THE INFLUENCE OF SELF-PERCEPTIONS OF AGING ON OLDER ADULTS' COGNITION AND BEHAVIOR

A Dissertation

by

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ABSTRACT

How old one feels, one's subjective age, has been shown to predict important psychological and health outcomes. However, few studies have demonstrated a relationship between subjective age and cognitive performance. The first aim of this paper was to determine if subjective age is correlated with cognition. Study 1A investigated whether baseline subjective age was correlated with cognitive performance in several laboratory tests. The results found preliminary evidence that subjective age was correlated with several cognitive measures. Bootstrapping revealed several significant correlations between subjective age and cognitive performance. Study 1B investigated whether this effect could be replicated in an online sample. Preliminary results suggested baseline subjective age was related to cognitive performance. Bootstrapping revealed that subjective age was correlated with several cognitive measures, as well as confidence ratings. Study 1C further demonstrated that baseline subjective age was correlated with cognitive performance using data from a nationwide longitudinal study.

The second aim of paper was to determine if manipulating subjective age would also affect cognition. Study 2 manipulated subjective age for a group of participants by giving them a memory test; a control group received a vocabulary test. There was evidence that manipulating subjective age affected some cognitive performance, such that higher subjective age was correlated with lower performance. Furthermore,

participants who felt older were less confident in their performance for some unfamiliar tasks.

The third aim of this paper was to determine whether subjective age could also be decreased, and if so, would this lead to an improvement for cognitive performance. In Study 3, half of the participants received positive feedback following a memory test, while the other half received no feedback after the test. The results suggest that positive feedback may lead to a lower subjective age, although this did not lead to higher cognitive performance.

In conclusion, these studies provided strong evidence that subjective age is correlated with cognitive performance. Furthermore, the results suggest that manipulating subjective age can also affect cognitive performance and subjective confidence. Finally, the results support the theory that subjective age is a malleable variable which can be increased or decreased, depending on contextual factors.

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INTRODUCTION

People's beliefs and expectations about aging can have a profound influence on their physical and psychological health, as well as their cognitive abilities. In this paper, I review the literature on *self-perceptions of aging*, or people's views of their own aging process. I also review stereotypes of aging, or people views of the aging process and of older adults. I discuss the various beliefs that people hold about being older and the aging process in general. I also discuss how these beliefs influence important outcomes such as physical ability and longevity. I focus on one type of self-perceptions of aging, called subjective age. Subjective age refers to how old an individual feels, regardless of their actual, chronological age. Subjective age is typically measured by asking participants how old they feel. This simple assessment has been shown to be associated with physical signs of aging, as well as susceptibility to age-related stereotypes. I conclude with future directions for work on subjective age. Subjective age can be manipulated by feedback or contextual information. Increased subjective age has been shown to be correlated with lower memory performance in laboratory studies. It is important to understand how an increase in subjective age affects older adults' behavior, and what factors play a role in manipulating subjective age.

Self-perceptions of Aging

Prior work has shown that self-perceptions of aging can be powerful predictors of physical health and longevity. For instance, an 18-year longitudinal study found that older adults who reported more positive self-perceptions of aging maintained higher

levels of functional health (i.e., how much health problems interfere with everyday life) in subsequent years than those who reported less positive self-perceptions of aging (Levy, Slade, & Kasl, 2002). Over 400 older adults (ages 50 and up) who participated in the Ohio Longitudinal Study of Aging and Retirement (OLSAR) were queried about their self-perceptions of aging at several times points across the 18 year study. They were asked to indicate their level of agreement with general statements about aging (e.g., "Things keep getting worse as I get older", "I am as happy now as I was when I was younger") and they were asked to answer questions about their physical abilities as a measure of functional health (e.g., "Which of the following things are you physically able to do? Heavy work around the house, walk a half mile"). Results showed that positive self-perceptions of aging measured up to 18 years prior significantly predicted self-reported functional health in older adults. Moreover, the relationship remained when several other baseline factors were controlled (e.g., age, baseline functional health, socioeconomic status). These data suggest that there is a strong link between one's mental representation of aging and the physical signs of aging.

People who have more positive self-perceptions of aging also live longer than people who have more negative self-perceptions of aging (Levy, Slade, Kunkel, & Kasl, 2002). Using data from the same longitudinal study (the OLSAR), Levy and colleagues (2002) found that older adults who reported more positive self-perceptions of aging lived an average of 7.6 years longer than those who reported more negative self-perception of age; those reporting positive perceptions survived on average 22.6 years after the baseline measure, while those reporting negative perceptions survived 15 years after the

baseline measure. The only variable with a stronger relationship to survival was the participant's age. In summary, when other factors are controlled for, self-perceptions of aging are strong predictors of longevity.

Similarly, self-perceptions of nearness to death are also strong predictors of longevity (Kotter-Grühn, Grühn, & Smith, 2010). As part of the longitudinal Berlin Aging Study, participants were asked to rate their level of agreement with a single question, "I have the feeling that my time is running out," from 1 (does not apply to me) to 5 (applies very well to me). Even when age was factored as a covariate, older adults over 70 who perceived themselves nearer to death died earlier than those who perceived themselves as farther from death. Older adults who felt closer to death (gave a rating of 5 out of 5) had a median survival of 3.6 years compared to older adults who felt farther from death (who gave a rating of 1 out of 5) who had a median survival of 6.1 years. The data suggest that older adults have a fairly accurate perception of their own mortality.

The studies reviewed thus far focused on older adults' self-perceptions of aging and how those perceptions can predict important outcomes health outcomes and mortality. One can also examine general perceptions, or stereotypes, of aging that are held by younger and older adults alike.

Aging Stereotypes

Stereotypes can be formed about any group, including older adults. One of the earliest studies to acknowledge older adults as a stereotyped group sought to identify the attitudes that younger adults hold about the older adults (Brewer, Dull, & Lui, 1981). In this study, younger adults reliably clustered pictures and descriptions of older adults

around three categories, the "grandmother," the "elder statesman," and the "senior citizen." The grandmother category described an older, family-oriented woman, and participants associated her with words such as *accepting, helpful, trustworthy, serene, kindly, optimistic, calm,* and *cheerful*. The elder statesman category described a distinguished older man and participants associated him with words such as *aggressive, intelligent, conservative, dignified, authoritarian, intolerant,* and *competitive*. Finally, the senior citizen category described an inactive, elderly person who participants associated with words such as, *lonely, old-fashioned, weak,* and *worried*. The findings from this study are important because they illustrate that younger adults hold specific stereotypes about older adults.

The previous study suggested that younger adults hold a handful of specific stereotyped categories of older adults, suggesting that they have a fairly narrow view of aging. One study directly compared the number of categories that younger adults have for younger and older adults (Hummert, 1990). College students were given 84 cards, each labeled with a trait, and asked to sort the traits into piles that would describe one person, and they could create as many piles as they liked. Participants were allowed to discard a trait if they felt it did not apply. Half of the participants were told that their piles described younger adults, while the remaining half was told they described older adults. Results showed that on average, participants created more groups for younger adults (M = 7.62) than for older adults (M = 6.00), which suggests that they formed a more complex schema of younger adults.

Younger adults also judge that negative traits are more typical of older adults than they are of younger adults (Hummert, 1990). Younger adults were given a list of traits and asked to indicate how typical the trait was for a particular age range. Participants were either instructed to think of younger adults or older adults. The results demonstrated that participants assigned more negative than positive traits to older age ranges, while they assigned more positive than negative traits to the younger ranges. Additionally, participants rated negative stereotypes as more typical of older adults than positive stereotypes. The opposite was true for ratings of younger adult stereotypes; positive stereotypes were rated as more typical of younger adults than negative stereotypes. The study demonstrates that younger adults hold more positive views of younger adults' personalities.

Other studies have examined how stereotypes of older people change and become more complex as one ages (Hummert, Garstka, Shaner, & Strahm, 1994). Younger, middle-aged, and older adults were asked to generate a list of traits for older adults. Results showed that older adults produced significantly fewer traits than younger and middle-aged adults, but there was significant overlap for the traits that the three age groups produced. A new sample of younger, middle-aged, and older adults was given these trait descriptions on individual cards and asked to sort them into separate piles, each describing an individual older adult. Consistent with the authors' hypothesis, older adults sorted the traits into more categories than middle-aged and younger adults. The findings suggest that younger adults tend to lump traits of older adults in a smaller number of categories (i.e., many negative stereotypes tend to be lumped together to

describe one type of older adult; many positive lumped together to describe another typical older adult). Middle-aged adults tended to create more categories than younger adults, but not as many as older adults. Older adults grouped fewer traits into more categories of older adults. These findings support the idea that older adults have a more complex representation of old age.

Another follow-up study demonstrated that attitudes of aging may become more negative over time, before becoming positive during old age. Using the clusters of traits developed in the prior study (Hummert, et al., 1994), researchers were able to assess how individuals rate a stereotype subcategory as a whole (Hummert, Garstka, Shaner, & Strahm, 1995). Participants in three age groups (younger, middle-aged, and older) were given a list of traits and asked to think of an older individual who would fit those traits. Five of these stereotype lists were positive and six were negative. Participants were then asked to make three judgments based on these traits. First, they were asked to assess the age group such an individual would represent (under 60, 60-64, 65-69, etc.) Second, participants were asked to use a 7-point scale to rate how typical this description was of an older adult. Finally, the participants' attitudes toward the individual were assessed. People of all ages rated the positive stereotypes as being associated with younger age-ranges, while the negative stereotypes were associated with older age-ranges. There were no significant differences in attitudes toward older adults, but the pattern of results were of interest as they trended toward significant; older participants did demonstrate more positive attitudes than younger adults, but middle-aged participants demonstrated the most negative attitudes. Older adults rated all stereotypes as less typical than the two

younger groups. This research demonstrates that stereotypes of aging largely overlap between different age groups, but that is not the whole story. There is a much more complex relationship between age and aging-stereotypes. Attitudes toward aging appear to become more negative as individuals approach old age, but then become more positive after they become older adults themselves.

Although a number of aging stereotype subcategories have been identified, the typical stereotype of an older adult has been described as incompetent, but warm (Cuddy, Norton, & Fiske, 2005). In one study, participants were given a passage that described an older adult who had lost his or her keys. In the incompetent condition, the older adult was described as having memory problems, whereas in the competent condition this description was absent. When the older adult was described as having memory problems, warmth ratings increased, relative to when this ability was not mentioned. Competency ratings did not differ across conditions. The interpretation of the results is that when older adults conform to typical stereotype beliefs (as having memory problems), they are more likely to be viewed positively by younger adults (Cuddy, et al., 2005).

Aging stereotypes may depend on the domain of life under consideration (Kornadt & Rothermund, 2011). In one study, participants aged 30 and up were asked to provide an age that they would consider old for eight life domains (family, friends, religion, social, personality, finances, work, and health). Participants assigned significantly different ages for the different domains. For the work domain participants considered 60-years-old to be old, while they considered 70-years-old to be old for the

family domain. In addition, participants rated older adults differently depending on domain. The domains of health and fitness, friendship, and finances, received more negative evaluations, whereas older adults were rated more positively in the family, spirituality, and work domains.

There has also been work demonstrating that people may hold implicit and explicit stereotypes of aging (Casper, Rothermund, & Wentura 2011). In two priming studies, participants were shown photographs of younger or older adults paired with a trait description immediately preceding a lexical decision task. Word processing was quickest when the target word conformed to their preexisting stereotypes. People were faster to correctly identify words on the lexical decision task when the photograph and trait description formed a stereotypic statement with the target word (e.g., photo of an older woman with the description "Crossing the street" plus the target word "slow"), than when the context did not form a stereotypic statement (e.g., photo of an old woman with the description "watering the flowers" plus the target word "slow"); These studies suggest that people hold implicit as well as explicit stereotypes about older adults and that these stereotypes differ for various domains of life..

Aging stereotypes also differ across cultures. In one study, American hearing older adults were compared with Chinese hearing older adults and American Deaf older adults (under the assumption that Deaf adults are exposed to fewer negative stereotypes than hearing older adults). All participants were first asked to describe a typical older adult, and these descriptions were rated as positive or negative. Participants were then shown a series of faces or dot patterns on a grid for a later recall test. American hearing

adults provided significantly more negative descriptions and remembered fewer items than both Chinese and American Deaf adults (Levy and Langer, 1994). However, later research would contradict on of the premises of this article, finding that negative aging stereotypes are also prevalent in Asian cultures as well (Boduroglu, Yoon, Luo, & Park, 2006).

In this follow-up study, younger and older adults in the US and China were asked to provide a description of a typical younger and older adult. The results demonstrated that participants from both cultures provided the same number of negative descriptions of the elderly. Contrary to beliefs that Eastern cultures hold more positive attitudes of their older adults, Chinese participants did not produce more positive words than US participants. These results are noteworthy as they suggest that aging stereotypes are not solely an American phenomenon, but present in other cultures as well, even those cultures that place high value on its elderly members. A possible explanation for the different results obtained by these studies is that Boduroglu and colleagues asked for descriptions of both younger and older adults, while Levy and Langer only asked for a description of older adults. Boduroglu and colleagues had participants describe their own age group first; meaning younger adults described a typical younger adult before describing an older adult. Therefore younger adults' descriptions of older adults were always provided in comparison to their prior description of younger adults, which could provide for a less favorable view of older adults. Likewise, older adults always described a typical older adult first, and prior research has demonstrated that older adults hold more positive attitudes about their own age group.

