The Gerontologist
cite as: *Gerontologist*, 2017, Vol. 57, No. S2, S206–S215
doi:10.1093/geront/gnx057

Research Article

Stereotypes, Warnings, and Identity-Related Variables Influence Older Adults' Susceptibility to Associative False Memory Errors

Amy M. Smith, MS,[1,*] David A. Gallo, PhD,[2] Sarah J. Barber, PhD,[3] Keith B. Maddox, PhD,[1] and Ayanna K. Thomas, PhD[1]

[1]Department of Psychology, Tufts University, Medford, Massachusetts. [2]Department of Psychology, University of Chicago, Illinois. [3]Department of Psychology, San Francisco State University, Los Angeles, California.

*Address correspondence to: Amy Smith, MS, Department of Psychology, Tufts University, 490 Boston Ave, Medford, MA 02155. E-mail: amy.smith@tufts.edu

Received September 10, 2016; Editorial Decision Date April 1, 2017

Decision Editor: Tamara Sims, PhD

Abstract

Background and Objectives: Activating ageist stereotypes can impair older adults' ability to remember information. This effect has been shown to be strongest for older adults who possess certain characteristics (e.g., young–old, highly educated). The present study extended this line of research to investigate the relationship between stereotyping and false memory susceptibility in older adults.

Research Design and Methods: We first presented older adults with lists of associated words in an incidental learning paradigm. Afterward, we manipulated whether participants were presented with stereotypes about aging and whether they were given warnings about the associative nature of the lists. Participants then completed a yes/no recognition test and answered demographic questions.

Results: Older adults in the stereotyped group were more likely to falsely recognize non-presented theme words than older adults in the control group. Further, those who were highly educated and/or retired were most likely to experience this false memory susceptibility.

Discussion and Implications: Similar to the research on veridical memory, these findings suggest that the effects of ageist stereotyping on older adults' false memory susceptibility may be best understood in terms of the individual differences that older adults possess. Identifying the types of people who are at risk of experiencing stereotype threat is an important step toward helping older adults avoid memory impairment in the presence of common stereotypes.

Keywords: Ageism, Analysis, Regression models, Memory, Cognition

In Western culture, older adults are stereotyped as being forgetful. The presence of this stereotype leaves older adults (i.e., 55+ years old) at risk of experiencing *stereotype threat*, a predicament that occurs when they encounter situations in which they feel they might confirm the stereotype (Steele & Aronson, 1995). The effects of stereotype threat on cognition can be likened to a self-fulfilling prophecy, in which individuals behave in a manner that causes them to fulfill an expectation. This is evident when researchers examine older adults' accurate recollection of information, which is termed *veridical memory*. After confronting stereotypes about their memory, older adults have been shown to underperform on a wide range of veridical memory tasks (for a review see Barber & Mather, 2014). Further, this effect has been shown to be strongest for older adults who possess certain characteristics. One such characteristic is level of education, as those who are highly educated have shown the greatest substandard performance when stereotyped (Hess et al., 2009; but see Andreoletti & Lachman, 2004). Another is age, as younger older adults, who are classified as young–old, have similarly demonstrated poor performance when stereotyped (Eich, Murayama, Castel, & Knowlton, 2014; Hess & Hinson, 2006; Hess, Hinson, & Hodges, 2009). Researchers often make the young–old (~60–75) and old–old (75+) distinction, since these age groups show differences in both physical health (e.g., Chuang et al., 2016) and various aspects of cognition such as decision-making (e.g., Abdel-Ghany & Sharpe, 1997), memory (e.g., Kvavilashvili, Kornbrot, Mash, Cockburn, & Milne, 2009; Small, Dixon, Hultsch, & Hertzog, 1999), and visual perception (e.g., Muiños, Palmero, & Ballesteros, 2016). We expanded upon this area of research to determine whether moderators similarly influence the effects of stereotype threat on older adults' *false memory*. That is, we aimed to determine whether certain variables could predict whether stereotyped older adults would remember events that never actually occurred.

Identity-Related Variables as Moderators

When confronted with an ageist stereotype, whether an older adult experiences stereotype threat and the resulting memory impairment may depend on a host of factors. Research suggests that older adults who are most likely to show memory impairment when faced with stereotypes are those who highly value their memory abilities (Hess, Auman, Colcombe, & Rahhal, 2003), are highly sensitive to age-related stigmata (Hess et al., 2009), are highly educated (Hess et al., 2009), and/or are in the young–old age group (Eich et al., 2014; Hess & Hinson, 2006; Hess et al., 2009). Thus, constructs such as stigma awareness as well as variables such as age and level of education may help predict which older adults will experience substandard memory performance in the presence of stereotypes.

Age-related stereotypes are present in everyday life, thus posing a threat to the cognitive abilities of older adults. For example, 8.3% of a large sample of late-middle-aged and older adults reported feeling age-stereotyped by healthcare professionals (Abdou, Fingerhut, Jackson, & Wheaton, 2016), and this has important clinical implications. Stereotype threat lowers performance on mental status examinations that are used to screen for cognitive impairment (Barber, Mather, & Gatz, 2015), which can increase the number of older adults who fall below the screening thresholds (Haslam et al., 2012; Mazerolle et al., 2016). As such, knowledge about the individual differences that contribute to stereotype sensitivity may be useful for predicting and preventing stereotype threat in real-world scenarios. Unfortunately, it may not always be practical to administer questionnaires assessing constructs such as stigma consciousness in real-word situations. Therefore, the present research focused on examining the predictive abilities of easily assessed variables on memory impairments that may result from stereotype threat.

