularly report experiences of discrimination not only exhibit elevated stress biomarkers and but also have worse mental and physical health outcomes (Pascoe & Smart Richman, 2009).

In a society where older adults are often overlooked and undervalued, perceived discrimination may be an important chronic stressor faced by older adults, who likely continue to experience discrimination due to other personal characteristics such as race and gender but must also cope with the added stress of being unfairly judged due to their age. Given the stress-buffering effects of positive SPA, having a more positive view of one's own aging may serve as a health-protective factor among those who report being the target of discrimination. Although many studies have examined the independent effects of SPA and perceived discrimination of health, few studies have looked directly at the interaction between perceived discrimination and

SPA and the extent to which SPA may have differential effects on health among those who do and do not report experiences of perceived discrimination.

SPA, Perceived Discrimination, and Kidney Functioning

Both perceived discrimination (Lewis et al., 2006; Troxel, Matthews, Bromberger, & Sutton-Tyrrell, 2003) and SPA (Levy, Zonderman, Slade, & Ferrucci, 2009) have been linked to an increased risk for cardiovascular disease and/or acute cardiovascular events. Given the intimate interconnection between the renal and cardiovascular systems (Ronco, Haapio, House, Anavekar, & Bellomo, 2008), SPA and perceived discrimination likely act through many of the same pathways to affect both cardiovascular and kidney functioning. Chronic kidney disease (CKD) and cardiovascular disease share several common risk factors including dyslipidemia, hypertension, and diabetes. Many of the same health behaviors that increase the likelihood of developing cardiovascular disease, such as smoking and physical inactivity, also contribute to one's risk for CKD (Stengel, Tarver-Carr, Powe, Eberhardt, & Brancati, 2003). We, however, are unaware of any studies that examine the effects of SPA and/or perceived discrimination on kidney functioning among the older adult population.

There has been growing interest in understanding the psychosocial and environmental contributors to CKD disease onset and progression, but the number of studies in this area is still relatively sparse. Bruce et al. (2009) developed a heuristic model of the associations between the social environment (e.g., economic deprivation, residential segregation, individual and institutional discrimination), psychosocial factors (e.g., anger, anxiety, depression, stress, social relations), behavioral factors (e.g., smoking, drug use, alcohol use, unhealthy diet, low physical activity), risk factors (e.g., hypertension, diabetes, obesity), and kidney outcomes (e.g., CKD, CKD progression, end-stage renal disease). Within this theoretical model, the authors highlight

discrimination as a potential environmental stressor that may act through several pathophysiological mechanisms (e.g., HPA axis, inflammatory cytokines, sodium/water retention) to increase the risk for poor kidney outcomes, supporting our view of perceived discrimination as a particularly important environmental factor in the context of CKD.

Cystatin C as a Biomarker of Kidney Functioning and the Risk for Adverse Events

Although creatinine is the most commonly used biomarker for assessing kidney functioning in the clinical setting, cystatin c has recently gained popularity as a kidney biomarker because it is less dependent on age, sex, race, and muscle mass and more sensitive to mild reductions in glomerular filtration rate (GFR) (Coll et al. 2000). Cystatin c is a lysosomal proteinase inhibitor that is produced at a constant rate by all nucleated cells in the human body and freely filtered by the glomerulus of the kidney. Rising cystatin c levels, therefore, often indicate a decline in kidney functioning. Serum cystatin c levels have also been associated with factors other than GFR including age, sex, height, weight, BMI, smoking, and c-reactive protein (Stevens et al., 2009; Knight et al., 2004).

Recent research suggests that cystatin c may function as more than a biomarker of kidney functioning and serve as a prognostic indicator of other adverse events. Cystatin c levels have been shown to be a linear predictor of mortality and cardiovascular outcomes among the older adult population (Sarnak et al., 2005; Shlipak et al., 2005; Shlipak, Fyr, et al., 2006), even among those without chronic kidney disease (Shlipak, Katz, et al., 2006). Therefore, small increases in cystatin c, even within the range of normal renal function, may be clinically significant and predispose individuals to the development of downstream health complications (Madero & Sarnak, 2009). Rapid declines in kidney functioning as measured by cystatin c have been shown to increase the risk for cardiovascular and all-cause mortality, even after stratification by baseline

kidney functioning (e.g., estimated GFR) (Rifkin et al., 2008). By monitoring changes in cystatin c, it may be possible to identify individuals at increased risk for poor renal and cardiovascular outcomes and reduce rates of morbidity and mortality among the older adult population.

Current Study

The current study examines the effects of self-perceptions of aging and perceived discrimination on kidney functioning as ascertained by changes in cystatin c over a four-year period. Using data from the Health and Retirement Study (N = 3336), we examine 1) the association between SPA and residual change in cystatin c four years later after adjusting for known sociodemographic and health-related predictors of CKD and/or cystatin c levels and 2) the moderating effect of perceived discrimination on the relationship between SPA and changes in cystatin c. We hypothesize that 1) more positive SPA will be associated with a smaller residual increase in cystatin c over 4 years in fully-adjusted models and 2) positive SPA may have a protective effect against the negative effects of perceived discrimination on cystatin c levels among a sample of community-dwelling US older adults over age 50.

Method

Study Participants

The Health and Retirement Study (HRS) is a nationally representative biennial panel study of U.S. adults over the aged 51 and older that is supported by the National Institute on Aging (U01AG009740) and conducted by the Survey Research Center at the University of Michigan's Institute for Social Research (Sonnega et al., 2014). In the present study, we use data from respondents who were originally assigned to complete an enhanced face-to-face (EFTF) interview that included the collection of biomarkers and psychosocial data in 2008 and were selected for a repeat of the EFTF protocol again in 2012. The study website

(http://hrsonline.isr.umich.edu/) provides extensive documentation on the protocol, instrumentation, sampling strategy, and statistical weighting procedures.

The 2008 EFTF interview included two modules that provided the central constructs: 1) a measure of SPA and perceived discrimination in a self-administered Psychosocial and Lifestyle Leave-Behind Questionnaire (89% response rate) and 2) the collection of blood spots from a finger prick for the analysis of biomarkers including cystatin c. The overall completion rates for DBS collection were 87% and 86% for 2008 and 2012, respectively. The HRS protocols are approved by the University of Michigan Health Services Institutional Review Board. The present study was exempted from review because it uses de-identified and publicly available data.

For the current study, participants were included in the analytic sample if they 1) were age-eligible (>50 years old), community-dwelling, and not interviewed by proxy, 2) were selected for the EFTF interview in 2008, 3) completed the Psychosocial and Lifestyle Leave-Behind Questionnaire in 2008, 3) provided blood spot samples for biomarker assessment in 2008 and 2012. Among the individuals who met these inclusion criteria, 563 individuals were excluded because they were missing one or more of the variables used in our analyses, resulting in a final analytic sample size of 3,336 individuals.

Self-Perceptions of Aging

In the Psychosocial and Lifestyle Questionnaire, SPA were measured in 2008 using an 8-item scale that included five items from the Attitude Toward Own Aging subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975; Liang & Bollen, 1983) and an additional three items from the Berlin Aging Study (Baltes & Mayer, 2001). On a scale from 1 (*strongly disagree*) to 6 (*strongly agree*), respondents indicated the degree to which they endorsed statements such as “Things keep getting worse as I get older,” “The older I get, the

more useless I feel," and "So far, I am satisfied with the way I am aging." Negatively worded items were reverse coded, and all items were averaged so that higher scores corresponded to more positive self-perceptions of aging. The final score was set to missing if there were more than four items with missing values. Cronbach's alpha for the overall scale was 0.82 in 2008. Scores were standardized ($\mu = 0$, $\sigma = 1$) to facilitate interpretation and comparison of effect size among other studies of self-perceptions of aging.

Perceived Everyday Discrimination

Perceived everyday discrimination (Kessler, Mickelson, & Williams, 1999) was measured in 2008 by asking respondents the frequency (1 = *Almost every day* to 6 = *Never*) with which they experienced six scenarios such as "You are treated with less courtesy or respect than other people," "People act as if they think you are not smart," and "You receive poorer service or treatment than other people from doctors or hospitals." An index of perceived discrimination was created by reverse-coding all items and averaging scores across all six items. Higher scores corresponded to a higher frequency of perceived discrimination. The final score was set to missing if there were more than three items with missing values. Cronbach's alpha in 2008 was 0.82. In our sample, approximately 38% of respondents reported never experiencing any of the six scenarios. Our indicator of perceived discrimination was, therefore, dichotomized into those who report never experiencing any situations of perceived discrimination versus those who report at least some degree of perceived discrimination.

Cystatin C

Cystatin C levels from dried blood spots (DBS) were analyzed by the University of Vermont in 2008 and the University of Washington in 2012. HRS provides extensive documentation regarding the specific laboratory protocols used to analyze DBS (Crimmins et al.,

2013). Although studies have shown a high degree of correlation between biomarker values derived from whole blood versus DBS samples, especially for cystatin c, c-reactive protein, and HbA1c (Crimmins et al., 2014), biomarker values based on DBS may not be directly comparable to those derived from venous blood samples. In order to adjust for variability between labs and facilitate comparison with other large population-based studies (e.g., National Health and Nutrition Examination Survey), HRS constructed NHANES equivalent assay values for each biomarker by mirroring the distribution of biomarkers from venous blood samples in NHANES after adjusting for any between-lab differences (Köttgen et al., 2008). We use the NHANES equivalent assay values for cystatin c and all other biomarkers analyzed in the present study.

Covariates

Baseline (2008) variables were included in our models based on factors known to affect CKD risk and/or cystatin c levels in our study population. Sociodemographic factors included age, gender (male/female), race/ethnicity (White/Caucasian, Black/African American, Hispanic, Other), and years of education. Health-related factors included self-reported diagnoses of hypertension (no/yes), diabetes (no/yes), and heart disease (no/yes), smoking status (never, former, current) and body mass index (kg/m^2). C-reactive protein (CRP) levels derived from DBS samples were also included in our models based on previous findings showing that cystatin c may be affected by CRP levels (Stevens et al., 2009). All continuous covariates were standardized ($\mu = 0$, $\sigma = 1$), and the first category was used as the reference group for all categorical covariates.

For sensitivity analyses, we used several additional covariates that measured 1) self-reported kidney trouble due to diabetes and 2) hypertension based on systolic/diastolic blood pressure measurements, and 3) diabetes based on A1c values. Among those who reported being

diagnosed with diabetes, kidney dysfunction at baseline was assessed by asking "Has your diabetes caused you to have trouble with your kidneys or protein in your urine?" (yes/no). For the assessment of hypertension, three readings of systolic and diastolic blood pressure were taken 45 seconds apart using an automated blood pressure cuff on the respondent's left arm. Values were averaged across the readings, and individuals were considered to have hypertension if they had an average systolic blood pressure ≥ 140 and/or a diastolic blood pressure ≥ 90. For the assessment of diabetes, hemoglobin A1c levels were measured using the same dried blood spots from which cystatin c and c-reactive protein were also assessed. Individuals were considered to have diabetes if they had an A1c ≥ 6.5. The HRS user guides provide additional information on the assessment of physical measures (Crimmins et al., 2008) and biomarkers (Crimmins et al., 2013) in the Health and Retirement Study.

Data Analysis

To begin, we conducted and compared findings from a series of linear regressions. In Model 1, we examined the association between SPA and cystatin c levels four years later, adjusting for baseline cystatin c levels. In Model 2, we added in a dichotomous measure of perceived discrimination to examine the effect of SPA on residual change in cystatin c levels after adjusting for exposure to perceived discrimination. In Model 3, we investigated the main effect of SPA, the main effect of exposure to perceived discrimination, and their interaction effect on change in cystatin c over four years. All sociodemographic and health-related covariates were included in the three models.

We performed several sensitivity analyses to assess the degree to which our findings may have been affected by the presence of extreme cases and/or the use of self-reported versus objective measures of disease status as covariates. First, we excluded individuals who already

reported having kidney problems due to diabetes at baseline because individuals with severe kidney disease may be on a different trajectory that those with relatively normal kidney functioning. Next, we replaced 1) self-reported diagnosis of hypertension (yes/no) with a measure of hypertension based on actual systolic and diastolic blood pressure measurements and 2) self-reported diagnosis of diabetes (yes/no) with a measure of diabetes based on hemoglobin A1c values. The final model excluded individuals with kidney damage from diabetes *and* replaced self-reported diagnoses of hypertension and diabetes with objective biomarker data.