Many stereotypes are based on common misconceptions of the aging process. For example, most people falsely believe that a majority of older adults are impoverished, irritable, and lonely. Additionally, they believe that a disproportional number of older adults live in nursing homes (people believe that 10% of older adults live in nursing homes while the actual number is less than five percent; Barrett & Cantwell, 2007; Abramson & Silverstein, 2004). Of the aging stereotypes, the belief that memory will decline substantially with age is most prevalent across people of all adult age groups. Research has demonstrated that adults aged 18 to 74 rated memory performance expectations significantly more positive for 25-year-olds than for 65-year-olds (Ryan, 1992). Older adults also expected there to be a larger memory difference between the younger and older age groups than did younger adults.

Although many older adults expect memory to decline with age, the degree to which they expect it to decline appears to depend on their personality. In one study, younger and older adults were shown photographs of older adults. Each photograph was accompanied with adjective clusters that described either positive (e.g., sociable, kind, etc.) or negative stereotypes (e.g., sad, stubborn, etc.). Each participant then rated the perceived memory ability of older adults in the photographs. Both younger and older adults rated individuals who were described positively as having better memory than those described negatively; however, older adults were particularly affected by these descriptions (Lineweaver, Berger, & Hertzog, 2009). While supporting research suggests that there is a universal belief in age-related memory declines, these results indicate that

not all older adults are treated equally. Older adults who conform to negative stereotypes of aging are judged to be more forgetful than those who fit a positive stereotype.

Taken together, the studies just described suggest that people of all ages hold stereotypes of older adults. While some stereotypes are positive in nature, the majority are negative and, as we will see in the next section, these negative aging stereotypes can affect older adults in a variety of ways.

Stereotype Threat

Before discussing how stereotypes affect older adults in particular, I'd like to briefly discuss the origins of *stereotype threat*. Stereotype threat describes a situation where a threatened individual performs worse on the stereotyped skill, thus confirming the stereotype. This finding was first reported by Steele and Aronson (1995) in a sample of African American students. These students, and their Caucasian classmates, were given a test (similar to college entrance tests) that was either described as diagnostic or non-diagnostic of the participants' strengths and weaknesses. In the diagnostic condition, participants were told that their test scores would give them perspectives on their abilities and limitations. African American students performed worse than Caucasian students, but only when they believed the test was diagnostic of their abilities. The authors theorized that Black students performed worse than the Caucasian students in the diagnostic condition because in the diagnostic condition the stereotype that African Americans score poorly on standardized tests was activated. It appears that simply indicating one's race is sufficient to activate the stereotype and show a threat effect. In another condition of the study, participants were given a personal information sheet.

Participants in the race-prime group were asked to indicate their race on the last question on the sheet; this question was omitted for the remaining participants in the no-race-prime group. African American participants in the primed group performed worse than those in the no-prime group, and they performed worse than Caucasian students who had indicated their race. The conclusion drawn from this study was that African American participants performed worse when they had to indicate race because they were aware of the stereotypes associated with their demographic group. That is, they performed worse because they believed they were supposed to perform worse, perhaps due to lowered expectations, anxiety, or decreased attention to the task (Cheryan & Bodenhausen, 2000; O'Brien & Crandall, 2001; Schmader & Johns, 2003).

Stereotype threat has been demonstrated for a number of other populations. In a follow-up study, female participants performed worse on a math test relative to their male peers, but only when their gender was primed; otherwise, male and female participant performed roughly equally (Spencer, Steele, & Quinn, 1999). But what happens if an individual belongs to multiple groups with conflicting stereotypes? This circumstance was put to the test in one study when Asian-American females were given a math test (Shih, Pittinsky, and Ambady, 1999). Asian-American females were given the test with one of three sets of instructions. Participants in the Asian-identity condition were asked several questions about their heritage. Participants in the gender-identity condition were asked questions about living in a single-sex or coed dorm. Participants in the control condition were asked questions about a phone service on campus. The results showed that participants in the gender-identity condition performed worse than control

(when they answered questions about phone service), thereby confirming the stereotype that women perform poorly on math tests. However, participants in the Asian-identity condition out-performed the control group, confirming the stereotype that those of Asian descent perform well on math tests. This finding demonstrates that stereotypes can positively and negatively affect performance. However, these findings have been met with some skepticism, with other researchers cautioning that activation of positive stereotypes may also be harmful by creating a higher pressure situation and the potential for the participant to "choke" under pressure (Cheryan & Bodenhausen, 2000).

The potential mechanisms of stereotype threat are still not fully understood, but several potential mechanisms have been advanced (Page, 2012). One idea is that stereotype threat hinders performance in the stereotyped domain by reducing the amount of cognitive resources available. Originally proposed by Steele and Aronson (1995) in their seminal paper, additional work supports this idea by showing that stereotype threat reduces working memory capacity (Schmader & Johns, 2003). In three studies, stereotype threat reduced the working memory capacity of women (Studies 1 & 3) and Latinos (Study 2). Participants were presented with a working memory test. For half of the participants the test was either framed as a stereotyped task (a test of math ability for women or a standardized intelligence test for Latinos) while the other half of the participants did not receive any information about the task. Performance on the working memory task was worse for the stereotyped groups when the task was framed as a stereotype-relevant task than when it was not framed in this was. In other work, stereotype threat was shown to impair performance on a standard cognitive measure

(Raven Advanced Progressive Matrices Test) by increasing mental load (Croizet et al., 2004). This study used electrocardiogram (ECG) heart rate measures as a proxy for mental load; the authors suggested that, while seated, an increase in heart rate indicated an increase in brain activity, as a body at rest wouldn't need additional blood flow unless it was required in the brain. When participants were told that they were taking part in a diagnostic test for intelligence, participants who believed that they were intellectually inferior to another group (psychology majors compared to science majors) performed worse than when they did not believe that the test was diagnostic of intelligence. This effect was mediated by mental load, as measured by variability in heart rate; all participants in the diagnostic test condition experienced higher heart rate variability than those in the non-diagnostic test condition. For the threatened group (psychology majors), this increase in heart-rate variability was associated with a decrease in performance. However, for those unthreatened students (science majors), this increase in heart-rate variability was associated with an increase in performance. This suggests that under diagnostic conditions, participants under threat may become preoccupied with threatening thoughts, while conversely unthreatened participants may exert more mental effort on the task at hand.

Others theorize that stereotype threat is best explained by an increasing arousal (O'Brien & Crandall, 2001). Men and women were given either an easy or a difficult math test. Participants were instructed that the test had been shown to either produce gender differences or they were told that the test did not show gender differences. A typical stereotype threat effect was found for women who took the difficult math test;

women who believed the test would show gender differences performed worse than women who believed the test would not show gender differences. However, on the easy test, women who believed there would be gender differences outperformed those who believed there would be no differences. There were no differences between men's scores on either test for either condition. After ruling out non-arousal factors (i.e., persistence on test, evaluation apprehension), the authors concluded that an arousal explanation fit the data, as arousal increases performance for easy tasks, while inhibiting performance for difficult ones. That is, they suggested that threat increased arousal for the women under threat and that this increased arousal aided performance on the easy math test while it inhibited performance on the difficult math tests.

The increased arousal theory also fits well with the idea that stereotype threat increases motivation. The idea is that, under threat, people are more motivated to perform well to disprove the stereotype. This increased motivation leads to an increase in effort on the task. For easy tasks, the increase in effort can produce a better result. For difficult tasks, though, it can lead worse performance, which has been described as choking under pressure as discussed above (Chervan & Bodenhausen, 2000). Not all theories posit that stereotype activation increases motivation. Some researchers suggest that stereotype threat reduces task expectations and motivation (Spencer, et al., 1999), which may negatively affect task performance (Bandura, 1977).

Another proposed mechanism for stereotype threat is the increase of negative affect. Bergeron, Block, and Echtenkamp (2006) found an increase in self-reported negative affect for women in the workplace who were presented with a description of a

masculine predecessor compared to women who were presented with a description of a stereotypical feminine predecessor. This increase in negative affect was associated with a decrease in performance on a task designed to simulate managerial decision-making. Other studies support the view that stereotypes increase negative mood or decrease positive mood. Kang and Chasteen (2009) tested older adults for their recall of a prose passage. All older participants completed the test in the same room as a younger confederate. Participants in the threat condition were told that the test was diagnostic of age differences while the control group was told nothing about age differences. Older adults in the threat condition reported a decrease in positive affect on the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). This decrease in positive affect was correlated with higher levels of stereotype threat, and lower levels of recall. While there has been a large amount of research conducted on the mechanisms of stereotype threat, the literature has not reached a general consensus on the underlying cause. For example Hess, Emery, and Queen (2009) found no difference in affective responses between threatened and non-threatened groups of older adults. It should be noted that a majority of these mechanisms are not mutually exclusive; in fact, one could imagine that several of these proposed mechanisms are actually part of the same process.

Stereotype threat and the mechanisms underlying threat have received much interest and there is vast literature with younger adults on the subject. A comprehensive review of this literature is beyond the scope of the current paper. However, the brief review presented here summarizes the basic theory, some seminal work on stereotype

threat, and the proposed mechanisms behind this effect. We turn next to an examination of the work on stereotype threat in older adults.

Stereotypes Affect Older Adults' Performance

We can think of older adults as another stereotyped group, similar to African Americans or women. As described earlier, there are many (mostly negative) stereotypes of older adults. Older adults are expected to be forgetful, weak, frail, irritable, slow, poor, and lonely when compared to younger adults. As with other stereotyped groups, stereotype threat effects can be observed with older adults. One of the most common stereotypes of older adults is that they have memory problems. When the concept of age is activated for older adults, they perform in line with the stereotype. For example, in one study older adults were exposed to a list of negative aging (e.g., *senile, forgets*) or positive aging (e.g., *wise, sage*) primes during an unrelated task (participants were asked to identify whether words appeared above or below a target). Later participants studied patterns, photographs, or spoken words for a recall test. Participants who had been exposed to the positive stereotype words later recalled more items on a memory test than those who had been exposed to the negative stereotype words. Younger adults did not exhibit the same pattern of results (Levy, 1996). However, replication of these results only supported the finding that negative stereotypes can reduce memory performance. There was no support for positive stereotypes increasing the memory performance of older adults (Stein, Blanchard-Fields, & Hertzog, 2002). In the study by Stein et al., younger and older adults were either primed with positive age-related stereotype words (e.g., wise, sage), negative stereotype words (e.g., Alzheimer's, senile), or neutral words

(e.g., between, sentence). The words appeared briefly on a computer screen and participants had to quickly indicate where on the screen the word appeared. Participants then completed a memory experiment in which they were shown photographs of faces with descriptions and were asked to later recall the descriptions associated with each face. The negative stereotype primes impaired memory performance for older adults who were unaware of the intention of the priming condition, but only for the photo recall task. Furthermore, positive stereotype primes had no effect on either memory test. Younger adult's memory performance was unaffected by the primes. Results supported the notion that negative stereotype primes impair memory performance, but revealed no evidence that positive stereotype primes could improve performance.

Other studies have activated negative stereotypes using different methods and shown a similar decrease in memory performance. In one such study, younger and older adults read news articles that either confirmed age-related memory declines or illustrated a positive relationship between age and memory before participating in a memory test, while some participants were given no article at all. Stereotype threat activation was then measured by recording the participants' reaction time to identify age-related stereotype words; faster judgments for a word prime indicated a higher degree of activation. Older adults who read the article about memory declines subsequently recalled fewer words than older adults in the other two conditions. Younger adults' memory performance was not affected by having read the previous passages or not (Hess, Auman, Colcombe, & Rahhal, 2003). Further, older adults' performance was shown to vary with the degree of stereotype activation; older adults who showed higher levels of stereotype activation (as

measured by their increased reaction time to identify stereotyped words) performed worse on the memory test than older adults show showed lower levels of stereotype activation. These findings support the idea that stereotype activation influences memory performance.

Not all studies have demonstrated a stereotype threat effect. In an attempted conceptual replication of the study just described, adults between the ages of 24 and 86 read articles that either highlighted positive or negative aspects of memory and aging prior to a memory test. Though a weak, non-significant threat effect was found in adults around 68 years old, the only significant result showed a reversal of the effect for adults at approximately 43 years old; recall was higher for participants who read the negative article (Hess & Hinson, 2006). The lack of a significant threat effect in this study may have been in part due to a relatively small sample size (approximately 16 per group) spread over five age ranges. It is of note that the middle-aged group revealed an increase in memory after reading the negative article, suggesting that those on the cusp of old age may be motivated to perform after threat is induced.

The idea that stereotype threat affects adults uniquely at different ages has led some researchers to separate older adults into young-old and old-old categories. One such study investigated the mechanisms of stereotype threat in older adults in two age ranges, one encompassing adults aged 60 to 70 years old (the young-old group) and the second from 71 to 82 years old (the old-old group). Stereotype threat had the largest effect on the young-old participants. Within this group of young-old adults, those who were more conscious of aging stigmas performed the worst; this effect was not observed

in the old-old participants (Hess, Hinson, & Hodges, 2009). These findings have been interpreted as evidence that the identity of "older adult" is particularly salient for those individuals who have recently entered, or are preparing to enter, that age group. The idea is that as people enter this new stage in their life, they may be particularly prone to feeling threatened by the new set of stereotypes that accompany it.

Although most research on stereotype threat in older adults has used free recall to examine memory performance, other memory tasks are not immune to the negative effects of stereotypes on performance. Recognition memory is also subject to the effects of stereotype threat, but only when task demands are high. Older adults recognized fewer items under threat when the memory test was timed, but not when they had an unlimited amount of time to try to recognize studied words. Also, participants were asked to indicate how confident they were in their judgments of recognition. If they could recall some detail of studying the word earlier, they assigned a *Remember* response to the word. If they just knew that the word had been presented earlier without remembered a specific detail associated with the presentation of the word, they assigned a *Know* response to the word. Results showed that *Remember* responses in the threat condition where higher when there were no time demands on the task (Hess, Emery, & Queen, 2009). These results suggest that time constraints reduce the memory ability of older adults; when older adults are given additional time, they can produce more high confidence responses on a recognition task. Stereotype threat had a larger effect when the participant was under an additional constraint, suggesting that the threat was slowing

down the participants cognitive processes. When more time is provided, older adults can overcome threat to some degree.

Roediger and McDaniel once quoted Mark Twain by saying "When I was younger, I could remember anything, whether it happened or not, but my faculties are decaying now and soon I shall be so I cannot remember any but the things that never happened. It is sad to go to pieces like this but we all have to do it" (Roediger & McDaniel, 2007, p. 105). As this quote suggests, not only do older adults have worse memory for veridical information than younger adults, they also tend to have higher levels of false memories. Researchers interested in false memories have frequently used a laboratory paradigm called the Deese-Roediger-McDermott (DRM; Roediger & McDermott, 1995) paradigm to assess this falsely recalled information. In a typical DRM task, participants read a list of semantically related words (e.g., bed, night, yawn, etc.), but the list omits a word or words that explain the semantic link (sleep). Participants are instructed to remember the words for a later test. At test, participants write down as many words as they can recall. Typically, participants will respond with the omitted word, and will in fact claim to remember the word with high confidence (Roediger & McDermott, 1995; 1999). This finding indicates that the paradigm successfully creates believable false memories.

Research shows that not only do stereotypes reduce recall, but they also increase false memories for older adults. Thomas and Dubois (2011) presented older adults with 12 lists of semantically related words. Participants were told to rate each word for pleasantness, but were not told they would be tested on these words. After a filler task,

the experimenter read the instructions for the memory test. Some participants read a passage that described age-related memory decline (threat condition) while others read one that described language processing (control condition). Then the participants were given a DRM list of words designed to produce false memories (i.e., they were given lists semantically associated words, such as bed, rest, awake, pillow and so on). Older adults presented with threatening information falsely remember more related lures (e.g., sleep) compared to the low threat group. The threat group was also more confident in these memories than the low threat group. There was no effect of threat on false memory for younger adults. These results suggest that stereotype threat may affect memory performance by inhibiting older adults' ability to discriminate studied and unstudied items.

Although the previous research indicates that stereotype primes affect the memory performance of older adults, the studies reviewed contained no direct measure of the level of threat the adults were feeling after the prime. To directly assess stereotype activation, one study used a lexical decision task (LDT), where participants had to identify strings of letters on a computer screen as either words or non-words. The words could be either positive (e.g., wise) or negative (e.g., frail) aging stereotype words. Older and younger adults then studied a list of sentences for a later recall task. Participants were randomly assigned to two instruction groups. One group was told to try to memorize the sentences, while the other group was asked to form a mental image of a person described by the sentence. Participants also filled out a questionnaire to determine how threatened they felt about aging stereotypes. As expected, younger adults

recalled more words than older adults. Participants who were asked to form an image of an older adult remembered more words than those asked to memorize the sentences. There were no differences in stereotype threat activation between the two instruction conditions. Therefore, it does not seem likely that reframing a memory test had any effect on reducing stereotype threat. This study also found that stereotype threat mediated the affect between age and memory performance, such that those who felt more stereotype threat recalled fewer items. Overall, older adults reported higher levels of stereotype threat than young adults (Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005).

Stereotype threat has also been shown to affect other cognitive process as well, such as working memory. Barber and Mather (2013) investigated the effect of threat on working memory performance for older adults. They also examined two potential mechanisms for stereotype threat in older adults. The first mechanism theorizes that people will do better on a task when their strategy for pursuing goals matches the reward structure for task at hand, a state referred to as *regulatory fit*. There are two major foci in which a person pursues a goal. The first, called *promotion focus*, is present when an individual is concerned with gaining a reward. The second, *prevention focus*, occurs when an individual is concerned with minimizing the loss of a reward. Negative stereotypes, like those most often associated with older adults, have been shown to promote a prevention focus (see Seibt & Förster, 2004), which would lead to a regulatory mismatch. The second mechanism that was under investigation was the ability of participants to suppress unwanted thoughts, or executive control. The theory

posited that stereotype threat created physiological stress that older adults attempt to suppress. This interference pulls cognitive resources away from any other task they may be working on, which would explain decreases in task performance. In this study (Barber & Mather, 2013), older adults were separated into a threat and a no threat group. Each group was given a working memory task where they were asked to determine if a sentence made sense, and remember the last word in that sentence to recall later. The study was designed such that older adults would either gain a small monetary reward for each word remembered, or lose a small amount for each word forgotten. The authors theorized that if regulatory fit explained the stereotype threat effects, threat would decrease performance for the reward-based payment structure, but improve it for loss-based structure. However, if instead stereotype threat interfered with executive control, then it was predicted that older adults would show decrements for both payout structures. The results demonstrated that stereotype threat impaired working memory capacity for the reward structure, and improved working memory capacity for the loss structure, supporting the regulatory fit hypothesis. These results do not support the theory that executive control interference is the underlying mechanism for stereotype threat effects as performance decrements were not found for both payout structures. These findings suggest that stereotype threat effects for older adults may be a function of the task used. It therefore may be possible to eliminate stereotype threat by using a task that fits best with a prevention focus, or altering the goal focus of older adults from prevention to promotion focus.

Stereotypes have been shown to affect older adults in other contexts as well. In one study, researchers activated health-related stereotypes, which often accompany aging stereotypes, in a group of patients at a veteran's hospital. Stereotype threat was elicited through the use of a questionnaire designed to highlight the patients' health. The control group was given a non-threating questionnaire about leisure activities. Older adults in the threat condition had higher blood pressure and skin conductance (a measure of stress) than older adults in the non-threat condition. This finding suggests that activating stereotypes may increase anxiety levels (Auman, Bosworth, & Hess, 2005).

Aging stereotypes can be activated about people in the work place (e.g., Hedge, 2006; Finkelstein & Farrell, 2007). In a web based survey, participants between 15 – 87 years old were presented photographs of older adult workers. Participants rated each picture on six factors related to emotional resilience. The participants rated older adult workers as less emotionally resilient than younger adult workers (Rauschenbach, Göritz, & Hertel, 2012). This was true whether the rater was a young or old adult. However, older adults rated their peers as more emotionally resilient than younger judges' ratings for the same group.

Another key context in which aging stereotypes are prevalent is in the health care field. The typical image of health care for an older adult is a long-term care facility, such as a nursing home. Some recent work has shown that older adults in these care facilities feel that that their caretakers treat them as incompetent because of their age (Lagacé, Tanguay, Lavallée, Laplante, & Robichaud, 2012). Older adults report that their caretakers speak to them in a patronizing manner, giving them few choices in their daily

routines. Researchers refer to this type of patronizing communication with older adults as "elderspeak." Elderspeak is characterized by enhancing the intonations of normal speech, similar to the way one might speak to a young child (Tamir, 1979; Cohen & Faulkner, 1986). Despite reporting that caretakers speak in this patronizing manner, older adults often accept, and even legitimize this behavior, even though they also report that these attitudes affect their quality of life.

Younger adults have been shown to engage in elderspeak when communicating with older adults. In one research study, younger adults were asked to imagine encountering an older adult in a positive (a neighbor) or negative (a nursing home) stereotype scenario. Younger adults in the negative scenario believed that the older adult would sound older, and engaged in more patronizing speech than those in the positive scenario. These findings suggest that patronizing speech is related to the process of stereotyping older adults (Hummert & Shaner, 1994). In another study, young adults were paired with an older adult to complete a communication task. Young adults were to give instructions to the older adults so they could reproduce a drawing of a map. In this study, the older adults were confederates who either behaved normally, or followed a script designed to mirror signs of dementia. The young adults were able to alter their speech patterns to suit the perceived level of the listener. Young adults provided more detailed descriptions and repeated instructions when the older adult was following the dementia script, but did not alter the prosody or intonation of their speech, factors often associated with demeaning elderspeak (Kemper, Finter-Urczyk, Ferrell, Harden, & Billington, 1998).

There are some benefits to the use of elderspeak. For example, elderspeak has been shown to improve comprehension and recall in older adults (Cohen & Faulkner, 1986). Later work suggested that elderspeak may only be helpful when it is elaborative, and contains a simpler syntax; when elderspeak is used with short sentences or exaggerated syllables, it becomes demeaning and insulting to older adults, and offers no benefits (Kemper & Harden, 1999). In fact, there is a growing body of literature aimed at improving communication and overcoming elderspeak in the healthcare community (e.g., Bethea & Balazs, 1997; Williams Kemper, & Hummert, 2004). However, there are also many negative consequences of elderspeak (Rodin & Langer, 1980; Baltes & Wahl, 1992; Ryan, Hummert, & Boich, 1995). For example, both parties (older adults receiving elderspeak and caretaker using elderspeak) are rated more negatively than those not using elderspeak in a caregiving setting (Balsis & Carpenter, 2006). Also, the use of elderspeak has been shown to increase dependent behavior in older adults (Rodin & Langer, 1980). Younger adults judged older adults receiving elderspeak to be incompetent and assigned them less responsibility. This type of patronizing behavior confirmed age-related stereotypes and exaggerated stereotypical behavior deficits from the older adults. Observational work in long-term care facilities supports these findings. Baltes and Wahl (1992) found that when the staff in these facilities speaks to older adults as incompetent or dependent, older adults produced more dependent behavior. Furthermore, independent behavior was ignored and not rewarded. Here, the effect of elderspeak on behavior can be seen as a kind of stereotype threat effect where the use of elderspeak leads older adults to behave consistent with those stereotypes.

Reducing Stereotype Threat

Some research has focused on ways of combatting the effects of stereotype thoughts. In five experiments, individuals who imagined counter-stereotypic scenes exhibited weaker implicit stereotypes (Blair, Ma, & Lenton, 2001). Participants were asked to either picture a stereotypical situation (i.e., imagine what makes a woman feminine), counter-stereotype situation (i.e., imagine what a strong woman would be like), neutral imagery (i.e., imagine a Caribbean vacation) or no imagery. College students were then given the Implicit Associates Test (Greenwald, McGhee, & Schwartz, 1998), in which they were asked to categorize words into four categories. The test highlights implicit stereotypes if the participant completes the task faster when the words given are consistent with a stereotype. The results demonstrated that participants were slower at the test (indicating less activation of the age stereotypes) when they were asked to imagine a counter-stereotypical situation, compared to stereotypical, neutral, or no imagery condition. This research indicates that implicit stereotypes can be counteracted by prompting thoughts that are inconsistent with the stereotype. While stereotype threat occurs when stereotypes are explicit, could this type of counter-stereotypical thinking reduce the effect of stereotype threat?

Stereotype threat affects a person who believes that they will confirm the stereotypes of a group with which they identify. It stands to reason that one way to combat threat effects would be to encourage an individual identify over a group identity. One study sought to test this hypothesis by orienting some participants toward individuated thoughts (Ambady, Paik, Steele, Owen-Smith, & Mitchell, 2004).

Participants in this study were female, and were primed with either feminine or neutral words disguised as a target identification task. Participants were told to identify whether a flash appeared on the left or right side of the screen. These flashes were in fact words that were displayed briefly and masked to avoid conscious detection. The words were either female primed (e.g., aunt, doll, dress) or neutral primed (e.g., place, banana, salt). Prior to taking a memory test, half of the female participants were asked to answer a set of questions designed to create individualized thoughts (i.e., what's your favorite food, favorite book, etc.). The other participants were given neutral questions to answer (i.e., where would you find tigers, what do tigers eat, etc.). In a second study, participants in the individualization condition were asked to list several positive and negative traits about themselves, while the control group was asked to list some positive and negative outcomes to a city works project. Across both studies, gender primed participants who were prompted with individualized questions performed better on a math test (female stereotyped test) then gender primed participants who did not receive individualized questions. Further, they performed as well as unprimed participants, demonstrating that the effects of stereotype threat can be neutralized by concentrating on individual, rather than group, identity.

Stereotype threat only affects individuals when they believe that a certain stereotype-relevant behavior or skill is being tested. For older adults, stereotype threat becomes an issue when they are told that they will be participating in a memory test. In studies of younger adults, typically the stereotype has to be activated before threat effects are evident. However, older adults are usually well aware of their stereotypes

before they begin a laboratory experiment. Rahhal, Hasher, and Colcombe (2001) tested the hypothesis that threat effects could be eliminated in older adults if the experimental instructions did not focus on the memory aspect of the study. Older and younger adults in this study received one of two sets of instructions. The first emphasized the memory aspect of the study (i.e., "you will be tested for your memory of this information"), while the second did not mention the memory aspect at all (i.e., "you will be tested on this information"). Participants then studied a list of facts. Each fact was paired with a label of TRUE or FALSE (in experiment 1, some facts were presented without labels). At test, the participant was presented with only a fact, and had to identify it as new (unstudied) true, or false (in experiment 1, participants also could identify a fact as blank if it was not labeled at test). Across two studies, younger adults outperformed older adults, but only when the instructions emphasized the memory component of the test; there were no age differences in the recall of facts in the memory-neutral instructions. These data show that manipulations of memory instructions are enough to alter the degree of age-related memory differences. These data fit nicely with a stereotype threat approach to memory. When older adults are aware their memory is under evaluation, they experience threat, which in turn inhibits their performance.

Stereotype Threat and Dementia

We have seen how stereotype threat can lead to memory problems for older adults. Recent work shows that threat can have significant medical implications for older adults as well. This work shows that older adults who were made to feel older than a comparison group were much more likely to meet clinical diagnosis for dementia than

those who felt younger (Haslam, et al., 2012). Healthy older adults between the ages of 60 to 70 were given different information about the study. Half of the participants were told that the age range for the study was between 40 and 70, thus encouraging this group to label themselves as old relative to others in the study. The other half of the participants were told that the age range for the study was between 60 and 90, encouraging this group to label themselves as young relative to others in the study. Next, participants were given either an article to read which described specific age-related memory declines, or they were given an article that described generalized age-related cognitive decline. Results showed that participants who felt they were in the older group performed worse on a number of tests of cognitive function than those who felt they were in the younger group. Within the group of people who believed they were in the older group of participants being tested, those who were primed with memory decline expectations performed poorly on memory tests, while those who were primed with general cognitive decline expectations performed poorly for general cognitive tests. Perhaps that most notable finding of this study was that the majority (70%) of those participants labeled as being in the older group who expected general cognitive decline met the diagnostic criteria for dementia using the Addenbrooke's Cognitive Examination-Revised (ACE-R; Mioshi, Dawson, Mitchell, Arnold & Hodges, 2006), compared with only 14% of participants averaged across the other participant groups. This remarkable finding demonstrated that feeling older and expecting to experience cognitive decline can have severe consequences for older adults and can even lead to an increased diagnosis of dementia.

This effect of stereotype threat on important real life cognitive and health domains is an exciting new area of research that deserves more study. Yet, as a recent review illustrates, the vast majority of research on stereotype threat has been conducted with non-clinical populations (Kit, Tuokko, & Mateer, 2008). Clearly, stereotype threat can play a role in diagnostic testing for neurologically compromised individuals. In addition, future work should examine how one's categorization as old can affect important social, health and cognitive outcomes. We turn next to a description of the research on age categorization on behavior.

Subjective Age

In addition to stereotypes of aging, another type of self-perception of aging that has received attention is one's subjective age. Subjective age refers to an individual's perceived age, as opposed to their chronological age. When an individual is asked to rate their subjective age, they often consider factors such as life satisfaction, the appearance of age-related symptoms, and fears of aging (Montepare & Lachman, 1989). However, there does appear to be one consistent finding with self-reports of subjective age; people rarely report that they feel the same age as their chronological age.

The distinction between subjective and chronological age has been noted for over 50 years when a large sample of adults 60 years old and up were asked how they classified their age. They were asked to use the categories middle-aged, elderly, old, or another description (Blau, 1956). Sixty percent of the older adults considered themselves to be middle-aged, while 38% considered themselves to be elderly of old (2% did not

respond). However, chronological age is not the only factor that influences an individual's subjective age.

Researchers have attempted to identify the variables that affect an individual's subjective age. One potential explanation for individual differences in subjective age reports is socioeconomic status (SES). Retirement age marks a transitional state for older adults where finances are less certain. They have forfeited their regular income and rely on their retirement savings, often resulting in a decrease in SES. Individuals who rate lower for SES tend to report older subjective ages (George, Multran, & Pennybacker, 1980; Markides & Boldt, 1983; Barrett, 2003). This transition may cause individuals with a higher SES to focus on all they stand to lose, and therefore may be more likely to adopt a lower subjective age (Rosow, 1967; 1973). Lower SES also leads to lower health expectations, which has also been shown to lead to an older subjective age (Linn & Hunter, 1979; Baum & Boxley, 1983). Additionally, health measures have been identified as mediating variables between SES and subjective age. A large sample of 2,864 adults between 25 and 74 were asked to rate their age and health. Participants of all ages who were rated lower on SES reported higher subjective ages than those who were higher on SES. This effect was explained by those of higher economic standing having better health, higher predictions of future health, and more perceived control over their health (Barrett, 2003). These results indicate that health discrepancies between SES strata help create subjective age differences, especially among old adults.

There are a number of ways researchers have examined subjective age. In a review of the literature, Barak and Stern (1986) described five types of subjective age

scales (see also Cutler, 1982). One type of scale assesses "identity age" (Markides & Boldt, 1983), where people report how old they feel in general terms (i.e., young, middle aged, old, or very old). Another type of scale assesses "comparative age" (Baum & Boxley, 1983), where participants report how old they feel relative to their chronological age (i.e., older, younger, or the same as chronological age). "Felt age" is another scale where participants provide a numeric response to describe how old the feel (Underhill & Cadwell, 1984). "Cognitive age" (Kastenbaum et al., 1972) refers to the specific age that participants feel in terms of their cognitive abilities. Finally, "stereotype age" asked participants to identify the descriptors that signify their age when compared to an older person or a middle-age person (George, Mutran, & Pennybacker, 1980). For example, a participant would rate themselves as active or inactive in comparison to an older adult. All of these measures tap into the same underlying concept, the individual's personal sense of aging.

There is a strong tendency for older adults to refuse to identify themselves as old (Peters, 1971), perhaps because of the negative stigma associated with the "elderly" label. Self-identification as "old" or "elderly" compared to self-identification as "young" or "middle-aged" has been associated with lower self-image and self-esteem (Rodin & Langer, 1980). Self-image often reflects the societal roles one fulfills. Subjective age may serve as a good indication of how well an older adult has adjusted to their role as an older adult. Lower subjective age is associated with higher self-esteem and morale, higher resistance to threat, and lower levels of depression.

In Western cultures, old age is often considered a stigma, and is associated with declines in physical appearance and performance (Ward, 1977). One might expect that individuals who maintain a stigmatized view of older adults would be less likely to apply an "old" label to themselves. However, prior work on the impact of these stigmas on older adults has revealed that this may not be the case. Three-hundred and twenty-three adults over the age of 60 were interviewed and asked about how old they viewed themselves, their attitudes toward older people, their self-esteem, age-related deprivation, levels of activity, and health. The results demonstrated that individuals who engaged in more self-derogatory behaviors were more likely to have accepted that others have negative attitudes about older adults. This study was one of the earliest that linked the consequences of stigmatization with the well-being of older adults.

People rarely report feeling their actual age, and whether they feel older or younger than their chronological age changes across the lifespan. In general, younger people report feeling older than they are and older people report feeling younger than they are. Rubin and Berntsen (2006) conducted a longitudinal study on how reported subjective age changes as we get older. Until the age of 25, most people report older subjective ages relative to their chronological age. Around age 25, there is a cross-over; people begin to report lower subjective ages relative to their chronological age. Subjective age becomes more constant after the age of 40. By that time, individuals report their subjective age at around 20% younger than chronological age. It appears that the age 25 acts as an ideal age on which individuals focus. After the age of 25, people slowly come to the realization that they are no longer considered a younger adult.

Having a younger subjective age may act as a buffer to prevent acknowledging ones actual age.

One study sampled over 5,000 adults ages 21 to 92 across four states and administered a subjective age questionnaire (Goldsmith & Heiens, 1992). The results of this study indicated that as people grow older, they report younger subjective ages. For individuals 60 years or older, more than 80% reported feeling younger than their chronological age, while less than 1% reported feeling older than their chronological age. In fact, research demonstrates that the older one is chronologically, the larger the discrepancy is between their subjective age and their chronological age (Hubley & Hultsch, 1994). Adults between the ages of 55 and 75 completed a battery of personality measures as well as questionnaires about subjective and ideal age. In line with prior research, most participants reported subjective ages that were younger than their chronological ages, but this difference was largest for adults between 65 and 75. Lower subjective ages were also correlated with higher self-reported ratings of health. Younger subjective age was correlated with extraversion and with the feeling of control of one's affairs. However these variables did not moderate the relationship between subjective age and health. This finding leaves unanswered the question as to how subjective age and health are related.

Although the relationship between health and subjective age is not entirely understood, subjective age has been shown to change as older adults near death. Using the Berlin Aging Study, researchers demonstrated that subjective age increased as older adults neared death age (Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith,

2009). As older adults approached death, they reported lower satisfaction with their age, and a higher subjective age. Older adults who reported a higher subjective age, or lower age satisfaction, four years after the baseline measure were more likely to die in the following 12 years than those whose ratings remained constant. These results may indicate that subjective age can be used to predict when an individual is nearing their death.

Subjective Age and Performance

While there have been a number of studies examining the factors that influence subjective age and showing correlations between subjective age and various health outcomes, there has been little work on how subjective age may affect older adults' physical or cognitive performance. One study manipulated subjective age to directly examine the effect of subjective age on a measure of physical health (Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). Participants in this experiment gave an initial report of subjective age as part of the demographic interview. Then they provided a baseline measure of handgrip strength. Some participants were told that their handgrip was stronger than 80% of participants in their age group. Other participants were not given any information about their performance on the task (control group). During a questionnaire portion of the study, participants again indicated their subjective age before performing a second handgrip task. While there were no group differences between baseline subjective age and handgrip strength, the group who received positive feedback on their handgrip test reported a significantly younger subjective age relative to baseline, while the control group's subjective age showed no change. Additionally, the

positive feedback group showed significantly stronger handgrip performance for the second test; again, the control group handgrip strength did not change, and in fact showed a numeric decrease in strength. The results of this study demonstrate a clear relationship between a younger subjective age and better physical performance in older adults.

Not only can positive feedback from a physical task affect subjective age, but physical symptoms associated with old age can also affect subjective age. In three studies, researchers provided older adults a printed passage to read (Eibach, Mock, & Courtney, 2010). Some of the participants were given a passage that was difficult to read (i.e., small, blurry text), and were given no explanation (unexplained visual disfluency). A second group was given the difficult to read text, but the experimenter explained that there had been a problem with the printer (explained visual disfluency). A third, control group was given easy to read text (i.e., large, clear print). Older adults who experienced an unexplained visual disfluency reported a higher subjective age and were more likely to endorse stereotypical attitudes of subjective age when compared to control. However, there was no difference between the control group and the older adults who experienced an explained visual disfluency. Participants who experienced the unexplained visual disfluency also reported lower self-evaluations on a three-item questionnaire. A third study implemented a generational gap manipulation in place of the visual disfluency. In this manipulation, older adults were shown a series of symbols and were either told they were emoticons used in text messages (generation gap condition), or symbols used by court stenographers (control condition). Participants were also given a passage either

confirming or countering age-related stereotypes. This generation gap manipulation was effective at increasing subjective age for older adults in the generation gap condition. Further, participants in the generation gap condition who read a passage confirming age-related stereotypes were more likely to assume a stance of rigid moral traditionalism, endorsing statements such as "newer lifestyles are contributing to the breakdown of our society" (Eibach, et al., 2010, p. 647), and conservatism by expressing objections to same-sex civil unions. This study demonstrated that when older adults have an experience that matches their expectations of old age, they will feel older. This finding may suggest that any difficulty in visual, physical, or cognitive ability may affect subjective age.

There is also emerging evidence that participating in a typical memory experiment may be sufficient to influence subjective age for older adults (Hughes, Geraci, & De Forrest, 2013). The authors hypothesized that the standard components of a typical memory study contain cues to older adults about their age and the expectation that they will have cognitive difficulties. For example, often are asked to complete a prescreening questionnaire to determine if they are cognitively intact, and are aware that their performance will be compared to that of younger adults. The authors hypothesize, therefore, that a standard testing situation would be sufficient to subjectively age older adults. In four studies, older adults completed a subjective age question as part of a demographic questionnaire. In the first study, older adults then completed the Mini-Mental Status Exam (MMSE: Folstein, Folstein, & McHugh, 1975) and a free recall test for a list of 30 categorizable words. Following recall, participants completed a second

subjective age measure. Participants reported a significantly higher subjective age post-test, relative to baseline. Results were interpreted as evidence that simply participating in a memory experiment was sufficient to "age" older adults. Study 2 replicated this effect and demonstrated that the effect is unique to older adults, showing that only older adults reported a higher subjective age following the memory test whereas younger adults did not show any change in a post-test subjective age measure. Study 3 examined the unique effect of taking a memory test on subjective age. Older adult participants either completed a free recall test or a standardized vocabulary test. Participants reported higher subjective age only in the memory test condition. Taking a vocabulary test did not affect subjective age, suggesting that only age-relevant memory tests age older adults. The fourth and final study examined whether the experience of taking a memory test was necessary to increase subjective age. Performance on the memory test could potentially confound the findings; a participant who remembers only a few items may feel as if they have conformed to older adult stereotypes, therefore increasing their subjecting age. Participants were given the instructions for an upcoming memory test, but were given the second subjective age measure prior to seeing the study list. In this study, simply expecting to take a memory test was sufficient to induce a higher subjective age compared to baseline. These results demonstrate that being in a memory testing context increases older adults' subjective age.

Thus, we have seen that subjective age is a type of self-perception of aging that predicts important physical and health outcomes. We have also seen that it can be manipulated in the lab using feedback and even with the simple administration of a

memory test. Subjective age can be increased with feedback on a visual test (Eibach, et al., 2010). It can also be increased by simply having older adults take a memory test (Hughes, et al., 2013). These manipulations of subjective age have been shown to affect behavior and judgment. In the hand grip study, having a younger subjective age was associated with better physical strength (Stephan et al., 2013).

While a few studies have demonstrated that subjective age can be manipulated and can affect behavior, many questions still remain for future research. For instance, it would be important to understand how subjective age affects cognition. Does having an older subjective age lead to poorer cognitive performance? Thus far only one study has examined the relationship between subjective age and cognitive performance (Stephan, Caudroit, Jaconelli, & Terracciano, in press). In this longitudinal study, participants provided a baseline subjective age during the first wave of measurements. Ten years later these participants completed the second wave of the study, which included measures of cognitive performance. The results demonstrated that, even when controlling for chronological age, participants who reported a younger subjective age at baseline was correlated with better memory and executive function ten years later. It will also be important to determine if subjective age can be manipulated to influence cognitive performance. If so, what is the mechanism by which subjective age affects cognition? One possibility is that subjective age is related to stereotype threat. It will be important to know if subjective age alone affects cognitive processes, or if it is a proxy for stereotype threat. In addition, it would be of interest to know if some tasks might make older adults feel younger. Only one study thus far has shown that older adults'

subjective age can be decreased – this study used false feedback after a physical task and found older adults who received positive feedback reported a younger subjective age (Stephan et al., 2013). What is the critical feature of this task that made older adults feel younger? Also, if higher subjective ages are associated with poor cognitive performance, it stands to reason that lower subjective ages would be associated with increases in cognitive performance. These are important, but untested, questions that should be addressed in future research with older adults.

Conclusion

In summary, people of all ages have expectations about what the aging process entails. For the most part, these expectations tend to be negative, but those who maintain positive perceptions of old age have been shown to live longer, healthier lives (Levy et al., 2002; 2002). Perceptions of aging lead to the development of age-related stereotypes. Older adults are generally considered to be incompetent, but warm. Negative stereotypes are associated with older ages, while the more positive stereotypes tend to describe adults closer to 65. Activation of these negative stereotypes can result in older adults performing worse on a memory test, which is a stereotyped ability. While some work has demonstrated that stereotype threat can be combated through the use of individualized thoughts or removing threatening information from the instructions, a memory test itself is threatening to older adults. Stereotypes may also influence an older adults' subjective age. Higher subjective ages have been associated with health risks and decreased physical performance. Research has shown that subjective age can be manipulated simply by taking or expecting to take a memory test (Hughes, et al., 2013).

One key feature to the aging stereotype is whether an individual self-identifies as an older adult. Older adults may be reluctant to self-identify as old. Indeed, many adults over 60 identify as middle-aged, not older, adults (Blau, 1956). This reluctance to classify themselves as older adults may be partially responsible for lower reported subjective age; many adults report feeling much younger (10 to 15 years) than their actual age (Montepare & Lachman, 1989). There is evidence that subjective age is a malleable variable that is subject to certain influences. For instance, standard memory tests have been shown to increase subjective age (Hughes, et al, 2013). Although there has been a great deal of research on the correlates of subjective age, to date there has been very few studies on the consequences of elevated subjective age. Positive feedback has been shown to promote a lower subjective age, which was associated with better performance on physical tasks (Stephan, et al., 2013), but overall the study of subjective age and its consequences for cognition and behavior has been lacking.

The consequences and potential benefits of subjective age represent an important avenue for future research. Increased subjective age has recently been associated with poor memory performance (Stephan, et al., in press), but will other cognitive processes be negatively related to subjective age? Can cognitive performance be changed, if we can change older adults' subjective age? The answers to these research questions could help shed light on how older adults' self perceptions affect their cognitive abilities.

There were two specific aims of the dissertation studies. The first aim was to determine if subjective age predicts present cognitive functioning. The second aim was to determine whether manipulations of subjective age affect older adults' cognitive

performance. Three studies examined the relationship between subjective age and cognitive functioning. Studies 1A-1C, examined whether subjective age was associated with current cognitive functioning. Study 2 also examined whether increasing older adults' subjective age decreased their cognitive performance and Experiment 3 examined whether decreasing subjective age increased cognitive performance.

STUDY 1A

The goals of Study 1A were to examine, 1), whether baseline subjective age correlates with current cognitive functioning and 2), whether this potential relationship depends on the type of cognitive task. In this study, older adults reported their subjective age and were given a series of cognitive tasks to perform. I predicted that, as with physical assessments (Stephan, et al., 2013), subjective age would be negatively correlated with performance—that is, a younger subjective age would be associated with better performance. Specifically, I expected that participants who feel younger would recall more words, would respond faster to a reaction time task, would provide more items in a verbal fluency task, and would correctly answer more reasoning questions. I expected that a task not typically associated with age-related declines – vocabulary knowledge – would not be correlated with subjective age. One might have also predicted that, a higher subjective age will lead to decreased performance across all cognitive tasks.

Method

Participants

Forty-seven older adults (25 female, 22 male) from the area surrounding Texas A&M University participated in the present study. Participants provided their own transportation to the Cognitive Aging laboratory in the Psychology Department and received a small honorarium for their participation. Upon arrival in the laboratory, all potential participants were given the Mini-mental Status Exam (MMSE; Folstein et al.,

1975), which is a brief measure of general cognitive ability including items on orientation, memory, language, and praxis. All participants included in this study scored 26 or higher on the MMSE. The mean age of these participants was 71.4 (*SD* = 7.1, range 65 - 84) and had on average 16.4 years (*SD* = 3.3 years) of education. All participants in the current study participated in another experiment, described elsewhere (Geraci, Hughes, Miller, & De Forrest, under review).

Measures

Long-term Memory

To assess memory ability, participants were given a free recall test. Before the test, participants were asked to predict how many words they would be able to recall. Participants were instructed to read a list of 30 catergorizable nouns for 2 minutes. After 2 minutes, the study sheet was taken away and participants were given a sheet with 30 blanks. Participants were instructed to type as many words as they can recall into a text box for 3 minutes.

Vocabulary Knowledge

The Shipley vocabulary test was given to participants to assess vocabulary knowledge (Zachary, 1986). The test is comprised of 40 English words paired with four possible answers. Participants were instructed to choose the best synonym for the word provided.

Speed of Processing

A lexical decision task (LDT) was used to assess cognitive speed. Participants saw a string of letters on their computer screen. These letters either spelled a word or a

non-word. Participants were required to indicate whether each string creates a word or a non-word by pressing a button on the keyboard. Each string of letters was only displayed for a short time, and participant's reaction time was recorded.

Working Memory

Participants were given a computerized version of the Operation Span task (Unsworth, Heitz, Schrock, & Engle, 2005) to assess their working memory (WM) ability. Participants sat individually in front of a computer screen with an experimenter sitting beside them. Participants first saw a math problem (2 + 2 X 2 = 6) on the screen and were instructed to indicate whether it was true aloud. Then the screen advanced and displayed a word (e.g., town). After a random number of trials (between 2 and 5), participants were then asked to recall the words in the order they were presented. The number of correct math problems and correctly recalled words were recorded.

Attentional Control

To assess attentional control abilities, older adults were given the F-A-S test of verbal fluency (Borkowski, Benton, & Spreen, 1967). During this task, participants were given one minute each to verbally produce as many words as they could think of that begin with the letter F, A, and S. Following the F-A-S task, participants were asked to produce as many examples as they could think of for the category "Animals" in one minute. The number of unique exemplars and perseverative errors were recorded.

Participants were also asked to complete a backward counting task in which they counted backward from 100 by seven. Participants recited the numbers aloud and the experimenter noted any errors.

Procedure

After providing consent, participants completed a demographic questionnaire and reported their subjective age. For the subjective age report, participants were presented with a horizontal line with the end points marked “0 years” and “120 years” and were instructed to estimate how old they felt most of the time by placing a tick mark along the line. Participants then were given the MMSE, and completed a measure for an unrelated experiment (as described in Geraci, Hughes, Miller, and De Forrest, under review). Next, participants were given the free recall task. After making a performance prediction, participants were given 2 minutes to study a list of 30 words, then were given 3 minutes to recall as many as they could remember. After completing the memory task, participants immediately completed the LDT. Participants then completed several more unrelated measures followed by the vocabulary test. After the vocabulary test, the participants were taken to another room on a different floor of the Psychology building for the final phase of the experiment. Once in the second room, participants completed the WM task, F-A-S, and backward counting tasks.

Results

Consistent with previous work (e.g., Rubin & Berntsen, 2006; Hughes et al., 2013), older adults reported feeling younger (M = 60.06, SD = 11.95) than their actual ages (M = 71.43, SD = 7.06). Turning now to the question of interest, was subjective age associated with performance on the cognitive tasks? The relationship between subjective age and cognition was analyzed in three ways. First subjective age was transformed into a discrepancy score, which is standard in the literature. The discrepancy score was

obtained by subtracting chronological age from subjective age to calculate how much older or younger each participant felt relative their actual age. We examined the correlation between subjective age discrepancy and memory performance (long-term memory and working memory). Results showed that the subjective age discrepancy score was not correlated with memory performance ($r(47) = .14$, $p = .35$), vocabulary ability ($r(46) = .04$, $p = .79$), processing speed ($r(47) = .06$, $p = .68$), working memory ($r(45) = -.02$, $p = .91$) math performance during the working memory test ($r(46) = .11$, $p = .45$), F-A-S score ($r(47) = .03$, $p = .84$), category fluency ($r(47) = -.06$, $p = .69$), F-A-S perseverative errors ($r(46) = -.10$, $p = .51$), category perseverative errors ($r(46) = -.11$, $p = .45$) or backward counting errors ($r(45) = -.02$, $p = .90$). Table 1 contains the performance score for each measure.

	Recall	Vocabulary	Processing Speed	Working Memory	F-A-S
Study 1A	.45 (.12)	34.73 (2.61)	801.45 (130.04)	8.59 (4.70)	46.36 (10.68)

Table 1. Cognitive performance for Study 1A. Note: Standard deviation in parentheses; processing speed presented in milliseconds.

We also examined the relationship between baseline subjective age and chronological age separately. Results showed that baseline subjective age was not

individually correlated with recall ($r(47) = .05$, $p = .72$), vocabulary ability ($r(46) = .02$, $p = .92$), processing speed ($r(47) = .15$, $p = .33$), working memory ($r(45) = -.08$, $p = .59$), math performance during the working memory test ($r(46) = .08$, $p = .58$), F-A-S fluency ($r(47) = 19$, $p = .20$), category fluency ($r(47) = -.05$, $p = .72$), F-A-S perseverative errors ($r(47) = .04$, $p = .77$), category fluency perseverative errors ($r(46) = -.09$, $p = .57$), or backward counting errors ($r(45) = -.01$, $p = .97$. However, chronological age was also not significantly correlated with the cognitive measures either. Chronological age was marginally correlated with F-A-S fluency ($r(47) = .28$, $p = .06$), but was not significantly correlated with recall ($r(47) = -.13$, $p = .39$), vocabulary ability ($r(46) = -.04$, $p = .80$), processing speed ($r(47) = .15$, $p = .32$) working memory ($r(45) = -.11$, $p = .46$, math performance during WM task ($r(46) = -.04$, $p = .81$), category fluency ($r(47) < .01$, $p = .98$), F-A-S perseverative errors ($r(46) = .23$, $p = .12$), category fluency perseverative errors ($r(46) = .03$, $p = .84$, or backward counting errors ($r(45) = .02$, $p = .88$).

We also examined the relationship between subjective age and memory confidence. The subjective age discrepancy score was not correlated with the recall test prediction ($r(47) = .09$, $p = .56$), nor was baseline subjective age ($r(47) = -.11$, $p = .47$). Chronological age on its own was negatively correlated with the prediction ($r(47) = -.32$, $p = .03$).

Finally the effects of subjective age on cognitive performance were analyzed while controlling for chronological age. Results showed a similar pattern when baseline subjective age was correlated with the cognitive measures while controlling for chronological age. Baseline subjective age was not correlated with memory ($r(44) = .12$,

p = .44), vocabulary (*r*(43) = .03, *p* = .83), processing speed (*r*(44) = .09, *p* = .54), working memory (*r*(42) = -.04, *p* = .80), math performance during the WM task (*r*(43) = .11, *p* = .48), F-A-S (*r*(44) = .09, *p* = .56), category fluency (*r*(44) = -.06, *p* = .69), F-A-S perseverative errors (*r*(43) = -.06, *p* = .71), category fluency perseverative errors (*r*(43) = -.11, *p* = .48), counting errors (*r*(42) = -.02, *p* = .92), or recall prediction (*r*(44) = .03, *p* = .86).

Given the small effect sizes (.06) reported in Stephan et al., (in press), it is possible that the failure to detect an effect in the present study is due to low power. Using the effect sizes from the Stephan et al. (in press) study, the present data analyzed again using a bootstrap with the smallest number of samples that would detect an effect (N = 1,000). Using this procedure, the discrepancy score was significantly correlated with recall (*r*(1000) = .11, *p* = .00), vocabulary (*r*(983) = .07, *p* = .03), category fluency (*r*(1000) = -.13, *p* = .00), math performance (*r*(979) = .08, *p* = .01), F-A-S perseverative errors (*r*(970) = -.09, *p* = .01), and category fluency perseverative errors (*r*(970) = -.11, *p* = .00), and was marginally correlated with working memory (*r*(961) = -.06, *p* = .07). Subjective age discrepancy was not significantly correlated with processing speed (*r*(1000) = .01, *p* = .77), F-A-S fluency (*r*(1000) = .00, *p* = .93), recall prediction (*r*(1000) = .05, *p* = .13), or counting errors (*r*(958) = .01, *p* = .88). These data suggest that subjective age is related to at least some measures of cognitive performance.

Baseline subjective age was significantly correlated with working memory (*r*(961) = -.10, *p* = .00), category fluency (*r*(1000) = -.08, *p* = .01), F-A-S fluency (*r*(1000) = .17, *p* = .00), math performance (*r*(979) = .07, *p* = .02), category fluency

perseverative errors (r(970) = -.10, p = .00), and recall prediction (r(1000) = -.12, p = .00), and was marginally correlated with recall (r(1000) = .05, p = .09). Subjective age was not significantly correlated with vocabulary (r(983) = .03, p = .31), processing speed (r(1000) = .01, p = .77), F-A-S perseverative errors (r(970) = -.04, p = .18), or counting errors (r(958) = .03, p = .31).

Chronological age was correlated with recall (r(1000) = -.09, p = .01), working memory (r(961) = -.08, p = .01), F-A-S fluency (r(1000) = .29, p = .00), processing speed (r(1000) = .17, p = .00), F-A-S perseverative errors (r(970) = .22, p = .00),and recall prediction (r(1000) = -.28, p = .00), and was marginally correlated with vocabulary (r(983) = -.05, p = .10) and counting errors (r(958) = .05, p = .13). Chronological age was not significantly correlated with category fluency (r(1000) = -.01, p = .72), math performance (r(979) = .00, p = .94), or category fluency perseverative errors (r(970) = -.01, p = .72).

While controlling for chronological age, baseline subjective age was correlated with recall (r(997) = .10, p = .00), working memory (r(958) = -.07, p = .02), category fluency (r(967) = -.12, p = .00), math performance (r(976) = .08, p = .01), and category fluency perseverative errors (r(967) = -.11, p = .00), and was marginally correlated with vocabulary (r(980) = .06, p = .06), F-A-S perseverative errors (r(967) = -.06, p = .09), and F-A-S fluency (r(997) = .05, p = .12). Subjective age was not significantly correlated with processing speed (r(997) = .04, p = .21), recall prediction (r(997) = .00, p = .99), or counting errors (r(1000) = .01, p = .68).

Conclusions

Study 1A investigated whether baseline subjective age was correlated with cognitive performance in a laboratory setting. However, there was no evidence for a relationship between older adults' current subjective age and their current cognitive functioning. Stephan et al. (in press) found a very small correlation (r = .06) between subjective age and cognitive performance ten years later. One possible explanation for the current results is that I was unable to detect such a small effect with our limited sample size. To this end, the current sample was also analyzed using a bootstrapping procedure. These analyses suggest that subjective age is correlated with cognitive performance, but may only be detected with sufficient power. However, not all cognitive measures were correlated with subjective age using this procedure.

It is also possible that the relationship between subjective age and cognitive functioning 10 year later that was reported by Stephan et al. reflects variability in how well an individual is aging. Rather than predicting how well that individual will perform today, subjective age may only predict how well cognitive performance will be preserved as we age. Study 1B used a larger sample of older adults to determine if current subjective age is correlated with current cognitive functioning.

STUDY 1B

As mentioned, Study 1A found mixed evidence of a correlation between baseline subjective age and several cognitive measures in a laboratory setting. However, this may be due to the relatively low number of participants in the study. Indeed, the bootstrapping analysis suggested that there may be a relationship between subjective age and cognition. It is also possible that the lack of a relationship reported in Study 1A was due to the relatively high mean age of participants (71.43 years). One possibility is that subjective age has more predictive power at younger ages. Study 1B investigated whether subjective age was related to cognitive performance in a younger population of older adults and also used a larger sample of older adults. Following the procedures used in Hughes et al., participants reported their baseline subjective age, and then took a in a memory test. Then participants completed several standardized cognitive tasks designed to measure cognitive performance (e.g., Lindenberger, Mayr, & Kliegl, 1993).

Method

Participants

Seventy-eight older adults (mean age 59.87, *SD* = 4.21, range 55 - 74) participated in the study online using Amazon's Mechanical Turk. Participants had an average of 15.50 years (*SD* = 2.10) of education. Participants completed the study on a computer in a location of their choosing. All participants were located in the Unites States and were compensated for their time.

Measures

To assess cognitive functioning, participants completed five measures. All measures were computerized and delivered via Amazon's Mechanical Turk. The memory, speed of processing, and vocabulary measures were identical to those used in Study 1A, except that they were presented via computer. Additionally, participants received a figure analogies test was given to participants to assess their reasoning ability. Three figures were presented in the question, and four figures were provided as answers. The participants were asked to discern the relationship between Figure A and Figure B, and extrapolate that relationship to determine which answer choice should be paired with Figure C.

Finally, participants were given a category exemplar generation task to assess their verbal fluency. Whereas participants in Study 1A were given one category, in Study 1B participants were given 10 categories. Participants were given a category (i.e., ANIMALS) and given one minute to provide as many members of that category as possible. Participants were asked to type their responses into a text box, and after one minute, the study advanced to the next category. There were a total of ten categories presented.

Procedure

After reading a consent form and completing a demographic questionnaire, participants were asked to indicate their subjective age by moving a slider on a scale from 0 years to 120 years. Roughly half (N = 44) of the participants used an unmarked scale at baseline instead of providing a number to prevent them from relying on their

memory for their baseline response when making their second subjective-age judgment. The remaining participants saw their subjective age as a number as they moved the slider along the scale. These two groups did not differ significantly on age or education (*t*s < 1), and were collapsed for data analysis.

Participants were then given a memory test. They were asked to study list of 30 words for 2 minutes. After the study period, participants were given 3 minutes to type as many words as they can remember. The remaining tasks were presented in the following order: LDT, reasoning, vocabulary, and fluency. Participants also provided a performance prediction before each of these measures.

Results

Once again, participants reported feeling younger (M = 50.08 years, SD = 12.24) than their actual chronological age (M = 59.87 years). As with Study 1A, subjective age was transformed into a discrepancy score before being correlated with the cognitive measures. This discrepancy score was significantly correlated with reasoning ability ($r(78) = -.24$, $p = .04$), but not significantly correlated with recall ($r(78) = .07$, $p = .56$), processing speed ($r(78) = -.12$, $p = .31$), vocabulary ($r(78) = -.11$, $p = .35$), or category fluency ($r(78) = .03$, $p = .79$). Baseline subjective age was also negatively correlated with reasoning ability ($r(78) = -.27$, $p = .02$), but not correlated with recall ($r(78) = .09$, $p = .43$), processing speed ($r(78) = -.12$, $p = .31$), vocabulary ability ($r(78) = -.05$, $p = .66$), or category fluency ($r(78) = .01$, $p = .79$). Chronological age was not correlated with recall ($r(78) = .06$, $p = .59$), processing speed ($r(78) = .00$, $p = 1.00$), reasoning ability

($r(78) = -.10$, $p = .39$), vocabulary ability ($r(78) = .17$, $p = .14$), or category fluency ($r(78) = -.07$, $p = .54$). Table 2 contains the performance score for each measure.

	Recall	Vocabulary	Processing Speed	Reasoning	Category Fluency
Study 1B	.55 (.12)	35.63 (2.75)	3011.46 (701.87)	8.35 (3.20)	94.47 (17.82)

Table 2. Cognitive performance for Study 1B. Note: Standard deviations in parentheses; processing speed is presented in milliseconds.

Once again I analyzed whether there was a relationship between predictions of performance and subjective age. The subjective age discrepancy score was not correlated with recall prediction ($r(78) = -.04$, $p = .72$), reasoning ability prediction ($r(78) = .14$, $p = .23$), vocabulary prediction ($r(78) = -.05$, $p = .66$), category fluency prediction ($r(78) = -.02$, $p = .85$), and was marginally correlated with LDT prediction ($r(78) = -.22$, $p = .06$). Baseline subjective age was marginally correlated with LDT prediction, ($r(78) = -.20$, $p = .09$), but was not correlated with recall prediction ($r(78) = -.07$, $p = .56$), reasoning ability prediction ($r(78) = .16$, $p = .17$), vocabulary prediction ($r(78) = -.02$, $p = .85$), or category fluency prediction ($r(78) = -.00$, $p = .98$). Chronological age was not correlated with recall prediction ($r(78) = -.07$, $p = .53$), LDT prediction ($r(78) = .06$, $p = .59$), reasoning ability prediction ($r(78) = .05$, $p = .66$), vocabulary prediction ($r(78) = .09$, $p = .45$), or category fluency prediction ($r(78) = .07$, $p = .53$).

Finally, the relationship between subjective age and cognitive measures was examined while controlling for chronological age. Baseline subjective age was correlated with reasoning ability ($r(75) = -.26$, $p = .02$), but not correlated with recall ($r(75) = .08$, $p = .47$), processing speed ($r(75) = -.12$, $p = .30$), vocabulary ($r(75) = -.08$, $p = .52$), or category fluency ($r(75) = -.02$, $p = .89$). Subjective age was marginally correlated with LDT prediction, ($r(75) = -.21$, $p = .07$), but was not correlated with recall prediction ($r(75) = -.06$, $p = .62$), reasoning ability prediction ($r(75) = .15$, $p = .19$), vocabulary prediction ($r(75) = -.03$, $p = .89$), or category fluency prediction ($r(75) = -.01$, $p = .95$).

Using the effect sizes from the Stephan et al. (in press) study, the present data analyzed again using a bootstrap with the smallest number of samples that would detect an effect (N = 1,000). Using this procedure, the discrepancy score was significantly correlated with processing speed ($r(1000) = .07$, $p = .03$), reasoning ability ($r(1000) = -.14$, $p = .00$), category fluency ($r(1000) = -.10$, $p = .00$), LDT prediction ($r(1000) = -.13$, $p = .00$), reasoning ability prediction ($r(1000) = .13$, $p = .00$), and vocabulary prediction ($r(1000) = -.14.$, $p = .00$), but was not significantly correlated with recall ($r(1000) = .00$, $p = .97$), vocabulary ($r(1000) = .03$, $p = .29$), recall prediction ($r(1000) = -.02$, $p = .64$), or category fluency prediction ($r(1000) = .01$, $p = .88$).

Analyzed individually, baseline subjective age was significantly correlated with processing speed ($r(1000) = .07$, $p = .04$), reasoning ability ($r(1000) = -.23$, $p = .00$), category fluency ($r(1000) = -.06$, $p = .04$), recall prediction ($r(1000) = -.08$, $p = .01$), LDT prediction ($r(1000) = -.15$, $p = .00$), reasoning ability prediction ($r(1000) = .07$, $p =$

.04), and vocabulary prediction (r(1000) = -.13., p = .00), but was not significantly correlated with recall (r(1000) = .03, p = .38), vocabulary (r(1000) = .05, p = .09), or category fluency prediction (r(1000) = .05, p = .13). Chronological age was correlated with recall (r(1000) = .09, p = .00), reasoning ability (r(1000) = -.32, p = .00), category fluency (r(1000) = .08, p = .01), vocabulary ability (r(1000) = .08, p = .02), recall prediction (r(1000) = -.21, p = .00), LDT prediction (r(1000) = -.09, p = .00), reasoning ability prediction (r(1000) = -.16, p = .00), and category fluency prediction (r(1000) = .14, p = .00) but not processing speed (r(1000) = .01, p = .69) or vocabulary prediction (r(1000) = -.01, p = .73).

While controlling for chronological age, baseline subjective age was correlated with processing speed (r(997) = .07, p = .04), reasoning ability (r(997) = -.10, p = .00), category fluency (r(997) = -.11, p = .00), LDT prediction (r(997) = -.12, p = .00), reasoning ability prediction (r(997) = .15, p = .00), and vocabulary prediction (r(997) = -.14., p = .00), but not recall (r(997) = -.01, p = .71), vocabulary (r(997) = .02, p = .47), recall prediction (r(997) = .02, p = .64), or category fluency prediction (r(997) = -.02, p = .64).

Conclusions

Study 1B investigated whether baseline subjective age would predict cognitive performance on a wide range of measures using a younger and larger online sample of older adults. Results showed some evidence for a relationship between subjective age and reasoning ability. This correlation persisted even when controlling for chronological age, which itself was not correlated with cognitive performance. There was also some

evidence that subjective age was correlated with predictions for the processing speed task.

It is also possible that the effect size for the relationship between subjective age and cognitive performance was too small to be detected with the number of participants in the study. Indeed, bootstrapping procedures reveal several significant correlations between subjective age and cognitive performance, even when chronological age is controlled. This suggests that subjective age does predict cognitive performance when there is sufficient power to detect the effect.

STUDY 1C

Studies 1A and 1B showed some evidence that baseline subjective age was correlated with some measures of current cognitive performance. Study 1B also showed that baseline subjective age was associated with confidence judgments, suggesting that subjective age may pick up on perceptions of performance rather than actual performance. The purpose of Study 1C was to investigate whether the relationship also exists in a previously published longitudinal dataset Study 1C used data from the second wave of Midlife in the United States survey (MIDUS II) to determine whether subjective age was correlated with current cognitive performance in a large national sample.

