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The impact of beliefs about face recognition ability on memory retrieval processes in young and older adults

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Abstract

This study examined whether beliefs about face recognition ability differentially influence memory retrieval in older compared to young adults. Participants evaluated their ability to recognize faces and were also given information about their ability to perceive and recognize faces. The information was ostensibly based on an objective measure of their ability, but in actuality, participants had been randomly assigned the information they received (high ability, low ability, or no information control). Following this information, face recognition accuracy for a set of previously studied faces was measured using a remember-know memory paradigm. Older adults rated their ability to recognize faces as poorer compared to young adults. Additionally, negative information about face recognition ability improved only older adults' ability to recognize a previously seen face. Older adults were also found to engage in more familiarity than item-specific processing than young adults, but information about their face recognition ability did not affect face processing style. The role that older adults' memory beliefs have in the meta-cognitive strategies they employ is discussed.

Keywords: aging, memory, face recognition, memory beliefs, response criteria.

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Research generally indicates that, as with other types of memory, such a verbal learning (e.g., Ozen, Skinner, & Fernandes, 2010), face recognition accuracy declines with age (e.g., Lamont, Stewart-Williams & Podd, 2005; Memon & Bartlett, 2002; Memon, Bartlett, Rose, & Gray, 2003; Memon & Gabbert, 2003; Memon, Hope, Bartlett & Bull, 2002; Rose, Bull & Vrij, 2003, 2005; Searcy, Bartlett, & Memon, 1999, 2000; Searcy, Bartlett, Memon & Swanson, 2001; Wilcock, Bull, & Vrij, 2005; Yarmey, Jones, & Rashid, 1984; though see Memon, Hope, & Bull, 2003). Declines in accuracy for healthy aging adults begin as early as age 50, and the onset of rapid decline begins at age 70 (Crook & Larrabee, 1992). Older compared to younger adults are more likely to respond to test faces on the basis of familiarity rather than on recollecting specific details about the context in which the face was studied (Edmonds, Glisky, Bartlett, & Rapcsak, 2011) and are less likely to remember that a face had a distinctive feature (Badham, Wade, Watts, Woods, & Maylor, 2012). Thus, older adults are less likely to encode and remember item–specific information about faces, which may account for why their face recognition accuracy is poorer compared to young adults.

Older adults' beliefs about their memory can also affect accuracy. Although stereotype threat (Steele, 1997; Steele, Spencer & Aronson, 2002) is not our central focus in this paper, much of the work about the effects of beliefs on memory in older adults has been carried out within this theoretical framework (e.g., Barber & Mather, 2013a, 2013b; Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005; Hess, Auman, Colcombe, & Rahhal, 2003; Hess & Hinson, 2006; Hess, Hinson, & Statham, 2004; Rahhal, Hasher, & Colcombe, 2001). According to the framework, people may feel threatened when their behavior has the potential to confirm a negative stereotype about their in-group. Feelings of threat cause stress, which in turn detrimentally affects performance by consuming cognitive resources. To illustrate, Hess and colleagues (2009) found that older adults under conditions of stereotype threat had less accurate memories and tended to rely on general feelings of familiarity rather than item-specific information on a word memory test that had a response deadline compared to a nonthreat control condition. However, recent evidence indicates that stereotype threat can also reduce older adults' memory errors by inducing more conservative responding (e.g., Barber & Mather, 2013b). Stereotype threat effects are larger for people who value their memory (Hess et al., 2003), for people who internalize negative stereotypes about memory and aging (Levy, 1996; Levy & Langer, 1994; Levy & Leifheit-Limson, 2009; Levy, Zonderman, Slade & Ferrucci, 2011), and for people who are just entering older adulthood, which has been defined as the age range between 60 to 70 years (Hess & Hinson, 2006). Additionally, Meisner (2012) recently performed a meta-analysis of the literature and found that the effect of negative aging stereotypes on behavior (i.e., memory, psychomotor skills, physiology, social perceptions) was more than three times larger compared to positive aging stereotypes. He proposed that negative aging stereotypes are more influential compared to positive stereotypes because they are more ubiquitous (e.g., Cuddy, Norton, & Fiske, 2005; Levy, 2008; Levy & Banaji, 2002; Nelson, 2005) and chronically activated in older adults (e.g., Levy, 2003).

Older adults who believe that age-related memory decline is inevitable perform more poorly on cognitive tasks compared to their counterparts, even in the absence of a stereotype threat manipulation (e.g., Chasteen, et al., 2005; Rahhal, et al., 2001. A key factor appears to be whether older adults believe that they have control over their memory (Lachman, 1991). If older adults believe they have little control over their own memory, this can reduce their motivation to try to perform well. Consequently, they will put forth less effort and show reduced task engagement compared to young adults (Bandura, 1997; Miller & Lachman, 1999). In line with this, older adults who perceive greater control over their memory perform better on a memory recall task than older adults perceiving lower memory control (Lachman & Andreoletti, 2006).

The present study examined how beliefs about face recognition ability influence face recognition in older and young adults. We expected that older adults would evaluate their face recognition ability as poorer compared to young adults. Based on previous research finding that older adults tend to believe that cognitive decline is inevitable with aging (e.g., Gilewski, Zelinski, & Schaie, 1990; Hultsch, Hertzog, Dixon, & Small, 1998; Lachman, Bandura, Weaver, & Elliott, 1995). We also examined how supposedly objective information about one's ability to perceive and recognize faces impacts older and young adults' subsequent performance on a face recognition test. Previous research on stereotype threat has used a variety of methods that may affect not only performance anxiety, but also participants' beliefs about their memory; such methods have included exposing participants to news articles about the negative effects of aging on memory (Coudin & Alexopoulos, 2010; Hess, et al., 2003; Hess & Hinson, 2006), to subtly informing participants that the purpose of a study is to examine age-differences in memory performance (Hess, et al, 2009; Hess, Hinson, & Hodges, 2009). Other research has given participants feedback about their performance on a trial by trial basis as they engage in a cognitive task (da Silva & Sunderland, 2010). We employed a direct approach to influence participants' beliefs about their memory. We administered participants a face perception test, and then gave them information about their face recognition ability that was ostensibly based on the results of the test. In reality, the test did not measure face recognition ability. Rather, we randomly assigned participants to receive either negative information about their ability (herein, they will be referred to as the *false negative* (FN) group), positive information about their ability (herein, they will be referred to as the false positive (FP) group), or no information about their ability (herein, they will be referred to as the control group).

On the basis of past research, we surmised that information about memory ability would affect response bias (i.e., participants' willingness to make positive identifications), or the decision criterion, that participants set on the face recognition test. In general, older adults set a relatively more liberal response criterion than young adults, and hence, they false alarm more often on memory tests (Howard, Bessette-Symons, Zhang, & Hoyer, 2006; Huh, Kramer, Gazzaley, & Delis, 2006) and in recognizing faces (Adams-Price, 1992; Bartlett & Leslie, 1986; Crook & Larrabee, 1992; Ferris, Crook, Clark, McCarthy & Rae, 1980; Firestone, