Psychology and Aging
2004, Vol. 19, No. 3, 495–505

0882-7974/04/$12.00 DOI: 10.1037/0882-7974.19.3.495

Explicit and Implicit Stereotype Activation Effects on Memory: Do Age and Awareness Moderate the Impact of Priming?

Thomas M. Hess, Joey T. Hinson, and Jill A. Statham
North Carolina State University

Two studies examined the effects of implicit and explicit priming of aging stereotypes. Implicit primes had a significant effect on older adults' memory, with positive primes associated with greater recall than negative primes. With explicit primes, older adults were able to counteract the impact of negative stereotypes when the cues were relatively subtle, but blatant stereotype primes suppressed performance regardless of prime type. No priming effects under either presentation condition were obtained for younger adults, indicating that the observed implicit effects are specific to those for whom the stereotype is self-relevant. Findings emphasize the importance of social-situational factors in determining older adults' memory performance and contribute to the delineation of situations under which stereotypes are most influential.

Although the biological bases for many aspects of normative and nonnormative variation in memory during adulthood are well-established (Craik & Grady, 2002; Prull, Gabrieli, & Bunge, 2000; Raz, 2000), there is emerging evidence that age differences in performance may also have social underpinnings. In particular, negative stereotypes of old age have been implicated as potential moderators of between-group differences in memory performance. There is substantial evidence that individuals in the United States possess relatively negative stereotypes of older adults' memory abilities (for a review, see Hummert, 1999), and it has been hypothesized that internalization of such stereotypes by older adults may affect memory performance through their impact on implicit theories and self-referent beliefs about cognition (Hertzog & Hultsch, 2000). Some initial evidence for the importance of stereotypes was obtained by Levy and Langer (1994), who found that variations in views about aging accounted for cross-cultural differences in memory performance in older adults. Specifically, older adults in cultures that hold generally positive views of aging (e.g., mainland China) performed better than similarly aged adults in cultures holding less positive views (e.g., United States). Although the specific mechanisms accounting for these effects are still unclear, Levy and Langer speculated that internalization of beliefs may influence things like effort and strategy use, which in turn affect level of memory performance.

Whereas the findings of Levy and Langer's (1994) study are certainly provocative, interpretation of the results is not unambiguous given the complexities of conducting cross-cultural research. For example, the comparability of the Chinese and American samples might be questioned, leading to the possibility of between-group variation in important characteristics other than views of aging. Some of this concern is reinforced by a similar study by Yoon, Hasher, Feinberg, Rahhal, and Winocur (2000) that used a sample of Anglophone Canadians and recently emigrated Chinese Canadians. These researchers found that Chinese Canadians possessed more positive views of aging than did Anglophone Canadians and that age differences in memory performance were smaller in the former group than in the latter. In contrast to Levy and Langer's findings, however, a positive view of aging was not found to mediate cultural differences in memory and culturally based differences in performance were not consistent across memory tests. Certainly, the fact that all participants in this study had some exposure to Western culture may have dampened the cross-cultural effects observed by Levy and Langer. Still, the lack of consistency with respect to the mediational analyses is problematic for the perspective espoused by these researchers, who posit that attitude, and not just culture, is the operative mechanism.

Perhaps more important, however, is the consistency in effects regarding the relationship between culture, age, and memory performance in these two studies. Although Yoon et al. (2000) found that the culture-based effects were not uniform across tests, both sets of researchers observed smaller age differences in groups with more positive beliefs about aging. Such findings are suggestive of the importance of aging stereotypes, with the operative mechanism perhaps being different than those investigated in these studies. For example, subtle cues in the test situation may implicitly activate general culturally held stereotypes that then influence performance in a manner consistent with these stereotypes (e.g., Rahhal, Hasher, & Colcombe, 2001). The fact that expressed attitudes about aging are not always good predictors of more general group-based effects may relate to the fact that explicit and implicit attitudes are not identical and do not always act in concert (e.g., Devine, 1989).

To date, two published studies have examined implicit stereotype activation effects on older adults' memory, with mixed results. Levy (1996) examined changes in older adults' performance on five different memory tests following subliminal exposure to

Thomas M. Hess, Joey T. Hinson, and Jill A. Statham, Department of Psychology, North Carolina State University.

Support for this research was provided by National Institute on Aging Grant AG20153. We are indebted to Cassandra Germain, Natalie Andrews, Christine Heinrich, and Gabrielle Serang for their assistance in various phases of this project.

Correspondence concerning this article should be addressed to Thomas M. Hess, Department of Psychology, North Carolina State University, Raleigh, NC 27695-7801. E-mail: thomas_hess@ncsu.edu

positive or negative aging-related primes. In four of these, a significant interaction between time of test (pre- vs. postprime) and type of prime was observed, with the general pattern of performance conforming to expectations (i.e., a decline in memory following the negative prime and an increase following the positive prime). Complicating things a bit was the fact that prime effects were not consistent across tasks. For example, performance on only two tasks—both assessing visual memory for patterns of dots—exhibited significant decline following exposure to the negative prime, whereas the only task associated with significant improvements in performance following the positive prime was a face–activity association task. Of interest, Levy also found that the implicit priming effects were stronger than those associated with a more explicit manipulation designed to provide participants with positive or negative attributions for their performance. This appears to further highlight the fact that conscious mediation is not necessary for stereotype activation to influence behavior. This observation is reinforced by the results of other studies by Levy and colleagues that have found implicit priming of negative aging stereotypes to be associated with greater physiological response to stress (Levy, Hausdorff, Hencke, & Wei, 2000), reduced gait speed (Hausdorff, Levy, & Wei, 1999), poorer handwriting (Levy, 2000), and greater refusal of life-prolonging interventions (Levy, Ashman, & Dror, 1999–2000) in older adults.

Stein, Blanchard-Fields, and Hertzog (2002) attempted a replication of Levy's (1996) study but obtained results that were only partially consistent. Specifically, performance in the face–activity association task declined significantly following exposure to the negative prime, and this decline was also reliably greater when compared with a neutral priming condition. No significant effects were observed in the dot memory task. The reasons for the inconsistency across these two studies is unclear but may have to do with slight variations in procedures, the apparently more select older adult sample in Stein et al.'s study, and reduced statistical power in this same study. Of more importance, both studies provide some evidence for implicit stereotype activation effects—particularly with respect to negative stereotypes—on memory performance while also suggesting that the results are somewhat variable across settings.

Another interesting aspect of the findings from these two studies is that no priming effects were observed for younger adults. This result appears to contradict recent research suggesting that implicit priming results in stereotype-consistent behavior (i.e., assimilation), even in cases where the stereotype itself is not self-relevant. For example, Bargh, Chen, and Burrows (1996, Experiment 2) found that priming of the aging stereotype resulted in a reduction in younger adults' walking speed relative to a control condition. Dijksterhuis et al. (1998) replicated this result and also found that implicitly exposing younger adults to aging-related primes results in significant increases in response times in a lexical decision task (Dijksterhuis, Spears, & Lépinasse, 2001) and reduced performance in free recall (Dijksterhuis, Aarts, Bargh, & van Knippenberg, 2000).

Building on James's (1890) notion of ideomotor action, Bargh (1997) argued that implicit stereotype-based priming effects may reflect a relatively passive perception–behavior connection in which behavioral tendencies associated with the stereotype are activated following automatic activation of the stereotype. This same process may underlie the implicit priming effects observed by Levy (1996) in her study of aging and memory and may explain the failure of Yoon et al. (2000) to observe explicit attitudes mediating cultural effects on memory. That is, implicit priming of aging stereotypes may have a relatively direct effect on memory through the activation of associated behavioral tendencies, a process that does not necessitate the involvement of conscious mediation processes.

What, then, accounts for the discrepancy in effects associated with aging-related primes on younger adults' behavior across studies? Some of this variation in results may be explained by the nature of the tasks and the context in which performance was examined. In those studies in which young adults exhibited priming effects, the responses examined were relatively simple, unmonitored behaviors (e.g., walking speed, response times) performed within the context of other goal-directed activities. In contrast, research demonstrating differential impact of implicit priming across age groups examined performance directly associated with the conscious, goal-directed efforts of the individual. For example, in Dijksterhuis et al.'s (2000) study, incidental memory was examined for words encountered in a previous task; that is, participants were unaware that their memory for the words would be tested while they were viewing them. In comparison, Levy (1996) used an intentional memory task. Priming effects for members of the nonstereotyped group may be less pervasive than those of the stereotyped group, with effects limited to relatively simple types of behavior in relatively constrained contexts. In situations in which the individual engages in more conscious control (e.g., intentional memory task), the implicit effects may be overcome by activation of competing self-relevant goals (e.g., younger adults' perceptions of themselves as good learners) that result in goal-directed behaviors that counteract those associated with the primed stereotype. Steele, Spencer, and Aronson (2002) have recently made a similar point.[1]

Shih, Ambady, Richeson, Fujita, and Gray (2002) have also argued that implicit priming effects will be stronger with self-relevant stereotypes because of the lower thresholds of activation associated with such stereotypes. In partial support of this, Dijksterhuis et al. (2000) found that priming effects in younger adults increased in strength with an increase in contact with older people. This suggests that associative strength of the stereotype may also be an important determinant of priming effects associated with nongroup members.

Experiment 1

The present research was designed to further examine stereotype activation effects on memory performance. In Experiment 1, young and older adults were primed with either positive or negative aging stereotypes under either implicit or explicit conditions, after which they were presented with a memory test. In conducting this research, we were interested in examining three basic issues.

[1] The absence of an older adult comparison group in the Bargh et al. (1996) and Dijksterhuis et al. (1998, 2000, 2001) research does not preclude the possibility that the observed priming effects were weaker than those that would have been observed with participants to whom the stereotype was self-relevant. It is important to note, however, that prime effects across studies examining walking speed were very similar for young (Bargh et al., 1996) and older (Hausdorff et al., 1999) adults.

First, we wanted to determine whether implicit stereotyping effects on memory performance occur reliably with older adults. Given the inconsistency in results of previous studies, it seemed useful to conduct additional research to clarify these findings. We also thought it would be helpful to use a more typical type of memory task other than those used by Levy (1996) and Stein et al. (2002) to more firmly ground the results within the context of cognitive aging research. To do so, we examined free recall of a list of words, a task on which age-related decrements have been consistently observed in both cross-sectional and longitudinal studies (e.g., Hultsch, 1969; Schonfield & Robertson, 1966; Small, Dixon, Hultsch, & Hertzog, 1999). Given the intentional nature of this memory task and our interest in behavior reflective of the individual's conscious goal-directed activities, it was expected that implicit activation of aging stereotypes would have a significant impact on recall in older adults but minimal influence on younger adults' performance.

Second, we wanted to examine the extent to which responses to stereotypic information might differ as a function of participants' awareness of associated primes. Because we hypothesized that priming would not affect younger adults' performance in the present context, our main interest here was in the degree to which awareness moderated the effects of stereotype activation on older adults' performance. On the basis of existing empirical work, two alternative outcomes appeared plausible. Some research (e.g., Blair & Banaji, 1996; Devine, 1989; Kray, Thompson, & Galinsky, 2002; Lepore & Brown, 2002; but see Bargh, 1999) suggests that heightened awareness, such as might occur through blatant priming, results in stereotype reactance along with active attempts to counteract the negative implications of the stereotype. This may negate priming effects on performance. Other research (Shih et al., 2002) has suggested that blatant priming results in depressed performance, in part reflecting motivational factors (e.g., impression management) that in particular limit the positive effects of primes. This perspective might predict null priming effects as well, but with performance depressed in both prime conditions relative to that observed with positive implicit primes.

In addition to the memory task, several other measures were included that were thought to reflect more subjective reactions to the priming manipulation: performance predictions, anxiety, and self-handicapping. If observed priming effects reflect direct stereotype–behavior linkages, then primes might be expected to have minimal impact on such measures. In contrast, primes might also affect other responses to the situation, which in turn may mediate their impact on memory.

Such a scenario is thought to be associated with stereotype threat (Steele, 1997), which occurs as a result of an individual perceiving that they are in a situation in which their behavior has the potential to confirm a negative stereotype about a group to which they belong. This perception results in responses (e.g., heightened anxiety, evaluation concerns, reduced motivation) that are thought to mediate the relationship between threat and performance (Steele et al., 2002; Wheeler & Petty, 2001), perhaps through their impact on working memory (Schmader & Johns, 2003). In addition, threat effects are most likely to occur in individuals who identify with the stereotyped domain.

The results of a recent aging study by Hess, Auman, Colcombe, and Rahhal (2003) illustrate such relationships. Young and older adults read fictitious newspaper articles that depicted negative or positive views of the impact of aging on memory and then were given a memory test that they were told was designed to test the ideas conveyed in the articles. Consistent with the just-described characterization of stereotype threat, the negative information only depressed performance in the stereotyped group (i.e., older adults), with the greatest impact being observed in those most identified with the stereotyped domain (i.e., memory). In addition, the threat effects on memory performance were partially mediated by strategy use, which could be inferred to reflect level of motivation or availability of working memory capacity.

Of particular interest here was whether prime effects on these self-report variables would vary as a function of presentation condition. It was hypothesized that such relationships would not be observed in the implicit condition, reflecting the presumed ideomotor basis of the predicted prime effects on memory. In contrast, if the explicit primes serve to heighten threat, then stereotype activation should influence factors related to motivation, anxiety, and strategy use, all of which have been shown to be associated with stereotype threat (e.g., Hess et al., 2003; Kray, Galinsky, & Thompson, 2002; Spencer, Steele, & Quinn, 1999; Steele & Aronson, 1995). In addition, the strength of priming effects should also be moderated by domain identification.

Method

Participants

A total of 146 individuals from two different age groups were tested. For reasons described later, 25 of these participants were dropped from the study. The final sample consisted of 59 older adults (28 men, 31 women; M_{age} = 71.7 years, range = 57–81) and 62 younger adults (31 men, 31 women; M_{age} = 19.6 years, range = 17–27). The older adults were recruited from the community through newspaper advertisements and were paid $20 for their participation. The young adults were students in an introductory psychology class who fulfilled a course option through their participation.

Materials

Demographic information. We administered a background questionnaire to collect basic demographic information, including education, employment history, and age.

Health assessment. The SF-36 Health Survey (Ware, 1993) was used to collect data on both self-rated physical and mental health. Internal reliability coefficients for items used to calculate *T* scores relating to each of these aspects of health are high (αs = .88–.93).

Domain identification. The Memory Achievement subscale of the Metamemory in Adulthood Questionnaire (MIA-Ach; Dixon & Hultsch, 1984) was used to assess the value that individuals place on their memory ability as a measure of identification with the memory domain. The scale is composed of 16 items and has good demonstrated internal consistency (αs = .76–.79). Hess et al. (2003) found that scores on this scale moderated the impact of stereotype threat on recall.

Stereotype activation. A scrambled sentence task similar to that used by Bargh et al. (1996) was used to activate stereotypes about aging and memory. This task consisted of 30 sets of five words (e.g., *ran, fork, dog, the, home*). In each set, four of the words could be used to create a sentence (e.g., "*the dog ran home*"). In the negative condition, 20 of the sets contained a word reflecting negative stereotypes about aging *(brittle, complaining, confused, cranky, depended, depressed, feeble, forgot, fragile, grumpy, incompetent, inflexible, lonely, rigid, sedentary, senile, sickly, slowly, stubborn, tired*), whereas in the positive condition, 20 of the sets

contained a word corresponding to positive views about aging and competence (*accomplished, active, alert, dignified, distinguished, experience, generous, independence, insightful, interesting, kindness, knowledgeable, loving, patience, pride, respected, sociable, successful, understanding, wise*). Terms were drawn from other studies examining aging stereotypes (Bargh et al., 1996; Hummert, Garstka, Shaner, & Strahm, 1994; Levy, 1996). The remaining 10 sets in each condition contained words without clear aging implications (e.g., *high, are, dolphin, prices, gas*). The five words in each set were printed in random order on 5 in. × 7 in. (12.7 cm × 17.8 cm) index cards. For the aware condition, the age-related words were highlighted with a yellow background.

Anxiety. The 10-item State–Trait Anxiety Inventory, Short Form (STAI-S; Form Y; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) was used to assess self-reported state anxiety.

Self-handicapping. A five-item questionnaire similar to that used by Steele and Aronson (1995) was used to assess self-handicapping. One item asked participants to report how many hours of sleep they got the night before. Responses to the other items were given on a 7-point Likert scale (1 = *not at all,* 7 = *very much*). These items asked participants how well they were able to focus, how much stress they were feeling, how motivated they were, and how comfortable they felt in the test situation. The second of these items was reverse scored.

Memory. A list of five words from each of six different semantic categories was constructed for the free-recall task. All items were moderate to high frequency exemplars of their respective categories on the basis of Howard's (1979) norms. The words were typed in two columns of 15 words each on a sheet of paper, and they were randomly listed with the exception that two words from the same category could not appear in adjacent positions on the page.

Ability measures. The Wechsler Adult Intelligence Scale—Third Edition Letter–Number Sequencing Task (Wechsler, 1997) was used to assess working memory functioning. Salthouse and Coon's (1994) letter and pattern comparison tasks were used to assess perceptual speed. Vocabulary Test II (Parts 1 and 2) from the Kit of Factor-Referenced Tests (Ekstrom, French, Harman, & Derman, 1976) was used to assess verbal ability.

Awareness assessment. A seven-item questionnaire similar to that used by Bargh et al. (1996) was developed to assess the extent to which participants were aware of the age-related nature of the words used in the scrambled sentence task. The questions were open ended and consisted of items such as "What do you think the purpose of the study was?" "How could the words in the scrambled sentence task have affected your behavior?" and "Did you notice any relation between the words in the scrambled sentence task and the concept of age?"

Procedure

Equal numbers of participants within each age group were assigned to one of four conditions representing the factorial combination of awareness conditions (aware vs. unaware) and stereotype prime (positive vs. negative). Prior to coming to the lab, the older adults in the study received a packet of materials in the mail that contained the background questionnaire, the SF-36 Health Survey, the MIA-Ach scale, and several attitude scales unrelated to the present study, which they were instructed to complete and bring to their individual test session. Younger adults initially participated in a group test session, where they completed the same set of forms. At that time, they signed up for an individual test session that took place approximately 1 week later. At the individual test session, the scrambled sentence task was given first. Each participant was presented with a set of cards containing the 30 sets of words and was instructed to form a grammatically correct sentence using four of the five words. In the aware condition, participants were also told that two thirds of the sets of words contained a trait—which was highlighted—that is often thought of in association with views of older people in our society. They were further instructed to use the trait words in forming their sentences and to underline these words in the sentences they formed.

All participants were then informed that they would be given a memory test. The experimenter told the participants that they would be given a list of 30 words to study and then asked to recall the words on the list. Participants were then informed that additional information would be collected before they were given the memory test. At this point, the STAI-S and self-handicapping scales were administered.

Following completion of these scales, the memory test was described once more and the participants predicted how many words they would be able to recall. The free-recall task was then administered. Participants were allowed 2 min to study the word list, after which they were instructed to write down as many of the studied words as they could in the order they remembered them. A minimum of 3 min for recall was given. If participants were still writing at the end of this period, additional time was given until 30 s passed without a response.

The experimenter next orally presented the awareness assessment questions and wrote down the participant's responses. Participants then completed the vocabulary test, the letter and pattern comparison tasks, and the Letter–Number Sequencing Task. Finally, participants were debriefed and compensated, and their questions about the study were answered.