Method

Participants

This sample consisted of 3,228 (1,476 (45.7%) male, 1,752 (54.3%) female) participants taken from Wave II of the Midlife in the United States longitudinal data set. Data were collected between 2004 and 2006. Participants had a mean age of 55.92 years (*SD* = 12.16, range 32-84) and an average of 14.43 years (*SD* = 2.67) of education.

Measures

The second wave of the MIDUS administered several cognitive measures that map onto the measures used in Studies 1A and 1B using the Brief Test of Adult Cognition by Telephone (BTACT, Tun & Lachman, 2006). The BTACT included two measures of recall (immediate and delayed), a speed of processing measure (counting

backward for 30 seconds), a working memory measure (backward digit span), a reasoning measure (completing a number series), and a category fluency measure.

Results

Consistent with previous studies, older adults reported a younger subjective age (46.29, *SD* = 13.25) relative to their chronological age (55.92). As with Studies 1A and 1B, a baseline discrepancy score was calculated by subtracting chronological age from subjective age. Subjective age discrepancy was significantly correlated with processing speed ((*r*(3224) = -.07, *p* = .00), and marginally correlated with the proportion of forgotten words between the two recall tests (*r*(3123) = -.03, *p* = .09) and reasoning ability (*r*(3224) = .03, *p* = .13). The discrepancy score was not correlated with immediate recall (*r*(3217) = -.00, *p* = .90), delayed recall (*r*(3129) = .02, *p* = .32), working memory (*r*(3226) = -.02, *p* = .24), or category fluency (*r*(3228) = .02, *p* = .34). Baseline subjective age was significantly correlated with immediate recall (*r*(3217) = -.28, *p* = .00), delayed recall (*r*(3129) = -.28, *p* = .00), the proportion of forgotten words between the two recall tests (*r*(3123) = .21, *p* = .00), processing speed ((*r*(3224) = -.34, *p* = .00), working memory (*r*(3226) = -.17, *p* = .00), reasoning ability (*r*(3224) = -.21, *p* = .00), and category fluency (*r*(3228) = -.27, *p* = .00). Chronological age was significantly correlated with immediate recall (*r*(3217) = -.30, *p* = .00), delayed recall (*r*(3129) = -.28, *p* = .00), the proportion of forgotten words between the two recall tests (*r*(3123) = .25, *p* = .00), processing speed ((*r*(3224) = -.42, *p* = .00), working memory (*r*(3226) = -.16, *p* = .00), reasoning ability (*r*(3224) = -.25, *p* = .00), and category fluency (*r*(3228) = -.30, *p* = .00). Table 3 contains the performance scores for each measure.

	Immediate Recall	Delayed Recall	WM Task	Processing Speed	Reasoning	Category Fluency
Study 1C	6.86 (2.26)	4.56 (2.59)	5.08 (1.47)	37.96 (11.05)	2.38 (1.50)	19.17 (6.07)

Table 3. Cognitive performance for Study 1C. Note: Standard deviations in parentheses; processing speed is presented in number of words per 30 seconds.

Finally, I analyzed the relationship between baseline subjective age and the cognitive measures while controlling for chronological age. Baseline subjective age was still significantly correlated with immediate recall ($r(3113) = -.09$, $p = .00$), delayed recall ($r(3113) = -.09$, $p = .00$), the proportion of forgotten words between the two recall tests ($r(3113) = .05$, $p = .01$), processing speed (($r(3113) = -.06$, $p = .00$), working memory ($r(3113) = -.07$, $p = .00$), reasoning ability ($r(3113) = -.05$, $p = .01$), and category fluency ($r(3113) = -.08$, $p = .00$).

I also examined the relationship between subjective age and cognitive performance for only those in the MIDUS sample that were over the age of 50 years (see also procedure used by Stephan et al., in press). In this older adult sample, participants reported feeling younger (51.39, $SD = 12.21$) than their chronological age (62.71, $SD = 8.79$). Even with a more restricted age range, the results were nearly identical. Subjective age discrepancy was significantly correlated with recall (($r(2128) = -.04$, $p = .00$) and working memory ($r(2134) = -.06$, $p = .00$), and trended toward a correlation with the delayed test ($r(2056) = -.03$, $p = .14$). The discrepancy score was not correlated with the proportion of forgotten words ($r(2056) = .01$, $p = .62$), reasoning ability ($r(2132) = -.01$, $p = .76$), processing speed ($r(2135) = .01$, $p = .55$), or category fluency ($r(2136) = -.02$, p

= .49). Baseline subjective age was significantly correlated with immediate recall ($r(2136) = -.25$, $p = .00$), delayed recall ($r(2061) = -.22$, $p = .00$), the proportion of forgotten words between the two recall tests ($r(2056) = .16$, $p = .00$), processing speed (($r(2135) = -.26$, $p = .00$), working memory ($r(2134) = -.15$, $p = .00$), reasoning ability ($r(2132) = -.17$, $p = .03$), and category fluency ($r(2136) = -.22$, $p = .00$). Chronological age was significantly correlated with immediate recall ($r(2128) = -.30$, $p = .00$), delayed recall ($r(2061) = -.27$, $p = .00$), the proportion of forgotten words between the two recall tests ($r(2056) = .20$, $p = .00$), processing speed (($r(2135) = -.38$, $p = .00$), working memory ($r(2134) = -.14$, $p = .00$), reasoning ability ($r(2132) = -.23$, $p = .00$), and category fluency ($r(2136) = -.28$, $p = .00$).

After controlling for chronological age, baseline subjective age was still significantly correlated with immediate recall ($r(2048) = -.09$, $p = .00$), delayed recall ($r(2048) = -.09$, $p = .00$), the proportion of forgotten words between the two recall tests ($r(2048) = .05$, $p = .03$), processing speed (($r(2048) = -.06$, $p = .00$), working memory ($r(2048) = -.06$, $p = .01$), reasoning ability ($r(2048) = -.05$, $p = .03$), and category fluency ($r(2048) = -.07$, $p = .00$).

Conclusion

Study 1C demonstrated that subjective age was correlated with current cognitive functioning in a large national sample using a larger age range. Although the discrepancy score was not significantly correlated with many cognitive measures, baseline subjective age was correlated with cognitive performance when chronological age was controlled for. Moreover, the sizes of the correlations found in the current study

were in line with those reported in the previous Stephan et al (2014) results showing a relationship between subjective age and cognitive performance 10 years later. The current results suggest that subjective age also predicts current cognitive functioning, above and beyond chronological age.

STUDY 2

Studies 1A-1C were designed to test whether there is a relationship between baseline subjective age and cognitive performance. Study 2 examined whether cognitive performance is affected when subjective age is manipulated. There were two main goals of Study 2. First, Study 2 investigated if manipulating subjective age affects cognitive performance. To examine this, some participants were given a memory test to increase subjective age, while others received a vocabulary quiz to serve as a control group. Prior research suggests that lowering subjective age in older adults can improve performance on a physical test (Stephan, et al., 2013). One may predict that the converse is also true; increasing subjective age may decrease cognitive performance. If this is true, then the experimentally-aged group should show lower performance on cognitive measures than the non-aged control group. Second, Study 2 sought to determine the underlying mechanism that explains how subjective age is manipulated. Namely, I investigated whether manipulations of subjective age influence stereotype threat activation, memory self-efficacy, or affect.

Method

Participants

A total of 111 (30 males, 80 females, 1 preferred not to answer) older adults participated in the study online using Amazon's Mechanical Turk. Participants had a mean age of 59.58 (*SD* = 3.94, range 55 - 74) and had an average of 15.34 (*SD* = 2.07) years of education. Participants completed the study on a computer in a location of their

choosing. All participants were be located in the Unites States and were compensated for their time.

Measures

To assess the cognitive function of older adults, Study 3 used the same five measures as used in Study 1A. A free recall memory test was used to experimentally manipulate subjective age for half of the participants. In addition, a second, novel free-recall test was added to assess both groups independently of the experimental manipulation of subjective age. To assess potential underlying mechanisms, several questionnaires were also added to the end of the study. Finally, participants were also asked to make performance predictions for each task to determine if subjective age might also affect confidence. All measures were computerized and delivered via Amazon's Mechanical Turk.

Perceived Stereotype Threat Questionnaire

Participants were asked to complete a questionnaire designed to assess stereotype threat (Chasteen, et al., 2005). In this questionnaire, participants were shown five statements that describe other people's belief about the memory abilities of older adults. Participants were asked to rate their level of agreement with each statement on a five point scale (1 – Strongly disagree, 5 – Strongly agree).

Memory Self-Efficacy Questionnaire

Participants were also asked to complete the Memory Self-Efficacy Questionnaire (MSEQ) (West, Bagwell, & Dark-Freudeman, 2005). For the MSEQ, participants were asked to rate their memory performance on a series of everyday tasks

(e.g., remembering errands without a list, locating objects around the house). For each scenario, participants reported their confidence in their ability to remember a number of items (e.g., all of the items, 6 of the 8 items, etc.). Confidence ratings were averaged to calculate a global memory self-efficacy score.

Positive Affect Negative Affect Schedule

Participants were asked to complete the Positive Affect Negative Affect Schedule (PANAS; Watson, et al., 1988). In this questionnaire, participants saw a list of words; half were positive affect words (e.g., excited, interested) and half were negative (e.g., bored, upset). Participants were asked to rate each word from 1 (little or not at all) to 5 (extremely), indicating if the word described their current emotional state. Scores for positive words and for negative words were added together to calculate both a positive and negative affect score.

Procedure

Participants were split into two groups, the experimentally-aged group (N = 60), and a non-aged control group (N = 51). Participants in the aged group were given a memory test before the other cognitive measures to increase their subjective age. Participants in the control group were given a vocabulary test, which has been shown to not increase subjective age (Hughes, et al., 2013). The two groups did not differ on age ($t < 1$) or education ($t(109) = 1.25$, $p = .21$). The experimental group had a mean age of 59.48 years ($SD = 4.18$) and 15.12 years ($SD = 2.00$) of education. The control group had a mean age of 59.69 years ($SD = 3.68$) and an average of 15.61 years ($SD = 2.15$) of education. Both groups were given a second subjective age measure after the memory

test. The remaining measures were given in the following order: LDT, reasoning, fluency, a novel vocabulary, a novel free recall (second recall test for aged group, first for control group), stereotype threat, MSEQ, and the PANAS.

Results

First, I analyzed whether the experimental manipulation effectively influenced subjective age. Indeed the experimental group's subjective age was significantly higher (55.30 years, *SD* = 15.89) than the control group's subjective age (47.78 years, *SD* = 15.00), $t(109) = 2.55$, $p = .01$, *SE* = 2.95, $d = .49$); at baseline, the experimental group (50.57 years, *SD* = 11.75) did not differ from the control group (48.02 years, *SD* = 8.63) on baseline subjective age, $t(109) = 1.28$, $p = .20$. Figure 1 shows the effect of condition on subjective age.

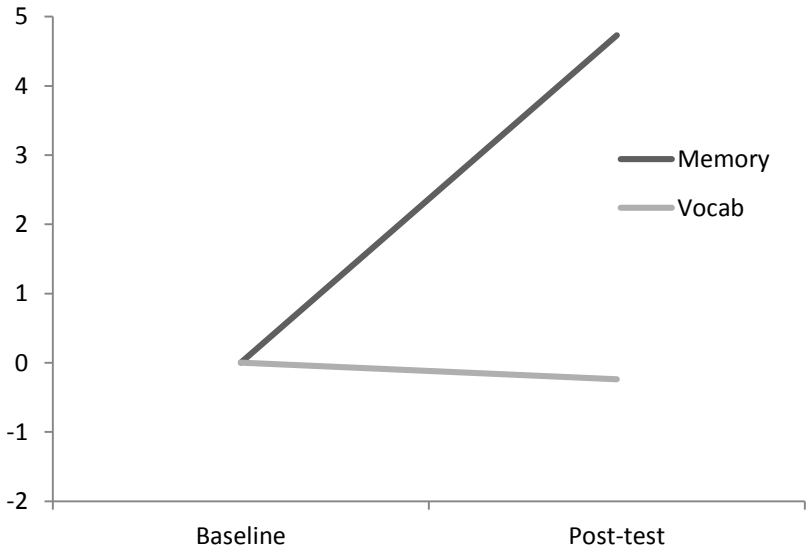

Figure 1. Experimental effect on subjective age.

Turning next to the cognitive variables of interest, there was a significant difference between the groups for category fluency, $t(108) = 2.75$, $p = .01$, $SE = 4.44$, $d = .53$. As predicted, the control group produced more exemplars than the experimental group. There was no significant difference for recall ($t < 1$), vocabulary ($t < 1$), processing speed ($t < 1$), or reasoning ability ($t < 1$). There were significant differences between the groups for the LDT prediction, $t(94) = 5.47$, $p = .00$, $SE = 6.58$, $d = 1.13$. There was also a marginally significant difference for reasoning ability prediction, $t(109) = 1.91$, $p = .07$. Both of these differences were driven by the control group predicting that they would perform better on these tasks than the experimental group. There were no significant differences for category fluency prediction ($t < 1$), vocabulary prediction ($t < 1$), or recall prediction ($t < 1$). Table 4 contains the performance score for each measure.

