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HOW FEELINGS OF STEREOTYPE THREAT INFLUENCE OLDER ADULTS' MEMORY PERFORMANCE

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The purpose of the present research was to explore the role of stereotype threat as a mediator of older people's memory performance under different instructional sets. In three studies, younger and older participants completed a memory test that was either framed as a memorization or as an impression formation task. Across these studies, memory performance was greater for younger than for older adults and was higher in the impression formation than memorization condition, but was not different

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for older adults in the two instruction conditions. These results also showed that age differences in memory performance were mediated by participants' feelings of stereotype threat, such that age was positively related to stereotype threat and stereotype threat was negatively related to memory performance. These data demonstrate that concerns about being negatively stereotyped influence age differences in memory performance, and that the effects of these feelings on performance are not easily reduced by reframing the task instructions.

Research on aging and memory has produced an impressive body of work demonstrating that many memory abilities decline with age (Craik & Jennings, 1992; Zacks, Hasher, & Li, 2000), a decline that many have suggested is associated with physiological changes, including sensory and other neural deficits (Lindenberger & Baltes, 1994; Raz, 2000; Reuter-Lorenz, 2000; Schneider & Pichora-Fuller, 2000). Another body of research has examined the role that people's beliefs about their memory ability play in their performance (Cavanaugh, 2000; Hertzog & Hultsch, 2000). It is this second group of factors, which constitute psychological rather than physiological variables, that is the focus of the present paper. As will be seen, these factors can influence apparent age differences in memory.

Aging and Memory Beliefs

A central theme that emerges from the literature on aging is that older adults have more negative beliefs about memory than do younger adults: they believe they will do less well on memory tasks (Berry, West, & Dennehy, 1989; Gilewski, Zelinski, & Schaie, 1990; Lineweaver & Hertzog, 1998); they feel their memory will worsen with increasing age (Dixon & Hultsch, 1983; Hultsch, Hertzog, & Dixon, 1987; Loewen, Shaw, & Craik, 1990; Smith, Petersen, Ivnik, Malec, & Tangalos, 1996); and they report less control over memory function as they age (Lachman, Bandura, Weaver, & Elliott, 1995; Soederberg Miller & Lachman, 1999). Furthermore, many of these negative beliefs worsen over time, with one longitudinal study reporting significant declines in ratings of perceived stability, personal control, and memory capacity, as well as increases in anxiety about memory over a 6-year period (McDonald-Miszczak, Hertzog, & Hultsch, 1995). These negative views can easily impact actual memory performance through the allocation of processing resources, the selection of strategies, motivation and effort, or a combination of these factors (Cavanaugh, 1996, 2000).

Other social factors, notably people's implicit theories about aging and cognition, may also affect memory performance. For example, several studies have shown that people expect memory declines to occur with age (e.g., Heckhausen, Dixon, & Baltes, 1989; Hertzog & Hultsch, 2000; Lineweaver & Hertzog, 1998; Ryan, 1992; Ryan & Kwong See, 1993), and stereotypes of aging held by both young and older adults include perceptions of decreased competence and increasing forgetfulness (Chasteen, 2000; Chasteen, Schwarz, & Park, 2002; Erber, 1989; Hummert, Garstka, Shaner, & Strahm, 1994; Kite & Johnson, 1988; Schmidt & Boland, 1986). Levy and her colleagues have shown that negative views of aging mediate the relation between culture and memory performance in older adults (Levy & Langer, 1994; but see Yoon, Hasher, Feinberg, Rahhal, & Winocur, 2000), and that subliminal exposure to negative aging stereotypes worsens older adults' memory performance (Levy, 1996; Stein, Blanchard-Fields, & Hertzog, 2002). Other evidence suggests that negative stereotypes can increase older adults' cardiovascular response to stress and worsen their math performance, suggesting the possibility that stress levels associated with the activation of negative stereotypes may play a role in memory performance as well (Levy, Hausdorff, Hencke, & Wei, 2000).

Although the effects of aging stereotypes on memory performance have been shown in studies using priming techniques (e.g., Levy, 1996; Levy et al., 2000), it is also conceivable that simply placing older adults into a situation in which the negative stereotypes about aging and cognition are activated might affect their memory performance. In the stereotype threat literature, Steele and Aronson (1995) found that African Americans performed worse than Caucasians on a test of intelligence when participants were first told that the test would be diagnostic of their intelligence. In contrast, no race differences in performance on the same task were found when participants were told the test was not diagnostic of intelligence. Given the widely held negative beliefs about memory performance, such an effect might also impact on the memory performance of older adults.

Rahhal, Hasher, and Colcombe (2001) investigated this possibility by varying the instructions they gave younger and older participants before completing a memory task. The instructions either emphasized that memory was going to be assessed or de-emphasized the memory component of the task. For example, in the memory-emphasis instructions participants were told the experiment tested how good their memory is, whereas in the memory-neutral instructions participants were told the experiment tested their ability to learn facts. Participants were then presented with trivia statements, were told

which were true and which were false, and later had to complete a recognition memory test for true versus false statements. Rahhal et al. (2001) found older adults performed worse than young adults in the memory-emphasis condition but they performed as well as young adults in the memory-neutral condition. These findings are generally consistent with Steele's (1997) notion of stereotype threat: when older adults were placed in a situation in which their negative stereotypes about aging and memory might have been activated, their memory performance was impaired. Of course, most explicit or deliberate memory studies include direct instructions about a forthcoming memory test and the combination of instructions and the beliefs older adults have about their memory may well lead to exaggerated age differences being reported in the literature.

Evidence consistent with such a view can be seen in a recent study by Hess, Auman, Colcombe, and Rahhal (2003), who used either positive or negative information about aging and memory in order to either contradict or reinforce traditional, negative beliefs about aging and memory relative to a neutral (no prior information) baseline. Older adults who received the negative information performed worse on a recall task than those who received either positive or no information. However, these effects were moderated by the degree to which participants valued memory ability, such that the more they valued memory, the greater the disruptive effect of the negative information. These data then are consistent with other stereotype threat research that has demonstrated greater threat effects in people who value the domain that is being assessed (e.g., Aronson et al., 1999).

Thus, a number of recent findings suggest that mediating variables such as stereotypes and anxiety (e.g., Hess et al., 2003; Levy et al., 2000; Rahhal et al., 2001) can influence age differences in memory performance. However, there are some limitations with these critical studies, such as no direct measure of stereotype activation (Rahhal et al., 2001), or a relatively strong manipulation (Hess et al., 2003).[1] Moreover, none of these studies examined the role of self-efficacy in stereotype threat effects concerning aging and memory. Finally, the memory tasks used in some of these studies (e.g., Hess et al., 2003) were word recall tasks that used standard, neutral terms. Other research suggests that materials with greater social or personal relevance are more engaging to older adults (Carstensen & Turk-Charles, 1994; Rahhal, May, & Hasher, 2002), so it would be

[1]Other stereotype threat studies often simply mention that a test is diagnostic of a particular stereotyped domain, rather than present multiple articles specifying a particular group's deficits in a stereotyped domain (e.g., Steele & Aronson, 1995).

worthwhile to examine potential stereotype threat effects on memory using a task that both age groups might find interesting.

In the present study, we used socially relevant materials and examined whether stereotype threat effects would occur when younger and older adults were given instructions that either emphasized or de-emphasized memory. Participants were presented with a series of behavioral descriptions that they were told to use to either form an impression of an individual or to memorize (Hamilton, Katz, & Leirer, 1980). We assumed that the memory instructions (but not the impression instructions) would induce stereotype threat in older adults and anticipated finding age deficits in recall for the memory instructions but possibly not for the impression instructions. In Study 2, we attempted to replicate the results of the first experiment and to investigate whether the instructions activated aging stereotypes and affected participants' self-efficacy. In addition, we measured participants' perceptions of stereotype threat and investigated the role of perceived threat in the relation between age and recall performance. In Study 3, we attempted to replicate the results for recall using a recognition task and to see whether participants' feelings of stereotype threat might also influence their recognition performance.

STUDY 1

A consistent finding in social cognition is that young adults show better recall for behavioral descriptions when they are given either explicit instructions (Hamilton et al., 1980) or implicit goals (Chartrand & Bargh, 1996) to form an impression compared to when they are instructed to memorize the information. Given Rahhal et al.'s (2001) success in eliminating age differences in recognition by de-emphasizing the memorial component of the task, we anticipated that there would be age differences in recall for the memory condition, but no differences in the impression formation condition.

Method

Participants and Design

Forty younger adults ($M_{age} = 19.43$ years, range = 18–25) and 40 older adults ($M_{age} = 70.05$ years, range = 61–87) participated in the study. The young adults were recruited from an introductory psychology course and received course credit for participating. The older adults were community-dwelling residents from the greater Toronto area and were paid $10 Canadian. The older adults had a higher education level ($M = 13.93$ years, $SD = 3.39$) than the younger adults

($M = 12.78$ years, $SD = 1.03$;), $t(78) = -2.05$, $p < .05$. For self-ratings of health (1 = very poor, 5 = excellent), the older adults had higher ratings ($M = 4.17$, $SD = .67$) than the young adults ($M = 3.90$, $SD = .57$), $t(118) = -2.35$, $p < .05$.[2] For the younger adults, 80% were female and for the older adults 68% were female.

A 2(age: young or old) × 2 (instruction: form impression or memorize) factorial design was used, with both factors varied between subjects.

Materials

Sentence predicate task. To assess recall performance, participants completed a sentence predicate task, in which they viewed 24 sentence predicates presented individually on a computer screen for 8 s with a 1-s pause between each. The predicates, adapted from Hamilton et al. (1980) and Chartrand and Bargh (1996), consisted of behaviors that represented four trait categories: social/interpersonal (e.g., "had a party for some friends last week"), athletic (e.g., "jogs every morning before going to work"), intelligent (e.g., "won the chess game"), and religious (e.g., "read the Bible in his hotel room"). Six predicates represented each of the 4 trait categories, for a total of 24 predicates. Two random orders of presentation were constructed, and participants were randomly assigned to one of the two orders.

Procedure

A maximum of two same-aged volunteers participated per session, and both participants in a session were assigned to the same condition. Participants were informed that they would be completing several tasks during the experimental session. They then read the instructions for the Sentence Predicate Task on the computer screen while the experimenter read the instructions aloud. In the impression formation condition, participants were told that the task examined how people form impressions of others based on their behavior (see

[2]As an indication of cognitive function, speed of processing scores were also available from the digit comparison task that served as a filler task in Studies 1 and 3. For that task, participants compared pairs of digit strings consisting of either three, six, or nine digits. Their task was to quickly decide whether the strings were the same or different and write S or D on the answer sheet. They were given 30 s to complete as many items as possible at each level (3, 6, or 9 digits). Participants' scores were calculated by taking the sum of the number correct at each of the three levels. For both studies there were no effects of condition, $Fs < 2.80$, but there were robust age differences. In Study 1, young adults correctly compared more digit strings ($M = 51.62$, $SD = 9.23$) than older adults ($M = 39.83$, $SD = 6.89$), $F(1, 114) = 62.75$, $p < .001$, $\eta^2 = .36$. A similar pattern occurred in Study 3, with young adults completing more digit strings ($M = 49.88$, $SD = 8.79$) than older adults ($M = 39.25$, $SD = 7.63$), $F(1, 77) = 34.50$, $p < .001$, $\eta^2 = .31$.

Hamilton et al., 1980). They were told to form an overall impression of what the person who performed the various behaviors was like, and that later they would be asked questions about the impression they formed. In the memorization condition, participants were told that the task examined how people memorize descriptions of actions. They were told to remember the exact wording of each description and that later they would be asked questions about those descriptions.

Immediately following presentation of the sentence predicates, participants worked on a 3-min filler digit comparison task. Next, they completed a free recall task in which they were asked to write down as many of the sentence predicates as they could remember in 4 min. They were told they should attempt to come as close as possible to the original wording they had read on the computer screen. Participants then completed a background information sheet and were debriefed, compensated, and thanked for their participation.

Results and Discussion

Data Analysis

Sentence predicates from the recall task were marked by two experimenters using a leniently scored 'gist' protocol (see Hamilton et al., 1980; Chartrand & Bargh, 1996). Items were scored as correct if they captured the essential meaning of both the behavioral description and the trait category it represented. Any discrepancies were resolved through discussion. The interjudge reliability was 0.98.

Recall Performance

A 2 (age: young or old) $\times$ 2 (instruction: impression or memorize) between-subjects analysis of variance (ANOVA) was conducted on the proportion of correctly recalled sentence predicates (Table 1). The young adults recalled more predicates than the older adults, $F(1,\ 76) = 13.05,\ p < .01,\ \eta^2 = .15$. As well, participants in the impression formation condition recalled more sentence predicates than participants in the memorization condition, $F(1,\ 76) = 11.79$, $p < .01,\ \eta^2 = .13$. The Age $\times$ Instruction interaction, however, was not significant, $F < 1$. Thus, there was no evidence that the memory instructions differentially decreased the recall of older adults, nor did the impression formation instructions eliminate age differences that were found under standard memory instructions.[3]

[3]Adjusted ratio of clustering scores (Roenker, Thompson, & Brown, 1971) were also calculated to check for differences in the clustering of the sentence predicates during the recall task. No significant effects were found, *Fs* < 1.

Table 1. Proportion correctly recalled by age and instruction for Studies 1 and 2

	Instruction		
Age	Impression	Memory	Mean
	Study 1		
Young adults	.46 (.15)	.37 (.10)	.42 (.14)
Older adults	.36 (.17)	.24 (.12)	.31 (.16)
Mean	.41 (.17)	.31 (.13)	
	Study 2		
Young adults	.52 (.15)	.35 (.16)	.44 (.17)
Older adults	.36 (.17)	.23 (.14)	.29 (.17)
Mean	.44 (.18)	.29 (.16)	

Note. Standard deviations are in parentheses.

Impression instructions improved participants' recall performance. However, these effects did not differ for the two age groups, a finding that was surprising given the Rahhal et al. (2001) study showing benefits for older adults' performance from instructions that de-emphasized the memorial aspects of the task. To understand the effects of instructions on participants' cognitive and affective experiences during the testing session, we conducted a second study using the same procedure as in Study 1, but now we included a direct measure of stereotype threat.

STUDY 2

Our initial study failed to find evidence that older adults' memory performance can differentially benefit from instructions that focus attention away from the memorial component of the task. Because both the memorize and impression groups were told they would be asked questions about the items they would be exposed to, we thought it possible that the general testing situation might have had features that triggered older adults' negative views about their performance ability. This seemed plausible because very subtle manipulations can trigger negative stereotypes (e.g., Davies, Spencer, Quinn, & Gerhardstein, 2002; Steele & Aronson, 1995). To explore this possibility, we conducted a second study to directly examine participants' cognitive and affective experiences during the testing situation. We did this by using a lexical decision task to measure stereotype activation and by including measures of

self-efficacy, evaluation apprehension, and anxiety to assess the affective outcomes of the two types of instructions on younger and older participants. In addition, we included a measure of the degree to which individuals felt stereotype threat regarding aging and memory performance. Although both the Rahhal et al. (2001) and Hess et al. (2003) studies suggest a connection between their findings and stereotype threat, we report the first direct empirical test of its role in memory performance. If stereotype threat were operating only in the memorize condition, then older adults in that condition should show greater perceived threat, greater activation of negative aging stereotypes, greater anxiety and apprehension, and lower self-efficacy than older adults in the impression condition. Given the outcome of Study 1, it is conceivable that impression instructions—or the larger experimental context itself—may also induce stereotype threat and activate negative aging stereotypes in older adults. To test this possibility, we examined the pattern of stereotype activation and also conducted mediation analyses to see whether perceived stereotype threat mediated the relation between age and recall for older adults in both instruction conditions.

The same basic procedure was used as in Study 1. Participants received either the memorization or impression formation instructions followed by the sentence predicates. Next, however, they completed measures of stereotype activation, self-efficacy, evaluation apprehension, and anxiety. As in other stereotype threat studies (e.g., Spencer, Steele, & Quinn, 1999), these measures were included as potential mediators of any stereotype threat effects. Following the recall task, participants completed a measure of perceived stereotype threat regarding aging and memory.

Method

Participants and Design

Forty-two young adults ($M_{age} = 19.00$ years, range = 17–25) and 39 older adults ($M_{age} = 73.97$ years, range = 65–88) were recruited as in Study 1. The two age groups had approximately equal levels of education ($M_{young} = 12.21$ years, $SD = .52$; $M_{old} = 13.03$ years, $SD = 2.81$), $t(74) = -1.83$, $p = .07$, but differed in vocabulary ($M_{young} = 29.47$, $SD = 3.05$; $M_{old} = 35.49$, $SD = 4.07$), $t(73) = -7.26$, $p < .001$ (Shipley, 1986). For the younger adults, 76% were female and for the older adults 74% were female.

The same 2 (age) $\times$ 2 (instruction) design was used as in Study 1.

Materials

Sentence predicate task. A shorter version of the sentence predicate task was used in Study 2, with 16 rather than 24 predicates presented.[4] Four predicates represented each of the four trait categories described in Study 1. All other aspects of this task were identical to Study 1, with exceptions as noted.

Stereotype activation task. A lexical decision task was used to measure stereotype activation. Participants completed a total of 150 trials, with 51 trials containing pronounceable nonwords (e.g., pupir, ketchen) and 99 consisting of words. Of the 99 words, 33 were target items, with 11 words related to memory failures (e.g., forget, confused), 11 words relating to memory successes (e.g., remember, retain), and 11 words related to negative, nonmemory aspects of aging (e.g., bitter, frail). Of the remaining words, 33 were positive traits that were nonstereotypic of the elderly (e.g., curious, eager), and 33 were neutral nouns (e.g., uniform, mountains). These words served as filler items to prevent participants from developing a response set to the target items. The target items were equal in word frequency ($p > .14$) and word length ($p > .24$) to both the nonstereotypic positive traits and neutral nouns.

Prerecall questionnaire. In line with previous work on stereotype threat (Spencer et al., 1999; Steele & Aronson, 1995), measures of self-efficacy, evaluation apprehension, and anxiety were included as potential mediators of the effects of stereotype threat on memory performance.

Self-efficacy was measured using five statements (e.g., ''I am unsure if I have the ability do well on this task'') to which participants had to indicate their level of agreement or disagreement using a (1) *strongly disagree* to (5) *strongly agree* scale. Evaluation apprehension was measured using two statements (e.g., ''Others may question my ability if I don't do well on this task.''). The same 5-point scale was used. State anxiety was measured using a short form of the Spielberger State-Trait Anxiety Inventory (STAI; Marteau & Bekker, 1992). The short form contains six statements (e.g., ''I am worried'') and participants circle a number from (1) *not at all* to (4) *very much*

[4]Because the mean number recalled in Study 1 was 8.95 predicates for young adults ($SD = 4.01$) and 6.05 predicates for older adults ($SD = 3.87$), it was clear that a shorter list would also demonstrate age differences in this task.

to indicate how they are feeling right now. All three scales had good internal consistency: self-efficacy Cronbach's $\alpha = .78$, evaluation apprehension Cronbach's $\alpha = .92$, and STAI Cronbach's $\alpha = .75$.

Perceived stereotype threat. Participants completed a measure of perceived stereotype threat. The five questions (see Appendix A) assess people's beliefs about age and memory and they were adapted from Steele and Aronson (1995). Participants responded to a 5-point scale ranging from (1) *strongly disagree* to (5) *strongly agree*. The composite scale had good internal consistency, Cronbach's $\alpha = .79$.