Results

Descriptive Statistics

In our analytic sample (N = 3336), there was a slight majority of women (60%), and the average age at baseline was approximately 69 years. In terms of race/ethnicity, 78% identified as non-Hispanic White, 12% identified as non-Hispanic Black, 9% as Hispanic, and 2% as Other. The sample was relatively well-educated with an average of 13 years of education. The prevalence of hypertension, heart disease, and diabetes in this sample were 58%, 24%, and 19%, respectively. Table 3.1 provides additional information on the characteristics of our analytic sample

With regards to our main variables of interest, the average score on the SPA measure in 2008 was 3.98, and some degree of perceived discrimination was reported by 62% of the sample. The average cystatin c level increased from 1.07 mg/L in 2008 to 1.25 mg/L in 2012. Based on a cut-off score of $\geq$ 1.55 mg/L, the percentage of individuals with elevated cystatin c levels increased by approximately 10% over the four-year period from 8% in 2008 to 18% in 2012. Figure 1 shows the distribution of cystatin c values in 2008 and 2012.

SPA, Perceived Discrimination, and Residual Change in Cystatin C

Among the covariates included in our models, increasing age, “other” race, hypertension, heart disease, diabetes, current smoking status, and higher BMI were all significantly associated with higher levels of cystatin c in 2012, adjusting for baseline cystatin c in 2008. More years of education were negatively associated with cystatin levels four years later. The direction and size of covariate effects on cystatin c did not change significantly from one model to the next (Table 3.2).

In the present study, we were interested in the effects of SPA on residual change in cystatin c above and beyond known sociodemographic and health-related risk factors (Table 3.2). Consistent with our hypothesis, each *SD* increase in positive SPA was associated with a lower cystatin c level in 2012, adjusting for 2008 cystatin c and all covariates in Model 1 (b = -0.016, SE = 0.007, p = 0.03). After adding perceived discrimination in Model 2, the effect of SPA on residual change in cystatin c was no longer significant (b = -0.013, SE = 0.007, p = 0.08). There was also no effect of perceived discrimination on cystatin c in Model 2 (b = 0.026, SE = 0.015, p = 0.08).

As predicted, an interesting effect emerged when the interaction between SPA and perceived discrimination was added to Model 3. There was no main effect of SPA (b = 0.005, SE = 0.011, p = 0.64), a main effect of perceived discrimination (b = 0.029, SE = 0.015, p = 0.05), and a significant interaction between SPA and perceived discrimination (b = -0.030, SE = 0.014, p = 0.04) on cystatin c. Figure 3.2 illustrates the differential effect of SPA on residual cystatin c by exposure to perceived discrimination as seen in Model 3.

Given that continuous covariates were standardized and categorical variables were compared to a reference category, we can interpret the intercept of Model 3 as the predicted cystatin c in 2012 for the “average” participant in our sample. In this sample, the prototypic

participant was a 69-year-old, non-Hispanic White male with 13 years of education and no self-reported diagnoses of hypertension, heart disease, or diabetes. He has never smoked, is slightly overweight, has a slightly elevated c-reactive protein level, and has moderately positive attitudes about his own aging process. Given a cystatin c of 1.07 at baseline, Model 3 predicted that he would have a cystatin c of 1.15 four years later. In Figure 3.2, the dotted reference line corresponds to the model intercept or the predicted 2012 cystatin c for this prototypical respondent.

The significant interaction effect suggests, however, that self-perceptions of aging are a significant predictor of residual change in cystatin c only among those who have experienced some degree of discrimination. Among those who reported never experiencing perceived discrimination, the predicted cystatin c level in 2012 did not differ significantly between those with more negative SPA (- 1 *SD*) and those with more positive SPA (+1 *SD*). Among individuals who reported experiencing at least some degree of perceived discrimination, however, those with more negative SPA had significantly higher cystatin c levels compared to their more positive counterparts (1.21 vs. 1.15). Positive SPA may exert a protective effect among those reporting perceived discrimination, mitigating the negative effects of discrimination on changes in cystatin c levels over time.

Sensitivity Analyses

We performed several sensitivity analyses to test the robustness of our results after accounting for extreme values or imprecisions in measurement. Given the significant interaction effect between SPA and perceived discrimination in the main analyses (Table 3.2), we performed all sensitivity analyses using the fully-adjusted model that included SPA, perceived discrimination, and their interaction (Table 3.3). Excluding individuals who reported kidney

trouble due to diabetes at baseline (Model 1) or replacing self-reported measures of hypertension/diabetes with objective assessments (Model 2) resulted in only minor changes in the magnitude of the main effect of perceived discrimination and the interaction effect of SPA and perceived discrimination on change in cystatin c. When we excluded individuals with pre-existing kidney problems *and* used objective measures of disease status, the main effect of perceived discrimination (b = 0.033, SE = 0.015, p = 0.03) and the interaction between SPA and perceived discrimination (b = -0.30, SE = 0.014, p = 0.03) increased slightly in magnitude.

Discussion

While kidney functioning tends to decline with age in older adulthood, we offer preliminary evidence that the rate of decline may be influenced by psychosocial factors above and beyond traditional sociodemographic and health-related risk factors. The role of social and environmental factors on kidney disease has been largely unexplored and may partially explain the increased prevalence of kidney disease in high-risk populations. The present study is the first, to our knowledge, to examine the association between SPA, perceived discrimination, and changes in cystatin c as a biomarker of changes in kidney functioning. According to Levy's stereotype embodiment theory, SPA influences health through multiple pathways, and the current study adds to the literature showing that how older adults feel about their own aging can be linked to changes that are occurring at the biological level.

We examined perceived discrimination as a specific context in which views about one's aging may be affecting the body's response to stressful circumstances, as reflected in larger increases in cystatin c over time. Experiences of discrimination may be one potential environmental stressor that influences the development and progression of chronic kidney disease, and we found SPA to be an important predictor of changes in cystatin c among this

vulnerable subgroup. Among older adults who reported being the target of discrimination, we found that individuals with more negative SPA had significantly larger increases in cystatin c over the 4-year follow-up period compared those with more positive SPA, suggesting that SPA may play a role in predicting cystatin c levels primarily when older adults perceive a heightened level of threat to their sense of self. With regards to kidney functioning, it seems that SPA alone may not affect changes in cystatin c but the addition of an insult such as perceived discrimination may be needed to affect long-term change.

Perceived discrimination and SPA likely act through many of the same pathways to influence long-term mental and physical health outcomes. Positive SPA may weaken the pathways through which perceived discrimination is negatively affecting health, while negative SPA may intensify the degree to which perceived discrimination wreaks havoc on the body. On a physiological level, negative SPA may then exacerbate the physiological stress response to perceived discrimination, resulting in blood pressure spikes that can have long-term consequences for renal function. On a behavioral level, individuals who perceive themselves to be the target of perceived discrimination may be less likely to engage in maladaptive behaviors that increase the risk of kidney disease and rising cystatin c levels (e.g., smoking, sedentary lifestyle, poor diet) if they have more positive attitudes about their own aging. On a psychological level, SPA may affect the way in which older adults view, interpret, and react to environmental stressors such as perceived ageist interactions or age discriminatory policies and influence the degree to which older adults believe these biased judgements are true or justified.

There are several limitations to the present study that should be addressed. First, the HRS collects data on psychosocial factors and biomarkers on the same subsample only every four years. We, therefore, assessed only relatively short-term linear changes in cystatin c based on

two time points over a four-year period. Future studies should consider using datasets with longer follow-up periods and closer time intervals between assessments to allow for a more detailed and nuanced understanding of the relationship between psychosocial factors, such as SPA and perceived discrimination, on long-term trajectories of biomarkers like cystatin c.

Given that the HRS does not provide weights for individuals who complete both the Psychosocial Leave-Behind Questionnaire and the biomarkers section of the EFTF interview, we were unable to generalize our findings to the larger population of older US adults over age 50. The purpose of the current study, however, was not to examine population trends but rather to explore a potentially novel relationship between an individual's perception of their own aging and a biological marker of kidney health. In addition, our sample consisted of a select group of older adults who met specific inclusion criteria (e.g., community-dwelling, non-proxy, alive at follow-up). It is important to acknowledge that selective mortality and drop-out of respondents in the poorest health may have resulted in a sample that is healthier than the general population.

Finally, we did not look specifically at respondents' attributions for their experiences of discrimination. For exploratory purposes, we found that approximately 56% of respondents reported age as a reason for why they believe they were the target of discrimination, suggesting that age discrimination may be the primary type of environmental threat experienced by older adults. In the present study, we examined general experiences of perceived discrimination as a context in which SPA may be particularly influential in predicting changes in cystatin c. Future studies, however, should consider how the relationship between SPA and changes in cystatin c may differ depending on individual attributions for discrimination (e.g. age, race, sex, religion, sexual orientation).

In addition, we examined general experiences of perceived discrimination as a moderator the relationship between SPA and changes in cystatin c, but some studies suggest a more direct mediational relationship between perceived age discrimination, SPA, and health. Han and Richardson (2015), for example, found SPA to mediate the relationship between perceived age discrimination and depressive symptoms: Everyday experiences of perceived age discrimination caused older adults to view their own aging experience more negatively, which then led to an increase in symptoms of depression. Cross-lagged models, on the other hand, have shown that the effects of SPA on perceived discrimination are stronger than the reverse (Voss, Wolff, and Rothermund, 2017), suggesting that a self-fulfilling prophecy effect is occurring in which individuals with negative SPA in a specific domain (e.g., personal competence, physical decline, social life) are more likely to perceive discrimination in the corresponding context (e.g., work, medical care, social life). Future studies should look more closely at the potentially reciprocal relationship between perceived discrimination and SPA and the pathways that lead to changes in cystatin c.

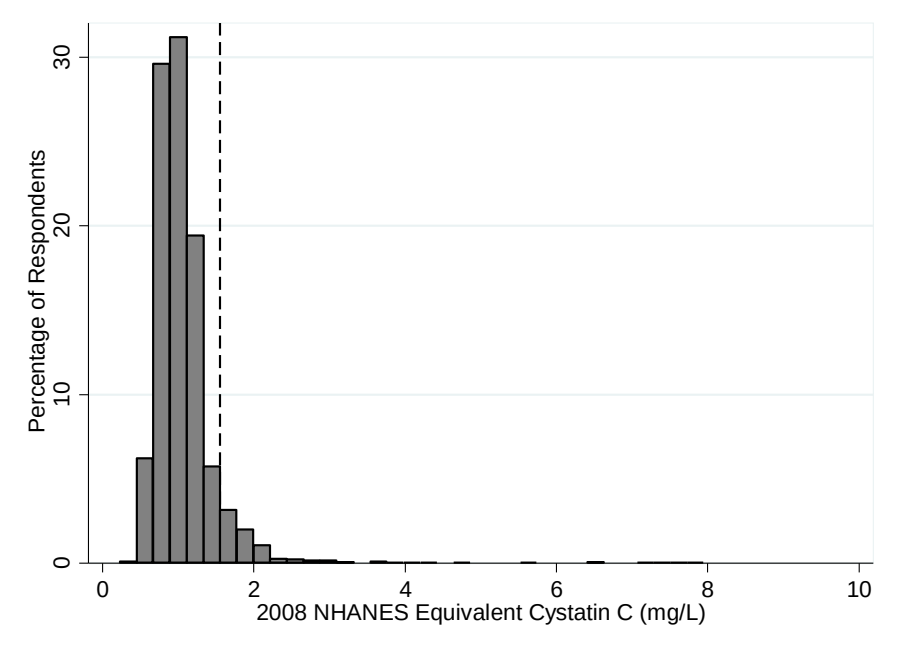
The pervasiveness of negative age stereotypes in American society has created an ageist environment where older adults regularly encounter situations in which they are judged or treated unfairly due to their age or other personal characteristics. Although experiences of discrimination are outside of one's control, self-perceptions of aging are potentially more modifiable and amenable to intervention at an individual level. Changing older adults' perceptions of their own aging does not solve the problem of systemic age discrimination in our society, but encouraging older adults to view their own aging in a more positive light could potentially slow the rate at which chronic exposure to stressful events, such as perceived discrimination, impacts kidney functioning and the body's overall homeostasis.

Table 3.1

Descriptive Statistics from the Analytic Study Sample[a]

SPA, *M (SD)*	3.98 (1.03)
Ever perceived discrimination, %	62.17%
Age, *M (SD)*	68.58 (8.37)
Female, %	60.04
Race/Ethnicity, %	
Non-Hispanic White	77.85
Non-Hispanic Black	11.54
Hispanic	8.75
Other	1.86
Years of education, *M (SD)*	12.74 (3.04)
Hypertension, %	58.45
Heart disease, %	23.89
Diabetes, %	19.36
Smoking status, %[b]	
Never	43.76
Former	45.11
Current	11.12
Body mass index, *M (SD)*	28.43 (5.73)
C-reactive protein, *M (SD)*	4.23 (8.24)
Cystatin c in 2008, *M (SD)*	1.07 (0.45)
Cystatin c in 2012, *M (SD)*	1.25 (0.57)

Note. SPA = self-perceptions of aging.
[a] Unweighted sample data. [b] Percentages may not sum to 100% due to rounding.



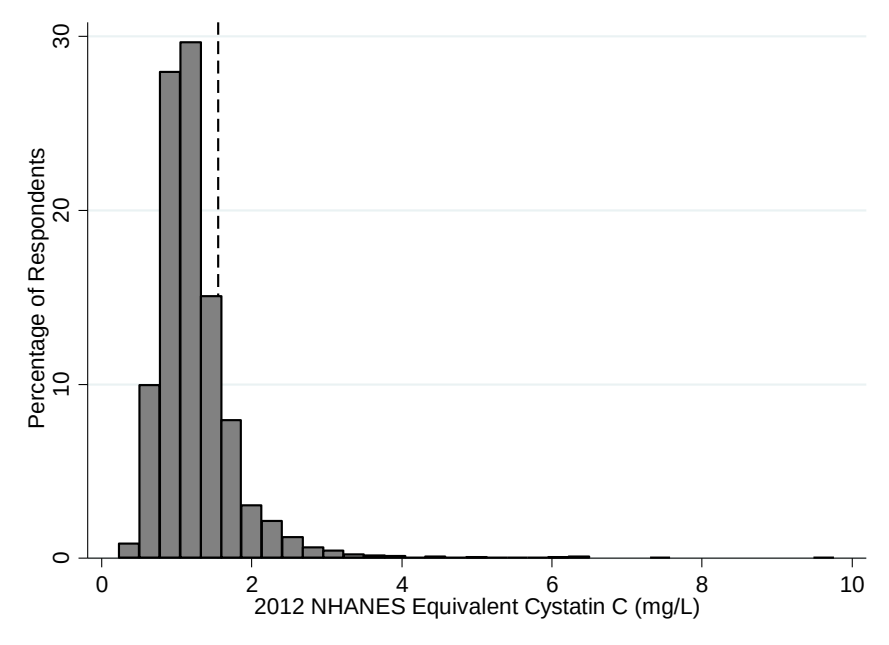


Figure 3.1. Distributions of NHANES equivalent cystatin c in 2008 and 2012. Reference line at 1.55 mg/L (cut-off for elevated cystatin c).

Table 3.2

Multiple Linear Regression Models of the Association Between SPA, Perceived Discrimination, and Residual Change in Cystatin C from 2008 to 2012 with Baseline Covariates (N = 3336)

	Model 1	Model 2	Model 3
	b (*SE*)	*b* (*SE*)	*b* (*SE*)
Intercept	1.18 (0.02)***	1.16 (0.02)***	1.15 (0.02)***
SPA	-0.016 (0.007)*	-0.013 (0.007)	0.005 (0.011)
Perceived discrimination		0.026 (0.015)	0.029 (0.015)*
SPA x Perceived discrimination			-0.030 (0.014)*
Age	0.036 (0.007)***	0.038 (0.008)***	0.039 (0.008)***
Female	-0.005 (0.014)	-0.004 (0.014)	-0.003 (0.014)
Race/Ethnicity			
Non-Hispanic White	Reference	Reference	Reference
Non-Hispanic Black	0.030 (0.022)	0.029 (0.022)	0.029 (0.022)
Hispanic	0.028 (0.027)	0.027 (0.027)	0.026 (0.027)
Other	0.136 (0.050)**	0.135 (0.050)**	0.134 (0.050)**
Years of education	-0.020 (0.008)**	-0.021 (0.008)**	-0.020 (0.008)**
Hypertension	0.040 (0.015)**	0.040 (0.015)**	0.040 (0.015)**
Heart disease	0.055 (0.016)**	0.054 (0.016)**	0.054 (0.016)**
Diabetes	0.055 (0.018)**	0.055 (0.018)**	0.055 (0.018)**
Smoking status			
Never	Reference	Reference	Reference
Former	0.022 (0.015)	0.021 (0.015)	0.021 (0.015)
Current	0.068 (0.023)**	0.070 (0.023)**	0.069 (0.023)**
Body mass index	0.019 (0.007)*	0.020 (0.007)**	0.019 (0.007)**
C-reactive protein	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)
Cystatin c in 2008	0.385 (0.007)***	0.385 (0.007)***	0.385 (0.007)***

Note. SPA = self-perceptions of aging. All continuous predictor variables were standardized. Cystatin c values in 2012 were not standardized to allow for the interpretation of the intercept using original units.
* $p < .05$, ** $p < .01$, *** $p < .001$

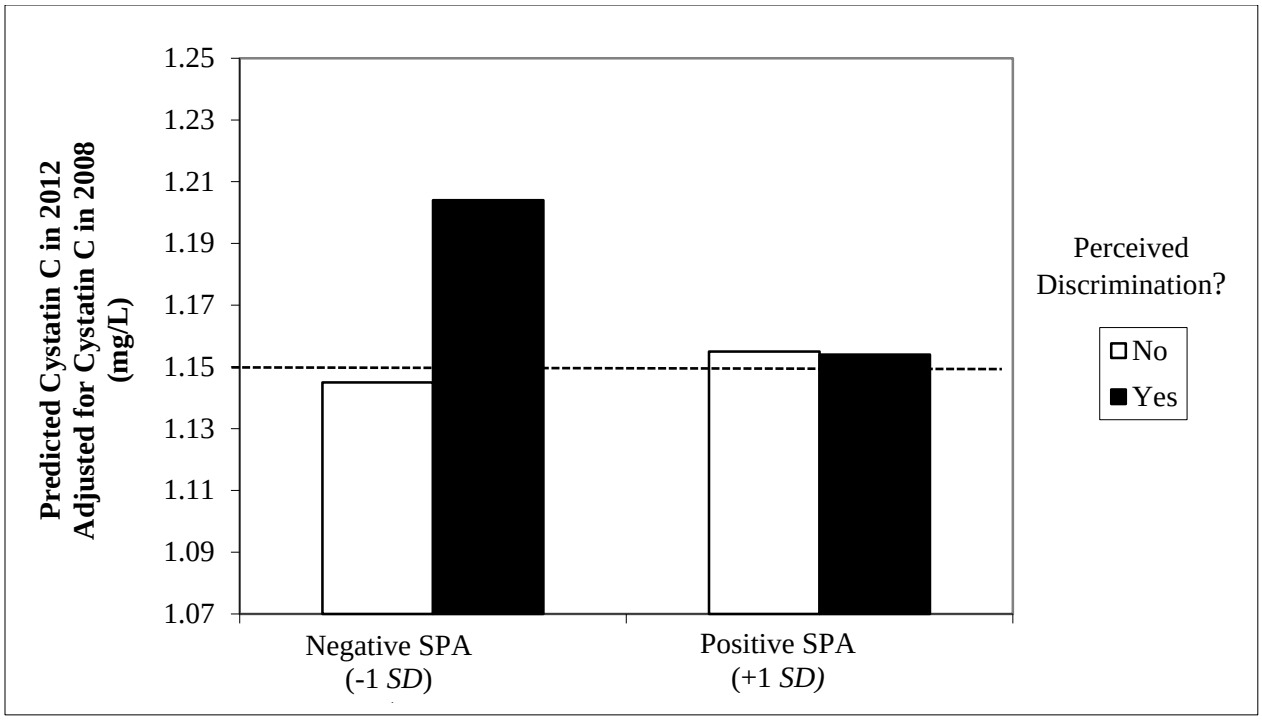


Figure 3.2. Interaction effect of self-perceptions of aging (SPA) and exposure to perceived discrimination on predicted cystatin c in 2012, adjusting for cystatin c in 2008 and all covariates. Dotted line corresponds to model intercept.

Table 3.3

Sensitivity Analyses of the Association Between SPA, Perceived Discrimination, and Residual Change in Cystatin C from 2008 to 2012

	[a]Model 1 (*N* = 3277)	[b]Model 2 (*N* = 3235)	[c]Model 3 (*N* = 3180)
	b (*SE*)	*b* (*SE*)	*b* (*SE*)
Intercept	1.16 (0.02)***	1.15 (0.02)***	1.16 (0.02)***
SPA	0.006 (0.011)	0.003 (0.011)	0.003 (0.011)
Perceived discrimination	0.029 (0.014)*	0.033 (0.015)*	0.033 (0.015)*
SPA x Perceived discrimination	-0.031 (0.014)*	-0.029 (0.014)*	-0.30 (0.014)*

Note. SPA = self-perceptions of aging. All continuous predictor variables were standardized. Cystatin c values in 2012 were not standardized to allow for interpretation of the intercept using original units. All models adjusted for baseline cystatin c, age, gender, race/ethnicity, years of education, hypertension, heart disease, diabetes, smoking status, body mass index, and c-reactive protein.

[a]Model 1: Exclusion of individuals with pre-existing kidney problems due to diabetes at baseline.

[b]Model 2: Replacement of 1) self-reported diagnosis of hypertension with systolic blood pressure ≥ 140 or diastolic blood pressure ≥ 90 and 2) self-reported diagnosis of diabetes with A1c ≥ 6.5.

[c]Model 3: Combination of Models 1 and 2

* $p < .05$, ** $p < .01$, *** $p < .001$

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CHAPTER IV

"Getting a Grip on my Own Aging":

Effects of Domain-Specific and Domain-General Perceptions on Mobility Limitations

Introduction

Mobility is important to the ability of older adults to maintain their independence and continue engaging in productive and meaningful activities as they enter their later years. Although cumulative wear and tear decreases the efficiency with which the body performs in old age, aging is not synonymous with physical decline, and a variety of behavioral and psychosocial factors have also been shown to reduce the risk of developing physical limitations later in life (Stuck et al., 1999). Among a sample of high-functioning older adults, for example, the availability of an emotionally supportive social network and participation in moderate and/or strenuous exercise were both linked to better physical performance two and half years later (Seeman et al., 1995).

On a psychological level, recent research suggests self-perceptions of aging (SPA), or subjective evaluations of one's own aging experience, may also be affecting the risk for functional decline (Levy, Slade, & Kasl, 2002; Sargent-Cox, Anstey, & Luszcz, 2012). Given the many stereotypes about aging that center around characterizations of older adults as weak, frail, and decrepit, older adults' perceptions of their physical abilities, such as their grip strength, may be particularly influential in understanding the relationship between more general self-perceptions of aging and functional health. The present study examines how domain-specific (e.g., perceived grip strength) and domain-general perceptions (e.g., self-perceptions of aging) of

one's aging are related to grip strength and predict changes in mobility limitations over four years.

Domain-Specific Perceptions of Grip Strength: Perceived Grip Strength

Weak grip strength has been shown to be an important predictor of disability and functional limitations among older adults (Bohannon, 2008; Rantanen et al., 1999). While many studies have used grip strength as an indicator of nutritional status (Norman, Stobäus, Gonzalez, Schulzke, & Pirlich, 2011) and/or frailty (Fried et al., 2001; Syddall, Cooper, Martin, Briggs, & Sayer, 2003), fewer studies have examined how older adults perceive their own grip strength and the extent to which older adults' perceptions of their grip strength at domain-specific and domain-general levels may be independently linked to mobility limitations.

On a domain-specific level, most individuals are unaware of their actual grip strength as measured by dynamometer, and perceptions of one's grip strength may not necessarily correspond with measured grip strength values. There are a significant number of studies that show the benefits of combining performance-based and self-reported measures of physical function (Fors, Thorslund, & Parker, 2006; Kempen et al., 1996; Myers, Holliday, Harvey, & Hutchinson, 1993; Reuben et al., 2004), as they likely capture different aspects of an individuals' functioning and have different underlying predictors.

Performance-based measures, for example, may be more closely tied to physiologic factors while self-rated measures of physical functioning are more associated with psychosocial factors (Bean, Ölveczky, Kiely, LaRose, & Jette, 2011). Perceptions of one's grip strength, therefore, may be independently linked to mobility limitations and reflect additional risk or protective factors not captured by performance-based measures. For example, perceived grip strength may function as a proxy for self-efficacy and be more accurate predictor of the types of

activities that older adults choose to engage in or avoid as they experience age-related physical declines.

Domain-General Perceptions of Grip Strength: Self-Perceptions of Aging

On a more domain-general level, some evidence suggests that how older adults perceive age-relates losses in grip strength may also contribute to their overall evaluations of their aging experience. In cross-sectional analyses by Stephan, Sutin, and Terracciano (2015), weaker grip strength was associated with older subjective age, controlling for sociodemographic factors, self-rated health, and depression. Blood pressure and telomere length, on the other hand, were not related to subjective age, suggesting that older adults rely on observable or perceptible biological cues, such as grip strength, to evaluate their own aging (Stephan et al., 2015).

Experimental studies have also shown that grip strength is sensitive to environmental cues and can be manipulated through upward or downward social comparison to others who are better or worse off (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013; Swift, Lamont, & Abrams, 2012). In one study, participants who were told they were stronger than 80% of same-aged peers reported feeling significantly younger and performed significantly better on a subsequent test of grip strength compared to those who received no feedback (Stephan et al., 2013). The intervention likely induced a younger subjective age, which then led to functional improvements (e.g., increases in grip strength). Older adults, therefore, seem to change their self-perceptions of aging in response to information about their relative grip strength in ways that influence their actual physical abilities.

Self-Perceptions of Aging, Perceived Grip Strength, and Mobility Limitations

Many researchers have examined the relationship between older adults' overall satisfaction with their own aging process and various indicators of health and well-being. These

overarching self-perceptions of aging (SPA), or attitudes towards one's own aging, have been associated with a variety of functional outcomes including better self-reported functional health (Levy et al., 2002), lower incidence of difficulties with activities of daily living (Moser, Spagnoli, & Santos-Eggimann, 2011), and higher likelihood of recovery from disability (Levy, Slade, Murphy, & Gill, 2012). Most studies of SPA, however, do not account for the effects of measured and/or perceived grip strength in predicting the development of functional limitations. It is, therefore, unclear how SPA and self-perceived grip strength are related and the extent to which they each uniquely predict changes in functional limitations.

In addition to examining the effects of SPA and perceived grip strength independently, it is also important to understand how these two related but distinct self-perceptions act synergistically or antagonistically with regards to mobility outcomes. Neither positive SPA nor positive perceptions of grip strength may be sufficient to promote engagement in the types of activities needed to maintain mobility if perceptions of one's abilities in the other area is overly negative. Individuals with more positive SPA have been shown to be more likely to engage in health-promoting behaviors (Levy & Myers, 2004), such as regular exercise, that slow the rate of physical decline. Negative expectations related to physical functioning, such as weak perceived grip strength, may prevent individuals from benefiting from the beneficial effects of positive views on aging if they perceive weak grip strength to be a barrier to physical exercise and do not believe they have the physical resources to successfully achieve their physical activity goals.

Current Study

In the present study, we use data from the Health and Retirement Study to examine three primary research questions among adults over age 65:

1) Is perceived grip strength associated with changes in mobility limitations above and beyond measured grip strength? After adjusting for measured grip strength and other sociodemographic, health-related, and behavioral covariates, we hypothesize that those with strong perceived grip strength will have better mobility four years later compared to those who believe their grip strength to be weak.

2) Are self-perceptions of aging associated with changes in mobility after adjusting for both measured and perceived grip strength? We hypothesize that more positive SPA will be associated with fewer mobility limitations after adjusting for both measured/perceived grip strength and all relevant covariates.

3) Does perceived grip strength moderate the effects of self-perceptions of aging on changes in mobility? We hypothesize that positive self-perceptions of aging will be associated with fewer mobility limitations only among individuals who believe their grip strength to be strong.

Method

Study Participants

The Health and Retirement Study (HRS) is a nationally representative biennial panel study of U.S. adults over the aged 51 and older that is supported by the National Institute on Aging (U01AG009740) and conducted by the Survey Research Center at the University of Michigan's Institute for Social Research (Sonnega et al., 2014). Each wave, a random 50% of the sample is assigned to participate in an enhanced face-to-face interview (EFTF) interview for the collection of measures related to physical and psychosocial functioning. In the present study, we combine the data from participants who were assigned to the EFTF interview in 2008 and 2010 to approximate the full HRS sample. Participants were included in our analytic sample if they

were 1) community-dwelling (e.g, not in a nursing home), 2) not interviewed by proxy, 3) over age 65, and 4) not missing any variables used in our analyses. Our final combined analytic sample consisted of 6,024 participants. Table 4.1 shows the characteristics of the 2008 and 2010 subsamples as well as the full combined 2008/2010 sample used in our analyses. The present study was exempted from review because it uses de-identified and publicly available data. The HRS study website provides extensive documentation on the protocol, instrumentation, and sampling strategy.

Self-Perceptions of Aging

In the Psychosocial and Lifestyle Questionnaire, self-perceptions of aging were measured in 2008/2010 using an 8-item scale that included five items from the Attitude Toward Own Aging subscale of the Philadelphia Geriatric Center Morale Scale (Lawton, 1975; Liang & Bollen, 1983) and an additional three items from the Berlin Aging Study (Baltes & Mayer, 2001). On a scale from 1 (*strongly disagree*) to 6 (*strongly agree*), respondents indicated the degree to which they endorsed statements such as "Things keep getting worse as I get older," "The older I get, the more useless I feel," and "So far, I am satisfied with the way I am aging." Negatively worded items were reverse coded, and all items were averaged so that higher scores corresponded to more positive SPA. The final score was set to missing if there were more than four items with missing values. Cronbach's alpha for the overall scale was 0.82. Scores were standardized $(\mu = 0, \sigma = 1)$ to facilitate interpretation and comparison of effect size among other studies of SPA.

Measured Grip Strength

As part of the EFTF interview, grip strength was measured in kilograms in 2008/2010 using a Smedley spring-type hand dynamometer (Crimmins et al., 2008). In a standing position

with their arm at their side at a 90-degree angle, participants were instructed to squeeze the meter as hard as they could for a few seconds and then let go. After one practice round with each hand, two measurements were taken for each hand, alternating hands. Maximum grip strength was determined to be the highest value across all four measurements. Based on previously established cut-points for clinically relevant weakness by gender (Alley et al. 2014; Studenski et al., 2014), we classified individuals as having normal (>32 kg for men, >20 kg for women), intermediate (26-32 kg for men, 16-20 kg for women), or weak (<26 kg for men, <16 kg for women) grip strength. The normal grip strength group was used as the reference group for all analyses.

Perceived Grip Strength

As part of the core HRS interview, perceived grip strength was measured in 2008/2010 by asking participants to rate their own grip strength based on the following prompt: "How would you rate your hand strength? Would you say it is very strong (1), somewhat strong (2), somewhat weak (3), or very weak (4)?" Responses were reverse coded so that higher values corresponded to higher perceived grip strength. Perceived grip strength was assessed prior to the measurement of actual grip strength and separated by several sections of the HRS core interview. Given the relatively small percentage of individuals who perceived their grip strength to be "very weak," we collapsed the "very weak" and "somewhat weak" categories as well as the "very strong" and "somewhat strong" categories for all analyses, using the "very/somewhat strong" group serving as the reference category.

Mobility Limitations

Mobility limitations were assessed at baseline (2008/2010) and four years later (2012/2014) based on the number of the following activities performed with at least some difficulty (0-5): walking one block, walking several blocks, walking across a room, climbing one

flight of stairs, and climbing several flights of stairs. Based on skip logic, if the respondent reported no difficulty walking several blocks/climbing several flights of stairs, they were not asked about walking one block/climbing one flight of stairs and assumed to have no difficulty completing these activities.

Covariates

All covariates were measured at baseline (2008/2010). Sociodemographic factors included age, gender (male/female), race/ethnicity (White/Caucasian, Black/African American, Hispanic, Other), and years of education (up to 17 years). Health-related factors included 1) body mass index, 2) an index of eight chronic conditions (high blood pressure; diabetes; cancer or malignant tumor of any kind; lung disease; heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; emotional, nervous, or psychiatric problems; arthritis or rheumatism; and stroke) (Fisher, Faul, Weir, & Wallace, 2005), 3) an index of eight depressive symptoms (felt depressed, everything an effort, sleep was restless, was happy [reversed], felt lonely, felt sad, could not get going, enjoyed life [reversed]), and 4) self-rated health (1 = *poor* to 5 = *excellent*). Health behaviors included smoking status (never, former, current) and frequency of moderate/vigorous exercise (>1x/week, 1-4x/month, never). Finally, we included a covariate to designate to which subsample (2008 vs. 2010) each respondent originally belonged. For analyses, all continuous variables were standardized ($\mu=0$, $\sigma=1$), and the first category listed served as the reference group for all categorical variables.

Data Analysis

We conducted a series of negative binomial regression analyses to examine the predictors of mobility limitations four years later, adjusting for baseline mobility limitations. In model 1, we examine the association between measured grip strength category and mobility limitations

over the four-year follow-up after controlling for baseline mobility limitations and all sociodemographic, health-related, and behavioral covariates. In model 2, we add in perceived grip strength categories to examine whether individuals' perceptions of their own grip strength influence mobility beyond their actual measured grip strength. In model 3, we also include SPA to assess whether global evaluations of the aging process affect mobility even after accounting for both measured and perceived grip strength. Finally, model 4 includes the interaction term between SPA and perceived grip strength to assess whether specific views about one's grip strength and more general views about one's own aging act interact to affect later mobility.

In follow-up sensitivity analyses, we 1) replace measured grip strength categories (e.g., normal, intermediate, weak) with continuously measured grip strength to examine the effects of using a more precise adjustment for measured grip strength, 2) compare the use of all four categories of perceived grip strength (e.g., very weak, somewhat weak, somewhat strong, very strong) to the use of only two categories of perceived grip strength (e.g., very/somewhat weak, very/somewhat strong) to examine any loss of information by collapsing categories, and 3) limit the analytic sample to only those with no reported mobility limitations at baseline to determine whether we observe the same pattern of results when modeling the onset of mobility limitations in a healthier sample.

Results

Descriptive Statistics

Overall, approximately 59% of our sample was female, and the average age of respondents was 74 years at baseline. In terms of race/ethnicity, roughly 81% self-identified as White/Caucasian, 11% as Black/African American, 7% as Hispanic, and 2% as "Other". The average years of education was 13 years, corresponding to slightly more than a high school

degree. Table 4.1 shows more detailed information about the characteristics of our total sample with regards to the sociodemographic, health-related, and behavioral variables used in the present study. While there were some statistical differences between then 2008 and 2010 subsamples at baseline, the differences tended to be relatively small in magnitude. In our analyses with the combined sample, we control for the effects of all covariates at baseline in our analyses and include an indicator of subsample status. The remainder of the results reported in this section will refer to the combined sample.

The average number of mobility limitations at baseline was 1.07, which increased to 1.45 four years later. While roughly 49% of the sample experienced no change in mobility limitations over the four-year period, 35% of the sample reported more mobility limitations and 16% reported fewer mobility limitations four years later. Only 8% of respondents experienced a change of ≥ 3 mobility limitations in either direction. Although the magnitude of absolute change is small, it is important to consider that even an increase in one mobility limitation, such as becoming unable to climb a flight of stairs, can significantly impact an individual's independence and quality of life.

Based on previously established grip strength cut-offs, approximately 76% of the sample were considered to have normal strength, 16% to have intermediate strength, and 8% to have weak strength. In terms of perceived grip strength, most respondents believed their grip strength to be very strong (18%) or somewhat strong (62%). Among those who perceived their grip strength to be weak, about 18% perceived their grip strength to be moderately weak, and only 2% perceived it to be very weak. There was a significant association between perceived and measured grip strength, suggesting that respondents tend to be fairly accurate in their judgments of strength, and those who perceive their grip strength to be strong tend to have higher measured

grip strength compared to those who perceive their grip strength to be weak. However, as seen in Figure 4.1, there was still a significant degree of variation in perceived grip strength within each of the measured grip strength groups. Among those categorized as having weak measured grip strength, for example, over 50% perceive themselves to have somewhat (46%) or very strong (8%) grip strength.

The average SPA score for the sample was 3.89. The correlation between baseline SPA scores and continuous measured grip strength scores was 0.14, suggesting a low degree of correlation. While there was a significant positive association between SPA and perceived grip strength, there also seems to be a significant degree of variation in SPA scores within each perceived grip strength group (Figure 4.2). For example, 67% of participants were in the lowest quartile of SPA despite their perceptions of having a very strong/somewhat strong grip strength. Conversely, 10% of those who perceived their grip strength to be very weak were in the highest quartile of SPA. Therefore, general positive attitudes towards aging do not necessarily translate into more domain-specific perceptions of one's own abilities.

Perceived Grip Strength, SPA, and Mobility Limitations

In Model 1, we examined the association between measured grip strength categories and mobility limitations four years later, adjusting for baseline mobility limitations, sociodemographic factors, health-related factors, and health behaviors. Consistent with previous studies on the effects of grip strength on functional health outcomes, individuals with intermediate (*IRR* = 1.16, 95% CI 1.09-1.23, $p < .001$) and weak (*IRR* = 1.20, 95% CI 1.12-1.30, $p < .001$) grip strengths had a significantly higher rate of mobility limitations compared to those with normal grip strength (Table 4.2).