	Recall	Vocabulary	Processing Speed	Reasoning	Category Fluency
Aged	.42 (.14)	12.18 (2.13)	3258.40 (1016.62)	8.70 (2.97)	98.13 (22.66)
Control	.43 (13)	12.30 (1.80)	3190.90 (748.69)	8.29 (2.73)	110.34 (23.75)

Table 4. Cognitive performance for Study 2. Note: Standard deviations in parentheses; processing speed is presented in milliseconds.

We examined whether changes in subjective age mediated the effect of the experimental condition on the cognitive tests. To test this theory, I conducted a

mediation analysis using PROCESS for SPSS (Preacher & Hayes, 2008) on each of the hypothesized variables. The results indicated that subjective age did mediate the effect of condition on category fluency (2.33, 95% CI = .18 to 7.00). Subjective age did not mediate the effect on recall (-.002, 95% CI = -.38 to .39), vocabulary ability (.002, 95% CI = -.23 to .25), processing speed (-.01, 95% CI = -.12 to .05), or reasoning ability (-.32, 95% CI = -.41 to .18). These data suggest that the effect of experimental manipulation first acts open an individual's subjective age, which in turn affects category fluency.

Finally, I assessed whether the experimental manipulation had an effect on several factors that could serve as underlying mechanisms. However, there was no evidence that the experimental and control groups were significantly different for stereotype threat activation ($t(103) = 1.58$, $p = .13$), positive affect ($t < 1$), negative affect ($t < 1$), or memory self-efficacy ($t < 1$).

Conclusions

The results of Study 2 supported the theory that manipulating subjective age affects some cognitive processes. Specifically, manipulating subjective age reduced the number of exemplars older adults generated during the category fluency task. Additionally, subjective age mediated this effect. These data fit nicely with previous research indicating that stereotype threat affects working memory tasks in older adults (Schmader & Johns, 2003; Barber and Mather, 2013), and that working memory loads reduce category fluency tasks (Rosen & Engle, 1997). It should be noted that there was no difference in stereotype threat between the experimental and control groups.

However, this is difficult to interpret due to experimental limitations. Namely, the stereotype threat activation questionnaire was placed after all cognitive tests, including a recall test, in order to maximize the effect of subjective age on the cognitive measures. Therefore, this second recall test may have increased stereotype threat activation in the control group, leading to a reduced effect of condition on threat. Future studies should measure stereotype threat activation immediately after manipulating subjective age.

The second finding of note was that manipulating subjective age altered the predictions that participants made for certain tasks. Specifically, people in the experimental condition who had a higher subjective age made lower performance predictions than people in the control group for the speed of processing task and the category fluency task. Both of these tasks are unfamiliar to participants, but a higher subjective age lead to lower confidence in ability to perform the task nonetheless. These data may suggest that subjective age also affects perceived abilities, rather than just actual ability. Future research should focus on whether having a higher subjective age leads to older adults having lower confidence while controlling for actual performance.

STUDY 3

Studies 1A - 1C examined whether subjective age predicts cognitive performance, while Study 2 examined whether manipulating subjective age (in particular, making older adults feel older) has an effect on cognitive performance. However, one may also ask whether subjective age can be reduced instead of elevated; can older adults be made to feel younger? Only one prior study has successfully induced a younger subjective age in older adults. Stephan et al. (2013) gave older adults a test of grip strength, which was described as a predictor of age-related deteriorating health. Half of the participants in the feedback condition were told that they performed better than 80% of their peers and half were given no feedback. Those who believed that they performed better on an age-relevant task reported lower subjective ages than control. Hughes et al. (2013) demonstrated that a memory test environment elevates older adults' subjective age. Would providing older adults with positive feedback following a memory test decrease their subjective age? Study 3 investigated if positive feedback after a memory test can reduce subjective age, effectively making older adults feel younger. Additionally, Study 3 examined whether a younger subjective age will affect cognitive performance.

Method

Participants

Forty-five older adults (ages 55 - 76) were recruited using Amazon's Mechanical Turk. Participants had a mean age of 59.96 years (*SD* = 4.92) and an average of 15.58

years (*SD* = 2.01) of education. Participants completed the study on a computer in a location of their choosing. All participants were located in the Unites States and were compensated for their time.

Measures

Measures were identical to those in Study 2.

Procedure

After reading a consent form and completing a demographic questionnaire, participants filled out a question on subjective age where they will be asked to move a slider on a scale from 0 years to 120 years. Participants were then given the memory test. Following the test, participants in the positive feedback condition were told that they recalled more words than 80% of their peers. The control group was given no feedback. Then all participants were asked to report their subjective age a second time. The remainder of the study followed the procedure of Study 1B. Participants were given the additional tasks in the following order: LDT, reasoning, vocabulary, the second recall, fluency, stereotype threat, PANAS, and MSEQ. After each measure, another subjective age question was asked.

Results

First, I analyzed whether the experimental condition effectively manipulated subjective age. Indeed, the experimental group's post-test subjective age was lower (51.23 years, *SD* = 12.56) relative to baseline (51.41, *SD* = 13.29), but this difference was not significant ($t < 1$). The control group's post-test subjective age was higher (54.52 years, *SD* = 11.63) than baseline subjective age (53.30, *SD* = 15.56), which was

also not significant ($t < 1$). While not significant, the results trended in the predicted direction. The experimental group felt an average of -.18 years younger ($SD = 15.45$), while the control group felt 1.22 years older ($SD = 14.66$). Figure 2 shows the effect of feedback on subjective age.

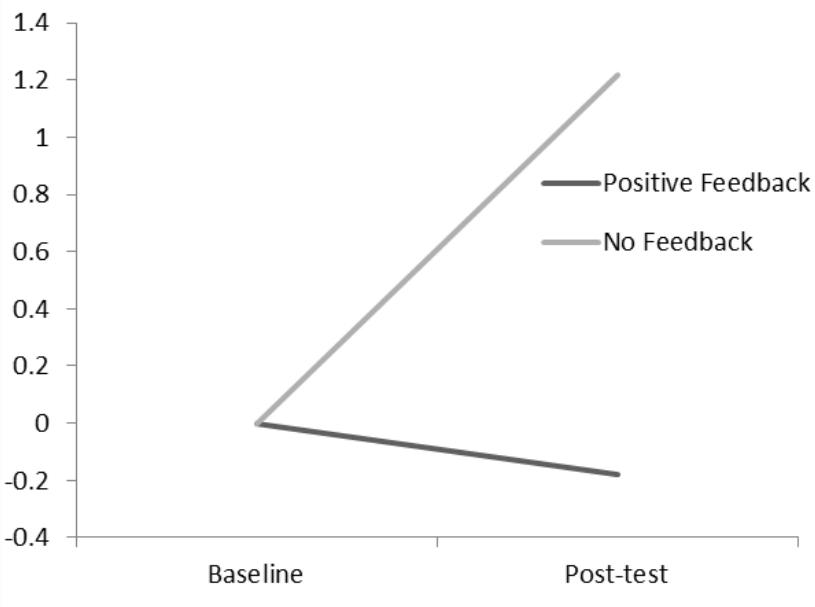

Figure 2. The experimental effect on subjective age.

Turning next to the cognitive variables of interest, there were no significant differences for the recall test ($t(43) = 1.20$, $p = .24$), vocabulary ($t < 1$), processing speed ($t < 1$), or reasoning ability ($t < 1$). I also analyzed whether subjective ratings of confidence differed between the two groups using participants' predictions. There were no significant differences for the LDT prediction, ($t < 1$), reasoning ability prediction, (t

< 1), category fluency prediction (t < 1), vocabulary prediction (t < 1), or recall prediction (t < 1). Table 5 contains the performance score for each measure.

	Subjective Age Post-test	Vocabulary	Processing Speed	Reasoning	Category Fluency	Recall
Positive Feedback	51.23 (12.56)	35.36 (3.80)	3247.43 (859.95)	8.95 (4.49)	110.77 (22.64)	.56 (.15)
No Feedback	54.52 (11.63)	36.04 (2.95)	3066.26 (748.85)	9.91 (3.49)	100.22 (30.77)	.51 (.12)

Table 5. Cognitive performance for Study 3. Note: Standard deviations in parentheses; processing speed is presented in number of words per 30 seconds.

Finally, I assessed whether the experimental manipulation had any effect on several factors that could serve as underlying mechanisms. However, there was no evidence that the experimental and control groups were significantly different for stereotype threat activation (t < 1), positive affect (t < 1), negative affect (t < 1), or memory self-efficacy ($t(42) = 1.06$, $p = .30$).

Conclusions

Study 3 examined whether or not subjective age could be reduced by giving participants positive feedback. The results suggest that positive feedback was sufficient suppress the subjective aging effect, or even to make older adults feel younger, although the differences were not significant. The failure to detect an effect may be due to a lack of power. There is little evidence that this manipulation affected cognitive performance

for some tasks, but performance on some tasks (i.e., category fluency and a novel recall test) did trend in the predicted direction.

SUMMARY AND CONCLUSIONS

Taken together, the studies reported in this dissertation show that subjective age is related to performance on some cognitive measures. Studies 1A and 1B found little evidence to support the idea that subjective age was correlated with cognitive performance. However, sample size and age range restriction may have limited the ability to detect an effect in these studies. Indeed, the relationship between subjective age and cognitive performance was present when a bootstrapping procedure was used in Study 1B. Study 1C also demonstrated that subjective age is correlated with middle-aged and older adults' current cognitive functioning using data from in a large, national sample. Overall, the results suggest that there is a small correlation between subjective age and current cognitive functioning.

Study 2 showed that manipulating subjective age can also affect some cognitive performance, especially for tasks with a working memory component. These findings support the idea that subjective age is influenced by stereotype threat. Stereotype threat has been shown to increase working memory load (Schmader & Johns, 2003; Barber and Mather, 2013), which can lead to a decline in performance for certain tasks (Rosen & Engle, 1997). These results suggest that subjective age may be a valuable predictor of one's cognitive function, even more than chronological age.

The findings of Study 2 replicated previously published work that demonstrated subjective age can be manipulated (Hughes, et al., 2013). Older adults who participated in a memory study reported a higher subjective age than those who completed a

vocabulary test. These results further support the theory that subjective age is malleable, and can be affected by certain contextual factors. Subjective age may reflect certain features of stereotype threat, as it affected by tests that older adults expect to perform poorly on (i.e., memory tests). However, subjective age was not correlated with scores on a stereotype threat activation questionnaire. This may have been due to an experimental limitation whereby the questionnaire followed a second memory test. Future research should ask these questions earlier to determine whether there is a difference in stereotype threat immediately after an experimental manipulation.

Study 2 also suggested that subjective age may be connected with an individual's perceived ability to complete a task, specifically for unfamiliar tasks. Older adults whose subjective ages had been increased gave lower predictions for novel tasks than those in a control group. This may suggest that subjective age affects perceptions of performance more than actual performance. These findings are logical when you consider that subjective age is affected by the perceptions of performance more than actual performance (Stephan et al., 2013; see also the discussion section of Hughes et al., 2013). Subjective age may simply assess how one feels about their performance, but these feelings may also accurately predict how that individual is coping with the aging process. This theory may explain why subjective age predicts cognitive performance after ten years (Stephan, et al., in press) as well as the correlation with various health outcomes. This finding suggests that subjective age measures how an older adult perceives their cognitive abilities. Individuals with lower subjective ages feel more confident in their own abilities than individuals with higher subjective ages. This is a

noteworthy finding as it provides us with a simple tool to assess how well an older adult is coping with the aging process. Older adults with relatively high subjective ages may be susceptible to lower self-esteem, and may be particularly vulnerable to the effects of aging. This may suggest simply asking older adults how old they feel may be a powerful screening tool that could be used to identify potential problems, even as early as 10 years before the abilities decline.

The results of Study 3 demonstrate that subjective age may be experimentally decreased, as well as increased, although the effects were non-significant. These results conceptually replicate the findings of Stephan et al. (2013) and show that positive feedback can lead older adults to feel younger relative to a no feedback condition. Study 3 was the first to demonstrate that feedback for a cognitive test can be used to promote a younger subjective age in older adults. These findings further support the theory that subjective age is malleable. These findings are of great practical importance, as they demonstrate that positive feedback and (perhaps successful performance) may lead older adults to feel younger and may, in turn, improve cognitive performance. Future studies should be run with greater power to determine whether there is a significant effect of positive feedback.

Although there was no conclusive evidence to suggest an underlying mechanism for subjective age, the present studies may have been limited by certain design choices. The questionnaires used in the present studies were placed at the end of the study in order to maximize the chance that any differences in the cognitive measures would be detected. However, this may have limited our ability assess possible underlying

mechanisms. Future work should alter the order of tasks and questionnaires in order to eliminate the possibility that this test order affected the results

In conclusion, the studies reported provide evidence that subjective age is related to cognitive performance, which suggests that subjective age is a measure that may be used to predict how an older adult will perform on cognitive tests. Subjective age may even be more useful to predict cognitive performance than chronological age. Subjective age is also a useful predictor for how much confidence older adults have in their own abilities. These studies are among the first to demonstrate such a relationship. Moreover, the studies in this dissertation add to the growing literature showing that subjective age is malleable. Given the relation between subjective age and cognition, methods that can decrease subjective age offer a promising tool for possibly increasing cognition.

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