Results and Discussion

Manipulation Checks

We initially tested 128 participants, but manipulation checks relating to our priming task raised some concerns. Our first check involved an examination of the amount of time that participants took to complete the scrambled sentence task. In particular, we were concerned that lengthy completion times might compromise the effectiveness of the priming manipulation. It was found that 8 older adults who took more than 19.5 min to complete the task were statistical outliers. (The mean for the older group was 13.8 min.) Thus, these individuals, as well as 1 with missing data on this measure, were dropped from further consideration.

Our second check involved examining responses of the remaining 119 participants to our posttest awareness questions. These responses were coded into two general categories: those reflecting spontaneous (i.e., without prompting by the experimenter) reports of awareness of the aging-related primes and those that did not. Responses were scored blind to condition and age by two different individuals, with an 86.8% agreement rate. Disagreements were resolved through discussion. Examination of these scores revealed several instances of lack of correspondence between condition assignments and reports of awareness. To deal with this problem, as well as the aforementioned loss of participants, 18 additional older participants were subsequently tested in hopes of obtaining sufficient numbers of participants within each condition to test our hypotheses. In the end, out of the 146 total participants tested, we eliminated 13 older adults with scrambled sentence times greater than 1,000 s or with missing data on this task. We also eliminated an additional 12 participants (2 young, 10 older) who were tested in the unaware condition but reported awareness of the primes.

Participant Characteristics

All dependent measures were examined using Age Group × Awareness × Stereotype Prime × Domain Identification general linear model (GLM)-based analyses of variance (ANOVAs). Domain identification, as reflected in MIA-Ach scores, was treated as a continuous variable and was included to examine whether importance attached to one's memory ability moderated the impact of

the primes on performance. Prior to conducting our main analyses, we examined several background measures to determine whether they covaried with any of these variables. Relative to the younger adults, older adults were found to have significantly ($p < .05$) higher levels of education, higher SF-36 Mental Health scores, lower SF-36 Physical Health scores, higher vocabulary scores, and lower scores on both the Letter–Number Sequencing Task and on the pattern and letter comparison tasks (see Table 1).

The only effects related to the predictor and treatment variables were found for (a) the Letter–Number Sequencing Task, where a significant Age × Awareness interaction, $F(1, 105) = 5.62$, $p = .02$, and a four-way interaction, $F(1, 105) = 4.51$, $p = .04$, were obtained; and (b) Physical Health, where a significant Age × Awareness interaction was obtained, $F(1, 105) = 4.20$, $p = .05$. Subsequent tests revealed that the conditions for inclusion of education or Physical Health scores as covariates (e.g., significant relationships between these and the dependent variables, homogeneity of regression) were satisfied only for clustering during recall, where Letter–Number Sequencing Task scores were included as covariates.

Memory Performance

Our primary interest was in performance on the recall task, from which two measures were obtained: proportion of words recalled and clustering, as reflected in adjusted ratio of clustering (ARC) scores (Roenker, Thompson, & Brown, 1971). With respect to memory, the young adults recalled more than the older adults (.63 vs. .48), $F(1, 105) = 41.07$, $\eta^2 = .28$, $p < .01$. Of most interest for present purposes were two interactions involving age. Specifically, the interaction between age and prime approached significance, $F(1, 105) = 3.07$, $\eta^2 = .03$, $p = .08$, with recall following the positive prime being greater than that following the negative prime in the older group (*M*s = .51 vs. .46, respectively), whereas the opposite was true in the young group (*M*s = .62 vs. .65, respectively). Of primary importance, however, was a significant Age × Awareness × Prime interaction, $F(1, 105) = 4.55$, $\eta^2 = .04$, $p = .04$.

Table 1
Participant Characteristics

	Young		Older	
Measure	*M*	*SD*	*M*	*SD*
	Experiment 1			
Education	13.1	1.2	15.6	2.4
SF-36: Physical Health	50.7	6.8	45.4	7.2
SF-36: Mental Health	45.4	13.0	55.8	6.8
Vocabulary	26.3	3.1	31.0	2.8
Letter-Number Sequencing	11.6	2.0	10.0	2.2
Perceptual speed	0.66	0.73	−0.32	0.71
	Experiment 2			
Education	12.6	0.9	15.9	2.7
SF-36: Physical Health	53.6	4.4	45.5	7.8
SF-36: Mental Health	46.1	10.5	55.8	6.7
Vocabulary	26.3	2.8	30.2	3.2
Letter-Number Sequencing	12.7	2.3	10.5	2.2
Perceptual speed	0.63	0.69	−0.62	0.63

Note. Score ranges are as follows: Vocabulary, 0–36; Letter-Number Sequencing Task, 0–21. Perceptual speed is the mean *z* score for the letter and pattern comparison tasks. SF-36 scores are *T* scores. Between-age-group differences were significant ($p < .05$) for each measure in each study.

Analyses within awareness groups revealed that this latter interaction was due to the differential influence of prime valence across age groups in the unaware group. As can be seen in Table 2, there was little variation in recall as a function of prime valence in either age group under aware conditions. In contrast, the Age × Prime interaction was significant in the unaware condition, $F(1, 49) = 6.06$, $p = .02$, because of older adults' recall being significantly greater following the positive prime than following the negative prime. Of interest, although the prime valence effect was not significant for the younger adults in the unaware condition, recall was actually greater following the negative prime, a finding that appears to be inconsistent with an ideomotor account of priming. It is important to note also that no significant effects involving domain identification were obtained (*p*s > .21).

On the basis of comparisons across Awareness × Prime conditions, it is clear that age differences in recall are greatest in the unaware condition following the negative prime. The age difference in this condition is more than twice that observed in any of the other three conditions. In addition, both recall levels and age differences in performance in the aware condition—regardless of prime type—were similar to those observed with the positive prime in the unaware condition. Taken together, these results are generally consistent with expectations. Specifically, the priming manipulations had little impact on the memory performance of younger adults. In contrast, significant effects of stereotype priming on recall performance were obtained in the older group, with these effects mainly occurring in those participants who had little awareness of the primes. The generally high levels of recall in the aware condition along with the null prime effects also suggest that the older adults were able to counteract the impact of the negative prime when they were aware of its occurrence, a finding in line with stereotype reactance predictions.

No significant effects for clustering were observed, perhaps reflecting low statistical power associated with this analysis. However, the Age × Awareness interaction approached significance, $F(1, 104) = 2.85$, $\eta^2 = .03$, $p = .09$. The pattern of means appears to provide support for a reactance explanation for the effects of awareness on memory in older adults in that ARC scores were higher in the aware condition ($M = .68$) than in the unaware condition ($M = .57$). (The means for the younger adults in the same conditions were .61 and .66, respectively.) This suggests that older adults were engaging in more strategic behavior in the aware condition, perhaps in an attempt to counteract the prime effects. In support of this, controlling for clustering scores reduced the Age × Awareness × Prime interaction in recall to nonsignificance ($p = .28$).

