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Improving Memory in Old Age Through Implicit Self-Stereotyping

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This research demonstrates that subliminally activated stereotypes can alter judgments about oneself and can change cognitive performance. In the first study, an intervention that activated positive stereotypes of aging without the participants' awareness tended to improve memory performance, memory self-efficacy, and views of aging in old individuals; in contrast, an intervention that activated negative stereotypes of aging tended to worsen memory performance, memory self-efficacy, and views of aging in old participants. A second study demonstrated that for the strong effects to emerge from the shifting stereotypes, the stereotypes must be important to one's self-image: Young individuals randomly assigned to the same conditions as the old participants in the first study did not exhibit any of the significant interactions that emerged among the old participants. This research highlights the potential for memory improvement in old individuals when the negative stereotypes of aging that dominate the American culture are shifted to more positive stereotypes.

When asked to describe the first image of old age that came to her mind, a 78-year-old participant in the following research project quickly replied, "senile, slow, sick, blind and stooped over." Although her description fits the predominant view of aging expressed by Americans as a time of inevitable cognitive and physical decline (Kite & Johnson, 1988; Levy & Langer, 1994), one might not expect it to come from an alert, energetic, healthy woman with normal eyesight and good posture. The tendency for individuals to subscribe to beliefs that denigrate their social group and potentially harm themselves exists not only among elderly people but can be found also among African Americans, homosexuals, Jews, and most other stigmatized groups (Gilman, 1986; Goffman, 1963; Pettigrew, 1964; Sartre, 1948; Steele & Aronson, 1995).

This phenomenon of negative self-stereotyping contradicts two of the major theories proposed to explain the operation of stereotypes: ego justification and group justification. These theories predict that people will hold stereotypes promoting themselves or the groups with which they identify (Allport, 1958; Freud, 1966; Jost & Banaji, 1994; Tajfel, 1981). An alternative way to think about self-stereotypes is that individuals acquire the stereotypes about how one should behave from their environments without awareness, regardless of whether the stereotypes benefit or harm themselves or their social groups.

This article consists of two parts. In the first study I examined whether both negative and positive stereotypes of aging can be activated in older individuals without their awareness and whether these stereotypes can influence memory performance. More specifically, this study focused on whether the activation of negative self-stereotypes (e.g., "Because of my age I am forgetful") can worsen old individuals' memory performance, whereas the activation of positive self-stereotypes (e.g., "Because of my age I have acquired wisdom") can improve individuals' memory performance. In the second study I explored the prediction that the implicit self-stereotyping effect should fail to emerge in young individuals to whom stereotypes of aging are not as relevant.

Implicit Self-Stereotyping

Over the last decade, researchers have been successful in documenting two domains of unconscious cognition: implicit memory or the unconscious establishment of memories, and semantic priming or the unconscious activation of schemas. One of the most societally relevant developments within the unconscious activation literature is the research on implicit stereotyping. Banaji, Hardin, and Rothman (1993) coined the term *implicit stereotyping* to refer to the activation of stereotypes without one's awareness, usually by the flashing of stereotype words at subliminal speeds on a computer.

Until now, research on implicit stereotyping has concentrated on how the unconscious activation of stereotypes influences one's judgments of others rather than on how implicit stereotyping influences self-perception (Jost & Banaji, 1994). This focus on social judgments rather than on self-perceptions may be due to the fact that it is difficult to operationalize the effects of most self-stereotypes that could work on an implicit level (e.g., women tend to be dependent) or would raise ethical concerns if operationalized (e.g., African Americans tend to be

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aggressive). Both of these stereotypes have been studied in terms of how implicit stereotyping influences judgments of others but not in terms of how these stereotypes influence the targets of the stereotypes (Banaji et al., 1993; Devine, 1989). Furthermore, previous implicit stereotyping research has worked with only negative stereotypes and only one stereotype per social group.

The stereotypes of cognitive aging, on the other hand, seem ideal for the study of how implicit stereotyping operates in both negative and positive self-stereotyping. Researchers have shown that most Americans hold both positive and negative stereotypes of old age, but the negative stereotypes are more prevalent (Brewer, Dull, & Lui, 1981; Kite & Johnson, 1988; Levy & Langer, 1994). Perdue and Gurtman (1990) demonstrated that negative age stereotypes exist below awareness in young participants. It follows that both negative and positive age stereotypes should also exist below awareness in old participants.

It is predicted that implicit self-stereotyping will occur in old age regardless of old people's explicit beliefs about aging. Studies have demonstrated that the same individual who will not openly express stereotypical views about women or African Americans will express stereotypes when they are activated and measured without the individual's awareness (Banaji et al., 1993; Devine, 1989; Eberhardt, 1993). In view of the accumulating evidence that implicit stereotyping influences judgments of others and that almost everyone studied is susceptible to their effects, research on implicit self-stereotyping seems especially critical.

Stereotypes may enter a person's mind as information or generalizations that initially seem irrelevant (Langer, 1989). For example, a child in a drugstore may open up the birthday card intended for an aging person that reads, "Sagging flesh and cataracts! Liver spots and more! Cellulite and senility! There's so much more in store!" The child may put this card back on the shelf and file away this image without giving any thought to the effect of holding such an image. In old age, cues in our society might prime the stereotype and thus contribute to memory difficulties as a self-fulfilling prophecy. The environmental cues that prime stereotypes may be as subtle as hearing an old person speak. Giles, Coupland, Williams, and Nussbaum (1992) found that hearing the voice of an older person can activate the use of age stereotypes.

Memory Deficits in Old Age: A Result of Self-Stereotypes?

Older people tend to report feeling less of a sense of mastery over their memory abilities than do young people (Hertzog, Dixon, & Hultsch, 1990). Research on the nature of the relationship between these memory self-efficacy beliefs and memory performance in old age has been inconclusive. Previous studies have not established whether these beliefs follow from inevitable biological decline of certain types of memory or whether these beliefs could contribute to the decline (Light, 1991; Smith, 1996).

A cross-cultural study conducted by Levy and Langer (1994) suggested that beliefs may contribute to memory decline in old age. The researchers examined memory processes in old age in two cultures: the Deaf American and the mainland Chinese cultures. The authors thought members of these cultures would be less exposed to the negative stereotypes of old age prevalent in the American mainstream culture. The Chinese and Deaf American old participants outperformed the American hearing old participants on the four types of memory studied. In China, where the most positive views of aging were expressed, no significant differences emerged on memory scores between the old and young Chinese participants, even though the types of memory selected were those for which researchers have documented a decline in old age (Schacter, Kaszniak, & Kihlstrom, 1991).

In the present studies I aimed to clarify two findings of Levy and Langer's (1994) cross-cultural study, which relied on correlational analyses. First, by experimentally manipulating stereotypes of old age, I examined whether stereotypes influence memory performance rather than the converse. Second, I examined whether the link between stereotypes of aging and memory performance in old age found in the cross-cultural study operates on an implicit level, an explicit level, or both.

An implicit intervention that can activate self-stereotypes might be able to bypass the processes that allow Americans to maintain their predominantly negative images of old age. It is possible that the reason researchers have had difficulty improving old people's memory is that they have relied exclusively on explicit interventions. For example, Lachman, Weaver, Bandura, Elliot, and Lewkowicz (1992) designed a study in which they tried to improve older adults' memory by teaching a group of old participants how to cognitively restructure their memory beliefs from maladaptive views of memory (e.g., memory inevitably deteriorates) to adaptive views (e.g., memory can be improved through effort). Lachman et al. compared the cognitive restructuring group with a control group that was given practice only with the memory tasks and also with a no-practice control group. The authors expressed surprise at finding that the cognitive restructuring group did not show a memory advantage over the other groups, including the no-practice control.

An explanation for this outcome may be that the cognitive restructuring intervention did not penetrate deeply enough to alter the participants' way of thinking. When an older individual performs a memory task it activates deeply enculturated stereotypes of old age as a time of cognitive decline. Therefore, it seems unlikely that a brief explicit intervention would change the associations between memory performance and negative self-stereotypes that have built up over a lifetime. An implicit intervention, on the other hand, may be able to shift the self-stereotypes from negative to more positive images of aging. By activating the stereotypes without awareness, individuals are less likely to resist a change in their self-stereotypes.

Study 1

To examine whether cultural stereotypes influence memory performance, in the following study I compared the influence on aging memory of an implicit intervention with two explicit interventions. The first explicit intervention involved giving false positive feedback. The second explicit intervention, following the paradigm used by Davison and Valins (1969), gave people either internal or external attributions for memory success.

In Study 1 I explored four hypotheses:

1. Self-stereotypes of wisdom and senility can be primed in old individuals without their awareness.
2. Priming negative stereotypes of old age in old individuals will (a) lead to the expression of more negative images of old age, (b) lead to lowered expectations about one's own memory abilities, and (c) worsen memory performance.
3. Conversely, priming positive stereotypes of old age in old individuals will (a) lead to the expression of more positive images of old age, (b) lead to higher expectations about one's own memory abilities, and (c) improve memory performance.
4. Unlike the implicit intervention, the explicit interventions should not change old individuals' images of old age, expectations about their memory abilities, or memory performance.

Method

Overview

The research compared the influence of an implicit intervention with two explicit interventions on memory performance in old individuals. All the participants were randomly assigned to one of two implicit self-stereotyping conditions in which a computer subliminally presented words related either to a senile or a wise image of old age. Participants were also randomly assigned to the explicit interventions, which consisted of three feedback attribution conditions (success feedback attributed to internal causes, success feedback attributed to external causes, and no feedback). The primary-outcome variable consisted of the difference between a set of memory scores given before and after the interventions. In addition, all participants responded to questions about their stereotypes of aging, and their metamemory.

Participants

Ninety individuals 60 years or older living in the Boston area or northern Vermont participated in the study. Participants found out about the study through fliers, advertisements in local newspapers, and letters sent to several housing units for older people in which residents live independently in their own apartments. Study announcements described the study as one that was exploring memory improvement. Criteria for inclusion consisted of being 60 years of age or older, speaking English as a first language, and having the ability to read and write. In addition, all participants were required to have grown up in North America and to be living independently. The last criterion for inclusion consisted of participants reporting that they perceived the primes flashing but had no awareness of the actual words.

The 90 participants who met the research criteria included 24 men and 66 women. The participants were randomly distributed into the six cells (two priming conditions for each of the feedback attribution groups), with an effort to include an equal ratio of men to women in each cell. Thus, each of the six cells included 11 women and 4 men. Participants' ages ranged from 60 to 90 years with an average of 73 years (SD = 6.77). Age did not differ significantly across priming or attribution condition.

Although most of the participants lived in the Boston area, a subset lived in or near St. Johnsbury, Vermont. Because some literature suggests that aged individuals living in rural areas may be better integrated into their small communities and less exposed to negative stereotypes of aging, these 22 participants from northern Vermont broadened the variability of the participant pool and allowed a comparison of urban and rural responses (Clayton et al., 1994; Lee & Whitbeck, 1987).

After completion of the study, all participants received $10 and a brochure describing memory strategies. Participants were not screened for level of ageism, because previous studies have found that priming of stereotypes can take place regardless of level of prejudice (e.g., Banaji & Greenwald, 1994; Devine, 1989).

Three participants reported seeing the priming words and thus were removed from the sample. The rejected participants did not seem to differ from those included in any significant way, except their average age was slightly younger than the participants that were included. I suspect that these participants have an unusually quick processing speed.

Apparatus and Materials

The following section comprises two parts. The first describes the development of the priming paradigm and the perception-without-awareness control conditions. The next section describes the dependent measures, which include (a) memory performance measures, (b) metamemory measures, (c) attitude-toward-aging measures, and (d) an affect measure.

Development of the implicit self-stereotyping paradigm. The priming words emerged from a method described by Banaji et al. (1993) to develop stereotype primes. The procedure began with a group of 10 individuals, ranging in age from 17 to 73 years, generating lists of phrases characteristic of senile or of wise behaviors. A list was then created on the basis of these phrases of 111 adjectives and behaviors, which included 47 phrases selected to represent senile behaviors (e.g., "Can't recall birthdate") and 48 to represent wise behaviors (e.g., "Sees all sides of issues"). The remaining 16 phrases assessed adjectives and types of behaviors thought to be uncharacteristic of aging, such as aggressive behavior. Then a new group of 10 people—5 under the age of 30 years and 5 over the age of 60 years—rated the phrases on two dimensions: how characteristic of old age they seemed and how positive or negative they seemed on a scale that ranged from 1 (*extremely positive*) to 7 (*extremely negative*).

The senility and wisdom items selected met the following criteria among all the raters: (a) the senility items were rated 4 or above on negativity, (b) the wisdom items were rated 4 or below on positivity, and (c) all items were judged to be characteristic of old age. The senility and wisdom behaviors and traits that met these criteria and were used to create the primes did not differ in terms of how characteristic of old age they were judged by the raters, $t(9) = 0.18, p > .80$. The 12 negative age-related primes generated were: *alzheimer's, decline, dependent, senile, misplaces, dementia, dying, forgets, confused, decrepit, incompetent,* and *diseased.* The 12 positive age-related primes were: *guidance, wise, alert, sage, accomplished, learned, improving, advise, creative, enlightened, insightful,* and *astute.*

The computer priming method was developed on Maclab, a software package designed for psychological experiments that present computer stimuli to individuals (Costin, 1988). Maclab records reaction time and accuracy of response. Participants were told to identify whether a flash occurred above or below a bullseye. Participants were told to press the corresponding computer key that either displayed an up arrow or a down arrow as soon as they noticed the flash. Participants were told to respond as quickly, but also as accurately, as possible and to focus their attention on the bullseye.

All participants completed 20 practice trials. The practice stimuli flashed progressively faster on the screen. Pilot testing revealed that individuals were better able to understand the directions for identifying whether the flash occurred above or below the bullseye if they were first given a chance to identify flashes at speeds that allowed awareness. Pretesting also revealed that speeds between 250–125 ms could be perceived with awareness by most of the participants. Thus, the first five practice trials flashed for 250 ms, the next five flashed for 200 ms, the next five flashed for 150 ms, and the last flashed for 100 ms. To avoid participants expecting to see words in the actual trials, the practice trials consisted of meaningless strings of letters.

Selecting the proper speed for flashing the primes, which followed the practice trials, to allow perception without awareness, presented a challenge for several reasons. First, visual processing speed and visual search abilities tend to decline with age (Fozard, 1990). Second, variability in visual abilities both between and within individuals increases with age (Fozard, 1990). This visual variability made it challenging to find a speed that was slow enough to allow encoding but fast enough to avoid conscious perception of the words among the older participants. Third, published research on stereotype priming could not provide a model, because these studies have included only young participants.

To meet these challenges, a paradigm was designed that could be adapted to each person's abilities and that would encourage participants to feel comfortable during testing. Considering that many of the participants had not used a computer before, the computer priming methods of Bargh and Pietromonaco (1982) and Devine (1989) were simplified by reducing the number of places the stimuli could randomly appear on the computer screen from four quadrants to two halves (i.e., above or below a midpoint). In addition, the speed of stimuli presentation was adjusted according to each individual's visual processing capabilities. This was achieved by selecting three trial speeds. The three speeds permitted old individuals with a range of visual processing speeds to meet the criterion of perception of the flashes without awareness of the words.

Everyone began on the fastest speed of 55 ms. Forty-nine participants claimed they could not see anything flashing after a block of 20 trials, thus the experimenter slowed the speed to 66 ms. Five participants reported they could also not see any flashes after another block of 20 trials, thus the experimenter slowed it for them to the slowest speed of 115 ms. Three of the 5 participants who needed the slowest speed spontaneously complained of eye problems of various sorts, such as cataracts, during the testing session. After the task, the experimenter asked all the participants to describe what they saw and if they had been able to read any words. Ninety of the 93 participants tested reported that they could see only flashes or blurs. As mentioned, 3 participants were removed from the sample because they reported seeing one or several words.

Pilot testing revealed that at 55 ms most old participants reported seeing the flash without awareness of the words. In reviewing the other implicit-priming literature, 55 ms seems relatively fast for an initial speed considering the participants and paradigm selected for this study. Bargh and Pietromonaco (1982) used a speed of 100 ms, Devine (1989) used a speed of 80 ms, and Perdue and Gurtman (1990) used a speed of 55 ms for their stereotype priming tasks. All of these researchers relied on college students as participants, who tend to demonstrate faster visual processing speeds than participants over the age of 60 years.

Despite their younger samples, Bargh and Pietromonaco (1982) and Devine (1989) required slower speeds in their studies than the initial speed used for this study because they used four quadrants of the computer screen to present the stimuli, as opposed to the two halves used in this study. Perdue and Gurtman (1990), on the other hand, used the same speed as this study and presented the priming words in only one location, the center of the screen. Thus, it seems likely that not all old participants would be able to perceive the flashes at this speed. The next-slower speed of 66 ms used in this study is still faster than that used by Bargh and Pietromonaco (1982) and Devine (1989).

The words were flashed in black on a white background. To reduce the likelihood of perception with awareness, a patterned mask thoroughly covered over the afterimages of the primes. The words flashed either 1 cm above the bullseye or 1 cm below the bullseye. The masks remained until participants pressed a button. The interstimulus intervals lasted 2–7 s.

Following the structure of Bargh and Pietromonaco (1982) and Devine (1989), the two priming conditions consisted of five blocks or sets of words, each containing 20 words each. Each block began with 1 of 2 category words: either *old* or *senior*. After the category word, the computer randomly presented the next 19 words. The second category word that did not introduce the block appeared within the next 18 words. The program counterbalanced word location, so that if a word appeared above the bullseye in one block, it would appear below it in the next block.

Also following the ratios of Devine (1989), 80% of the words were stereotype-related words, and 20% were neutral or non-stereotype-related words. The neutral words consisted of high-frequency words matched in length to the stereotype-related words (Carroll, Davies, & Richman, 1971). The same neutral words were presented in the senile and the wise conditions. These words included: *together, another, between,* and *sentence*. To make the priming powerful, we followed the design used by Devine (1989) of repeating prime words within blocks. Thus, of the 14 words, 2 words repeated within each block. In the senile condition the words *Alzheimer's* and *senile* repeated, whereas in the wise condition the words *wise* and *sage* repeated.