In Model 2, perceived grip strength was a significant predictor of mobility limitations four years later, above and beyond measured grip strength and all covariates included in Model 1. Specifically, older adults who perceived their grip strength to be very/somewhat weak had a 7% higher rate of mobility limitations over the four-year follow-up compared to those who perceived their grip strength to be very/somewhat strong (*IRR* = 1.07, 95% CI 1.01-1.13, p = .02). The effect of measured grip strength on mobility limitations was slightly attenuated with the addition of perceived grip strength in Model 2 but remained highly statistically significant.

In addition to accounting for measured and perceived grip strength, Model 3 examined the added effect of SPA in predicting future mobility limitations. As hypothesized, self-perceptions of aging were significantly associated with mobility limitations four years later, with every *SD* increase in positive SPA corresponding to a 10% lower rate of mobility limitations (*IRR* = 0.90, 95% CI 0.87-0.92, $p < .001$). The addition to SPA to the model decreased the magnitude and significance of association between perceived grip strength and mobility limitations (*IRR* = 1.05, 95% CI 1.00-1.11, $p = .06$). The effect of measured grip strength on mobility limitations, however, were unaffected by the addition of SPA to the model.

In the final model (Model 4), we investigated whether the effect of SPA on mobility limitations four years later differed by perceived grip strength. There was a main effect of both perceived grip strength (*IRR* = 1.14, 95% CI 1.07-1.20, $p < .001$) and SPA (*IRR* = 0.87, 95% CI 0.84-0.89, $p < .001$), as well as a significant interaction effect (*IRR* = 1.14, 95% CI 1.08-1.20, $p < .001$). As seen in Figure 4.3, the significant interaction effect showed that positive SPA only had a protective effect against mobility limitations if individuals believed their grip strength to be very/somewhat strong. While there appeared to be a slight benefit to having more positive SPA among those with very/somewhat weak perceived grip strength, the slope, however, was not

significantly different from zero. Interestingly, those with more negative SPA had a similar predicted number of mobility limitations four years later regardless of their perceived grip strength.

Sensitivity Analyses

We performed a series of sensitivity analyses to test the robustness of our results. First, we examined whether the effects of perceived grip strength and/or SPA would change with the use of a more precise measurement of grip strength. After replacing the categories of measured grip strength (e.g., normal, intermediate, weak) with continuously measured grip strength, we observed only very small to no changes in the sizes of our effects. Next, to determine whether there were differences in the significance or magnitude of association between those who perceived their grip strength to be "very" versus "somewhat" weak/strong, we reran our analyses using all four perceived grip strength categories despite a relatively small cell size for the "very weak" group. While there was indeed a dose-response relationship with those perceiving their grip strength as "very weak" having the highest predicted number of mobility limitations and those perceiving their grip strength as "very strong" having the lowest predicted number of mobility limitations, these groups did not differ significantly from their respective "somewhat" weak/strong groups, suggesting that the major point of distinction is the belief that one is generally strong/weak rather than the specific degree of strength/weakness (Supplementary Figure 4.4) .

Given that the full sample already had an average of one mobility limitation at baseline, we also conducted a follow-up analysis to determine if the effects of perceived grip strength and SPA would be similar among a subsample of respondents who had zero mobility limitations at baseline. As seen with the full sample, perceived grip strength was associated with the

development of mobility limitations above and beyond measured grip strength, and SPA had an additional effect after accounting for both perceived and measured grip strength (Table 4.3). Compared to the full sample, a similar pattern was seen where positive self-perceptions of aging being associated with a lower rate of mobility limitations only among those with strong perceived grip strength (Table 4.3, Figure 4.5).

Discussion

A growing body of work has shown that how we perceive ourselves can play a prominent role in how we age. Given recent research showing the relationship between measured grip strength and future physical functioning, we examined whether perceptions of one's grip strength would be associated with the rate of developing mobility limitations after adjusting for measured grip strength and other important sociodemographic, health-related, and behavioral predictors of physical functioning among older adults. While there was a significant correlation between measured and perceived grip strength, we found that a relatively large proportion of individuals whose grip strength would be classified as "weak" based on cut-off scores for clinically significant mobility impairment considered their grip strength to be somewhat or very strong. In adjusted analyses, individuals who perceived their strength as somewhat/very strong had a lower rate of mobility limitations four years later, regardless of their actual measured grip strength category. The perception of having a strong grip strength, independent of actual grip strength, was protective against future mobility difficulties, suggesting that changes in mobility are not purely a result of biological changes in muscle mass or composition but also affected by behavioral and psychological processes associated with the perception of being relatively weak versus relatively strong.

Perceived grip strength, therefore, may reflect psychosocial factors, such as feelings of general and grip-related self-efficacy, that are not captured by measured grip strength. More specific measures of grip self-efficacy that assess the degree of to which individuals believe they can navigate environmental grip-related challenges, however, are needed to examine this possibility. Although we are not aware of any existing measures of self-efficacy specific to grip strength, perceived grip strength may also be related to older adults' overall perceptions of their own frailty and relate to mobility through other domain-specific measures of self-efficacy for balance (Powell & Myers, 1995), exercise (McAuley, 1993), and/or gait (McAuley, Mihalko, & Rosengren, 1997).

In the present study, we were interested in not only the effects of domain-specific perceptions (e.g., perceived grip strength) but also domain-general perceptions (e.g., SPA) on the rate of developing mobility limitations. We, therefore, examined whether how older adults perceive their own aging more generally would predict mobility limitations four years later, even after adjusting for both perceived and measured grip strength. As predicted, having positive SPA was associated with a lower rate of mobility limitations after accounting for perceived grip strength. The effect of perceived grip strength was no longer significant after adjusting for SPA, suggesting that SPA and perceived grip strength may act through similar pathways to affect one's risk for mobility limitations in older adulthood. Just as perceived grip strength may reflect grip self-efficacy, positive SPA may influence functional health through increasing feelings of self-efficacy regarding one's aging. Indeed, perceived control was found to partially mediate the association between SPA and self-reported functional health in previous longitudinal studies (Levy et al., 2002)

Our final question related to how self-perceived grip strength and SPA interacted to affect mobility limitations among older adults over the four-year follow-up. As predicted, having more positive SPA was only predictive of future mobility problems among respondents who perceived their grip strength to be strong, suggesting that general efforts to increase positive SPA may not be effective in preventing functional decline if older adults do not believe themselves to be strong. Perceptions of grip strength, however, did not seem to affect the number of mobility difficulties reported if respondents had relatively negative SPA. Negative SPA, therefore, also seems to block older adults from experiencing any physical benefits of having better perceived grip strength.

Unlike more genetically or biologically-based risk factors, self-perceptions can potentially be modified with targeted interventions and lead to improvements in health and functioning. It is unclear, however, at what level such interventions should occur. Should interventions aim to enhance general positive perceptions of oneself with the assumption that it will trickle down to affect perceptions of one's abilities in more specific domains? Alternatively, should interventions be more targeted in their approach and address perceptions related to particular domain? The present study suggests that one must have not only positive perceptions of aging but also positive perceptions of one's own grip strength in order to benefit from better functional health, suggesting that interventions that aim to improve SPA more generally may not lead to meaningful improvements if they do not simultaneously bolster individuals' feelings of self-efficacy in the targeted domain.

There are several limitations to the present study that should be addressed. Given that perceived grip strength and SPA were assessed at the same time, we were unable to determine the directionality of the relationship and the extent to which perceived grip strength mediates the

effect of SPA on mobility limitations or vice versa. In addition, our measure of perceived grip strength uses an absolute scale, making it unclear what older adults use as their reference point when rating their current strength. While some older adults may be comparing their grip strength to same aged-peers, others may be comparing their grip strength to that of their younger selves. For the purposes of designing future interventions, it is important to determine the sources of information that older adults are using to assess their own abilities so we can more effectively boost feelings of self-efficacy regarding one's grip strength. Our measure of mobility limitations was based on self-report, which may be subject to biases regarding what constitutes "difficulty" when performing a specific activity. From a methodological perspective, we assessed changes in mobility using only two time points, which makes it difficult to determine the degree to which the change observed could be attributable to measurement error or stochastic processes. Future studies should consider using longer follow-up periods that allow for the modeling of long-term trajectories in mobility limitations.

In sum, the findings from the present study suggest that interventions for reducing mobility limitations in older adulthood must take a multi-faceted approach that includes both exercise training that improves actual grip strength and cognitive attributional training that promotes physical self-efficacy and better *perceptions* of grip strength. We found that strong perceived grip strength must also be coupled with positive self-perceptions of aging and the belief that one has control over the aging process. The current study, therefore, illustrates the need to improving both domain-specific and domain-general self-perceptions by 1) promoting confidence in one's abilities (e.g. increasing perceived grip strength) and 2) instilling the notion that one's efforts can lead to meaningful changes in physical functioning even in older adulthood (e.g., increasing positive SPA).

Table 4.1

Descriptive Statistics from 2008 and 2010 Analytic Study Samples[a]

	2008 Sample (*N* = 3167)	2010 Sample (*N* = 2857)	Total Sample (*N* = 6024)
SPA, *M (SD)*	3.91 (1.02)	3.87 (1.00)	3.89 (1.01)
Age, *M (SD)*	73.72 (6.32)	74.46 (6.44)	74.07 (6.38)
Female, %	58.57	58.80	58.68
Race/ethnicity, %			
White	79.70	81.83	80.71
Black	11.08	10.85	10.97
Hispanic	7.48	5.53	6.56
Other	1.74	1.79	1.76
Years of education, *M (SD)*	12.49 (3.06)	12.84 (2.84)	12.66 (2.96)
Body mass index, *M (SD)*	27.90 (5.48)	28.09 (5.54)	27.99 (5.51)
Chronic illnesses, *M (SD)*	2.26 (1.34)	2.34 (1.35)	2.30 (1.34)
Depressive symptoms, *M (SD)*	1.19 (1.75)	1.13 (1.70)	1.16 (1.73)
Self-rated health, *M (SD)*	3.21 (1.02)	3.31 (0.98)	3.26 (1.00)
Smoking status, %[b]			
Never	43.45	46.48	44.89
Former	47.74	45.85	46.85
Current	8.81	7.67	8.27
Exercise frequency, %			
>1x/week	59.90	54.67	57.42
1-4x/month	22.70	26.25	24.39
Never	17.40	19.08	18.19
Baseline functional limitations, *M (SD)*	1.05 (1.35)	1.09 (1.38)	1.07 (1.36)
Maximum grip strength, %[b]			
Normal	75.72	75.57	75.65
Intermediate	15.41	17.19	16.25
Weak	8.87	7.25	8.10
Perceived grip strength, %[b]			
Very strong	18.91	16.73	17.88
Somewhat strong	61.16	62.55	61.82
Somewhat weak	17.81	18.80	18.28
Very weak	2.12	1.93	2.03

Note. SPA = self-perceptions of aging.
[a] Unweighted sample data. [b] Percentages may not sum to 100% due to rounding

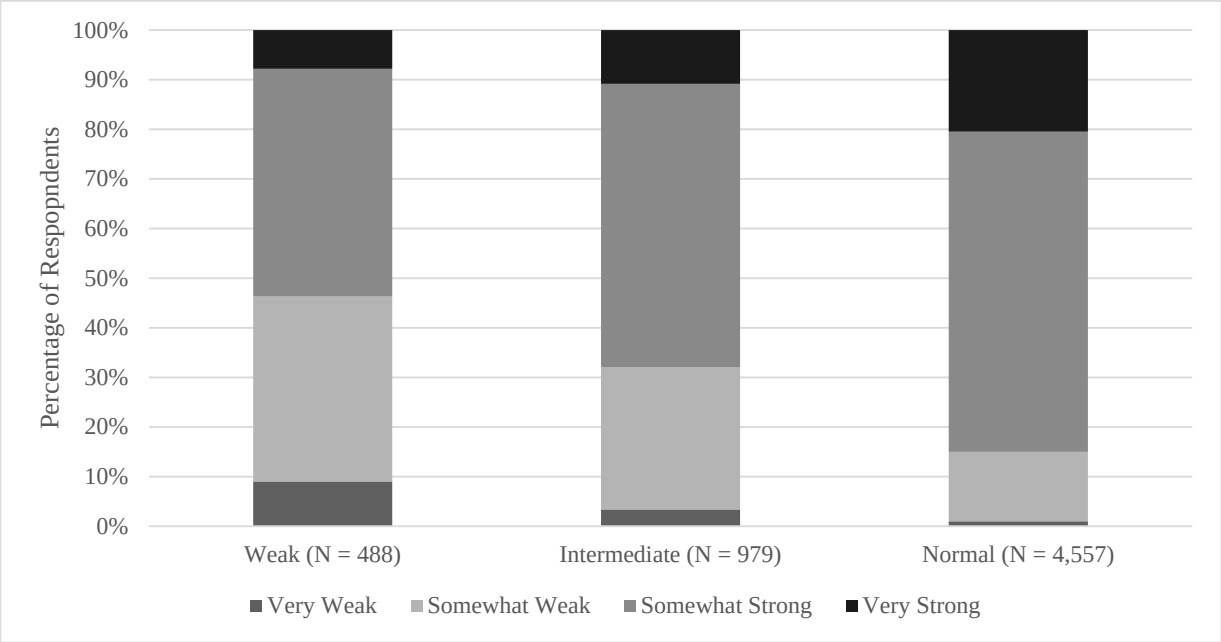

Figure 4.1. Percentage of respondents with each level of perceived grip strength (very weak, somewhat weak, somewhat strong, very strong) within each category of measured grip strength (weak, intermediate, normal).