Additional Measures

Anxiety. The older adults had significantly lower state anxiety scores ($M = 14.1$) than did the younger adults ($M = 17.4$), $F(1, 105) = 14.31$, $\eta^2 = .12$, $p < .01$. A significant Awareness × Prime × Domain Identification interaction was also obtained, $F(1,$

Table 2
Experiment 1: Mean Proportion Recalled and Standard Deviation by Age, Awareness, and Prime Valence

Age group and measure	Unaware		Aware	
	Positive	Negative	Positive	Negative
Young				
M	.62	.67	.61	.63
SD	.12	.10	.09	.13
n	15	15	16	16
Old				
M	.53	.40[a]	.48	.50
SD	.16	.15	.14	.10
n	14	13	15	17

[a] Significant prime effect ($p < .04$) within Age × Awareness condition.

105) = 7.34, $\eta^2 = .07$, $p = .01$, but follow-up analyses did not reveal any interpretable effects.

Self-handicapping. Self-handicapping scores were constructed by standardizing responses to each of the five items associated with this construct and then summing these scores (Cronbach's $\alpha = .54$). Of interest, younger adults were more likely to report self-handicapping than were older adults, $F(1, 105) = 11.19$, $\eta^2 = .10$, $p = .01$. Self-handicapping was also more evident in the unaware condition than the aware condition, $F(1, 105) = 5.32$, $\eta^2 = .05$, $p = .03$. No other effects were significant.

Predicted recall. The only significant effect observed was due to the interaction between age, prime, and domain identification, $F(1, 105) = 7.47$, $\eta^2 = .07$, $p = .01$. Analyses within age and prime categories suggested that this effect was primarily due to an increase in predictions with domain identification in older adults exposed to the positive prime ($b = .35$, $p = .06$); no other relations involving identification were significant ($ps > .18$).

Together, these analyses revealed little evidence of differential patterns of performance on these self-report measures in either age group at either level of awareness. This result was predicted in the implicit priming condition. In contrast, it was thought that these variables might be affected by prime valence in the aware condition, where explicit noting of age-stereotypic information could have heightened stereotype threat in the negative condition. The fact that threat was not induced in the aware condition is evident, however, on the basis of the recall data. Thus, the null effects here are not surprising.

In summary, Experiment 1 resulted in several important findings. First, reliable implicit priming effects on older adults' memory performance were obtained. Recall performance of those participants exposed to negative stereotypical terms was approximately 81% of that of those exposed to a positive stereotype. Second, the absence of significant effects associated with presumed mediators and moderators of stereotype threat provides indirect support for an ideomotor account of implicit stereotype activation on older adults' memory performance. It is important to note here that Steele et al. (2002) have argued that potential mediators of the type examined here may vary across stereotype domains, and thus the absence of such relationships does not necessarily preclude the operation of threat. The failure of domain identification to moderate prime effects—as observed by Hess et al. (2003)—however, is inconsistent with the operation of threat.

Third, the implicit priming effect was obtained only for older adults. The failure to find such effects in younger adults is consistent with the findings of Levy (1996), who also examined memory performance, but inconsistent with previous research with younger adults examining the impact of aging-related primes on simpler aspects of behavior (e.g., Bargh et al., 1996). The null findings in the young group also appear to be inconsistent with an ideomotor account of stereotype activation. We argue, however, that these null effects may represent the counteracting effects of other goals activated in younger adults by the testing context, possibly in conjunction with age differences in threshold of activation of aging stereotypes on the basis of self-relevance (see Shih et al., 2002). Finally, the prime effects on older adults' performance were eliminated, and age differences were smallest, when participants were aware of the primes. This suggests that older adults are able to consciously counteract the influence of activated stereotypes, with some support for this position provided by the greater evidence of strategic behavior in the aware than in the nonaware condition.

Experiment 2

Experiment 2 was conducted in an attempt to replicate and extend the results obtained in Experiment 1. The basic design of Experiment 2 was similar to that of Experiment 1. Specifically, young and older adults were exposed to positive and negative aging-related terms under implicit or explicit priming conditions, and memory performance was subsequently examined. In an attempt to avoid the problems associated with stereotype activation in Experiment 1, we used a priming task similar to that used by Levy (1996) and Stein et al. (2002). Specifically, prime words were presented within the context of a lexical decision task, with the presentation rate for these words being varied so that they would be displayed above or below the participant's threshold of awareness. This procedure permitted more direct control over the priming manipulation and provided data (i.e., number of correct responses) that permitted a more objective assessment of the success of the procedure. The lexical decision format also ensured that participants in the explicit priming group would actually process the prime words while maintaining consistency in format of the priming task with those in the implicit condition.

Another change in the procedure involved an investigation of priming effects on memory-related beliefs. In particular, we were interested in whether variations in memory performance in the older adults associated with the priming manipulations were accompanied by corresponding differences in perceptions of one's memory ability (e.g., issues of control) and concerns about the effects of aging on memory-related problems.

The final change in procedure was a subtle but potentially meaningful one. Specifically, following the priming task, all participants were informed that they would be taking a memory test that was typically used in studies of aging and memory. This labeling was intended to make salient the diagnosticity of the memory test with respect to aging, a condition necessary for the operation of stereotype threat (Steele et al., 2002). Previous research by Rahhal et al. (2001) has suggested that labeling a memory task in such a manner exacerbates age differences in memory performance. If this label, along with activation of the negative stereotype, does induce threat, then prime effects similar

to those obtained in the implicit priming condition would be expected in the explicit priming condition. Alternatively, the addition of this diagnostic label may increase the blatancy of the primes, which Shih et al. (2002) have argued results in suppression effects associated with the positive primes. Thus, an alternative prediction is that performance in the explicit priming condition will be suppressed regardless of prime valence.

Method

Participants

Participants were recruited and compensated in the same manner as in Experiment 1. Both the older adult group (M_{age} = 70.9 years, range = 59–82) and the young adult group (M_{age} = 19.2 years, range = 17–35) consisted of 36 men and 36 women.

Materials

Except for the scrambled sentence task and self-handicapping questionnaire, the instruments and tasks used in Experiment 1 were also used here. The following additional materials were specific to the present study.