Perception-without-awareness control conditions. To investigate whether the priming task allowed perception without awareness, 10 participants participated in a guess task and a recognition task. The tasks resembled those used by Devine (1989) and Bargh and Pietromonaco (1982) in their computer priming studies. These researchers reasoned that evidence for perception without awareness would be the detection of a flash without any recognition of the priming stimuli content. Both studies included a guess condition in which participants tried to guess words as they flashed and a recognition condition in which participants tried to identify the words after the priming task.

In the guess condition in this study, participants were asked to keep their gaze on the bullseye in the center of the screen and repeat aloud each word that flashed on the screen. To encourage participants to use a low guessing criterion, participants were told that free associating a word after a flash would be better than not guessing at all. The experimenter verbally encouraged participants if they did not guess spontaneously. Half the participants were exposed to the wise priming condition, and half were exposed to the senile priming condition. These two conditions gave every participant 100 words to guess.

The recognition task followed the guessing task. The experimenter gave the participants a list of 38 words that included the 12 stereotype and 6 neutral priming words to which they had been exposed. The control words included the 12 stereotype priming words from the other priming condition and 6 additional control words. The experimenter encouraged the participants to check the words that they thought might have appeared on the computer or that felt familiar in any way.

Memory performance. The memory tests were administered before and after the priming intervention. The memory tasks assessed a variety of the types of memory that have been shown to decline in old age, could be given in 10 min or less, and could be administered in two similar forms during a single testing session. The testing session was kept to under 90 min to minimize fatigue. Schacter et al. (1991) found in their review of patterns of memory decline in old age that recall as opposed to recognition, explicit as opposed to implicit, and episodic memory (from a specific visual spatial context) as opposed to semantic memory, tend to decline in old age. Thus, the participants responded to the following memory tasks:

The *immediate recall, learned recall, and delayed recall tasks* were based on a modified version of the 7/24 task (Lezak, 1983), which measures visual spatial recall without requiring keen eyesight or good motor control. The participants studied an array of seven dots on a grid for 10 s. Then the experimenter removed the pattern, gave the participants a blank grid with a collection of nine dots, and asked the participants to reproduce the design. Four 10-s learning trials with the same pattern were given. The immediate recall measure consisted of the first trial, and the learned recall measure consisted of the fifth learning trial. Then, after about 8 min of responding to other types of memory items, the participants were asked, without warning, to recall the design. The test designers call this last trial the *delayed recall* measure (Lezak,

1983). Participants produced one set of immediate, learned, and delayed recall scores in response to a dot pattern before the interventions and generated a second set of scores in response to a different dot pattern after the interventions. The participants' scores consisted of the number of dots they placed in the correct locations on the blank grid for each trial.

The *photo recall test* resembles the photo association task designed by Langer, Rodin, Beck, Weinman, and Spitzer (1979). Rather than associate photographed faces with names, as done in the original research, participants matched faces with activities. The experimenter showed eight photographs of older adults and told the participants an activity carried out by each person. The activities consisted of four active statements (e.g., "She swims every day") and four passive statements (e.g., "He spends most of his time watching television"). After viewing all the photographs, the participants viewed the photographs again and tried to name the corresponding activities. Participants responded to one set of photographs and activities before the interventions and another set after the interventions.

The *auditory recall task* consisted of the experimenter reading a list of 15 words with 5 words from three taxonomic categories at the rate of 1 word per second. After hearing the entire list, participants repeated as many words as they could recall. One list of words preceded the interventions, and a different list of 15 words followed the interventions. The task is a modified version of the one designed by Hertzog et al. (1990).

Metamemory. The metamemory measures consisted of two types: prediction questions to assess more immediate perceptions of memory capabilities, and questions from the Metamemory in Adulthood questionnaire (Dixon, Hultsch, & Hertzog, 1988). Participants were asked to predict the number of dots they would correctly place on the grid of the learned recall task and to predict the number of activity statements they would correctly match to the photographs of the photo recall task before responding to either of these measures. Luria (1966) suggested asking participants to estimate how many stimuli they will recall in the next trial. According to Lezak (1983), prediction questions require little added time, do not seem to interfere with learning or recall, and with them "one can obtain information about the accuracy of patients' self perceptions, appropriateness of goal setting and their ability to apply data to themselves" (p. 424).

The assessment of longer term metamemory beliefs was based on three metamemory subtests selected from the Metamemory in Adulthood questionnaire: Locus, Change, and Capacity. Dixon et al. (1988) reported that these tend to decline with age. The authors composed the Locus questions to assess perception of internal control over memory skills (e.g., "Even if I work on it my memory ability will go downhill"), the Change questions to assess perceived change in memory abilities (e.g., "I misplace things more frequently now than when I was younger"), and the Capacity questions to assess beliefs about one's current memory capacity (e.g., "I am good at remembering conversations I have had").

Attitudes toward aging. The views-of-aging measures included two measures more likely to tap shifting stereotypes and one measure more likely to assess longer held beliefs. To assess views of aging as a result of priming condition or shifting stereotypes, a target story with an old protagonist was developed. The story and the related questions followed the models developed by Banaji et al. (1993); Bargh and Pietromonaco (1982); and Higgins, Rholes, and Jones (1977). The first story of this kind, designed by Higgins et al. (1977), described the behaviors of a man named Donald. The authors chose behaviors that could easily be interpreted in more than one way. For example, the following sentence from the Donald story describes a behavior that could be interpreted as reckless or adventurous: "He was thinking, perhaps, he would do some skydiving or maybe cross the Atlantic in a sailboat" (p. 145, Higgins et al., 1977).

The target story in the present study described a 73-year-old woman named Margaret who moves in with her adult daughter and attends a college reunion. The stimulus story consisted of 21 sentences. Similar to the Donald story, this story conveys information that can be judged in more than one way and is assessed with follow-up questions. The ambiguous items are meant to convey images that vary on three dimensions: dependent–interdependent, loss of reality–creativity, and forgetting due to internal global causes (e.g., senility)–forgetting due to external and temporary causes (e.g., lack of sleep). The experimenter told the participants that the story exercise measured their recall abilities rather than their views of aging.

I predicted that participants primed with the senility-related stereotypes, as compared to those primed with the wisdom-related stereotypes, would judge Margaret as more dependent than interdependent in her relationship with her daughter and as more senile or out of touch with reality than creative when Margaret describes daydreams in which she imagines that a person and an object look like animals. In addition, I expected that participants primed with the senility-related primes would describe Margaret in more negative terms and would blame her forgetting on more internal than external and temporary factors.

All of the participants in the feedback attribution conditions read the Margaret story. After reading the story, participants tried to reproduce the story verbatim from memory and give an opinion about Margaret. Two individuals who were blind to the participants' priming group read each participant's two open-ended responses and then rated the responses on three 9-point scales and one 5-point scale. Pilot testing revealed that individuals tended to mix different types of relevant information in these two responses; thus they were evaluated together. The four scales used by the raters consisted of: a scale with 1 representing *extremely interdependent* and 9 representing *extremely dependent*, a scale with 1 representing *extremely creative* and 9 representing *extremely senile*, a scale with 1 representing *forgetful totally due to external causes* and 9 representing *forgetful totally due to internal causes*, and a scale with 1 representing *extremely negative* and 5 representing *extremely positive*. In the first three scales 5 was considered neutral, and in the last scale 3 was considered neutral. The two raters obtained an effective reliability of .85.

The second measure of participants' views of aging was Palmore's (1988) Fact on Aging Quiz. One could argue that, similar to the Margaret story, this is also an indirect measure of attitudes toward aging, because the Facts on Aging Quiz looks like a true–false knowledge questionnaire rather than a measure of attitudes.

The third view-of-aging measure was the open-ended question "When you think of somebody old, what are the first five words that come to mind?" Two individuals who were blind to the participants' priming groups rated the open-ended questions according to the scoring criteria described in Levy and Langer's (1994) article. They obtained an effective reliability of .92.

Mood. The Geriatric Depression Scale (Yesavage et al., 1982–1983) assessed the participants' moods. The authors of this scale found the scale to be valid and reliable as a self-report depression scale for older individuals living in the community.

Procedure

All participants were individually tested in a quiet room in one of several locations. Each room's furnishings included a long desk, a computer, and a big lamp with a large heating bulb that was shut off. Participants began by responding to some background questions. Next they tried out the first battery of memory tests. The experimenter asked the participants to predict how they thought they would perform on two of the memory tasks before trying them. All participants then tried the priming task, in which they were exposed to the self-stereotypes without their awareness. The experimenter told the participants that the computer task measured motor and attention skills. Participants pressed arrow buttons on the computer that corresponded to where they

thought they saw the flash occur on the screen. When the participants finished this task, the experimenter asked them about what they had seen on the screen.

Next, two-thirds (60) of the participants entered one of the attribution feedback conditions, whereas the remaining one-third proceeded directly to the second battery of memory tasks. All 60 participants in the two attribution feedback groups were told they were going to be exposed to a memory-enhancing light called a "cognitive luminescence bulb." The experimenter told the participants that the development of the bulb followed from two research projects. The first project found that light can improve some of the symptoms of a type of depression—seasonal affective disorder; and the second, more recent research project, conducted by a team of scientists, found that light can improve some of the symptoms of Alzheimer's disease. Some of the participants mentioned that they had read about one or both of these studies, which had appeared in newspapers.