As mentioned, two variables have been shown to moderate the effects of stereotyping on veridical memory performance: age and years of education. Specifically, Hess and colleagues (2009) found that accurate word recall decreased as a function of years of education for older adults in the young–old age group who were given a manipulation designed to induce stereotype threat. Additional support for the impact of age on stereotype threat susceptibility comes from Hess and Hinson (2006) and Eich and colleagues (2014). Both studies found that young–old adults demonstrated the greatest memory deficits after reading about ageist stereotypes.

The moderating roles of age and education may speak to an underlying group-identification construct. In studies with other stigmatized groups, individuals who highly identified with their stereotyped group experienced strong stereotype-based decreases in cognitive performance (e.g., Shih, Pittinsky, & Ambady, 1999; Tomasetto, Alparone, & Cadinu, 2011). In studies with older adults, stereotype threat manipulations emphasize poor cognitive performance for people over the age of 55. As such, the passage targets those who self-identify as old and those who value their cognitive abilities. Young–old adults may be especially sensitive to stereotypes about aging since they only recently entered the "older adult" age group and have fewer strategies developed for coping with age-related stereotypes. Further, those who are more highly educated may self-identify as intellectuals, thus increasing the likelihood that they would internalize threats to their memory. Thus, stereotypes about memory and aging may be especially salient for young–old and highly educated older adults because these characteristics are related to older adults' sense of identity.

In the present study, we extended this budding area of research to examine whether readily available, identity-related variables moderate the effects of stereotype threat on older adults' false memory susceptibility. Previous studies were too underpowered to observe individual differences in older adults' susceptibility to stereotype threat. For instance, of the 50 age-based stereotype threat studies included in a recent meta-analysis that focused on dependent measures related to older adult memory, only four had sample sizes above 100 (Lamont, Swift, & Abrams, 2015). The remaining 46 studies had an average sample size of 47.26, suggesting that there were fewer than 24 older adults on average in each study's stereotype-threat group. To examine individual differences in susceptibility to stereotype threat, in the present study, we collected a large sample of 166 older adults.

In addition to years of education and age, we also examined the influence of an exploratory identity-related variable: retirement status. In a study by Kruse and Schmitt (2006) involving several hundred participants, older adults who were employed demonstrated high levels of agreement with statements that old age was a time of developmental gains and low levels of agreement with statements suggesting that older people were socially downgraded. This pattern was not found in retired older adults. These findings suggest that retired older adults are more likely to believe negative stereotypes about aging than those who are employed. This may be due to the fact that retirement is accompanied by a host of lifestyle changes that signal the entrance into older adulthood and leave individuals vulnerable to ageist stereotypes. Because retired older adults are more likely to agree with negative stereotypes about aging, they may also be more likely to show stereotype-related memory deficits than those who are employed. We thus aimed to determine whether retirement status would moderate the relationship between stereotyping and older adults' false memory errors.

The Effects of Stereotype Threat on False Memory in Older Adults

The finding that exposure to stereotypes negatively affects memory for older adults is robust (for a meta-analysis, see Lamont et al., 2015). However, research investigating the effect of stereotyping on false memory in older adults has been limited to two experiments (Thomas & Dubois, 2011; Wong & Gallo, 2016). Both of these studies assessed false memories in the context of the Deese-Roediger-McDermott (DRM) paradigm (Roediger & McDermott, 1995). In a typical DRM experiment, participants are presented with lists of related words, each list consisting of 15 semantic associates (e.g., *bed, rest, tired*) of a critical non-presented lure word (e.g., *sleep*). On a subsequent memory test, participants often falsely recall or recognize the critical lure words (Roediger & McDermott, 1995, for reviews see Gallo, 2006, 2010). Thomas and Dubois (2011) found that older adults exposed to negative stereotypes about aging were more likely to falsely recognize critical lure words than those exposed to positive stereotypes. More recently, Wong and Gallo (2016) found that older adults who were exposed to these stereotypes were less likely to demonstrate false memories in the DRM paradigm than a control group. Crucially, before taking the memory test, Wong and Gallo (2016) warned both groups of older adults about the deceptive nature of DRM lists. The DRM warning was intended to ensure that any false recognition errors could be attributed to genuine false memories as opposed to gist-based guessing (Gallo, Roediger, & McDermott, 2001).

Both studies used standard DRM methodology, manipulated stereotype threat after incidental encoding, and assessed memory using a yes/no recognition test. However, findings from these studies are in conflict. Whereas Thomas and Dubois (2011) found that negative stereotypes were associated with increased false memory susceptibility, Wong and Gallo (2016) found that negative stereotypes were associated with decreased susceptibility. A few methodological differences may account for these conflicting results. One difference was Wong and Gallo's (2016) inclusion of a DRM warning prior to memory testing. A second difference was in the nature of their control groups. Thomas and Dubois' (2011) control group was given a positive stereotype manipulation and Wong and Gallo's (2016) control group received the warning manipulation. Thus, neither study compared the effects of their experimental manipulations to a manipulation-free control group. In the present study, we addressed these methodological differences by examining older adults' false recognition when only negative stereotypes were present, when only DRM warnings were present, when both manipulations were present, and when both were absent.

The Present Study

The goals of the present study were to determine whether identity-related variables moderate the relationship between ageist stereotyping and older adults' false recognition, and to compare the effects of stereotyping on false recognition when warnings were present or absent. To that end, we fully crossed an ageist stereotype manipulation (present vs. absent) with a DRM warning manipulation (present vs. absent), yielding four between-subjects groups: stereotype threat with no warning, no stereotype threat with a warning, stereotype threat *and* a warning, and control (no stereotype threat, no warning). Further, we collected information regarding years of education, age, and retirement status.

In accordance with the findings regarding veridical memory, we hypothesized that identity-related variables would moderate the effects of stereotype threat on false memory susceptibility. Specifically, we predicted that our ageist stereotype threat manipulation would increase older adults' false memory susceptibility as a function of years of education (Hess et al., 2009), decrease false memory susceptibility as a function of age (Eich et al., 2014; Hess & Hinson, 2006; Hess et al., 2009), and increase false memory susceptibility for retired versus working older adults (Kruse & Schmitt, 2006). We further hypothesized that our investigation of the interaction between stereotype threat and the DRM warning would help explain the discrepancy between Thomas and Dubois (2011) and Wong and Gallo (2016).

Method

Participants

Two hundred older adults participated in the experiment. Thirty-four older adults were not included in our analyses because they did not complete all components of the experiment. Thus, all following analyses were conducted on 166 older adults. Participants were selected from a preestablished participation pool maintained by the Cognitive Aging and Memory Laboratory at Tufts University and were paid \$15.00 for their participation (M age = 70.59, SD = 6.79, range = 56–90). Participants were screened on the basis of their performance on the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975; M = 28.78, SD = 1.60), information regarding general health, and mood disorder history. Group order was randomized such that each participant was assigned to the next randomly selected group. Forty-three older adults were assigned to the *stereotyped, not warned* group, 42 to the *warned, not stereotyped* group, 41 to the *stereotyped and warned* group, and 40 to the *control* (not stereotyped, not warned) group. All participants provided informed consent.

Materials

Stimuli

Stimuli consisted of 24 DRM word lists, each of which contained the 15 strongest semantic associates of a critical non-presented lure word (Stadler, Roediger, & McDermott, 1999). Of these lists, 12 were studied and words from the other 12 lists served as distractors on the recognition test. We counterbalanced which lists served as stimuli and which served as lists from which we chose distractor items. Please see Supplementary Appendix A for three example lists.

Recognition Test

The yes/no recognition test consisted of 120 words: 12 words were the non-presented lures associated with the studied lists, 48 words had been studied, and 60 words were taken from non-presented lists. The 48 studied words on the recognition test consisted of the first, fifth, eighth, and tenth strongest associates of each critical lure word (Stadler et al., 1999). The 60 distractor items on the recognition test consisted of the critical lure words from each of the 12 non-studied lists, as well as the first, fifth, eight, and tenth strongest associates from each of those lists. Stimuli and methodology were taken from standards in the DRM literature (see Gallo, 2006 for a review).

Stereotype and Warning Passages

The stereotype passage (209 words) described research that has demonstrated age-related declines in memory (borrowed from Thomas & Dubois, 2011). Prior to reading this passage, participants were instructed that they would read a short passage that was related to the research in which they were participating. The warning passage (176 words) revealed the deceptive nature of the DRM paradigm by drawing participants' attention to the fact that the words they had previously learned were associates of theme words that participants often falsely remembered (borrowed from Gallo et al., 2001). Prior to reading the warning passage, participants were told that they were about to take a memory test that was going to have a tricky component. Participants in the control group did not read the stereotype or warning passages, and thus, prior to the recognition test, were simply told that they would now take a memory test.

Procedure

We employed a 2 (stereotype: present vs. absent) × 2 (warning: present vs. absent) between-subjects factorial design. The experiment was programmed using E-Prime software (Version 2.1; Schneider, Eschman, & Zuccolotto, 2001). A young adult experimenter tested participants one-at-a-time at the Cognitive Aging and Memory Lab at Tufts University in Medford, Massachusetts. During each testing session, the experimenter sat quietly next to the participant. She advanced the computer program at different stages of the experiment and entered all computer-based responses so as to minimize older adult differences in computer experience. To avoid biasing participants' behavior, the experimenter avoided friendly conversation with each participant until the end of the experiment.

After providing informed consent, participants began the study phase. This consisted of an incidental learning task, in which participants were presented with DRM word lists in blocked form at a rate of 1.5 s per word. Participants were instructed to rate each word for pleasantness on an 8-point Likert-type scale (0 = *not pleasant*, 7 = *extremely pleasant*). List order and item order within each list were random. After encoding, participants were given a timed 5-min break in which they were offered a glass of water and a chance to use the restroom.

Depending on the group to which they were assigned, participants then read the stereotype passage, warning passage, both passages, or no passages (control). Reading of passages was self-paced but never took longer than 2 min. The retention interval between study and test, which could have included reading passages, was between 5 and 7 min for all participants. We did not include a time-matched passage for control participants for two reasons. First, pilot testing revealed that passage reading always took less than 2 min. Second, the main purpose of the retention interval was to eliminate recency effects, which can be eliminated in as few as 30 s (e.g., Bjork & Whitten, 1974). Thus, we are confident that the slight difference in retention interval for participants in the control group did not differentially affect their performance on the recognition test.

Participants next completed the yes/no recognition test, in which they indicated whether they had previously rated each word for pleasantness. After each recognition judgment, participants rated their confidence in that judgment on an 8-point Likert-type scale. Because analyses on confidence ratings did not reveal any group differences (all $ps > .10$), they will not be further discussed.

After completing the recognition test, participants answered questions regarding age, gender, retirement status (yes/no), and total completed years of education since kindergarten. At the end of the experiment, participants were paid and debriefed. The experiment took approximately 45 min.