Memory-related beliefs. The Memory Controllability Inventory (MCI; Lachman, Bandura, Weaver, & Elliott, 1995) was used to assess beliefs about memory. The scale consists of 12 items, with 3 associated with each of 4 subscales: Present Ability (PA), Potential Improvement, Effort Utility (EU), and Inevitable Decrement. The Aging Concerns Scales (ACS; Lachman et al., 1995) was used to assess general memory-related concerns about aging. The ACS is a seven-item scale consisting of two subscales: Independence and Alzheimer's Likelihood (AL). Lachman et al. (1995) reported reliability (coefficient α) to range from .49 to. 77 across all subscales of both measures.

Pretest threshold. A word-identification task was developed to determine the slowest speed at which words could be presented on a computer screen without participants being able to identify them. For each trial, a fixation point (+) appeared in the middle of the screen for 1,000 ms, followed by a word presented 10 mm above or below where the fixation point had appeared. This word was then masked by a string of random consonants, which was replaced by a question mark in the middle of the screen. At this point, participants were to identify the just-presented word. The presentation time for the target words decreased as the task progressed, with 10 words being presented at each of the following speeds: 100 ms, 82 ms, 66 ms, 50 ms, 33 ms, and 17 ms. The words for this task were chosen on the basis of Francis, Kučera, and Mackie's (1982) frequency norms, such that both word length and frequency of use were equated across presentation speeds.

Stereotype priming. A lexical decision task was used to prime stereotypes of aging. This task was similar to the pretest threshold assessment with the following exceptions: (a) Both words and pronounceable nonwords (e.g., *chugbott*) were presented following presentation of the fixation point, (b) participants made a word–nonword decision rather than identifying the word, and (c) presentation rate was individually tailored on the basis of performance in the pretest (see below). Responses were made with the right hand using two buttons on a response box.

The lexical decision task consisted of three sets of 30 trials. Each set consisted of 16 aging-related words and 14 nonwords. Two aging-related category words (*aged, old, senior*) were presented during the first three trials of each set to facilitate association of the subsequent words with the category of aging. Depending on the priming condition, the remaining 14 aging-related words reflected either positive views about older adults in our society or negative stereotypical views about older adults. (These words were drawn from the larger set of items used in Experiment 1.) The same nonwords and filler items were used across prime conditions. In addition, each set of 30 trials represented a different random ordering of the same items, with the exception of the category words, which were rotated through sets and always appeared in the first three trials.

Posttest threshold. A task nearly identical to that used in the pretest program was developed to examine changes in perceptual threshold—and potential awareness of the priming stimuli—over the course of the study. The only difference was that the posttest consisted of only 10 trials at the presentation rate identified in the pretest and used in the lexical decision–priming task.

Procedure

Eighteen participants within each age group were assigned to one of four conditions representing the factorial combination of awareness conditions (aware vs. unaware) and stereotype prime (positive vs. negative). Because of a mistake in the assignment procedure for the younger adults, however, the positive unaware condition contained 19 participants and the negative unaware condition contained 17. Following the same procedure as in Experiment 1, each participant completed a package of test items prior to their individual test session. During this session, participants first completed the pretest threshold task. Although the primary purpose of this task was to determine the presentation speed of the prime words in the unaware condition, participants in the aware condition also completed this task. For those participants in the unaware condition, presentation speed in the priming task was based on the slowest speed at which they were unable to correctly identify any words.

Following the pretest threshold task, the experimenter informed the participants that their memory would be examined later in the study. A brief description of the free-recall task was given, and participants were informed that this type of test is commonly used to measure the effects of aging on memory. Each participant then completed the lexical decision–priming task. For those participants in the unaware condition, the target items were presented at the speed identified in the pretest. For participants in the aware condition, target items were presented for 250 ms, at which rate all participants were able to consciously perceive the stimuli.

After completion of the lexical decision task, the experimenter again informed the participants that they would be asked to take a memory task, this time providing more complete details about the test. The STAI-S was then administered. Afterward, participants were given the detailed memory instructions one more time, and then recall predictions and free recall were assessed as in Experiment 1. Following the memory task, the MCI and ACS were administered.

On completion of these scales, participants in the unaware condition completed the posttest threshold task. Of interest was whether the ability to identify words at the speed identified in the pretest had changed over the course of the study, which would have implications for the success of the unaware priming manipulation. The awareness assessment questionnaire was then administered to all participants, followed by the vocabulary test, the Letter–Number Sequencing Task, and the pattern and letter comparison tasks. Participants were then debriefed, during which time the nature of the words used in the lexical decision task, as well as the purpose of the other tasks, was explained.

Results and Discussion

All dependent variables were examined using Age Group × Awareness × Prime Valence × Domain Identification GLM-based between-participants ANOVAs, with the last factor—indexed by MIA-Ach scores—being treated as a continuous variable.

Manipulation Checks

Prior to analyzing the data, we conducted several checks to determine whether our awareness manipulation worked as desired.

First, self-reported levels of awareness were examined. Responses to the awareness questionnaire were coded as in Experiment 1, with 85.4% initial agreement between raters. Examination of these ratings revealed several things. First, those in the aware condition were more likely to report awareness of the aging-related primes than were those in the unaware condition: 71% vs. 10%, respectively. Second, levels of awareness—across awareness conditions—were higher in the negative than in the positive condition: 51% vs. 29%, respectively. Finally, younger adults were more likely to report awareness than were older adults (44% vs. 36%), primarily because of differences observed in the unaware condition.

We next examined a more objective index of conscious processing of the positive and negative primes by comparing the proportion of correct responses on the lexical decision task across conditions. Consistent with expectations, participants who viewed the target items above perceptual threshold (i.e., the aware condition) had significantly higher levels of performance (.86) than those who viewed them below threshold (i.e., the unaware condition; .58), $F(1, 128) = 324.25$, $\eta^2 = .72$, $p < .01$. A significant Age × Prime interaction was also observed because of the greater difference in performance levels between the positive and negative prime conditions for the young (.67 vs. .76, respectively) than for the older (.73 vs. .71) adults, $F(1, 128) = 8.10$, $\eta^2 = .06$, $p = .01$. In spite of this effect, the general pattern of means indicates that the target terms were generally being perceived in a manner consistent with the intent of the awareness manipulation.

Finally, changes in perceptual threshold from the pretest to posttest were examined in those participants in the unaware condition. It was found that 8 young and 5 older adults were able to identify two or more words in the posttest. As would be expected, the proportion of correct identifications on this test was highly correlated with response accuracy in the priming task ($r = .47$). Given these data, we were concerned that some participants in the unaware condition may have actually been able to read the prime words. Our concerns were reinforced when we examined individual response accuracy levels in the priming task. In the aware condition, all participants had performance levels well above chance, indicating that the intent of this condition was realized. In the unaware condition, where chance performance would have been indicative of a successful manipulation, 12 younger adults and 8 older adults exhibited performance significantly above chance levels (i.e., $> .603$).