The experimenter then presented the following fabricated research results: In the Alzheimer's disease light research, the scientists accidentally discovered that normal control participants also showed some improvement under certain kinds of lights on certain kinds of memory tasks, such as text recall. The advantage of this light is that it works immediately, as it is pointed at the recipient. The disadvantage of this light is that its influence is temporary and seems to help only when the bulb is turned on.

The experimenter then, in full view of the participants, turned on the "cognitive luminescence bulb" that gave off a red hue and a slight warmth. Participants then read the Margaret story and answered questions. When these 60 participants finished responding to the questions about Margaret, the researcher turned off the lamp, again in full view of the participants, and then told the participants that their responses to the story's recall questions would be scored. All received positive feedback regardless of how they answered the questions. The researcher showed the participants a memory chart and pointed out that their recall score placed them in the top 1% for their age group and the top 10% for all age groups.

Half of the 60 people who received the positive feedback were given an internal attribution. The experimenter told these 30 participants that they were in the placebo group and thus not exposed to the "cognitive luminescence bulb" but rather to a normal heat bulb. Thus, they were told that the high scores from the text recall task must be due to their own effort. The other 30 participants, in the external attribution condition, were not told that the lamp was a placebo but rather that the lamp succeeded in producing their high text recall scores.

After the feedback, the participants in the internal and external attribution conditions responded to the second battery of memory tests. The participants in the no-feedback condition proceeded immediately to the second memory battery. Again, the participants predicted their performance on two of the memory tasks before trying them.

Before leaving, participants filled out three questionnaires: the Facts on Aging Quiz, the Metamemory In Adulthood questionnaire, and the Geriatric Depression Scale. The researcher debriefed participants and asked them not to share the content of the session with others who might volunteer.

Results

Memory Performance

A 2 (priming condition: senile or wise) × 3 (success feedback attribution condition: success feedback attributed to internal causes, success feedback attributed to external causes, or no feedback) × 2 (time of memory task: before or after the intervention) multivariate analysis of variance (MANOVA) was conducted with the five types of memory tasks serving as the dependent variables, the time of memory task acting as the within-subjects factor, and the other two variables serving as the between-subjects factors. As predicted, the two-way interaction between priming condition and time of memory task was significant, $F(1, 83) = 37.78$, $p < .001$. No other effects reached significance at the multivariate level. As predicted, the explicit success feedback attribution condition did not interact with the time-of-memory-task variable.

To analyze the effects of the second explicit intervention, false positive feedback, a 2 (priming condition) × 2 (false positive feedback or no false positive feedback) × 2 (time of memory task) MANOVA was performed. The false-positive-feedback condition did not interact with the time-of-memory-task variable. This suggests that the false positive feedback did not boost people's memory scores over those who did not receive any feedback. In addition, a Priming Condition × Time of Memory Task × False Positive Feedback Condition interaction did not emerge. Considering that the false-positive-feedback intervention lasted approximately 20 min, this suggests that the priming effect was as powerful for those participants who experienced the 20-min delay as those who went immediately to the second set of memory tasks after the priming intervention.

Although a significant Priming Condition × Time of Memory Task interaction emerged in both the MANOVAs when all the memory tasks were analyzed together, each of the five memory tasks was also analyzed separately, to better understand the individual trends. This analysis consisted of 2 (priming condition) × 3 (success feedback attribution condition) × 2 (time of memory task) repeated measure analyses, with the first two factors acting as the between-subjects variables and the time of memory task serving as the within-subjects variable. The two-way interaction between priming condition and time of memory task was significant for the four memory tasks that involved visual memory: the immediate recall task, $F(1, 84) = 18.78$, $p < .001$; the learned recall task, $F(1, 84) = 5.55$, $p < .05$; the delayed recall task, $F(1, 84) = 10.55$, $p < .01$; and the photo recall task, $F(1, 84) = 16.84$, $p < .001$. The interaction did not reach significance for the auditory recall task.

To better understand how the priming intervention influenced each of the memory tasks, paired t tests were conducted within each priming condition (see Table 1). As expected, within the wisdom priming condition the immediate, learned, delayed, and photo recall task means all increased following the priming intervention. After the alphas were Bonferroni adjusted, only the photo recall reached significance, $t(44) = 6.61$, $p < .001$.

As expected, within the senility priming condition, the immediate, learned, delayed, and auditory recall task means all decreased following the priming intervention. The photo recall tasks means of participants in the senility condition did not decrease but increased less than means of participants in the wisdom condition. After the alphas were Bonferroni adjusted, the differences between the pre and post memory tasks reached significance for the immediate recall task, $t(44) = 5.74$, $p < .001$, and the delayed recall task, $t(44) = 4.14$, $p < .001$.

Although participants were randomly assigned to the priming groups, to make sure that the participants did not differ significantly before the intervention, the memory performance of those who were exposed to the senility primes was compared

Table 1
Memory Score Means of Old Participants Before and After the Priming Intervention

	Priming condition				
	Senility		Wisdom		
Memory task	Pre	Post	Pre	Post	Interactions
Immediate recall[a]	4.44[b]	2.67[b]	3.40	4.38	$F(1, 84) = 18.78, p < .001$
Learned recall[a]	6.02	5.56	5.53	6.02	$F(1, 84) = 5.55, p < .05$
Delayed recall[a]	5.91[b]	4.80[b]	5.27	5.47	$F(1, 84) = 10.55, p < .01$
Photo recall[c]	4.84	4.98	4.16[b]	5.56[b]	$F(1, 84) = 16.84, p < .001$
Auditory recall[d]	7.75	7.11	7.58	7.56	$F(1, 84) = 1.82, p < .19$
Photo recall[c] prediction	4.06	4.14	4.16[b]	4.81[b]	$F(1, 75) = 4.50, p < .04$
Learned recall[a] prediction	5.28	5.05	5.03	5.47	$F(1, 73) = 1.91, p < .18$

[a] Scored out of a total of 7 points. [b] Reflects significant differences within rows, $p < .05$. [c] Scored out of a total of 8 points. [d] Scored out of a total of 15 points.

with that of participants who were exposed to the wisdom primes before they experienced the intervention. There was a tendency for participants in the senility condition to score slightly higher on the memory tasks than those in the wisdom condition before the intervention. However, no significant differences emerged on any of the five memory tasks.

Metamemory

In 2 (priming condition) × 3 (success feedback attribution condition) × 2 (time of memory prediction) repeated measure analyses of variance (ANOVAs), with the first two variables serving as the between-subjects factors and the time-of-memory-prediction variable acting as the within-subjects factor, priming group interacted with the participants' predictions of their memory performance on the photo recall task over time, $F(1, 65) = 4.50, p < .04$. As can be seen in Table 1, on the photo recall task the predictions increased less for participants who were exposed to the senile primes than for those who were exposed to the wisdom primes. Although the increase in means did not reach significance for those exposed to the senility primes, the increase reached significance for those in the wisdom priming condition, $t(30) = 2.48, p < .02$.

The learned recall predictions over time also interacted with priming group but did not reach significance, $F(1, 73) = 1.91$, $p < .18$. As can be seen in Table 1, on the learned recall task, as expected, the predictions tended to decrease following the senile primes and tended to increase following the wisdom primes. As expected, these two metamemory prediction measures tended to reflect the implicit priming condition but not the explicit success feedback interventions.

Although, as mentioned, all participants were randomly assigned to the priming groups, to check that the interactions were not due to different baseline scores, t tests were performed. Neither the learned recall predictions nor the the photo recall predictions differed significantly by priming group before the priming intervention. Following the intervention, the photo recall prediction means differed significantly by priming group, $t(38) = 2.11, p < .04$. The learned recall prediction means following the intervention did not differ significantly by priming group.

The three Metamemory in Adulthood questionnaire measures of Locus, Capacity, and Change did not reflect either the implicit or the two explicit interventions.

Attitudes Toward Aging

Two (priming group) × 3 (success feedback attribution group) ANOVAs were performed on the view-of-aging measures. No effects emerged as a result of the success feedback attribution conditions. Similar to Bargh and Pietromonaco (1982) and Banaji et al. (1993), I found that the old participants in the two priming groups emphasized different images in their descriptions of the story protagonist. On the free-recall items in which the participants reproduced the story verbatim and then gave a description of Margaret in their own words, differences emerged on the three dimensions of dependence–interdependence, loss of reality–creativity, and forgetful due to internal and global causes–forgetful due to external and temporary causes. As predicted, participants who were primed with senility-related words, as opposed to those who were primed with wisdom-related words, described Margaret as more dependent as opposed to interdependent, $F(1, 57) = 4.21$, $p < .05$ (senility $M = 4.10$, wisdom $M = 3.41$); more senile as opposed to creative, $F(1, 57) = 3.84, p < .06$ (senility $M = 5.61$, wisdom $M = 5.00$); and more forgetful due to internal causes as opposed to external causes, $F(1, 56) = 2.89, p < .10$ (senility $M = 5.29$, wisdom $M = 4.89$). In addition, when participants described Margaret in their own words, those primed with positive stereotype words were significantly more likely to describe Margaret in positive terms ($M = 2.87$) as compared to those primed with the senility primes ($M = 2.33$), $F(1, 54) = 10.30, p < .01$.

When describing Margaret, a participant exposed to the wise prime wrote, "A rather typical grandmother trying to adjust to a new situation after a traumatic event. Concerned for her children's and grandchildren's welfare. Interested in people who are her own age." The above contrasts with participants in the senile group. One wrote, "Getting older and forgetful which is natural for most old people." Another wrote just two words: "Alzheimer's disease!"

On the two more explicit measures of views of aging, the Facts on Aging Quiz and the open-ended question in answer to which

participants listed the five words that best describe an old person, no significant differences emerged. In the open-ended measure, the words named most frequently were analyzed to examine whether the words reflected distinct images or merely the prime words to which the participants had been exposed. The words listed according to frequency of mention, with the number of participants who named them in parentheses, are *wrinkled* (19), *gray* or *white hair* (17), *slow* (11), *forgetful* (10), *wise* (10), *ill, sick,* or *infirm* (8), *stooped* or *bent over* (7), *deaf* or *hard of hearing* (6), *alert* (6), *frail* (6), *happy* (6), *glasses* (5), *lame* (5), *decrepit* (5), and *senile* (4).

Of the 15 most commonly mentioned terms, the following 5 appeared in one of the prime lists: *forgetful, wise, alert, decrepit,* and *senile.* On 4 out of 5 of these words, participants who had previously been exposed to 1 of these words did not tend to mention the term more frequently than those who had not been primed with the term. Less than half of the participants (40%) who mentioned 1 of the 5 terms that had appeared in either the wisdom or senility prime lists had previously been exposed to the same word. Thus, the words given in response to the open-ended view-of-aging measure seem to reflect the participants' images of aging rather than the subliminally presented words.

Participant Variables

To determine if any of the major participant variables influenced the relationship between priming condition and time of memory task, six 2 (priming condition) × 3 (success feedback condition) × 2 (time of memory task) repeated measure MANOVAs, with priming condition and success feedback condition as between-subjects variables, were performed. In each MANOVA a different participant variable (region, sex, computer experience, priming speed, age, education, or affect) served as the third between-subjects factor. These MANOVAs also provided information about whether the relationship between attribution condition and memory performance over time becomes significant when any of these participant variables are included in the analyses. Both the education and age variables were converted into dichotomous variables by dividing participants into those who fell below the mean and those who were equal to or above the mean (education M = 15 years; age M = 73 years).

These analyses revealed that none of the analyzed participant variables influenced the relationship between priming condition and the time of memory task. This suggests that the interaction between priming condition and time of memory task is quite robust. Also, the inclusion of the participant variables did not make any of the Attribution Condition × Time of Memory Task interactions significant. Several of the participant variables, however, seemed to influence memory performance. Main effects emerged for the following variables: region, $F(1, 78) = 20.44$, $p < .01$; computer usage, $F(1, 77) = 13.48$, $p < .01$; age, $F(1, 77) = 7.97$, $p < .01$; and affect, $F(1, 76) = 15.18$, $p < .01$. Priming speed and sex did not produce significant main effects.

The main effect for region was such that participants who lived in Vermont performed worse on the memory tasks than those who lived in the Boston area. This may be due to a difference in familiarity and comfort with experiments. Many of the participants who lived in Boston reported that they had previously participated in research, as opposed to many of the participants who lived in Vermont, who reported that this study was a new experience for them. Similarly, the main effect for computer use may be due to participants with previous computer experience feeling more at ease with the memory testing situation. The main effect of age on memory is consistent with the memory literature that reports that younger individuals perform better on many memory tasks. The main effect for affect fits in with the research documenting that depression interferes with cognitive processing, whereas heightened mood may stimulate processing (Ikegami, 1986; Isen, Daubman, & Nowicki, 1987).

In this study, affect acted as both an independent and as a dependent variable in the analyses. Participants filled out the Geriatric Depression Scale after they had undergone the priming intervention. When affect, as measured by the Geriatric Depression Scale, served as a dependent variable, an ANOVA revealed that it did not reflect either the priming or the feedback attribution interventions.

Activation of Internalized Stereotypes of Aging

The evidence that the study primed existing images of old age comes from the influence of the primes on the memory performance scores, memory prediction scores, and views-of-aging measures. It also can be inferred from two reaction time findings. First, participants in both the prime groups took longer to identify the location of the flash when responding to the priming words (M = 631 ms) as opposed to the neutral control words (M = 581 ms), $F(1, 76) = 3.46$, $p < .07$. This trend occurred in all five presentation blocks and reached significance in Block 1, $F(1, 80) = 6.03$, $p < .02$; Block 2, $F(1, 82) = 4.27$, $p < .05$; and Block 3, $F(1, 83) = 6.70$, $p < .02$.

The second finding that suggests that the study primed existing images of old age emerged from the comparison of reaction times across prime groups. Participants who were presented with the wisdom-related primes took longer to identify the location of the flashes (M = 695 ms) than those who were presented with the senility-related primes (M = 547 ms), $t(84) = 1.76$, $p < .05$.

The finding that the reaction times for the wisdom primes were slower than the reaction times for the senility primes does not seem to be due to word frequencies. Although the first finding that the primes took longer to identify than the neutral words can be explained by the fact that the neutral words appear more frequently in the English language, the second finding cannot be explained by relative word frequencies. When a standard frequency index was calculated for the prime words, the senility words received a score of 43.59, and the wisdom words received a score of 48.68. A higher standard frequency index score indicates greater frequency in the English language (Carroll et al., 1971). Thus, the fact that the wisdom primes took longer to identify than the senility primes suggests that the effect is due not to word frequencies but rather to the relative saliency of the stereotypes the primes activate.

Perception-Without-Awareness Checks

Although the findings support the hypotheses that negative and positive implicit self-stereotyping exist and tend to influ-

ence memory, metamemory, and views of aging in opposite directions, it remains to be demonstrated that the self-stereotype paradigm presented the primes in a way that permitted perception without awareness in the old participants. In the following section I describe the results from the guessing condition and recognition condition checks on immediate awareness.

Most participants explained that, because they could not make out words on the screen, they found both the guessing and recognition tasks difficult. The average age of the 10 participants in the awareness check conditions (M = 72 years) was similar to the average age of the 90 participants that participated in the priming intervention study (M = 73 years).

The hit rates for the guess conditions of this study resemble those reported by Devine (1989) as indicating perception without awareness. Of the 1,000 guesses in this study, 25 were identified correctly. Thus, the overall hit rate for this study was 2.5%. Participants achieved a 5.0% neutral-primes hit rate by accurately reporting 15 of the 300 neutral words and a 1.4% stereotype word hit rate by accurately identifying 10 of the 700 stereotype primes.

The reason the hit rate for neutral words exceeded that of the stereotype words may be due to the fact that the neutral words occur at higher frequency in everyday language than the stereotype-related words and thus would be more easily detected (Bargh & Pietromonaco, 1982; Devine, 1989). When the incorrect guesses were examined for their stereotype relatedness, none were found to be related to aging.

All of the accurate stereotype guesses, and all but one of the accurate neutral word guesses, came from a 70-year-old man. It is probable that if he had participated in the priming intervention study he would have been excluded from the sample. A criterion for the participants to be excluded from the priming intervention study was reporting that they had seen any of the words flash on the screen.

When the total number of guesses served as the denominator, the overall recognition rate of the stimuli was at chance level (45.5%). Participants in the wisdom priming condition had a recognition rate of 41.6%, as opposed to those in the senility priming condition who had a recognition rate of 49.4%. When the number of stereotype words served as the denominator, the hit rate for all the participants was 43.5%. When the number of neutral words served as the denominator, the hit rate was 47.5%.

The combined results from the recognition and guess conditions suggest that the participants were not aware of the prime content and that the priming paradigm successfully allowed perception without awareness.

Discussion

The results support the hypotheses that self-stereotypes of wisdom and senility can be primed in older individuals without their awareness and that priming these stereotypes can influence memory performance and indirect measures of views of aging and memory self-efficacy in opposite directions.

This influence of implicit self-stereotyping on the memory performance of older individuals appears to be quite robust. The change in memory according to the stereotypes implicitly presented occurred regardless of the sex, education, mood, location of residence (rural or urban), previous computer use, or age of the old participants. The fact that the effect was as strong in the participants between the ages of 60 and 72 years as those between the ages of 73 and 90 years suggests that the self-stereotyping effect targets individuals of wide-ranging experiences and cognitive abilities. It also suggests that implicit self-stereotyping operates as an all-or-nothing mechanism for individuals in a social group. That is, to be older or a more prototypic member of a social group may not matter as much as whether one is a member of that group. In addition, the effect was as strong in those who experienced a 20-min delay following the priming task as those who went immediately to the second set of memory tests. Future research is needed to examine how long this implicit self-stereotyping effect can last.

The Metamemory in Adulthood questionnaire, the Facts on Aging Quiz, and the open-ended view-of-aging measure provided a direct approach to gathering information about how the participants assess old age. The memory prediction questions and the Margaret story questions indirectly measured the same information. The memory prediction questions made no reference to aging, and the directions for the Margaret story questions led participants to believe that the questions assessed their recall ability rather than their views of aging. These indirect measures reflected priming conditions, whereas the direct measures did not. The indirection seemed to allow the participants to operate on an unconscious level that was receptive to the subliminally activated self-stereotypes. The direct measures, on the other hand, tended to activate the habituated negative self-stereotypes of old age in participants regardless of their priming condition.

In addition, as hypothesized, the two explicit interventions, unlike the implicit intervention, did not influence the participants' memory performances. Specifically, the positive feedback or the attributions given to the participants about why they performed well under the "cognitive luminescence bulb" did not influence memory performance in the MANOVA with the five memory tasks analyzed together or in the univariate analyses with the five memory tasks analyzed separately. Furthermore, these explicit interventions did not influence the attitude-toward-aging measures.

The credibility of the two explicit interventions used in this study needs to be considered. Although it is possible that the high memory scores conveyed to the participants as part of the false positive feedback were too far out of their usual range for them to be believed, none of the participants openly expressed disbelief or verbally questioned their scores. Instead, many participants expressed pleasure at their high scores and commented on how they looked forward to telling a friend or family member about their performance.

To assess how much participants believed that the "cognitive luminescence bulb" would help them, a random selection of 6 participants, out of the 60 given the success feedback attribution intervention, were asked if they felt the lamp helped them in recalling the details of the Margaret story. Three thought it definitely helped them, 2 thought it might have helped, and 1 questioned whether it helped. Thus, it appears unlikely that skepticism toward the memory-improving bulb would explain why no difference emerged between participants who were told that the bulb was a placebo (internal attribution) and those who were left with the impression that the bulb caused their high performance (external attribution).

It is possible that advertising this study as memory improvement research led to a sample of participants who tended to be committed to a positive self-stereotype of aging and were thus particularly susceptible to memory improvement. However, only the participants in the positive priming group tended to show memory improvement; the participants in the negative priming group tended to demonstrate memory decline. Moreover, it also is possible that the prospect of memory improvement attracted participants who were apt to see themselves in need of such improvement and were therefore more committed to a self-stereotype of aging that included memory deficits.

People over the age of 60 do not always consider old age part of their self-identity. To highlight this aspect of participants' identity, this study included four reminders. First, participants were recruited with advertisements for individuals aged 60 years or older. Second, the first questions participants answered included five items related to their age or age cohort. Third, in the priming task the first word of each of the five blocks consisted of what Devine (1989) calls a *category word,* or a word that labels the priming category. Either the category word *old* or *senior* began each of five blocks, and the other category word appeared randomly in the block. In addition, the rest of the prime words had been previously judged as age related by a group of raters.

Even though this study highlighted old age as a self-identity, and the data indicated that the priming intervention influenced memory performance, memory predictions, and the more automatic measures of views of aging, it remains to be conclusively demonstrated that this effect is an implicit self-stereotyping effect. It seems logical that self-stereotypes subliminally evoked in elderly people would influence their memory, memory self-efficacy, and views of aging in the ways described. However, one could also explain these results without evoking self-stereotypes. It is possible that the mood transmitted by the primes directly caused these effects. Even though affect as measured by the Geriatric Depression Scale did not reflect priming condition, it is possible that the priming generated affect that is not picked up by the Geriatric Depression Scale. Researchers constructed the Geriatric Depression Scale to assess mood experienced over the last week rather than over the last hour. One way to test the assumption that implicit self-stereotyping caused the effects was to conduct another study. If the intervention yielded its effect by priming pre-existing stereotypes relevant to the older participants' self-concepts, it seems logical that the effect should be weaker or nonexistent for another group for whom these stereotypes are not as relevant, such as young people. Thus, I conducted a second implicit stereotyping study, with young participants.

Study 2

Because the implicit intervention, but not the two explicit interventions, produced significant effects in Study 1, only the implicit priming intervention was used in this study. The priming paradigm used with the young participants duplicated the one used in the first study, with one exception. Young people tend to have a faster visual processing speed than older individuals. Thus, in the priming paradigm the stereotype words were flashed at a speed of 33 ms, as opposed to the fastest speed with the older participants of 55 ms, to continue to allow perception without awareness in the young participants.

Pilot testing revealed that 33 ms is the fastest speed at which young participants reported that they could see a flash on the screen but not the actual words. Although the speed is faster than most of the other implicit stereotyping experiments, other subliminal-exposure studies have found that individuals can encode stimuli presented as fast as 1 ms. Researchers studying the *mere-exposure phenomenon,* in which participants who are exposed to stimuli at subliminal speeds later report that they like these stimuli more than others to which they had not been exposed, flash stimuli at speeds ranging from 1 to 8 ms (Bornstein, 1992). Thus, the speed used with the young participants of this study, 33 ms, should be slow enough to allow perception but fast enough to prevent awareness. To examine this assumption, the same perception-without-awareness checks conducted in the first study were also conducted with the young participants.

Two researchers, one blind to the hypotheses, exposed half the participants to the wise priming intervention and half the participants to the senile priming intervention. No significant differences emerged in the results generated by these two researchers. As with the older participants, all participants responded to a battery of memory tasks before and after the priming intervention. Parallel to the design of Study 1, two thirds of the participants experienced a 20-min delay after the priming intervention during which they read and answered questions about the Margaret story, and one third went immediately from the priming intervention to the second set of memory tasks.

The hypothesis of this study was that the priming intervention should not cause a change in memory performance, metamemory, or views of aging in the young participants.

Method

Participants

Sixty individuals between the ages of 18 and 35 years (M = 26 years) were recruited from the Boston area. All participants met the following criteria: they grew up in North America, spoke English as a first language, were able to read and write, and reported that they perceived the primes flash but had no awareness of the actual words. To make the recruiting process similar to that of the older people, the study was advertised as a memory improvement study. Thirty-one men and 29 women participated in the study.

Measures

In this study the same memory, views-of-aging, and metamemory measures as described in the first study were used, with one exception. The Metamemory in Adulthood questionnaire was omitted from this study because it was designed for older individuals, and it revealed no effects in the first study. All measures were given in the same order that they were given in the first study.

Results and Discussion

Memory Performance

When a 2 (priming condition) × 2 (time of memory task) MANOVA with the five types of memory tasks serving as the dependent variables was performed with the young partici-

pants' data, no significant main effects or interaction effects emerged. In support of the hypothesis, the interaction between priming condition and the time of memory task did not reach significance with these young participants.

To better understand the lack of a global interaction effect among the young participants, univariate analyses were performed. Five repeated measure ANOVAs were conducted. In 2 (priming condition) × 2 (time of memory task) repeated measure analyses with the time of memory task the within-subjects variable, no significant Priming Condition × Time of Memory Task interactions emerged for any of the five memory tasks.

As would be expected, t tests revealed that the two priming groups did not differ on any of the memory tasks before the priming intervention. When paired t tests were performed on the differences between memory performance before and after the intervention among the young participants who were exposed to the wisdom primes, no significant trends emerged (see Table 2). Among the young participants who were primed with the senile primes, no significant trends emerged on three of the five memory tasks. On the photo recall and learned recall tasks, however, significant trends emerged. The participants in the senile prime group tended to increase their performances following the priming intervention on both the photo recall task, $t(28) = 2.98, p < .01$, and the learned recall task, $t(28) = 2.20$, $p < .05$.

Metamemory

Two (priming condition) × 2 (time of memory prediction) repeated measure ANOVAs were conducted with the photo recall and learned recall predictions. These analyses revealed interactions when the time-of-memory-prediction variable was crossed with the priming condition variable, such that participants in the wisdom condition decreased their estimates, whereas participants in the senility condition increased their estimates. This interaction trend reached significance for the photo recall prediction, $F(1, 58) = 11.01, p < .01$, and almost reached significance for the learned recall prediction, $F(1, 58) = 3.31, p < .08$.

Paired t tests revealed that the decreases in predictions following the wisdom primes did not reach significance, but the increases following the senility primes reached significance for both the learned recall predictions, $t(30) = 3.10, p < .01$, and the photo recall predictions, $t(30) = 3.61, p < .01$. In addition, t tests revealed that the predictions for the learned recall task did not differ by priming group before the intervention but differed significantly after the intervention, $t(30) = 2.09, p < .05$. In the photo recall tasks the predictions differed significantly before the intervention. Thus, an analysis of covariance was performed with the predictions before the intervention serving as the covariate and the predictions following the intervention acting as the dependent variable. This analysis showed a main effect for priming group with the first predictions held constant, $F(1, 57) = 6.23, p < .03$.

View of Aging and Mood

With the young participants no significant trends emerged for any of the views-of-aging measures, which included the three dimensions of the Margaret story, the description of Margaret in the participants' own words, the Facts on Aging Quiz, or the open-ended question in answer to which participants listed the five words that they thought best describe an older person. The three dimensions of positivity, activity, and externality did not reflect participants' priming group.

In the open-ended measure of views of aging, the words that the young participants most frequently used to describe an older person were analyzed. These words did not simply reflect the primes to which the participants had been previously exposed. Of the 15 most commonly mentioned words, the following appeared in one of the prime lists: *wise, death* or *dying, senile, forgetful,* and *decrepit.* Those who were primed mentioned only 1 of these 5 words—*senile*—more than those who were not primed with it. Four of the 7 people who mentioned the word *senile* were exposed to the word during the priming task. Of the other 4 words, participants who were exposed to the word as a prime were equally or less likely to mention the word as compared with participants who were not exposed to the word as a prime.