Results

Identity-Related Variables as Moderators

Using multiple regression, we aimed to determine (a) whether identity-related variables moderated the effects of stereotyping on older adults' false recognition, and (b) whether these variables influenced the discrepant results from Thomas and Dubois (2011) and Wong and Gallo (2016). To address our first aim and to examine whether identity-related variables influenced the Thomas and Dubois (2011) findings, we constructed moderated regression models for the two groups that did not receive a DRM warning: the *stereotyped, not warned* and *control* groups. To determine whether identity-related variables influenced the Wong and Gallo (2016) findings, we constructed separate regression models for the two groups that did receive a warning: the *warned, not stereotyped* and *stereotyped and warned* groups.

In the following regression models, our identity-related variables included age, years of education, and retirement status. Our dependent measure of interest was false alarm proportions. A *false alarm* occurs when a participant falsely recognizes a critical lure word on the recognition test. Proportions were calculated by dividing the number of critical lure words associated with studied lists that each participant falsely recognized by the total number of these lures that were presented on the recognition test.

Models 1 and 2 examined the influence of identity-related variables when participants were not given a DRM warning (i.e., the *stereotyped, not warned* and *control* groups). Models 3 and 4 examined the influence of these variables when participants were given a DRM warning (i.e., the *warned, not stereotyped* and *stereotyped and warned* groups). Model 1 included years of education and retirement status as potential moderators, and Model 2 included years of education and age. Retirement status and age were examined in separate models because these variables demonstrated collinearity in preliminary analyses. Model 3 was identical to Model 1, with the exception that all participants had been given a DRM warning prior to the recognition test. Similarly, Model 4 was identical to Model 2, but all participants had been given the DRM warning.

Moderated Regression: Warning Absent

Recall that 43 older adults were in the *stereotyped, not warned* group, and 40 older adults were in the *control* group. Thus, we conducted the following regression analyses using this reduced sample of 83 older adults.

Model 1. We used three-step hierarchical multiple regression to examine main effects of group (*stereotyped, not warned* vs. *control*), years of education, and retirement status, all two-way interactions between these variables, and the three-way interaction. Main effects were entered in the first step of the analysis, all two-way interactions in the second step, and the three-way interaction in the third step. As shown in Table 1, this model yielded a significant R^2 of .17, F (7, 75) = 2.17, p = .046, with four significant effects. First, we found a main effect of group (β = 4.27, t = 2.76, p < .01) as older adults who were stereotyped falsely recognized more critical lure words than those in the control group. This finding extends prior results from Thomas and Dubois (2011).

As depicted in Figure 1, we also found a group by retirement status interaction (β = 4.54, t = 2.55, p = .01). For older adults who were still employed, stereotyping predicted lower false alarm proportions than the control group. In contrast, for older adults who were retired, stereotyping predicted increased false alarm proportions.

We also found a group by years of education interaction (β = 4.27, t = 2.58, p = .01). As seen in Figure 2, older adults in the control group demonstrated decreased false alarms as years of education increased, whereas older adults who were stereotyped did not.

Lastly, we obtained a three-way interaction between group, years of education, and retirement status (β = −4.00, t = 2.28, p = .03). Because this interaction encapsulated the previous two-way interactions, only the three-way interaction was decomposed via simple slopes analysis. Figure 3 displays the results. In general, stereotyping predicted increased false alarm proportions. However, one exception to this was older adults who were employed and had low (low = 13.5 years; β = −.51, t = 3.02, p < .01) or average (average = 16.25 years; β = −.20, t = 2.10, p = .03) years of education. For this subgroup of older adults, stereotyping predicted decreased false alarm proportions.

Model 2. Similar to Model 1, we used three-step hierarchical multiple regression to examine main effects of group (*stereotyped, not warned* vs. *control*), years of education, and age, all two-way interactions between these variables,

Table 1. Predictors Included in the Final Multiple Linear Regression on False Alarms to Critical Lure Words in the Stereotyped, not Warned and Control Groups

Variable	*B*	*SE (B)*	β	*t*	*p*
Constant	1.01	0.39		2.60	.01
Group (*stereotyped, not warned* vs. *control*)	1.98	0.72	4.57	2.76	.01
Years of education	−0.02	0.03	−.28	0.90	.37
Retirement status	−0.09	0.47	−.18	0.18	.86
Group*years of education	0.11	0.04	4.27	2.58	.01
Group*retirement status	2.00	0.79	4.54	2.55	.01
Retirement status*years of education	0.00	0.03	.06	0.06	.95
Group*years of education*retirement status	−0.11	.047	−4.00	2.28	.03

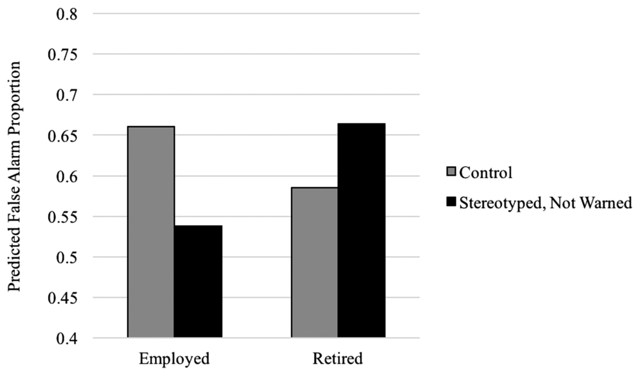

Figure 1. The two-way interaction between group (*stereotyped, not warned* vs. *control*) and retirement status, controlling for years of education.

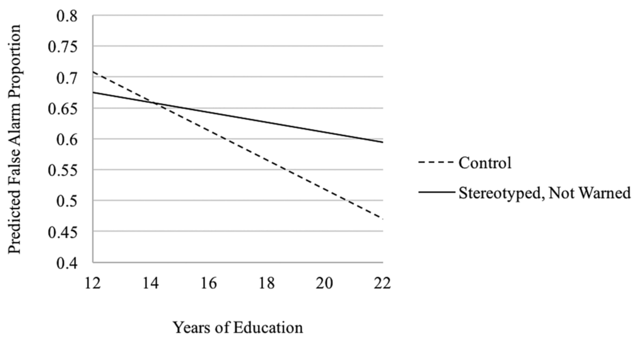

Figure 2. The two-way interaction between group (*stereotyped, not warned* vs. *control*) and years of education, controlling for retirement status.

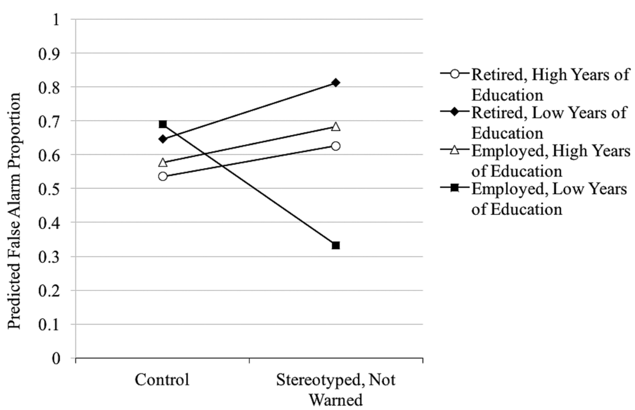

Figure 3. The three-way interaction between group (*stereotyped, not warned* vs. *control*), retirement status, and years of education.

and the three-way interaction. Main effects were entered in the first step of the analysis, all two-way interactions in the second step, and the three-way interaction in the third step. Though this model yielded a non-significant R^2 of .13, F (7, 69) = 1.49, p = .18, we found a marginally significant interaction between group and age (β = .30, t = 1.72, p = .09). As shown in Figure 4, older adults in the control group demonstrated decreased false alarms as age increased. In contrast, older adults who were stereotyped demonstrated increased false alarm proportions as age increased.

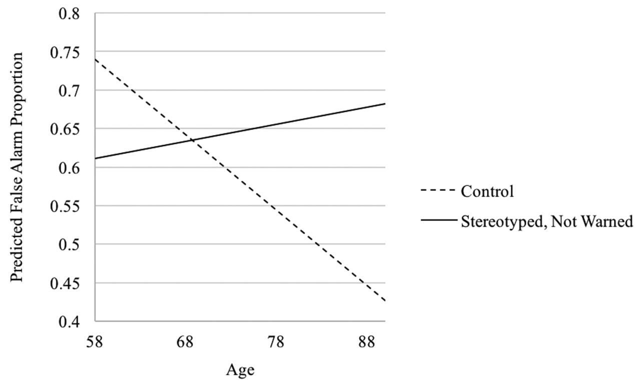

Figure 4. The two-way interaction between group (*stereotyped, not warned* vs. *control*) and age, controlling for years of education.

Moderated Regression: Warning Present

Recall that 42 older adults were in the *warned, not stereotyped* group, and 41 older adults were in the *stereotyped and warned* group. Thus, the following analyses were conducted on this sample of 83 participants, all of whom received a DRM warning prior to the recognition test.

Model 3. Similar to Model 1, we used three-step hierarchical multiple regression to examine main effects of group (*warned, not stereotyped* vs. *stereotyped and warned*), years of education, and retirement status, all two-way interactions between these variables, and the three-way interaction. This model yielded a non-significant R^2 of .30, F (7, 75) = 1.22, p = .30, with no significant effects.

Model 4. Similar to Model 2, we used three-step hierarchical multiple regression to examine main effects of group (*warned, not stereotyped* vs. *stereotyped and warned*), years of education, and age, all two-way interactions between these variables, and the three-way interaction. This model yielded a non-significant R^2 of .15, F (7, 75) = 1.60, p = .15. The only significant effect that emerged was the age by years of education interaction (β = .53, t = 2.62, p = .01). Because this interaction was not relevant to the questions posed by the present study, we did not pursue it any further.

Standard Analyses

False Alarms to Critical Lures (Uncorrected)

We also examined older adults' false alarm proportions in an analysis of variance (ANOVA), which allowed us to examine the potential interaction between our stereotype and warning manipulations. A 2 (stereotype: present vs. absent) × 2 (warning: present vs. absent) between-subjects ANOVA on average false alarm proportions found no significant main effects nor an interaction (all ps > .28). See Table 2 for average uncorrected false alarm proportions.

Note that Thomas and Dubois (2011) compared the false memory performance of a *stereotyped, not warned* group to a control group, and Wong and Gallo (2016) compared performance for a *warned, not stereotyped* group and a *stereotyped and warned* group. For a direct comparison to Thomas and Dubois (2011), we ran a planned independent samples t test on false alarm proportions for the *stereotyped, not warned* and *control* groups. Though our mean false alarm proportions trended in the right direction, we found no significant difference in performance between these groups, t (81) = 0.49, p = .32. Similarly, comparing our data to Wong and Gallo (2016), we ran a planned independent samples t test on false alarm proportions for the two groups in which warning was present. We found no significant difference in performance between the warning-present versus stereotype-present *and* warning-present groups, t (81) = 1.02, p = .16. A post hoc power analysis revealed that on the basis of the between-groups comparison effect size observed by Thomas and Dubois (2011) (d = .86), a sample size of 83 would obtain statistical power at the .99 level (G*Power 3.0; Faul, Erdfelder, Lang, & Buchner, 2007). Similarly, based on the effect size observed by Wong and Gallo (2016) (d = .52), a sample size of 83 would obtain power at the .73 level. Thus, our inability to detect these previously reported effects was not due to a lack of statistical power.

False Alarms to Critical Lures (Corrected)

We implemented a high-threshold false alarm correction suggested by Gallo and colleagues (2001) and used by Wong and Gallo (2016) to further examine group differences in false memory susceptibility. We calculated this correction by subtracting the proportion of false alarms to non-studied critical lure words (i.e., the critical lure words taken from distractor lists) from the proportion of false alarms to critical lure words associated with studied lists for each participant. This technique serves to reduce the influence of unknown response biases (e.g., a participant's response criterion) on false alarm rates. A 2 (stereotype: threat vs. no threat) × 2 (test instruction: warning vs. no warning) between-subjects ANOVA on average corrected false alarms revealed a main effect of stereotype, as stereotyped older adults demonstrated higher false recognition than those who were not stereotyped, regardless of whether they were warned, $F(1, 156) = 7.49$, $p < .01$, $\eta_p^2 = .05$. No other effects were statistically significant. See Table 2 for average corrected false alarm proportions.

General Discussion

The goals of the present study were to determine whether identity-related variables moderate the relationship between ageist stereotyping and older adults' false recognition, and to compare the effects of stereotyping on false recognition when warnings were present or absent. We succeeded in identifying two strong moderators of stereotype threat and false memory, namely, level of education and retirement status. We also found a marginally significant moderating effect of a third variable, age. Our first regression model predicted false memory increases for all stereotyped older adults who were retired, as well as those who were both employed and highly educated. Our second regression model suggested that false memory susceptibility may generally decrease as a function of age, except when negative stereotypes about aging are present.

Our results are consistent with the previous finding that highly educated older adults may be particularly at risk of experiencing memory deficiencies that result from stereotype threat (Hess et al., 2009). As Hess and colleagues (2009) hypothesized, individuals who are highly educated may place more value on their cognitive abilities, thus increasing the likelihood that they would internalize threats to their intellect. Our findings support this hypothesis, and add to the evidence suggesting that older adults' levels of education are useful to consider when determining whether they will be sensitive to stereotypes about aging and cognition.

Several previous studies have shown that age also moderates the effects of stereotyping on older adults' veridical memory performance. Specifically, researchers demonstrated that ageist stereotyping reduced accurate recall for older adults in the roughly 60–75-year-old age range, but not for those who were older (Eich et al., 2014; Hess & Hinson, 2006; Hess et al., 2009). In the context of a model that tested the influence of age with a large sample size, we found only a marginal interaction of age with stereotyping. This suggests that age, on its own, may not be the most useful predictor of older adults' false memory susceptibility when under stereotype threat. Rather, age may only partially capture the influence of other variables that contribute to stereotype threat susceptibility. In the present study, we found that retirement status accounted for a significant proportion of variance when examining the effects of stereotype threat on false memory. Retirement status and objective age are typically related, such that with increasing age, retired status is more common than employed status. Furthermore, the interaction between age and stereotype group in Model 2 closely mimicked the interaction between retirement status and stereotype group in Model 1. However, only retirement status played a significant

Table 2. Average Proportions of Uncorrected and Corrected False Alarms to Critical Lure (CL) Words

Measure	Stereotyped, not warned	Warned, not stereotyped	Stereotyped and warned	Control
Uncorrected false alarms to CLs	0.64 (*0.24*)	0.61 (*0.20*)	0.66 (*0.23*)	0.61 (*0.19*)
Corrected false alarms to CLs	0.52 (*0.22*)	0.43 (*0.19*)	0.55 (*0.21*)	0.47 (*0.16*)

Note: *SD*s are given in parentheses.

moderating role. Thus, our findings suggest that retirement status may better predict the effects of ageist stereotyping than objective age in the context of a false memory paradigm.

From an applied perspective, professionals who work with older adult clients or patients may benefit from knowing common variables that predict which older adults are most likely to be vulnerable to the negative effects of stereotyping. We and other researchers have demonstrated that three such variables may be retirement status, level of education, and age. Our study is the first to show increased false memory susceptibility for retired older adults who were stereotyped. This finding is not surprising given that, in comparison to employed older adults, those who are retired have been shown to agree less with positive statements about aging and agree more with negative statements about aging (Kruse & Schmitt, 2006). This negative outlook on aging may increase the likelihood that retired older adults experience stereotype threat when confronted with stereotypes, and as a result demonstrate substandard memory performance. Though further investigation of this new finding is necessary, considering older adults' retirement status may be helpful for predicting whether they will experience memory impairment in stereotype-present, real-world scenarios.

A second aim in the present study was to further explore the interaction between stereotype threat and DRM warnings. Previous researchers reported reduced false memory susceptibility when stereotype threat was combined with warning (Wong & Gallo, 2016), seemingly conflicting with an earlier study showing increased false memories when stereotypes, but not warnings, were present (Thomas & Dubois, 2011). Our findings were more consistent with the latter study. In our analysis on corrected false alarm proportions, we found that stereotyping increased false memory susceptibility. However, we did not find the interaction of stereotyping with warning that was predicted from the results of Wong and Gallo (2016). Further, when warnings were absent and influential variables were controlled for (see Model 1), stereotyping again increased older adults' false recognition. However, when warnings were added to this model (see Models 3 and 4), the results were inconclusive. Although our results were consistent with Thomas and Dubois (2011), it remains unclear why we did not replicate Wong and Gallo (2016). Individual differences between the present and Wong and Gallo's (2016) samples, as well as unreported methodological variations, may have contributed to the different patterns of results.

To elaborate on this, our finding regarding the moderating role of years of education may help explain the discrepancy between Wong and Gallo (2016) and Thomas and Dubois (2011). Consider that 45% of the Thomas and Dubois (2011) older adult sample and only 31% of the Wong and Gallo (2016) sample met our "high" level of education criterion (*M* years of education = 19+). Though neither of the previous studies examined the moderating role of level of education, our results suggest that Thomas and Dubois (2011) were substantially more likely than Wong and Gallo (2016) to detect false memory increases for stereotyped older adults. This might explain why Thomas and Dubois (2011) found increased false recognition for stereotyped older adults, whereas Wong and Gallo (2016) did not.

In considering limitations, the present study did not directly examine mechanisms by which stereotype threat may increase older adults' false memory susceptibility. One possibility is that stereotype threat induces a negative mood (Schmader, Johns, & Forbes, 2008), which disrupts older adults' ability to engage in careful source-monitoring. Source-monitoring refers to attempting to recall the context from which a piece of information originated. Stereotype threat may induce stress that impairs the ability to distinguish between memories that originated from an external source (i.e., the DRM word lists) and an internal source (i.e., critical lure words). However, the opposite could also be true. Instead of feeling stressed, older adults may upregulate positive affect as a self-preserving response to stereotype threat. Our findings would also support this hypothesis, as researchers have shown that inducing positive moods can increase false memory susceptibility in the DRM paradigm (Storbeck & Clore, 2005).

Our study also had a few methodological limitations that could be addressed in future research. First, we examined false memory susceptibility when stereotype threat was induced immediately before retrieval but did not examine the effects of inducing threat before encoding. Previous researchers have found that stereotype threat prior to encoding can disrupt veridical memory (see Barber & Mather, 2014 for a review), but the effects on false memory have yet to be determined. Second, it is possible that certain aspects of the experiment could have caused implicit stereotype activation in our participants. As examples, our older adult participants were tested by a young adult experimenter and were aware that the experiment was taking place at the "Cognitive Aging and Memory Lab." Some older adults, regardless of their experimental group, therefore may have experienced stereotype threat as a result of merely participating in the experiment. If many older adults in our nonstereotyped groups did experience stereotype threat, this might explain why we failed to find a main effect of stereotype threat in our ANOVA on uncorrected false alarm proportions. To address this issue in the future, researchers may consider automating experiments with older adults so that the presence of an experimenter is not necessary, or using mild deception regarding the purposes of the research.

Conclusions

In the present study we showed that level of education, retirement status, and age moderated the extent to which older adults were susceptible to false memories when confronted with age-related stereotypes. Our results add to a growing body of research investigating how identity-related variables influence the relationship between stereotype threat and memory in older adults. Future researchers should expand the search for variables that help predict which older adults are most likely to internalize negative aging stereotypes. Identifying the types of people who are at risk of experiencing stereotype threat is an important step toward helping older adults avoid memory impairment in the presence of common ageist stereotypes.

Supplementary Material

Supplementary data is available at *The Gerontologist* online.

Conflict of Interest

None declared.

Funding

This paper was published as part of a supplement sponsored and funded by AARP. The statements and opinions expressed herein by the authors are for information, debate, and discussion, and do not necessarily represent official policies of AARP.

References

Abdel-Ghany, M., & Sharpe, D. L. (1997). Consumption patterns among the young-old and old-old. *Journal of Consumer Affairs*, **31**, 90–112. doi:http://dx.doi.org/10.1111/j.1745-6606.1997.tb00828.x

Abdou, C. M., Fingerhut, A. W., Jackson, J. S., & Wheaton, F. (2016). Healthcare stereotype threat in older adults in the health and retirement study. *American Journal of Preventive Medicine*, **50**, 191–198. doi:http://dx.doi.org/10.1016/j.amepre.2015.07.034

Andreoletti, C., & Lachman, M. E. (2004). Susceptibility and resilience to memory aging stereotypes: Education matters more than age. *Experimental Aging Research*, **30**, 129–148. doi:http://dx.doi.org/10.1080/03610730490274167

Barber, S. J., & Mather, M. (2014). Stereotype threat in older adults: When and why does it occur and who is most affected? In P. Verhaeghen & C. K. Herzog (Eds.), *The Oxford handbook of emotion, social cognition, and problem solving in adulthood* (pp. 302–319). New York, NY: Oxford University Press. doi:http://dx.doi.org/10.1093/oxfordhb/9780199899463.013.008

Barber, S. J., Mather, M., & Gatz, M. (2015). How stereotype threat affects healthy older adults' performance on clinical assessments of cognitive decline: The key role of regulatory fit. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences*, **70B**, 891–900. doi:http://dx.doi.org/10.1093/geronb/gbv009

Bjork, R. A., & Whitten, W. B. (1974). Recency-sensitive retrieval processes in long-term free recall. *Cognitive Psychology*, **6**, 173–189. doi:http://dx.doi.org/10.1016/0010-0285(74)90009-7

Chuang, T., Huang, C., Lee, C., Hsieh, C., Hung, Y., Hung, C.,…Pei, D. (2016). The differences of metabolic syndrome in elderly subgroups: A special focus on young-old, old-old and oldest old. *Archives of Gerontology and Geriatrics*, **65**, 92–97. doi:http://dx.doi.org/10.1016/j.archger.2016.03.008

Eich, T. S., Murayama, K., Castel, A. D., & Knowlton, B. J. (2014). The dynamic effects of age-related stereotype threat on explicit and implicit memory performance in older adults. *Social Cognition*, **32**, 559–570. doi:http://dx.doi.org.ezproxy.library.tufts.edu/10.1521/soco.2014.32.6.559

Faul, F., Erdfelder, E., Lang, A. G., Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavioral Research Methods*, **39**, 175–191. doi:http://dx.doi.org/10.3758/BF03193146

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, **12**, 189–198. doi:http://dx.doi.org/10.1016/0022-3956(75)90026-6

Gallo, D. A. (2006). *Associative illusions of memory: False memory research in DRM and related tasks*. New York, NY: Psychology Press.