Rather than eliminate these individuals from the study and reduce the statistical power of our analyses, we decided to reexamine the assignment of these participants to awareness conditions. Assignment based solely on performance above or below chance in the lexical decision task would have resulted in cell sizes less than 10 in a couple of conditions. To maintain a reasonable cell size, therefore, we only reassigned participants in the unaware condition to the aware condition if they had lexical decision accuracy above .65 and exhibited a decrease in their perceptual threshold over the course of the study. This resulted in reassignment of 8 younger adults and 5 older adults. All subsequent analyses were performed using these newly configured conditions. Of importance, all of the remaining participants in the unaware group also reported no awareness of the aging-related primes.

Participant Characteristics

Demographic, health, and ability variables were examined to both characterize the sample and identify inadvertent biases associated with assignment to conditions. As can be seen in Table 1, the age-related characteristics of the sample were similar to those in Experiment 1, with the between age-group differences being significant for each measure ($p < .05$). In addition to these age main effects, several effects involving our task conditions were obtained: (a) For education, significant effects were observed for prime, $F(1, 128) = 4.85$, $p = .03$, domain identification, $F(1, 128) = 6.14$, $p = .02$, and interactions between age and both valence, $F(1, 128) = 6.14$, $p = .02$, and identification, $F(1, 128) = 10.66$, $p < .01$; (b) a significant Age × Prime effect was observed for vocabulary, $F(1, 128) = 4.94$, $p = .03$; and (c) a significant Awareness × Prime interaction for SF-36 Physical Health scores was also observed, $F(1, 128) = 4.42$, $p = .04$. For subsequent analyses, criteria for treatment of these background variables as covariates were assessed for each dependent variable. The only situation in which these criteria were fulfilled was for the aging concerns scale, where Physical Health score was used as a covariate in analyzing these data.

Memory Performance

As before, our primary interest was in performance on the free-recall task. When proportion recalled was examined, two significant effects emerged. First, recall was higher in the young than in the older group (.60 vs. .50), $F(1, 128) = 21.15$, $\eta^2 = .14$, $p < .01$. More important for present purposes, significant interactions were obtained between age and prime, $F(1, 128) = 4.12$, $\eta^2 = .03$, $p = .05$, and between age, awareness, and prime, $F(1, 128) = 4.19$, $\eta^2 = .03$, $p = .04$. Focused analyses were subsequently conducted within awareness conditions.

In the unaware condition, the only significant effect was the Age × Prime interaction, $F(1, 51) = 5.80$, $p = .02$. As can be seen in Table 3, the pattern of performance was similar to that obtained in Experiment 1, with older adults exhibiting significantly ($p = .02$) higher levels of recall with positive than with negative primes. Prime valence had no impact on younger adults' recall. In addition, the age difference in recall was only significant ($p < .01$) in the

Table 3
Experiment 2: Mean Proportion Recalled and Standard Deviation as a Function of Age, Awareness, and Prime Valence

Age group and measure	Unaware		Aware	
	Positive	Negative	Positive	Negative
Young				
M	.57	.63	.62	.59
SD	.17	.13	.10	.09
n	16	12	21	23
Old				
M	.58	.46[a]	.50	.47
SD	.13	.12	.15	.12
n	15	15	20	21

[a] Significant prime effect ($p < .02$) within Age × Awareness condition.

negative prime condition, with recall being comparable across age groups with the positive prime.

As before, the primes had no reliable impact on recall for either age group in the aware condition. In contrast to the unaware condition, however, a significant main effect of age was obtained, $F(1, 77) = 24.07$, $p < .01$, with younger adults exhibiting significantly higher levels of recall in both prime conditions. In addition, and in contrast to Experiment 1, age differences in memory performance were greater in the aware condition than in the unaware condition. As can be seen in Table 3, recall levels did not vary appreciably for younger adults across conditions, whereas the level of older adults' recall in both prime conditions in the aware group was similar to that of the negatively primed participants in the unaware condition. This pattern of results appears to be consistent with predictions based on suppression effects associated with blatant primes.

When clustering at recall was examined, no significant effects were observed. Once again, no significant effects involving domain identification were obtained for either measure.

Other Measures

Anxiety. No significant effects were found for state anxiety scores.

Predicted recall. Younger adults predicted that they would recall significantly more words than did older adults (13.7 vs. 12.5), $F(1, 128) = 3.96$, $\eta^2 = .03$, $p = .05$. A significant Awareness × Prime × Domain Identification interaction was also obtained, $F(1, 128) = 4.00$, $\eta^2 = .03$, $p = .05$, reflecting the fact that MIA-Ach scores were positively associated with predicted recall following the positive prime in the aware condition.

Memory beliefs. Mean ratings for each of the subscales on the MCI and ACS were calculated, and multivariate ANOVAs were performed on the set of scores obtained from each scale. Only two significant effects were observed for the MCI: age, $F(4, 124) = 4.20$, $\eta^2 = .12$, $p < .01$, and domain identification, $F(4, 124) = 4.19$, $\eta^2 = .12$, $p < .01$. Univariate follow-up tests revealed that the age effect was due to younger adults having significantly higher PA scores than older adults (5.6 vs. 5.0), $F(1, 127) = 7.16$, $p < .01$, and the domain identification effect was due to EU scores increasing with memory achievement scores, $F(1, 127) = 11.26$, $p < .01$. The age effect was also significant for the ACS, $F(2, 124) = 3.23$, $\eta^2 = .05$, $p = .04$, because of younger adults having significantly lower scores than older adults on the AL subscale (2.4 vs. 3.2), $F(1, 125) = 5.75$, $p = .02$. Of importance, neither awareness nor prime had reliable effects on beliefs in either age group on either scale. This null finding is similar to that observed by Levy (1996), who found that implicit priming had no effects on explicit responses reflecting beliefs about aging.

In summary, the findings with respect to the effects of implicit priming of positive and negative aging-related stereotypes on older adults' memory performance replicate the general findings of Experiment 1 and of Levy (1996). Consistent with these two studies, but inconsistent with those of other researchers (e.g., Bargh et al., 1996; Dijksterhuis et al., 2001), we also found that implicit priming had little impact on the performance of younger adults. Thus, the effects of the prime were specific to members of the stereotyped group. It is also important to note that these implicit priming effects on recall were not associated with related effects in self-report measures of anxiety, performance expectations, and memory-related beliefs. This suggests once more that the implicit prime effects are fairly specific with respect to both the individuals and behaviors, and these null findings provide indirect evidence for an explanation of the priming effects that is based in activation of direct stereotype–behavior linkages. Of special significance here also is the fact that implicit priming of positive aging terms appeared to benefit older adults' recall—at least in relation to the negative priming condition—when the diagnosticity of the memory task with respect to the aging stereotype was made salient.