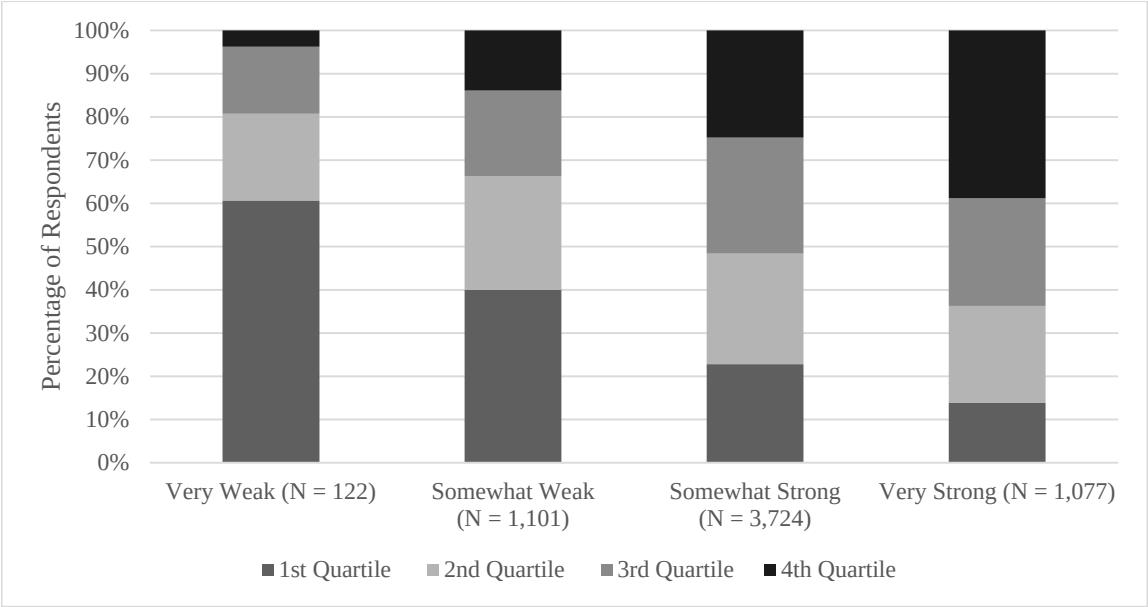

Figure 4.2. Percentage of respondents in each quartile of SPA within each category of perceived grip strength.

Table 4.2

Negative Binomial Regression Models of Perceived Grip Strength and Self-Perceptions of Aging on IRR of Mobility Limitations with All Covariates

	Model 1	Model 2	Model 3	Model 4
Measured grip strength				
Normal	1.00	1.00	1.00	1.00
Intermediate	1.16 (1.09-1.23)***	1.15 (1.08-1.22)***	1.15 (1.08-1.21)***	1.14 (1.07-1.20)***
Weak	1.20 (1.12-1.30)***	1.18 (1.10-1.27)***	1.19 (1.10-1.28)***	1.19 (1.11-1.27)***
Perceived grip strength				
Very/somewhat strong		1.00	1.00	1.00
Very/somewhat weak		1.07 (1.01-1.13)*	1.05 (1.00-1.11)	1.14 (1.07-1.20)***
SPA			0.90 (0.87-0.92)***	0.87 (0.84-0.89)***
SPA x Perceived grip strength				
SPA x Very/somewhat strong				1.00
SPA x Very/somewhat weak				1.14 (1.08-1.19)***
Age	1.19 (1.16-1.22)***	1.19 (1.17-1.22)***	1.18 (1.15-1.21)***	1.17 (1.15-1.20)***
Female	1.08 (1.03-1.13)**	1.07 (1.02-1.12)*	1.08 (1.03-1.13)**	1.07 (1.02-1.12)**
Race/ethnicity				
White	1.00	1.00	1.00	1.00
Black	0.96 (0.89-1.03)	0.96 (0.90-1.03)	0.98 (0.92-1.05)	0.98 (0.92-1.05)
Hispanic	0.95 (0.87-1.05)	0.95 (0.87-1.05)	0.97 (0.89-1.07)	0.97 (0.89-1.06)
Other	0.88 (0.74-1.06)	0.89 (0.74-1.06)	0.90 (0.75-1.07)	0.90 (0.76-1.07)
Years of education	0.97 (0.95-1.00)*	0.97 (0.95-1.00)*	0.97 (0.95-1.00)*	0.97 (0.95-0.99)*
Body mass index	1.10 (1.08-1.12)***	1.10 (1.08-1.13)***	1.10 (1.08-1.12)***	1.09 (1.07-1.12)***
Chronic conditions	1.11 (1.08-1.13)***	1.10 (1.08-1.13)***	1.10 (1.07-1.13)***	1.09 (1.07-1.12)***
Depressive symptoms	1.01 (0.99-1.04)	1.01 (0.99-1.03)	0.99 (0.97-1.01)	0.99 (0.97-1.01)
Self-rated health	0.87 (0.85-0.90)***	0.88 (0.85-0.90)***	0.90 (0.88-0.93)***	0.91 (0.88-0.93)***
Smoking status				
Never	1.00	1.00	1.00	1.00
Former	1.04 (0.99-1.09)	1.04 (0.99-1.09)	1.04 (0.99-1.09)	1.04 (0.99-1.09)
Current	1.42 (1.31-1.53)***	1.41 (1.30-1.53)***	1.40 (1.29-1.52)***	1.39 (1.28-1.50)***
Exercise frequency				
>1x/week	1.00	1.00	1.00	1.00
1-4x/month	1.10 (1.04-1.17)**	1.10 (1.04-1.17)***	1.09 (1.03-1.16)**	1.09 (1.03-1.15)**
Never	1.11 (1.05-1.18)**	1.11 (1.05-1.18)**	1.10 (1.03-1.16)**	1.09 (1.03-1.16)**
Baseline mobility limitations	1.43 (1.40-1.47)***	1.43 (1.40-1.47)***	1.41 (1.38-1.45)***	1.40 (1.37-1.43)***

Note. SPA = self-perceptions of aging.
* $p < .05$. ** $p < .01$. *** $p < .001$.

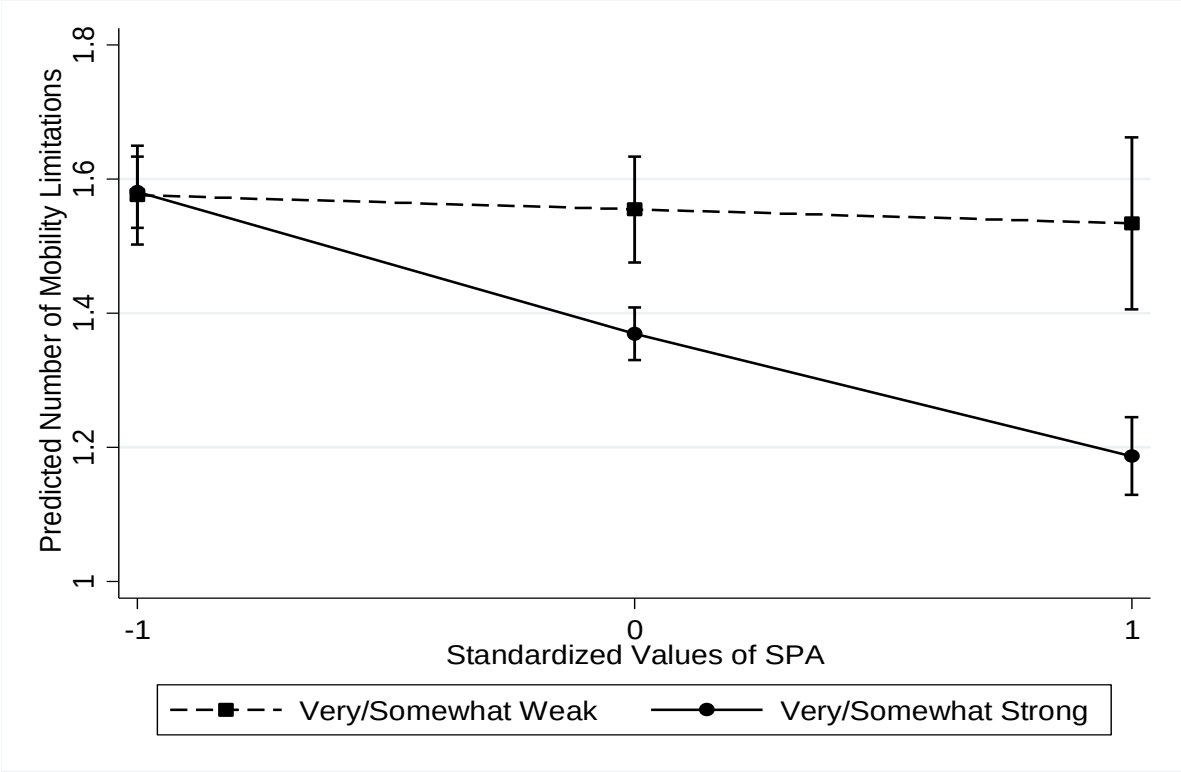

Figure 4.3. Interaction between perceived grip strength and self-perceptions of aging on predicted number of mobility limitations four years later in full model with all covariates.

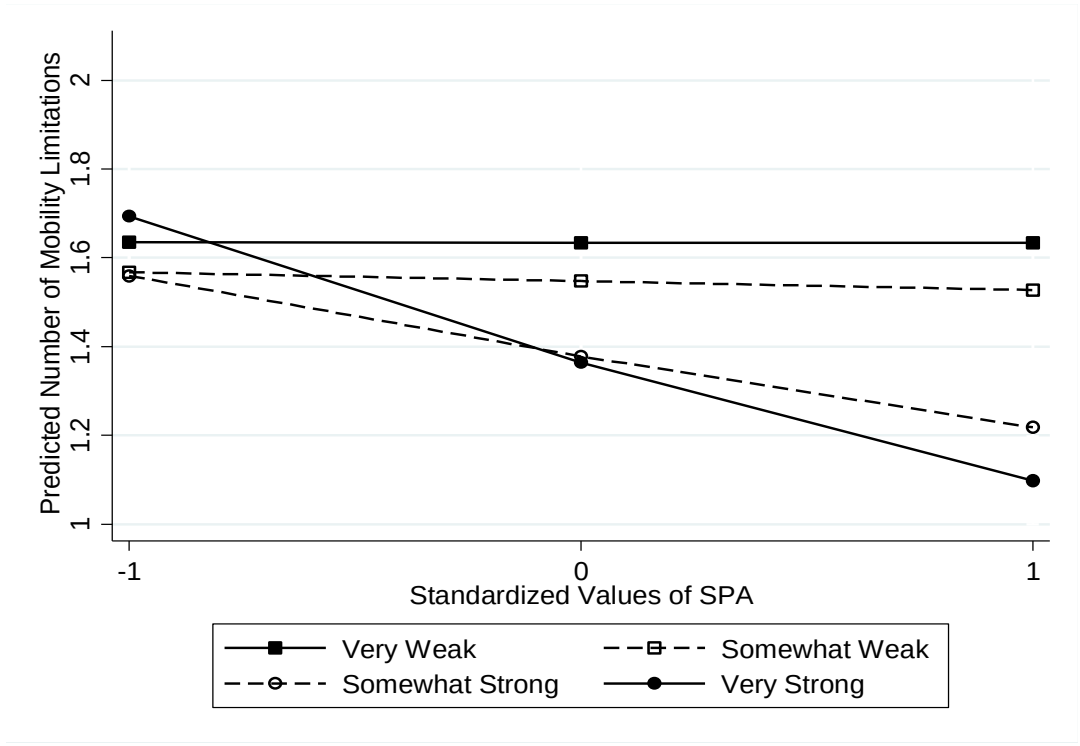

Figure 4.4. Interaction between all four levels of perceived grip strength and self-perceptions of aging on predicted number of mobility limitations four years later in full model with all covariates.

Table 4.3

Negative Binomial Regression of Perceived Grip Strength and Self-Perceptions of Aging on IRR of Mobility Limitations Four Years Later Among Those with No Mobility Limitations at Baseline

	Model 1	Model 2	Model 3	Model 4
Measured grip strength				
Normal	1.00	1.00	1.00	1.00
Intermediate	1.36 (1.14-1.61)***	1.32 (1.11-1.57)**	1.33 (1.12-1.58)**	1.33 (1.12-1.58)**
Weak	1.42 (1.11-1.83)**	1.37 (1.06-1.76)*	1.35 (1.05-1.73)*	1.34 (1.04-1.72)*
Perceived grip strength				
Very/somewhat strong		1.00	1.00	1.00
Very/somewhat weak		1.27 (1.06-1.51)	1.23 (1.03-1.47)*	1.36 (1.12-1.64)**
Self-perceptions of aging (SPA)			0.85 (0.80-0.92)***	0.82 (0.77-0.89)***
SPA x Perceived grip strength				
SPA x Very/somewhat strong				1.00
SPA x Very/somewhat weak				1.26 (1.07-1.49)**

Note: Models include all covariates: age, gender, race/ethnicity, years of education, body mass index, chronic conditions, depressive symptoms, self-rated health, smoking status, exercise frequency, baseline mobility limitations
* $p < .05$. ** $p < .01$. *** $p < .001$.

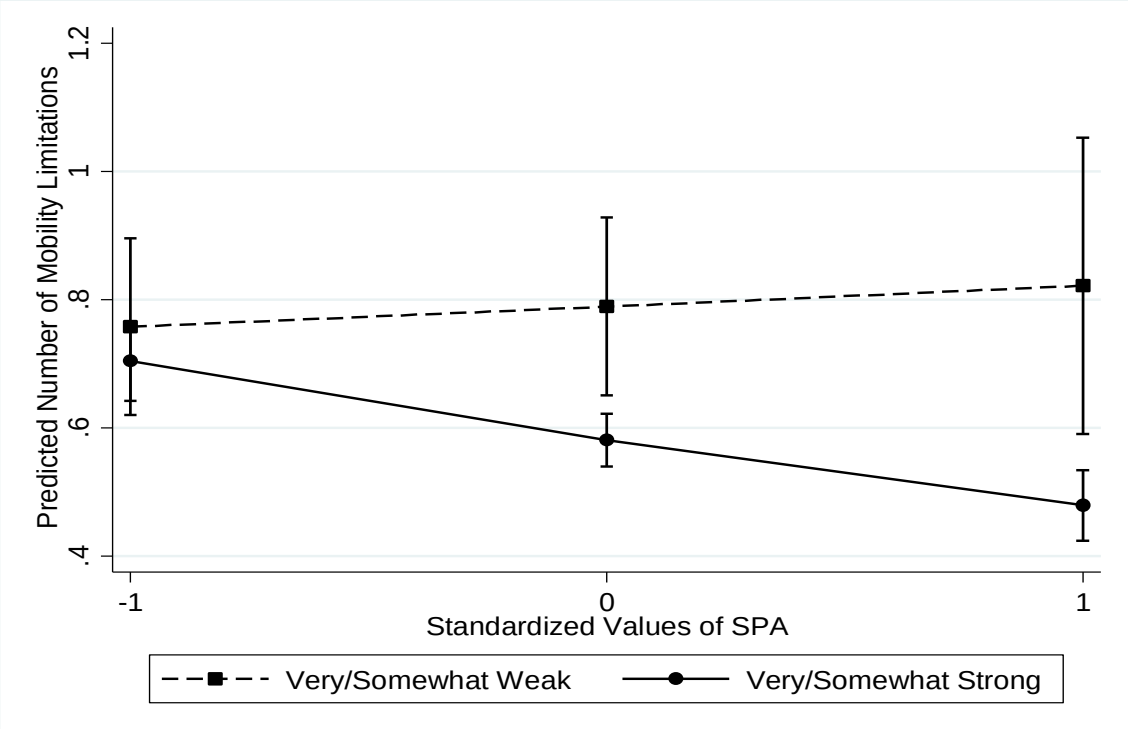

Figure 4.5. Interaction between perceived grip strength and self-perceptions of aging on predicted number of mobility limitations four years later among respondents with no reported mobility limitations at baseline.

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CHAPTER V

Introduction

The purpose of the current dissertation was to take a closer look at the processes that potentially underlie the relationship between self-perceptions of aging and health after age 50. Based on the conceptual model described in the first chapter (Figure 1.3), I used data from the Health and Retirement Study to examine the association between SPA and health from different behavioral, physiological/biological, and psychological perspectives (Figure 1.4). Study 1 examined the association between SPA and health care delay as a potential behavioral explanation for why older adults with negative SPA tend to have an increased risk of hospitalization and other adverse events. Study 2 considered the association between SPA and changes in cystatin c, a biomarker of kidney functioning, as one physiological/biological process through which age stereotypes may be getting "under the skin." Finally, Study 3 investigated the relationship between two different psychological perceptions of the aging process, perceived grip strength and SPA, in predicting mobility limitations, with a focus on understanding how domain-specific (e.g., perceived grip strength) and domain-general (e.g., SPA) jointly influence functional health in older adulthood. This multi-level approach to understanding SPA and health allows us gain a more complete picture of how negative views of our own aging may not only affect how we think and behave but also how our bodies function at a biological or physiological level.

Taken together, these three dissertation studies offer a glimpse into the diverse and complex ways in which age stereotypes are affecting the health of the aging population and

further supports the need for interventions that take a multi-faceted approach to promoting more positive SPA. In this final chapter, I have four major aims: 1) to summarize how the major findings from each study add to our understanding of SPA and health, 2) to give a brief overview of existing interventions for improving SPA, 3) to describe interventions to improve attitudes towards older adults among younger populations, with a special emphasis on views of aging/older adults among health care professionals and trainees, and 4) to offer some final thoughts on the need for promoting more positive views of aging not only at an individual level but also at the institutional and societal levels.

Summary of Major Findings

At the behavioral level, the first study in this dissertation found an association between negative SPA and an increased risk for health care delay, offering one potential explanation for why older adults with negative attitudes toward aging may suffer from worse health outcomes. This study makes a novel contribution to the literature by examining not only the association between SPA and health care delay but also the reasons that older adults give for delaying care. Specifically, individuals with negative SPA were more likely to delay care due to practical reasons such as not being able to get an appointment soon enough as well as psychosocial issues such as disliking going to the doctor. Thus, how older adults perceive their own aging experience may also place individuals at risk for health care delay and act as a cognitive and emotional barrier to seeking care.

Although not all health care-related delay is preventable, patient delay in recognizing symptoms or initiating contact with the health care system is one area in which increased education about the aging process may be beneficial in helping older adults distinguish between benign and worrisome symptoms. While there have been efforts in minimizing prehospital delay

by aiding older adults in recognizing the symptoms of acute events (e.g., heart attack) and forming an action plan (Dracup et al., 1997), additional efforts to increase older adults' awareness of their own age-related biases may yield additional benefits in preventing delay of care. Given the large proportion of older adults reporting disliking going to the doctor as a reason for delaying care, interventions that improve doctor-patient communication and reduce ageism in the health care setting may improve older adult's perceptions of how they will be treated by physicians and other health care professionals.

At a biological/physiological level, the second study examined the association between SPA and changes in cystatin c, a biomarker of kidney functioning, to understand how negative age-related attitudes may be getting "under the skin." Attitudes towards one's own aging experience were associated with changes in cystatin c even after accounting for demographic and health-related risk factors associated with the chronic kidney disease. Interestingly, a significant interaction effect emerged, showing that negative self-perceptions of aging were associated with residual increases in cystatin c (e.g., worse kidney functioning) four years later, but only among those individuals who reported being the target of perceived discrimination.

This second study adds to our understanding of the effects of SPA on health in several ways. First, it shows that how we view our own aging experience affects health not only through overt changes in behavior but also through changes at the biological level. Next, we show the importance of considering environmental factors, such as experiences of perceived discrimination, when evaluating the conditions under which SPA may be especially protective or detrimental to health. With regards to cystatin c, it seems that negative SPA may exacerbate the stress of being the target of perceived discrimination, interfering with the kidney's ability to maintain an optimal level of functioning. Finally, the combination of negative SPA and

perceived discrimination may be useful for identifying those at especially high risk of developing chronic kidney disease or progressing to end-stage renal failure. Relatively little is known about the psychosocial predictors of kidney disease onset and progression, and the findings from study 2 suggest that this may be an exciting area for future research.

At a psychological level, the third study examined the relationship between measured grip strength, perceived grip strength, and SPA on the rate of developing mobility limitations among older adults over age 65. Given that grip strength has been proposed to be a potential biomarker of aging, perceived grip strength may thereby be a more domain-specific measure of how older adults perceive their own aging process. Therefore, we aimed to understand how more domain-general perceptions of aging (e.g., SPA) would interact with more domain-specific perceptions of aging (e.g., perceived grip strength) in predicting functional health four years later. Interestingly, having more positive SPA was only predictive of fewer future mobility problems among respondents who perceived their grip strength to be strong.

The findings from this third dissertation study suggest that general efforts to increase positive SPA may not be effective in preventing functional decline if older adults have poor perceptions of their own physical abilities. How individuals perceive their own aging is only one of the factors defining an individual's sense of self, and positive attitudes towards one's own aging in general do not necessarily translate into positive attitudes in other domains. Interventions to prevent functional decline among older adults should focus not only on physical strength training but also on improving feelings of self-efficacy about one's own strength and one's own aging.

Future Directions

Together, the three studies in this dissertation added to the literature on SPA and health by 1) identifying novel relationships between SPA and health, 2) clarifying the conditions under which negative SPA may be particularly detrimental, and 3) assessing the relationship between SPA and changes in health status as measured by biomarkers or self-reported physical functioning. There is, of course, much more that much that remains to be explored. There are currently only two longitudinal waves of psychosocial, biomarker, and physical functioning data for each respondent in the Health and Retirement Study. We, therefore, were only able to model change using two time-point residual change models. The release of the 2016 wave of the Health and Retirement Study, however, will make it possible to examine trajectories of change and test formal mediation models of the psychological, behavioral, and biological pathways linking SPA. Future studies should continue to focus on understanding the dynamic interplay of how changes in SPA affect changes in health and vice versa.

At a more conceptual level, studies thus far have focused on understanding the relationship between SPA and health one pathway at a time, and more complex modeling techniques are needed to understand the ways in which these pathways affect each other and form a complex network of interactions. In terms of measurement, the three studies in this dissertation all used one measure of SPA, a modified version of Lawton's Philadelphia Geriatric Center Morale Scale (Lawton, 1975). However, there are many other existing scales that have been used to measure self-perceptions of aging, and future studies should investigate whether the findings in this dissertation hold true across different measures of SPA. Finally, at a more practical level, we need more studies that examine if 1) self-perceptions of aging are amenable to intervention and 2) changes in SPA can lead to significant changes in health. For the remainder

of this chapter, I turn my attention to the existing literature on changing both self-perceptions of aging among older adults and changing attitudes towards older adults among younger adults, especially students in the health care professions.

Changing Self-Perceptions of Aging Among Older Adults

Can we promote better health and well-being by modifying self-perceptions of aging in older adulthood? Unfortunately, there have been few interventions thus far that have improved older adults' attitudes towards aging in a way that has resulted in better health outcomes. Given the long follow-up times needed to track changes in morbidity and mortality, most studies have focused instead on health behaviors such as physical activity as their main outcome of interest. In the following section, I review the few notable intervention studies that have yielded positive results in terms of improving self-perceptions of aging and physical activity engagement.

In one attribution retraining intervention, sedentary adults participated in 4 weekly 1-hour group sessions where trained health educators taught participants that a sedentary lifestyle was not an unavoidable part of aging and helped them set goals for increasing the number of steps they took each day. These discussions were followed by a 1-hour physical activity class lead by a certified instructor. Seven weeks after the first session, age expectation scores went up by 30%, and participants had, on average, increased their weekly number of steps by 5,959, or the equivalent of about 2.5 miles. Participants also reported improved mental health-related quality of life and less difficulty with activities of daily living (Sarkisian, Prohaska, Davis, & Weiner, 2007).

Wolff, Warner, Ziegelmann, and Wurm (2014) conducted a randomized control trial with adults 65+ to examine the effects of a "views-on-aging" component on attitudes towards older adults and physical activity. Participants in the "views-on-aging" group were 1) provided with

information from recent scientific studies to correct common misconceptions about the aging process and 2) trained to identify automatic, unconscious negative thoughts about aging and replace them with neutral or positive ones. Compared to the physical activity intervention group without a "views-on-aging" component, the "views-on-aging" group had more positive attitudes towards older adults, especially in regards to the satisfaction of older adults and expectations for the future. Furthermore, this attitude change was related to subsequent levels of physical activity, with more positive views leading to larger increases in exercise time per week.

Brothers and Diehl (2016) tested the feasibility and efficacy of Aging Plus, an 8-week multi-component program that aimed to promote physical activity among middle-aged and older adults by targeting 1) negative views on aging and 2) personal control beliefs. During the first four weeks, participants attended weekly classroom sessions in groups of 8-12, where they focused on the attitudinal and motivational aspects of behavior change (e.g. educational component). During the subsequent four weeks, participants worked towards personalized physical activity goals with the support of research staff (e.g., experiential component).

Overall, participants reported significantly less negative views on aging and more positive views on aging over the course of the intervention based on measures of age-related gains/losses, age stereotypes, expectations regarding aging, and subjective age. They did, however, observe a slight decay effect after the end of the intervention, with a significant decline in perceived age-related gains and positive age stereotypes between week 4 (post-test) to week 12 (delayed post-test). The significant increase in the average reported number of minutes in physical activity, on the other hand, persisted even after the end of the program. Finally, age group did not act as a moderator of training effects, suggesting that middle-aged and older adults

exhibited similar changes in their views on aging and levels of physical activity in response to the intervention.

There, however, may be a reciprocal relationship between attitudes toward aging and physical activity. While most studies try to promote positive views of aging in hopes of increasing engagement in physical activity, the act of participating in physical activity itself may promote positive perceptions of aging. Klusmann, Evers, Schwarzer, and Heuser (2012) conducted a 6-month exercise intervention study in order to examine the effects of physical activity on older women's views on aging. A sample of 247 healthy women aged 70-93 years were randomized to one of three groups: 1) exercise course (e.g., aerobic endurance, strength, and flexibility training; 90-min sessions, 3 days per week), 2) active control (e.g., computer course; 90-min sessions, 3 days per week), or 3) passive control (e.g., life as usual). After adjusting for baseline levels, the exercise intervention group had lower levels of aging dissatisfaction at the end of the 6-month intervention compared to each of the two control groups. The effects of the intervention on views toward aging may be partially mediated by direct approach motivation toward physical activity, or being motivated by expectations of deriving immediate positive outcomes when engaging in physical activities.

In general, the results of intervention studies on SPA, especially with regards to physical activity, are promising. The evidence, however, is still sparse in terms of whether improving SPA can lead to better outcomes in other health behaviors and eventually reduce rates of morbidity and mortality. Not all studies include a control group, making it difficult to quantify the size of the effect and isolate the "active" component of the intervention. Furthermore, there are also limited studies on the maintenance of effects over the long-term. The positive effects of short-term interventions on SPA may decay over time if individuals continue to be exposed to

negative environmental factors that challenge their views on aging. Perceptions of one's own aging may also change on a day to day basis based on environmental influences (Kotter-Grühn, Neupert, & Stephan, 2015), and identifying the activities and interactions that negatively impact one's self-view as an older adult may also be an important step to understanding the factors that contribute to how individuals feel about their own aging process.

Changing Attitudes Toward Aging/Older Adults Among Younger Populations

While some preliminary evidence suggests that self-perceptions of aging can be improved later in life, age-related attitudes that are the product of years of exposure to age stereotypes may be very resistant to change. Given that age stereotypes are internalized across the life course, some researchers have focused their efforts on understanding and changing attitudes towards aging earlier in life before they have become fully ingrained and incorporated in the self-concept. Given that individuals who hold more negative age stereotypes earlier in life are at an increased risk for cardiovascular events in older adulthood (Levy, Zonderman, Slade, & Ferrucci, 2009), there are significant benefits to targeting age-related attitudes even before individuals reach old age. For younger individuals, efforts to increase positive attitudes towards aging can be viewed an investment in the health of their future selves.

In a society dominated by negative age stereotypes, interventions that encourage younger individuals to view older adults in a more positive light may also promote a more age-friendly environment and improve the quality of interactions between younger and older individuals. Levy (2016)'s Positive Education about Aging and Contact Experiences (PEACE) model emphasizes the importance of two key elements for reducing ageism, prejudice, and discrimination against older adults: 1) education about aging and 2) positive contact with older adults. In the following section, I explore each of these two approaches for promoting more

positive age-related attitudes and present a few examples of successful interventions that have utilized each method.

Education on Aging

One factor contributing to the development of negative age stereotypes among children and young adults may be a lack of education regarding the aging process. Students receive relatively little formal education on aging in school and often turn to more informal sources of information, such as the media, to learn about the aging process. Given the predominantly negative portrayals of older adults in books, television shows, and advertisements, it is not surprising that younger adults hold many misconceptions about the physical and mental abilities of older adults. For example, individuals tend to overestimate the amount of time older adults spend on passive activities such as sleeping and watching television and underestimate the amount of time older adults engage in active activities such as working or volunteering (Wurtele, 2009; Wurtele & Maruyama, 2013).

Educational programs that promote more accurate views about aging and correct common myths and misconceptions about older adults may be one way to reduce negative age stereotypes earlier in life (Wurtele & Maruyama, 2013). The incorporation of examples from geriatrics and gerontology into required curricular lessons has also been shown to promote more positive views of aging among middle-school students (Lichtenstein et al., 2001). Some educational interventions that have attempted to improve attitudes toward aging among high school students, however, have been ineffective, suggesting that attitudes towards older adults formed in early childhood become more difficult to change in adolescence (Klein, Council, & McGuire, 2005).

In addition to traditional classroom learning, simulations in which students wear heavy gloves to simulate decreased manual dexterity or wear glasses covered with petroleum jelly to simulate visual decline have shown to increase positive attitudes and empathy towards older adults (Green & Dorr, 2016) It is important, however, to be aware of educational activities that may in and of themselves be promoting negative stereotypes about aging and lead to negative SPA by implying that aging is associated with inevitable sensory decline. Ideally, educational activities on aging would present a positive but realistic representation of the aging process that also emphasizes the ability of individuals to play an active role in their own aging.

Intergenerational Contact

Increased intergenerational contact has also been proposed as a way to reduce negative age stereotypes and foster more meaningful positive relationships between younger and older adults. By providing younger adults with positive role models of aging and giving them the opportunity to interact with healthy older adults in a community setting, younger adults may be more likely to challenge their own stereotypic views of older adults. Not all programs that promote interactions between younger and older adults necessarily lead to more positive views of aging, and in some cases, may even lead to the more negative feelings towards aging in cases where children interact primarily with frail, immobile, or non-responsive older adults (Seefeldt, 1987).

In accordance with the contact hypothesis (Allport, 1954), Seefeldt (1987) suggests that the following conditions must be met for positive attitude change to occur: “(a) equal status between groups; (b) intimate, rather than casual, contact; (c) contact that is pleasant and rewarding for both groups; and (d) functional interaction taking place, with both groups involved in goal setting and participating in important activities” (Seefeldt, 1987, p. 231-232).

Intergenerational programs, especially those that meet the criteria mentioned above, have been successful in promoting more positive views of older adults among children and adolescents (Aday, Sims, McDuffie, & Evans, 1996; Aday, McDuffie, & Sims, 1993; Aday, Rice, &Evans, 1991; Bales, Eklund, & Siffin, 2000; Couper, Sheehan, & Thomas, 1991). In the Intergenerational Partners Program, for example, fourth graders were paired with elderly volunteers from a senior center to participate in a variety of interdisciplinary activities over a 9-month school year. Compared to a control group who had no contact with older volunteers, the experimental group had significantly more positive attitudes towards older adults at follow-up that persisted at both 1-year and 5-year follow-up (Aday et al., 1996). Large-scale programs such as the AARP's Experience Corps program and the Senior Corps' Foster Grandparents program have also been used to bring together young and older members of the community, and both young and older participants mutually benefit from the relationship (Fried et al., 2004).

It is still unclear, however, what duration of contact is necessary to give rise to significant and enduring changes in age-related attitudes. While some studies suggest that short one-time exposures may be enough, others suggest that more long-term contact is necessary for stable attitude change. There has also been significant interest in understanding the importance of quality versus quantity of contact in shaping attitudes towards aging. Schwartz and Simmons (2001), for example, found that self-reported quality, but not frequency, of contact with older adults predicted more positive attitudes toward older adults. Ideally, interventions that improve attitudes towards aging among young adults will change not only how they view older adults as an out-group but also how they will view their older selves when they become part of the in-group.

A Special Emphasis on the Attitudes of Health Professionals

Although fostering positive attitudes towards aging and older adults is important for all segments of the population, the attitudes of individuals in the health care professions may be especially influential in how older adults view their own aging and evaluate their health care experience. As the aging population continues to grow, interactions between health care professionals and older adults will only become more frequent, and addressing providers' unconscious biases and ageist attitudes will help ensure that older adults receive care that is not only high in quality but also focused on continued adaptation and growth rather than unavoidable loss and decline. Health care workers can play a critical role in helping patients successfully transition into older adulthood by discussing patient concerns regarding age-related issues and reinforcing the idea that mental and physical decline are not inevitable in old age.

Given that attitudes toward older adults tend to become more negative with increasing numbers of years in practice (Hellbusch, Corbin, Thorson, & Stacy, 1995), intervening early in training may be the best way to promote positive views of aging among future health care professionals. Changing the attitudes of health care trainees towards older adults, however, may prove to be a formidable challenge. Many first-year medical students, for example, already have unfavorable attitudes about older adults at the start of medical school (Reuben, Fullerton, Tschann, & Croughan-Minihane (1995), and many express a preference for working with younger versus older patients (Perrotta, Perkins, Schimpfhauser, &Calkins, 1981), reducing the likelihood that they are exposed to geriatric medicine during their training. The "medicalization" of aging, portrayals of aging as inevitable biological decay, and the emphasis on speed and efficiency in health care settings may all be contributing to especially negative attitudes towards

aging patients among physician-in-training (Higashi, Tillack, Steinman, Harper, & Johnston, 2012).

Education on aging and increased contact, the two core elements for reducing ageism mentioned above (Levy, 2016), have also been applied to improving attitudes towards aging among students in the health professions. The ability of education on aging to change age-related attitudes, however, are mixed. While there is some support for the benefits of specialized courses in geriatric medicine for decreasing negative attitudes towards older adults (Deary, Smith, Mitchell, & MacLennan, 1993), other studies show no or very minor differences in the attitudes of participants versus non-participants (Carmel, Cwikel, & Galinsky, 1992; Diachun, Van Bussel, Hansen, Charise, & Rieder, 2010). Participation in simulated "aging games" has led to improvements in attitudes towards older adults in some studies (Varkey, Chutka, & Lesnick, 2006), but a worsening of attitudes towards older adults in others (Lucchetti, Lucchetti, de Oliveira, Moreira-Almeida, & da Silva Ezequiel., 2017).

Contact with older adult patients outside the clinical context has also shown to improve views of older adults among medical trainees, especially when the interaction is with healthy older adults living in the community rather than older adults who resided in nursing homes (Adelman, Fields, & Jutagir, 1992; Wilkinson, Gower, & Sainsbury, 2002). Longitudinal programs in which medical students are paired with older adult volunteers in the community to engage in conversation and/or shared activities have also been linked with better attitudes towards older adults (Bernard, McAuley, Belzer, & Neal, 2003; Duke, Cohen, & Novack, 2009) with some exceptions (Lu, Hoffman, Hosokawa, Gray, & Zweig, 2010; Shue, McNeley, & Arnold, 2005).

In general, more research is still needed to determine the exact components of interventions that are effective in eliciting changes in attitudes towards older adults. A recent review by Samra, Griffiths, Cox, Conroy, & Knight (2013), for example, suggests interventions that include an empathy-building component are most successful in inducing medical students to adopt more positive attitudes towards older adults.

Final Thoughts

Given the many ways in which negative SPA have been shown to affect the health of older adults, the majority of this final chapter was dedicated to discussing the state of research on interventions that promote more positive self-perceptions among older adults and more positive attitudes towards older adults among younger individuals, especially health professional students. Unfortunately, individual-level interventions that change personal views on aging are not enough. More must be done at both the institutional and national levels to ensure that older adults are viewed and treated as respected and productive members of the community rather than as burdensome and worthless drains on society. Organizations must be vigilant to how stereotypes and biases against older adults are affecting the health and well-being of their workers. The media must be more cognizant of how the messages they are sending are teaching children about what it means to age. The ultimate answer to better health and well-being for our aging population may not be to change the person but to change the ageist society in which he or she lives.

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