Gallo, D. A. (2010). False memories and fantastic beliefs: 15 years of the DRM illusion. *Memory & Cognition*, **38**, 833–848. doi:http://dx.doi.org/10.3758/MC.38.7.833

Gallo, D. A., Roediger, H. L., & McDermott, K. B. (2001). Associative false recognition occurs without strategic criterion shifts. *Psychonomic Bulletin & Review*, **8**, 579–586. doi:http://dx.doi.org/10.3758/BF03196194

Haslam, C., Morton, T. A., Haslam, S. A., Varnes, L., Graham, R., & Gamaz, L. (2012). "When the age is in, the wit is out": Age-related self-categorization and deficit expectations reduce performance on clinical tests used in dementia assessment. *Psychology and Aging*, **27**, 778–784. doi:http://dx.doi.org/10.1037/a0027754

Hess, T. M., Auman, C., Colcombe, S. J., & Rahhal, T. A. (2003). The impact of stereotype threat on age differences in memory performance. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences*, **58**, 3–11. doi:http://dx.doi.org/10.1093/geronb/58.1.P3

Hess, T. M., & Hinson, J. T. (2006). Age-related variation in the influences of aging stereotypes on memory in adulthood. *Psychology and Aging*, **21**, 621–625. doi:http://dx.doi.org/10.1037/0882-7974.21.3.621

Hess, T. M., Hinson, J. T., & Hodges, E. A. (2009). Moderators of and mechanisms underlying stereotype threat effects on older adults' memory performance. *Experimental Aging Research*, **35**, 153–177. doi:http://dx.doi.org/10.1080/03610730802716413

Kruse, A., & Schmitt, E. (2006). A multidimensional scale for the measurement of agreement with age stereotypes and the salience of age in social interaction. *Ageing and Society*, **26**, 393–411. doi:http://dx.doi.org/10.1017/S0144686X06004703

Kvavilashvili, L., Kornbrot, D. E., Mash, V., Cockburn, J., & Milne, A. (2009). Differential effects of age on prospective and retrospective memory tasks in young, young-old, and old-old adults. *Memory*, **17**, 180–196. doi:http://dx.doi.org.ezproxy.library.tufts.edu/10.1080/09658210802194366

Lamont, R. A., Swift, H. J., & Abrams, D. (2015). A review and meta-analysis of age-based stereotype threat: Negative stereotypes, not facts, do the damage. *Psychology and Aging*, **30**, 180–193. doi:http://dx.doi.org/10.1037/a0038586

Mazerolle, M., Régner, I., Barber, S. J., Paccalin, M., Miazola, A., Huguet, P., & Rigalleau, F. (2016). Negative aging stereotypes impair performance on brief cognitive tests used to screen for predementia. *The Journals of Gerontology: Series B: Psychological Sciences and Social Sciences*, **00**, 1–5. doi:10.1093/geronb/gbw083

Muiños, M., Palmero, F., & Ballesteros, S. (2016). Peripheral vision, perceptual asymmetries and visuospatial attention in young, young-old and oldest-old adults. *Experimental Gerontology*, **75**, 30–36. doi:http://dx.doi.org.ezproxy.library.tufts.edu/10.1016/j.exger.2015.12.006

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **21**, 803–814. doi:http://dx.doi.org/10.1037/0278-7393.21.4.803

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological Review*, **115**, 336–356. doi:http://dx.doi.org/10.1037/0033-295X.115.2.336

Schneider, W., Eschman, A., & Zuccolotto, A. (2001). *E-Prime user's guide*. Pittsburgh, PA: Psychology Software Tools.

Shih, M., Pittinsky, T. L., & Ambady, N. (1999). Stereotype susceptibility: Identity salience and shifts in quantitative performance. *Psychological Science*, **10**, 80–83. doi:http://dx.doi.org/10.1111/1467–9280.00111

Small, B. J., Dixon, R. A., Hultsch, D. F., & Hertzog, C. (1999). Longitudinal changes in quantitative and qualitative indicators of word and story recall in young-old and old-old adults. *The Journals of Gerontology*, **54B**, 107–115. doi:http://dx.doi.org/10.1093/geronb/54B.2.P107

Stadler, M. A., Roediger, H. L. III, & McDermott, K. B. (1999). Norms for word lists that create false memories. *Memory & Cognition*, **27**, 494–500.

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, **69**, 797–811. doi:http://dx.doi.org/10.1037/0022-3514.69.5.797

Storbeck, J., & Clore, G. L. (2005). With sadness comes accuracy; with happiness, false memory: Mood and the false memory effect. *Psychological Science*, **16**, 785–791. doi:http://dx.doi.org/10.1111/j.1467-9280.2005.01615.x

Thomas, A. K., & Dubois, S. J. (2011). Reducing the burden of stereotype threat eliminates age differences in memory distortion. *Psychological Science*, **22**, 1515–1517. doi:http://dx.doi.org/10.1177/0956797611425932

Tomasetto, C., Alparone, F. R., & Cadinu, M. (2011). Girls' math performance under stereotype threat: The moderating role of mothers' gender stereotypes. *Developmental Psychology*, **47**, 943–949. doi:http://dx.doi.org/10.1037/a0024047

Wong, J. T., & Gallo, D. A. (2016). Stereotype threat reduces false recognition when older adults are forewarned. *Memory*, **24**, 650–658. doi:http://dx.doi.org/10.1080/09658211.2015.1036885