This replication of the implicit priming effects across experiments is also important, given concerns about the priming manipulation in Experiment 1. This suggests that the effect is a reliable one. The replication across different priming techniques and operationalizations of awareness is also important in establishing the generalizability of the effect.

The results of this study also differ in a potentially important way from those of Experiment 1. Specifically, age differences in recall were significantly greater in the aware condition than in the unaware condition. In contrast to Experiment 1, where aware older adults' performance in both prime conditions was similar to that observed with the positive prime in the unaware condition, older adults in the present aware condition exhibited recall levels similar to that of unaware participants in the negative prime condition. The variations in effects associated with awareness appear to be due to explicitly noting the diagnostic value of the recall task for examining aging effects on memory in Experiment 2. Test diagnosticity has been shown to moderate stereotype threat effects on performance (e.g., Steele & Aronson, 1995). Coupling this instruction with explicit exposure to aging-related primes may have created threat in the aware condition. The fact that performance following the positive prime appeared to be suppressed to the level observed following the negative prime is also consistent with the results of Shih et al. (2002) on the effects of blatant stereotype activation.

General Discussion

The goal of the research presented here was to provide further evidence regarding the impact of aging stereotypes on both older adults' memory performance and age differences therein. Of primary interest was whether older adults' memory performance could be manipulated through the activation of negative and positive aging stereotypes and whether such effects were moderated by the explicitness of cues associated with activation.

In both studies, we found significant implicit priming effects on older adults' recall, with performance being significantly lower in the negative priming condition than in the positive. In addition, age differences were significantly reduced following the positive prime, with young and older adults performing at almost identical levels in Experiment 2. Previous research examining implicit priming effects on older adults' memory (Levy, 1996; Stein et al., 2002) has been somewhat mixed, but the present study clearly demonstrates the presence of such effects, thereby supporting Levy's (1996) initial reports of the phenomenon. The reasons for the discrepancies across studies is unclear, but two possibilities come to mind. First, previous implicit priming studies used a pretest–posttest procedure and examined priming effects on the basis of changes in performance levels across trials. It may be that

experience with the memory tasks prior to priming dampened the effect of the implicitly activated stereotypes. The discrepancies may also be due to differences between the memory tasks used in those studies and the free-recall task used here. This latter task may have allowed for more flexibility in strategy use, creating the potential for more variability in performance—and thus more reliable effects—than the tasks used by Levy (1996) and Stein et al. (2002). Of significance in the present case, however, is that the priming effects were observed with a task that is used frequently in studies of aging and memory, implicating the possibility of a socially based causal mechanism as a basis for observed aged differences on similar tasks.

Another goal of the present research was to determine whether the priming of implicit aging stereotypes affected the memory performance of younger adults. The results of previous studies examining such effects has also been mixed (e.g., Bargh et al., 1996; Levy 1996). In the present research, we found no evidence that primes based in aging stereotypes had any impact on the memory performance of younger adults. This replicates previous findings by Levy (1996) and Stein et al. (2002) but appears to contradict findings by Bargh et al. (1996) and Dijksterhuis et al. (2000, 2001). We suggest that the discrepancies across studies are based in the nature of the behaviors being primed and the context in which the priming occurred. As noted earlier, the behaviors being examined in these latter studies were relatively simple and somewhat incidental to the individual's goals in the test context. In the present research, as well as in the Levy (1996) and Stein et al. (2002) studies, participants knew that their memory was going to be tested. This could have resulted in the activation of more personally relevant self-constructs and associated goals (e.g., identity as good student and learner) in young adults that would counteract more subtly primed and less relevant aging-related stereotypes. This seems especially likely when information about aging is explicitly mentioned—in terms of the prime or diagnosticity of the test—which in turn may enhance the distinction between themselves and older adults. The obtained age differences in implicit priming are consistent with the hypothesis that the threshold of stereotype activation is lower in those individuals for whom the stereotype is self-relevant (Shih et al., 2002). Unfortunately, the present study does not provide data relevant to distinguishing between these two explanations.

We also found that awareness interacted with task characteristics to moderate the nature of age and prime effects. In Experiment 1, making participants aware of the primes eliminated the effects associated with the negative primes in the implicit condition, indicating that older adults are capable of counteracting the effects associated with activation of negative stereotypes. Of importance, however, is that the opposite effect occurred in Experiment 2, with awareness resulting in suppression of the effects associated with the positive primes in the implicit condition. In contrasting the two awareness conditions, the primary difference had to do with the addition of instructions highlighting the diagnostic value of the memory test for examining aging effects on memory. This instruction, along with the explicit aging-related primes, may have increased the blatancy of the stereotype manipulation, which Shih et al. (2002) have shown to be associated with suppression of performance enhancements associated with activation of positive stereotypes under more subtle conditions. They suggest that such effects have to do with the pressures associated with high group-based expectations.

It should be noted that the overall level of recall in the older–unaware group was about .06 higher in Experiment 2 than in Experiment 1, whereas performance in the older–aware group was comparable across studies. Thus, it is possible that the just-described variation in results across experiments partially reflects nonsystematic fluctuations in level of performance because of sampling error. Given this possibility, the strength of conclusions based on comparisons across experiments should be tempered somewhat pending future replication.

These results, when taken in conjunction with previous studies (e.g., Hess et al., 2003; Levy, 1996), lead to the following general characterization of stereotype priming effects on older adults' memory performance. Assimilation effects associated with stereotype activation are most likely to occur under implicit priming conditions. The fact that situational factors (e.g., task instructions) appear to have little moderating impact when the stereotypes are self-relevant suggests that such effects are reflective of direct stereotype–behavior linkages. Under explicit conditions, the present study provides evidence that older adults can control the impact of negative stereotype activation but only when the primes are relatively subtle. In contrast, when explicit linkages between aging and performance are created or when the stereotype primes are relatively blatant, memory performance tends to be negatively affected.

In conclusion, the results of this study add to a growing list of findings that implicate the importance of the social context in affecting older adults' memory performance. Such findings, along with those that have identified more biologically based mechanisms, argue for a more multidimensional approach to the study of aging effects on memory performance. As noted by Hess et al. (2003) and Rahhal et al. (2001), the observation that simple situational factors associated with the testing context can have significant effects on the memory performance of older adults also argues for researchers to seriously consider such factors in the design of their studies. Failure to do so may have serious implications for both the internal and construct validity of such research.

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Received July 10, 2003
Revision received April 13, 2004
Accepted April 30, 2004 ■