Procedure

In this study, a maximum of three same-aged people participated per session, and all participants in a session were assigned to the same condition, impression formation or memorization. Participants read the sentence predicates on a computer screen. They then completed the lexical decision task. On each trial, participants first saw a central fixation point for 200 ms, followed by a blank screen for 200 ms. Next, a word or nonword was presented, and participants pressed either a Yes or No key to indicate whether the item was a word. The z and/ keys were used as the response keys, and were counterbalanced across subjects. The word or nonword remained on the screen either until the participant responded or until 5000 ms elapsed, whichever came first. A blank screen then appeared for 2000 ms before the next trial began. The items were presented randomly in three blocks of 50 trials, and participants took brief breaks between blocks.

Next, participants were reminded of their initial task instructions and completed the prerecall questionnaire, assessing self-efficacy, evaluation apprehension, and anxiety. Participants then completed the recall task, followed by the stereotype threat measure.[5] Lastly, they completed a vocabulary task, a background information sheet, and were then debriefed, compensated, and thanked for their participation.

[5]For Studies 2 and 3, a follow-up questionnaire was administered after the recall (or recognition) task to assess participants' experiences during the memory task that they had just completed. No informative results were obtained from this measure, so it will not be discussed further. For information about this measure, please contact the first author.

Results and Discussion

Data Analysis

The sentence predicates from the recall task were again scored by two experimenters using a 'gist' protocol. The interjudge reliability was 0.95.

Recall Performance

A 2 (age) $\times$ 2 (instruction) between-subjects ANOVA was conducted on the proportion of correctly recalled sentence predicates (see Table 1). As before, young adults recalled more predicates than older adults, $F(1, 77) = 16.40$, $p < .001$, $\eta^2 = .18$, and participants in the impression formation condition recalled more sentence predicates than participants in the memorization condition, $F(1, 77) = 18.18$, $p < .001$, $\eta^2 = .19$. The Age $\times$ Instruction interaction was again nonsignificant, $F < 1$. Thus, although impression instructions boosted performance, they did so for both young and older participants equivalently.

Stereotype Activation

The responses of interest in the lexical decision task were those made to the three types of target words: memory failures, memory successes, and negative aging words. Each participant's latency data were checked for errors and outliers. All errors and outliers ($M \pm 2.5$ *SDs*) were excluded as missing values. The mean exclusion rate was 4.00% for the young adults and 2.19% for the older adults. Mean response times by age and instruction are shown in Table 2.

A 2 (age: young or old) $\times$ 2 (instruction: impression or memory) $\times$ 3 (word type: memory failures, memory successes, or negative aging) repeated-measures ANOVA was then conducted on the target

Table 2. Mean latencies (ms) by age, instruction, and type of word

	Instruction	
Wordtype	**Impression**	**Memory**
	Young adults	
Memory failure	838 (176)	710 (117)
Memory success	730 (185)	645 (155)
Negative aging	637 (121)	577 (108)
	Older adults	
Memory failure	938 (248)	874 (153)
Memory success	869 (259)	791 (147)
Negative aging	776 (186)	773 (112)

Note. Standard deviations are in parentheses.

latencies, with the last factor within subject. Although there were three types of target words, two of them contained words related to memory. Apart from two anticipated findings, that older adults were slower than younger adults ($Ms = 836$ versus 689 ms, respectively), $F(1, 76) = 18.75$, $p < .001$, and responses to memory words were faster in the memorize than impression formation condition ($Ms = 728$ versus 797 ms, respectively), $F(1, 76) = 4.21$, $p < .05$, no other effects were relevant for the two types of memory-related words.[6] The items of greatest interest were those related to negative aging, because these items go to the heart of stereotype activation in older adults. Young adults were slightly faster on the negative aging words in the memorize condition than in the impression condition, $t(40) = 1.69$, $p < .10$, suggesting that the memorize instructions (at least in the context of this test) activated negative views of older adults. Unlike younger adults, older adults in the two instruction conditions did not differ in their speed of response to negative aging words, $t(36) = 0.07$, $p > .94$. Either negative stereotypes were not activated in either group—or, as subsequent findings suggest—they were equally activated in both groups.

Perceived Stereotype Threat

Evidence consistent with the reaction time findings for older adults' responses to negative words in the lexical decision task comes from the measure of perceived stereotype threat. Older adults perceived greater stereotype threat about aging and memory ($M = 2.62$, $SD = .74$) than did the younger adults ($M = 1.59$, $SD = .57$), $F(1, 73) = 46.49$, $p < .001$, $\eta^2 = .39$. No other effects, including that of instructions, were significant, $Fs < 1$. Thus, the older adults, regardless of whether the instructions mentioned memory or not, showed greater stereotype threat than the younger adults.

Mediation Analyses

In order to determine the influence of perceived stereotype threat on the relation between age and recall, we conducted a mediation analysis. Following the regression procedure of Baron and Kenny (1986), we first demonstrated the direct effect of age on recall by regressing

[6]There was also a significant Instruction × Wordtype interaction, Wilks' Lambda = .91, $F(2, 75) = 3.56$, $p < .05$, $\eta^2 = .09$. Post hoc comparisons on the effects of instruction for each type of word revealed the source of the interaction. Participants in the memorize condition responded faster to both sets of memory words (failure and success) than participants in the impression condition, consistent with the idea that memory instructions prime memory-related words. Neither the Age × Instruction × Word type interaction nor any others were significant, all $Fs < 1$.

recall performance on age, $\beta = -.39$, $p < .001$. Next, we regressed the mediator, stereotype threat, on age and found a significant positive relation, $\beta = .62$, $p < .001$. Finally, we regressed recall performance on age and stereotype threat simultaneously. Stereotype threat significantly predicted recall, $\beta = -.43$, $p < .01$, but the effect of age was reduced to nonsignificance, $\beta = -.10$, $p > .40$. A modified Sobel test revealed that the direct effect of age on recall performance was significantly reduced when stereotype threat was added to the equation, $Z = 3.01$, $p < .01$. These data indicate that stereotype threat completely mediated the relation between age and recall performance (Figure 1*a*). Age was positively associated with stereotype threat, suggesting that with increased age, stereotype

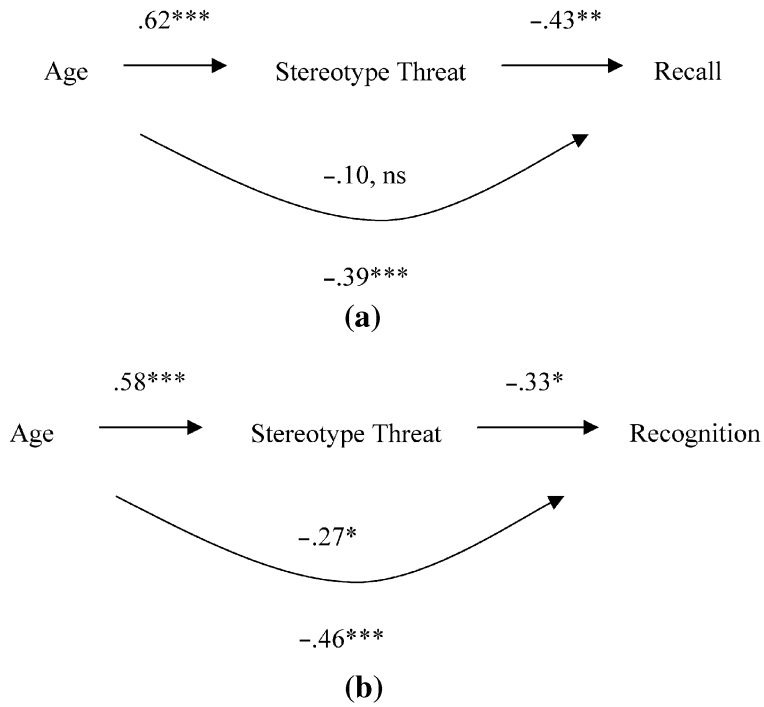

Figure 1. Mediation of stereotype threat in age differences in (*a*) recall and (*b*) recognition. Path coefficients are standardized betas. The coefficient below the path from age to memory performance represents the direct effect without stereotype threat in the model. The coefficient above the path represents the direct effect when stereotype threat is included in the model. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

threat levels increase. Stereotype threat was negatively associated with recall performance, indicating that the more threat individuals felt about aging and memory, the worse their performance on the recall task.

An initial purpose of these studies was to determine whether age differences in memory performance could be eliminated using instructional sets and memory tasks that differed from those used by Rahhal et al. (2001). Although we found a consistent effect of instructions on performance, that effect occurred in both age groups, with participants in the impression condition recalling more predicates than participants in the memory condition. This condition effect was not moderated by age, and age differences in recall were robust across the two studies. Given that stereotype threat mediated the relation between age and memory performance, it would seem that the instructions failed to have any effect on people's levels of stereotype threat. We tested this notion by regressing stereotype threat on instruction type, and found no relation between the two variables, $\beta = -.01$, $p > .95$. Thus, although the impression instructions improved older adults' memory performance, they did not ameliorate the negative effects of stereotype threat.

Prerecall Questionnaire

A series of 2 (age) $\times$ 2 (instruction) ANOVAs were conducted on the self-efficacy, evaluation apprehension, and state anxiety measures. For self-efficacy, participants in the impression condition reported higher levels of self-efficacy ($M = 4.05$) than participants in the memory condition ($M = 3.53$), $F(1, 77) = 9.40$, $p < .01$. No other effects were significant, $Fs < 1.25$. For state anxiety, young adults reported greater anxiety ($M = 1.68$) than older adults ($M = 1.45$), $F(1, 77) = 5.38$, $p < .05$. No other effects were significant, $Fs < 1$, and there were no significant effects for evaluation apprehension, $Fs < 2.23$.

Because there were no age differences in self-efficacy, it was not possible to examine self-efficacy as a potential mediator of the relation between age and recall. However, we were able to examine whether self-efficacy mediated the relation between instructions and recall. Although there was a direct relation between recall and instructions, $\beta = -.41$, $p < .001$, and a negative relation between instruction and self-efficacy, $\beta = -.33$, $p < .01$, there was no significant relation between self-efficacy and recall, $\beta = .16$, $p > .13$. Thus, unlike stereotype threat, self-efficacy did not influence memory performance.

As in Study 1, impression formation instructions did not reduce age differences observed when participants were given memory

instructions. The results of Study 2, however, clearly suggest that the overall recall differences can be attributed to the fact that stereotype threat was present for older adults in both instruction conditions. This was seen directly in the mediation analysis showing that age differences in memory performance were completely mediated by stereotype threat. Indeed, the direct relation between age and recall became nonsignificant when stereotype threat was included in the analysis. These data suggest that stereotype threat regarding memory increases with age, and further, that the more stereotype threat participants felt, the worse their recall performance. The lexical decision data support this point because the older adults were equally fast in their responses to negative aging words independent of instructions. Apparently, older adults in both conditions were affected by stereotype threat, reducing or eliminating any benefits that might otherwise have been seen in the impression formation condition.

STUDY 3

The present findings indicate that older adults feel threatened by stereotypes of aging and memory, even when the memorial aspects of a memory task are de-emphasized. These stereotype perceptions, in turn, worsen older adults' recall performance. In Study 3, we sought to determine whether this would also be the case for recognition performance. Using a paradigm similar to Study 2, participants received either memorization or impression instructions and then read a series of sentence predicates. Later, they completed a recognition test as well as a measure of perceived stereotype threat. We note that the Rahhal et al. (2001) study that eliminated age differences in memory used a recognition test rather than recall as in Studies 1 and 2. It is possible that instructions are more effective in a task like recognition that has more environmental support (Craik & McDowd, 1987) than recall. Based on the findings of Study 2, we also expected that perceived stereotype threat would mediate the relation between age and recognition memory performance.

Method

Participants and Design

Forty-five older adults and 43 young adults were recruited and compensated as before. Seven participants were excluded from the analyses due to not following instructions ($N = 4$) or to a computer malfunction ($N = 3$). Thus, the remaining sample consisted of 40 older adults ($M_{age} = 70.4$ years, range = 64–84 years, 62.5% female),

and 41 young adults ($M_{age} = 18.80$ years, range = 17–22 years, 75.6% female). The older adults had significantly more years of education than the young adults (Ms = 15.46 versus 12.41, respectively), $t(78) = -6.90$, $p < .001$. For self-ratings of health, the older adults had higher ratings ($M = 4.26$, $SD = .72$) than the young adults ($M = 4.10$, $SD = .62$), but this difference was not significant, $t(78) = -1.06$, $p < .30$. The same Age × Instruction design was used as in the previous two studies.

Materials

Virtually all of the materials were the same as in Study 2, with the exception of the recognition task. For that task, a total of 66 sentence predicates were used, with 28 presented at the encoding stage, 28 presented as foils during the recognition test, and 10 fillers. The two lists of 28 sentence predicates represented an expanded version of the predicates used in Study 1 and both lists represented the same four trait categories. The two lists contained predicates that had similar sentence structure so as to make the task sufficiently challenging (e.g., an item from List 1 was "Read a medical journal" and an item from List 2 was "Read a law review"). In addition, there were also 10 sentence predicates created as fillers, which were not representative of the four trait categories.

We pilot-tested the newly created sentence predicates to ensure they were appropriate examples of the four trait categories. Nine judges rated how well each predicate described its corresponding trait category using a (1) *not at all* to (7) *extremely* scale. The mean descriptiveness ratings were 5.4 ($SD = 0.82$) for List 1 and 5.5 ($SD = 0.94$) for List 2, suggesting that these newly created sentence predicates appropriately tapped the 4 trait categories.

During the recognition test, participants were presented with the 28 predicates they had seen earlier in addition to 28 foils and 10 distracters. The predicates were randomly presented on the computer screen one at a time and participants were required within 10 s to either press the "old" key if a predicate had the same exact wording as one they saw before, or press the "new" key if the predicate was different and not one they had seen before.

Procedure

The same basic procedure was used as in Study 2, with a few exceptions. Consistent with Rahhal et al. (2001), most of the older participants were tested in the morning and most of the younger adults were tested in the afternoon. The instructions for the memorization condition were changed from the original stating we would ask them

questions to explicitly indicating that memory for the sentence predicates would be tested. At presentation, participants received either List 1 or List 2 of the predicates, with the other list serving as foils during the recognition test. After viewing the predicates, participants completed the measures of self-efficacy, evaluation apprehension, and anxiety. Next, they completed a 3-min filler task and then proceeded to the recognition test. Following the test, participants completed the stereotype threat measure and then were debriefed, compensated, and thanked for their participation.[7]

Results and Discussion

Recognition Performance

Hits, false alarms, and corrected recognition (hits – false alarms) are shown in Table 3. A 2 (age) × 2 (instruction type) ANOVA was performed on the corrected recognition scores. Participants in the impression condition were more accurate (32%) than participants in the memorize condition (27%), $F(1, 77) = 5.75$, $p < .05$, $\eta^2 = .07$. Younger adults (34%) were more accurate than older adults (24%), $F(1, 77) = 22.84$, $p < .001$, $\eta^2 = .23$. The interaction was not significant, $F < 1$. These data replicate our findings with recall performance and demonstrate that impression formation strategies improve memory function in both age groups but do not reduce the age differences.

Perceived Stereotype Threat

Reliability for the stereotype threat measure was similar to Study 2 (Cronbach's $\alpha = .74$). As in Study 2, older adults reported greater stereotype threat ($M = 2.56$, $SD = .59$) than younger adults ($M = 1.64$, $SD = .70$), $F(1, 77) = 40.43$, $p < .001$, $\eta^2 = .34$. No other effects were significant, Fs < 1.

Mediation Analyses

The regression procedure used in Study 2 was used in this study to determine whether people's feelings of stereotype threat mediate the relation between age and recognition performance. The results are consistent with those of Study 2. Age had a direct effect on corrected

[7]A stereotype activation task was not included in the Study 3 for two reasons. First, we were concerned that presenting words related to aging stereotypes prior to the recognition test might affect older adults' performance and nullify any potential benefits of the impression instructions. Second, we wanted to test the efficacy of the impression instructions using a paradigm that closely resembled that used by Rahhal et al. (2001), who also did not include an activation task.

Table 3. Mean percentage of hits, false alarms, and corrected recognition by age and instruction for study 3

Instruction type	Hits	False alarms	Corrected recognition
		Young adults	
Impression	.88	.15	.37
	(.08)	(.11)	(.08)
Memory	.86	.22	.32
	(.12)	(.14)	(.12)
		Older adults	
Impression	.75	.22	.27
	(.14)	(.17)	(.10)
Memory	.71	.28	.21
	(.13)	(.13)	(.09)

Note. Standard deviations are in parentheses. Corrected recognition = hits − false alarms.

recognition, $\beta = -.46$, $p < .001$. Regressing stereotype threat on age indicated a positive relation between age and the mediator, $\beta = .58$, $p < .001$. The final regression of corrected recognition on age and stereotype threat showed that stereotype threat significantly predicted recognition, $\beta = -.33$, $p < .01$. The effect of age was reduced to $\beta = -.27$, $p < .05$. A modified Sobel test indicated that the direct effect of age on recognition was significantly reduced when stereotype threat was added to the equation (see Figure 1*b*), $Z = 2.57$, $p = .01$. People's perceptions of stereotype threat partially mediated the relation between age and recognition performance. A similar pattern was obtained as in Study 2—age was positively associated with stereotype threat, and stereotype threat was negatively associated with recognition performance.[8] In both studies, stereotype threat significantly influenced memory performance, as it completely mediated the relation between age and recall (Study 2) and partially mediated the relation between age and recognition (Study 3). It may be that stereotype threat was a stronger mediator of recall because of the reduced amount of environmental support that is available for that task (Craik & McDowd, 1987). With less environmental support, older adults had fewer tools with which to perform the recall task and might have been affected more by feelings of stereotype threat.

[8]In order to ensure that the mediation was not due to the use of an extreme groups design, we examined the correlations between perceived threat and memory performance in the older adult samples for both Studies 2 and 3. The correlations were in the expected direction ($r = -.42$, $p = .01$; $r = -.32$, $p < .05$ for Studies 2 and 3, respectively), demonstrating that the mediation represents a robust relation between age, perceived threat, and memory performance.

In any case, despite differences in task characteristics, stereotype threat mediated memory performance for both recall and recognition. Further, as before, the instructions participants received had no effect on their feelings of stereotype threat, $\beta = -.01$, $p > .95$.

Other Effects

Internal consistency for each of the prerecognition measures was self-efficacy Cronbach's $\alpha = .80$, evaluation apprehension Cronbach's $\alpha = .76$, and STAI Cronbach's $\alpha = .57$. Analyses indicated that participants in the impression condition again had greater self-efficacy ($M = 4.13$) than participants in the memorize condition ($M = 3.23$), $F(1, 77) = 38.28$, $p < .001$. Participants in the memorize condition felt greater anxiety ($M = 1.68$) than those in the impression condition ($M = 1.47$), $F(1, 77) = 4.29$, $p < .05$. No other effects were significant, Fs < 1.25.

Additional regression analyses were conducted to see whether state anxiety mediated the relation between instruction type and memory performance. Anxiety was only a marginally significant predictor of corrected recognition, $\beta = -.21$, $p < .06$, and although the effect of instruction type was reduced to nonsignificance, $\beta = .17$, $p > .13$, the Sobel test indicated that this was not a significant reduction, $Z = 1.41$, $p > .15$. Thus, state anxiety did not mediate the relation between instruction type and corrected recognition. Self-efficacy also did not mediate the relation between instruction type and recognition, as it again failed to significantly predict memory performance, $\beta = .15$, $p > .25$.

Thus, the results of Study 3 replicate those found in the earlier experiments. These data confirm that although impression formation instructions improve older adults' memory performance, they do not reduce the feelings of stereotype threat that older participants experience in the laboratory. Moreover, these results show that feelings of stereotype threat worsen memory performance for older adults, both for recall and recognition tasks. Although participants in the memorization condition felt greater anxiety than those in the impression condition, this pattern did not differ for younger and older adults. More importantly, anxiety did not mediate the relation between instruction type and recognition performance, reinforcing the notion that perceived stereotype threat has a strong influence on memory function.

GENERAL DISCUSSION

Across three studies we found that impression formation instructions led to better recall and recognition performance than did

memorization instructions. The benefits of the impression instructions were not differential, however, as age differences in recall were still obtained. The failure to eliminate these age differences suggests that there were other factors operating that affected the older participants' memory performance. Clearly, one factor was stereotype threat. Across two types of memory tasks, older adults showed higher levels of stereotype threat than young adults. Moreover, stereotype threat mediated the relation between age and memory performance. Finally, instruction type had no effect on stereotype threat. These results, in conjunction with those of Rahhal et al. (2001) and Hess et al. (2003), highlight the importance of considering the social context of memory performance. In addition, these results suggest future attempts to reduce or eliminate age differences in memory performance should address the stereotype threat that older adults feel in laboratory situations.

It is not yet clear what the conditions are that decrease or eliminate age differences in memory performance. One factor may be the explicitness of the instructions used to counter stereotype threat effects. For example, Hess and colleagues (2003) used a relatively strong manipulation, giving participants two articles containing positive information about aging and memory prior to their completing a recall task. In a less explicit approach, Rahhal et al. (2001) de-emphasized the memorial nature of the recognition task by framing it as a test of learning. Using an approach similar to Rahhal et al., we de-emphasized the memorial components by framing the recall and recognition tasks as impression formation tasks.

Unlike Rahhal et al., however, we did not reduce age differences in memory performance, either for recall or for recognition. This could be due to any number of factors, including the particular instructions used in both studies. It may also be tied to a combination of instructions and materials. Other evidence suggests that the information in the Rahhal et al. study (true and false statements) is of special interest to older adults (Rahhal et al., 2002). Although we expected that behavioral descriptions that imply various traits about an unknown person would be at least as engaging as the statements used by Rahhal et al., it may be the case that they were actually less so. This remains to be seen. In any event, it is clear that our failure to reduce age differences in memory performance was due to the fact that in both instruction conditions, older adults felt greater stereotype threat than younger adults. The results of the mediation analyses show that experiencing greater stereotype threat was associated with poorer memory function on both recall and recognition tasks. Future work should continue to assess both how older adults' interest in task

stimuli and how framing memory task instructions affect their performance. Although interventions exist now that can improve older adults' memory function, it remains to be seen whether the above factors could work in combination to actually restore older adults' memory function to the level of younger adults.

Besides specifying the role that perceived stereotype threat plays in the relation between age and recall performance, the present study also extends previous research on person memory. Across three studies, forming impressions based on the sentence predicates led to better recall and recognition in both younger and older adults. These findings suggest that processing information with the aim of achieving a social goal (forming an impression) is a viable strategy for improving older adults' memory function, and is consistent with other work showing the benefits of deeper encoding of information (for a review see Craik & Jennings, 1992). Although the present study used behavioral descriptions as the stimuli, it might be possible to use an impression goal to improve memory for other types of listed information, such as locations and objects. For example, participants could be told that an individual went to the following places and events (e.g., bookstore, café, symphony concert) and they should use those locations to form an impression of the person. Thus, person perception goals might provide an effective means for improving older adults' memory for a variety of information.

We note that the impression formation instructions also increased participants' feelings of self-efficacy in both Studies 2 and 3. However, self-efficacy did not mediate the relation between instruction type and memory function. Thus, although the impression instructions appeared to improve participants' affective state, it did not strongly influence their memory function, unlike their feelings of stereotype threat. We note that in the case of the present study, the self-efficacy questions were framed within the context of different instructional conditions, and others have suggested that context can easily influence the relation between self-efficacy and memory performance (Cavanaugh, 2000; Hertzog & Hultsch, 2000).

In conclusion, the present data suggest that social context is an important factor determining older adults' memory performance, consistent with other recent findings (Hess et al., 2003; Rahhal et al., 2001, 2002). Here we showed that feelings of stereotype threat regarding aging and memory influenced the relation between age and memory performance on both recall and recognition tasks. More research is required to determine precisely how this mechanism affects performance, but it is clear that perceived stereotype threat is an important determinant of memory functioning.

REFERENCES

Aronson, J., Lustina, M. J., Good, C., Keough, K., Steele, C. M., & Brown, J. (1999). When white men can't do math: Necessary and sufficient factors in stereotype threat. *Journal of Experimental Social Psychology*, *35*, **29–46.**

Baron, R. M. & Kenny, D. A. (1986). The moderator-mediator variable in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, **1173–1182.**

Berry, J. M., West, R. L., & Dennehy, D. M. (1989). Reliability and validity of the Memory Self-Efficacy Questionnaire. *Developmental Psychology*, *5*, **701–713.**

Carstensen, L. L. & Turk-Charles, S. (1994). The salience of emotion across the adult life course. *Psychology and Aging*, *9*, **259–264.**

Cavanaugh, J. C. (1996). Memory self-efficacy as a moderator of memory change. In F. Blanchard-Fields & T. M. Hess (Eds.), *Perspectives on cognitive change in adulthood and aging* **(pp. 488–507). New York: McGraw-Hill.**

Cavanaugh, J. C. (2000). Metamemory from a social-cognitive perspective. In D. C. Park & N. Schwarz (Eds.), *Cognitive aging: A primer* **(pp. 115–130). Philadelphia, PA: Psychology Press.**

Chartrand, T. L. & Bargh, J. A. (1996). Automatic activation of impression formation and memorization goals: Nonconscious goal priming reproduces effects of explicit task instructions. *Journal of Personality and Social Psychology*, *71*, **464–478.**

Chasteen, A. L. (2000). The role of age and age-related attitudes in perceptions of elderly individuals. *Basic and Applied Social Psychology*, *22*, **147–156.**

Chasteen, A. L., Schwarz, N, & Park, D. C. (2002). The activation of aging stereotypes in younger and older adults. *Journal of Gerontology: Psychological Sciences*, *57B*, **P540–P547.**

Craik, F. I. M. & Jennings, J. M. (1992). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition* **(pp. 51–110). Hillsdale, NJ: Lawrence Erlbaum.**

Craik, F. I. M. & McDowd, J. M. (1987). Age differences in recall and recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *13*, **474–479.**

Davies, P. G., Spencer, S. J., Quinn, D. M., & Gerhardstein, R. (2002). Consuming images: How television commercials that elicit stereotype threat can restrain women academically and professionally. *Personality and Social Psychology Bulletin*, *28*, **1615–1628.**

Dixon, R. A. & Hultsch, D. F. (1983). Structure and development of metamemory in adulthood. *Journal of Gerontology*, *38*, **682–688.**

Erber, J. T. (1989). Young and older adults' appraisal of memory failures in young and older adult target persons. *Journal of Gerontology: Psychological Sciences*, *44*, **P170–P175.**

Gilewski, M. J., Zelinski, E. M., & Schaie, K. W. (1990). The Memory Functioning Questionnaire for assessment of memory complaints in adulthood and old age. *Psychology and Aging*, *5*, **482–490.**

Hamilton, D. L., Katz, L. B., & Leirer, V. O. (1980). Cognitive representation of personality impression: Organizational processes in first impression formation. *Journal of Personality and Social Psychology, 30*, 1050–1063.

Heckhausen, J., Dixon, R. A., & Baltes, P. B. (1989). Gains and losses in development throughout adulthood as perceived by different adult age groups. *Developmental Psychology, 25*, 109–121.

Hertzog, C. & Hultsch, D. F. (2000). Metacognition in adulthood and old age. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition*, (2nd ed., pp. 417–466). Mahwah, NJ: Erlbaum.

Hess, T. M., Auman, C., Colcombe, S. J., & Rahhal, T. A. (2003). The impact of stereotype threat on age differences in memory performance. *Journal of Gerontology: Psychological Sciences, 58B*, P3–P11.

Hultsch, D. F., Hertzog, C., & Dixon, R. A. (1987). Age differences in metamemory: Resolving the inconsistencies (Special Issue). *Canadian Journal of Psychology, 41*, 193–208.

Hummert, M. L., Garstka, T. A., Shaner, J. L., & Strahm, S. (1994). Stereotypes of the elderly held by young, middle-aged, and elderly adults. *Journal of Gerontology: Psychological Sciences, 49*, P240–P249.

Kite, M. E. & Johnson, B. T. (1988). Attitudes toward older and younger adults: A meta-analysis. *Psychology and Aging, 3*, 233–244.

Lachman, M. E., Bandura, M., Weaver, S. L., & Elliott, E. (1995). Assessing memory control beliefs: The Memory Controllability Inventory. *Aging and Cognition, 2*, 67–84.

Levy, B. (1996). Improving memory in old age through implicit self-stereotyping. *Journal of Personality and Social Psychology, 71*, 1092–1107.

Levy, B. & Langer, E. (1994). Aging free from negative stereotypes: Successful memory in China and among the American deaf. *Journal of Personality and Social Psychology, 66*, 989–997.

Levy, B. R., Hausdorff, J. M., Hencke, R., & Wei, J. Y. (2000). Reducing cardiovascular stress with positive self-stereotypes of aging. *Journal of Gerontology: Psychological Sciences, 55B*, P205–P213.

Lindenberger, U. & Baltes, P. B. (1994). Sensory functioning and intelligence in old age: A strong connection. *Psychology and Aging, 9*, 339–355.

Lineweaver, T. T. & Hertzog, C. (1998). Adults' efficacy and control beliefs regarding memory and aging: Separating general from personal beliefs. *Aging, Neuropsychology, and Cognition, 5*, 264–296.

Loewen, E. R., Shaw, R. J., & Craik, F. I. M. (1990). Age differences in components of metamemory. *Experimental Aging Research, 16*, 43–48.

Marteau, T. M. & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety Scale (STAI). *British Journal of Clinical Psychology, 31*, 301–306.

McDonald-Miszczak, L., Hertzog, C., & Hultsch, D. F. (1995). Stability and accuracy of metamemory in adulthood and aging: A longitudinal analysis. *Psychology and Aging, 10*, 553–564.

Rahhal, T. A., Hasher, L., & Colcombe, S. J. (2001). Instructional manipulations and age differences in memory: Now you see them, now you don't. *Psychology and Aging, 16*, 697–706.

Rahhal, T. A., May, C. P., & Hasher, L. (2002). Truth and character: Sources that older adults can remember. *Psychological Science*, *13*, 101–105.

Raz, N. (2000). Aging of the brain and its impact on cognitive performance: Integration of structural and functional findings. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition*, (2nd ed., pp. 1–90). Mahwah, NJ: Erlbaum.

Reuter-Lorenz, P. A. (2000). Cognitive neuropsychology of the aging brain. In D. C. Park & N. Schwarz (Eds.), *Cognitive aging: A primer* (pp. 93–114). Philadelphia, PA: Psychology Press.

Roenker, D. L., Thompson, C. P., & Brown, S. C. (1971). Comparison of measures for the estimation of clustering in free recall. *Psychological Bulletin*, *76*, 45–48.

Ryan, E. B. (1992). Beliefs about memory changes across the adult life span. *Journals of Gerontology: Psychological Sciences*, *48*, P199–P201.

Ryan, E. B. & Kwong See, S. (1993). Age-based beliefs about memory changes for self and others across adulthood. *Journal of Gerontology: Psychological Sciences*, *48*, P199–P201.

Schmidt, D. F. & Boland, S. M. (1986). The structure of impressions of older adults: Evidence for multiple stereotypes. *Psychology and Aging*, *1*, 255–260.

Schneider, B. A. & Pichora-Fuller, M. K. (2000). Implications of perceptual deterioration for cognitive aging research. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition*, (2nd ed., pp. 155–220). Mahwah, NJ: Erlbaum.

Shipley, W. C. (1986). *Shipley Institute of Living Scale*. Los Angeles: Western Psychological Services.

Smith, G. E., Petersen, R. C., Ivnik, R. J., Malec, J. F., & Tangalos, E. G. (1996). Subjective memory complaints, psychological distress, and longitudinal change in objective memory performance. *Psychology and Aging*, *2*, 272–279.

Soederberg Miller, L. M. & Lachman, M. E. (1999). The sense of control and cognitive aging: Toward a model of mediational processes. In T. M. Hess & Blanchard-Fields, F. (Eds.), *Social cognition and aging* (pp. 17–42). San Diego, CA: Academic Press.

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, *35*, 4–28.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, *52*, 613–629.

Steele, C. M. & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, *69*, 797–811.

Stein, R., Blanchard-Fields, F., & Hertzog, C. (2002). The effects of age stereotype priming on the memory performance of older adults. *Experimental Aging Research*, *28*, 169–181.

Yoon, C., Hasher, L., Feinberg, F., Rahhal, T. A., & Winocur, G. (2000). Cross-cultural differences in memory: The role of culture-based stereotypes about aging. *Psychology and Aging*, *15*, 694–704.

Zacks, R. T., Hasher, L., & Li, K. Z. H. (2000). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition*, (2nd ed., pp. 293–358). Mahwah, NJ: Erlbaum.

APPENDIX A

Please indicate how much you agree or disagree with each of the statements below by indicating the appropriate number using the scale below:

1 2 3 4 5
strongly disagree strongly agree

Some people feel I have less memory ability because of my age.
Based on my age, people often underestimate my memory ability.
I often feel I have to prove to others that their perceptions of my memory ability are wrong.
The experimenter expected me to do poorly because of my age.
In memory experiments people my age often face biased evaluations.