The 15 most commonly mentioned words, with the number of participants who named them in parentheses, are as follows: *gray* or *white hair* (23), *wrinkled* (21), *wise* (18), *slow* (9),

Table 2
Memory Score Means of Young Participants Before and After the Priming Intervention

	Priming condition				
	Senility		Wisdom		
Memory task	Pre	Post	Pre	Post	Interactions
Immediate recall[a]	4.43	4.07	4.37	4.27	$F(1, 58) = 0.57$, *ns*
Learned recall[a]	6.27[b]	6.70[b]	6.53	6.60	$F(1, 58) = 0.78$, *ns*
Delayed recall[a]	6.07	6.40	6.17	6.10	$F(1, 58) = 0.80$, *ns*
Photo recall[c]	6.00[b]	6.77[b]	6.23	6.47	$F(1, 58) = 2.13$, *ns*
Auditory recall[d]	9.20	8.73	9.03	8.43	$F(1, 58) = 0.06$, *ns*
Photo recall[c] prediction	5.00[b]	5.73[b]	5.66	5.50	$F(1, 58) = 11.01, p < .01$
Learned recall[a] prediction	6.37[b]	6.90[b]	6.43	6.40	$F(1, 58) = 3.31, p < .08$

[a] Scored out of a total of 7 points. [b] Reflects significant differences within rows, $p < .05$. [c] Scored out of a total of 8 points. [d] Scored out of a total of 15 points.

death or *dying* (6), *senile* (6), *ill* or *infirm* (5), *forgetful* (5), *small* (4), *kind* (4), *frail* (4), *grandparent* or *grandmother* (4), *experienced* (3), *lonely* (3), and *decrepit* (3). Nine of the 15 words were among those most frequently mentioned by the older participants in Study 1. The 9 overlapping words were *gray* or *white hair, wrinkled, wise, slow, senile, ill* or *infirm, forgetful, frail,* and *decrepit.*

As with the older participants in the first study, no effect of priming emerged on the Geriatric Depression Scale.

Activation of Internalized Stereotypes of Aging

Similar to the older participants, the young participants took longer to identify the location of the primes than the neutral words, $t(58) = -1.99, p < .03$, with an average reaction time of 537.70 ms for the neutral words and 562.00 ms for the primes. In addition, the young participants took longer to identify the wisdom primes than the senile primes, $t(57) = 1.25, p < .13$, with an average reaction time of 588.68 ms for the wisdom primes and 536.87 ms for the senility primes. The trend appeared in all five blocks but reached significance only in the fifth and last block of the priming paradigm, $t(29) = 1.39, p < .05$.

Perception-Without-Awareness Checks

Ten participants between the ages of 18 and 35 years served in the control conditions. The perception-without-awareness checks were the same as those described in Study 1. Half of the participants were exposed to the wisdom primes, and half were exposed to the senile primes. Similar to the old control participants, the young control participants found these tasks difficult to perform. Many reported that they felt that their guesses were random.

The overall hit rate for the guess condition with the young participants was 1.3%. Similar to the findings from the first study and studies conducted by Devine (1989) and Bargh and Pietromonaco (1982), the hit rate for the neutral words exceeded the hit rate for the stereotype words. Participants accurately guessed 0.8% of the stereotype words and 2.0% of the neutral words. As Devine (1989) and Bargh and Pietromonaco (1982) pointed out, this may be due to the higher word frequency of the neutral words. None of the incorrect guesses generated by the young participants related to aging.

The guess hit rates of the young participants in this study are slightly lower than the hit rates for the older participants in Study 1. This can be explained by the single participant who increased the hit rates for the old participants and who would have been removed from the actual analyses of older participants. He would not have met the inclusion criterion of reporting that he was not aware of the priming stimuli.

When total number of guesses served as the denominator, the overall recognition rate was below chance level (41.9%). For participants in the wisdom priming condition, the recognition rate was 40.3%, whereas those in the senile priming condition achieved a recognition rate of 43.7%.

These results from the recognition and guess conditions suggest that the young participants were not aware of the prime words and that the revised priming paradigm successfully allowed perception without awareness.

Analyses With Old and Young Participants

The finding that the memory, memory prediction, and Margaret story measures reflected priming group of the old participants but not of the young ones supports the existence of implicit self-stereotyping. To directly compare the significant trends that emerged in the old participants with the lack of trends in the young, the data from the old and young participants were analyzed together. For each of the memory tasks, a 2 (priming condition) × 2 (age group) × 2 (time of memory task) repeated measure ANOVA was performed, with the first two variables serving as the between-subjects factors and the last variable serving as the within-subjects factor. As predicted, when priming condition was crossed with age group and time of memory task, significant interactions emerged for the four visually based recall tasks. The interactions reached significance for the immediate recall task, $F(1, 146) = 4.83, p < .05$; the learned recall task, $F(1, 146) = 4.87, p < .05$; the delayed recall task, $F(1, 146) = 7.91, p < .01$; and the photo recall task, $F(1, 146) = 14.58, p < .001$. The auditory recall interaction did not reach significance. Consistent with the aging memory literature, main effects for age group emerged in the five analyses. The young participants outperformed the old ones in the immediate recall task, $F(1, 146) = 16.33, p < .01$; the learned recall task, $F(1, 146) = 12.93, p < .01$; the delayed recall task, $F(1, 146) = 12.88, p < .01$; the photo recall task, $F(1, 146) = 34.03, p < .01$; and the auditory recall task, $F(1, 122) = 33.56, p < .01$.

To compare the memory prediction trends in the old participants with that of the young participants, 2 (priming condition) × 2 (age group) × 2 (time of memory prediction) repeated measure ANOVAs were performed for both of the memory prediction measures, with the first two variables serving as the between-subjects factors and the last variable serving as the within-subjects factor. Also as expected, when priming condition was crossed with age group and time of memory prediction, interaction effects emerged for both the photo recall predictions, $F(1, 122) = 0.03, p < .01$, and the learned recall predictions, $F(1, 135) = 3.75, p < .06$.

The views-of-aging measures that significantly reflected priming condition in the older participants—the Margaret story items—also were compared across age groups. Two (priming condition) × 3 (feedback attribution condition) × 2 (age group) ANOVAs, with the measures from the Margaret story serving as the dependent variables, were performed. When priming condition was crossed with age group, the following interactions emerged: $F(1, 97) = 2.43, p < .13$ for the interdependence–dependence dimension; $F(1, 97) = 2.62, p < .11$ for the creativity–senility dimension; $F(1, 97) = 4.88, p < .05$ for the dimension of attributing forgetting due to external as opposed to internal causes; and $F(1, 94) = 2.74, p < .11$ for the overall positivity dimension.

General Discussion

These studies considered the influence of implicit self-stereotyping. The findings suggest that when either negative or positive images of aging are activated in older individuals without the individuals' awareness, these images can influence views of

aging, beliefs about one's memory abilities, and memory performance in opposite directions. This research demonstrates the potential for memory improvement in people over the age of 60. A mere 10-min priming intervention brought about improvement in the older participants in four types of memory documented as declining in old age: immediate, learned, delayed, and photo recall (Levy & Langer, 1994; Schacter et al., 1991). For the intervention to succeed, it had to shift the dominant negative self-stereotypes, found in most older Americans, to positive self-stereotypes (Kite & Johnson, 1988).

These are the first studies to explore implicit self-stereotyping. Although the effects of implicit stereotyping on judgments about others have been documented, there is no previously reported finding that shows that implicitly activated stereotypes can alter judgments about oneself. Much of the research to date has shown the effects of implicit stereotyping on an individual's thinking about members of stereotyped groups, whereas this research shows an effect on memory performance of aged individuals, a behavior that is not considered to be influenced by expectancies (Smith, 1996).

Evidence for Implicit Self-Stereotyping

Contrast Between the Young and Old Participants

The evidence for implicit self-stereotyping derives from two sets of findings. The first set relates to the finding that, as expected, the positive primes tended to improve and the negative primes tended to lessen the memory performance and the indirect measures of metamemory and the views of aging in the old but not the young participants. These outcomes were predicted on the basis of the assumption that if primes can change a self-stereotype of aging, they must evoke a personally relevant image.

Accordingly, among the old participants, those who were exposed to the wisdom primes showed improvement in four of the five memory tasks, whereas those who were exposed to the senility primes showed decline in four of the five memory tasks. The primes did not change the memory performance of the young participants, with the exception of the learned recall and photo recall tasks, on which their performance increased significantly following the senility primes. On the memory prediction measures among the old participants, interactions emerged such that the predictions tended to reflect priming group. Participants who were exposed to the wisdom primes tended to increase estimates of their memory performance more than participants who were exposed to the senility primes. In contrast to this, the young participants who were exposed to the senility primes tended to increase their estimates of how they would perform on both the learned recall task and the photo recall task. Last, on the views-of-aging measures, significant trends emerged only for the old participants; that is, those for whom the primes evoked self-stereotypes. Among the old participants, the Margaret story measures tended to reflect the priming groups. The primes did not influence any of the views-of-aging measures in the young participants.

Primes Activating Internalized Stereotypes

Additional evidence for implicit self-stereotyping comes from the findings that suggest the primes evoked internalized stereotypes of aging. For example, when the young and old participants described the first image that comes to mind when they think of an old person, they both spontaneously mentioned a wise and senile image of aging. They most frequently mentioned the words *wise, slow, senile, ill* or *infirm, forgetful, frail,* and *decrepit.* Thus, the senile and wise primes matched pre-existing categories in both the young and old participants, and the senile image was dominant in both groups. It makes sense that these stereotypes would be internalized in the young participants even though these stereotypes do not appear to be self-stereotypes for them. The young participants are exposed to the same negative stereotypes of aging as the older participants, even if they are not yet thinking how these may apply to themselves. Researchers have shown that negative stereotypes of aging begin as early as 6 years of age (Isaacs & Bearison, 1986).

Evidence for the internalized positive and negative images of aging in both the young and the old participants is also based on two reaction time findings of the computer priming task. The first finding is that both the young and the old participants took longer to press the corresponding arrow button after the primes flashed on the screen, as opposed to when the neutral words flashed. This finding supports the reasoning presented by Bargh and Pietromonaco (1982) that reaction time should be greater when existing categories are primed as opposed to neutral words not related to each other.

The second finding, that both the old and young participants took longer to identify the location of the wisdom-related primes as opposed to the senility-related primes, suggests that the wise primes are more incongruous to the dominant image of old age held by most participants. This fits in with the findings of Perdue and Gurtman (1990) that after exposure to the prime *old,* participants took longer to evaluate positive traits than to evaluate negative traits. It appears that the location of the wisdom-related primes took longer to be identified than the senility-related primes because the wisdom primes required a shift of the participants' dominant image of old age. The senility primes highlighted the most familiar and available image of a mentally incompetent old person, whereas the wisdom primes highlighted the less familiar image of a wise old person. The adaptation to the less frequently evoked image is likely to require additional time.

The finding that the reaction times for the wisdom primes were slower than the reaction times for the senility primes does not seem to be due to affect associated with the primes. Previous research on affect information has found the opposite trend: Positive affect information tends to facilitate cognitive processing more than negative affect information (Ikegami, 1986; Isen et al., 1987).

Furthermore, the finding that the reaction times for the wisdom primes were slower than the reaction times for the senility primes does not seem to be due to word frequencies. According to standard frequency index calculations, the wisdom words appear more frequently in the English language than the senility words (Carroll et al., 1971). Thus, if the differences in reaction times were due to word frequencies, one would expect that the wisdom primes would be more accessible and thus be identified more quickly than the senile primes. The opposite occurred. Accordingly, the difference in reaction times supports the inter-

pretation that the wisdom stereotype is a less salient image than the senile stereotype.

Mechanism

In this study only the interventions that operated without the participants' awareness succeeded in changing the older individuals' memory performance, memory predictions, and views of aging. It seems that the two explicit interventions failed because the conscious nature of these interventions did not penetrate deeply enough to change self-beliefs. The old participants may have had such strongly enculturated negative images of aging that if given the chance to process positive interventions with awareness they could have found ways to discount them. For example, the old participants in the success feedback group might have thought of their high performance as an exception to their diminished memory abilities. The failure of the explicit intervention in changing memory fits in with the lack of memory improvement found by Lachman et al. (1992) after their two explicit interventions with old participants. Once the intervention bypasses awareness in old people, however, it seems to influence a set of cognitive processes, including memory performance, as well as views of both their own memories and of aging.

Importance of Relevance in Implicit Self-Stereotyping

As indicated, primes can be expected to alter self-stereotypes only when the self-stereotypes are relevant to the individuals. The pivotal role of relevance would account for why it is that among the old participants interactions emerged for the predictions of performance on the learned recall and the photo recall tasks that reflected priming group. In contrast, among the young participants those in the wisdom condition decreased predictions of their performance on these tasks and those in the senility condition increased their predictions.

This anomaly can be understood in terms of the old participants implicitly seeing themselves in the image evoked by the primes, whereas the young participants implicitly saw others in the image. That is, the wise primes caused the young participants to compare themselves with others who were dauntingly superior, with a resulting more humble prediction. The senile prime, on the other hand, caused the young participants to compare themselves with others who were reassuringly inferior, with a resulting more confident prediction. The same phenomenon was found in the performance of the young participants when those who were exposed to the senility primes scored higher on the learned recall tasks, whereas the older participants who were exposed to the senility primes decreased their learned recall performance. Although both the old and the young participants increased their photo recall performance following the senility primes, the old participants increased their performance less than the old participants who were exposed to the wisdom primes, whereas the young participants who were exposed to the senility primes increased their performance more than those who were exposed to the wisdom primes.

Responses to the ambiguous Margaret story demonstrate the extent to which relevance is the basis on which self-stereotypes are successfully primed. It seems that the young participants' perception of Margaret was not affected by primes because she was a distant other. On the other hand, the primes did affect the older participants' perception of Margaret because they apparently regarded her as an extension of themselves; their descriptions of her appear to correspond to their self-stereotypes. This lack of a priming effect on the young participants' perceptions of Margaret fits in with recent research on stereotype expression. Several researchers have demonstrated that individuals with limited cognitive resources express stereotypes only when the stereotypes threaten their self-esteem (Hilton & von Hippel, 1996). The young individuals in this study, who were busy trying to recall the many details of the Margaret story, might not have expressed the age stereotypes because the primed images were not relevant to their self-identities and thus they were not motivated to use them.

The remoteness of aging as a concern for the young participants contrasts with the centrality of race for Whites and gender for males. Devine (1989) found that primed stereotypes of African Americans influenced White participants' perceptions of African Americans. Banaji et al. (1993) found that primed stereotypes of women influenced the male participants' perceptions of a woman in a story as much as it influenced the perceptions of the female participants. In other words, perceptions of race and females were susceptible to change through priming because they are relevant to Whites and males, respectively. Insofar as aging is not a currently relevant category to the young participants, the primes directed at it were thwarted.

In suggesting that to be effective a prime must be relevant to the self-stereotype, it is assumed that elderly people have both positive and negative self-stereotypes of aging. Considering that among the old participants the negative and positive primes tended to influence memory, memory self-efficacy, and views of aging in opposite directions, it seems the positive primes evoked the positive self-stereotype, and the negative primes evoked the negative self-stereotype. However, given the prevailing societal images of aging and the fact that it took both the old and the young participants longer to identify the location of the positive primes than the negative primes, the negative image seems to dominate over the positive image of aging. Further research will determine whether the positive primes operate by reinforcing the positive self-stereotype, undermining the negative self-stereotype, or both.

Implicit Self-Stereotyping Involves Visual Images

Although in all five measures of recall older participants who were primed with the senility-related primes tended to decline and in four of the memory measures those who were primed with the wisdom-related primes tended to improve, the effect was greatest for the four memory measures that draw on spatio-visual skills, as opposed to the fifth measure, which relies on auditory recall of words. This finding suggests that self-stereotypes of aging evoke visual imagery and processes rather than verbal descriptions and processes.

The visual nature of the self-stereotype is revealed in other findings. When asked to describe an old person, the two most popular traits mentioned by both the old and young participants, *wrinkled* and *gray* or *white hair,* refer to appearance. Also, participants did not tend to name the words to which they

had been exposed in the priming task. This suggests that the implicit stereotypes primed a general category that had an image associated with it rather than only the words related to old age from the prime list. Allport (1958) wrote that what distinguishes a stereotype from a category is that a stereotype "is freighted with 'pictures' and judgments" (p. 187).

Mediating Mechanisms

There are at least three mechanisms that have the potential to mediate the relationship between priming and memory: metamemory, views of aging, and affect. Our results suggest that metamemory and view of aging mediate the relationship. As noted, the primed stereotypes of old age influenced the older participants' judgments of Margaret and their own memory performance. Both of these findings can be explained by the primes highlighting the senility self-schema, which the participants then used to judge themselves and, by extension, Margaret. This highlighted schema, in the senility condition, then seemed to reduce memory performance either indirectly, through memory self-efficacy, or directly, through a connection to memory skills. The wisdom primes activated the wisdom schema, which yielded the opposite effects.

Priming group did not influence mood for the old or the young participants. This finding could reflect the participants' dissociating memory functioning from their general self-concepts. This fits in with the self-concept research that has found that individuals tend to think of themselves as many possible selves, each existing in different domains (Markus & Nurius, 1986). Thus, the research participants might have maintained their affect by shifting their cognitive or memory-related selves without altering their other selves, such as the grandparent self, the ballet dancer self, or the great Cajun chef self.

Conclusion

Two messages emerge from this research. The pessimistic one is that older individuals' memory capabilities can be damaged by self-stereotypes that are derived from a prevalent and insidious stereotype about aging. Specifically, the stereotype that memory decline is inevitable can become a self-fulfilling prophecy. This research also offers an optimistic message. The findings indicate that memory decline is not inevitable. In fact, the studies show that memory performance can be enhanced in old age.

This enhancement occurred as the consequence of a brief priming intervention. The duration of the intervention's effect was not measured, although it was found that the improvement was undiminished in those participants who were tested after a delay of 20 min, compared to those who were tested immediately after the priming. Presumably, longer term interventions would cause longer term results. This research suggests directions in which the intervention may be most effective in reversing negative stereotypes of aging—for instance, through the use of visual images rather than verbal ones.

A more manageable way of reversing negative stereotypes may be to communicate both the optimistic and pessimistic messages derived from this research, not only to the older members of our society but also to the societal institutions that propagate the stereotypes, for extending productive lives benefits not only the individuals themselves but also their communities.

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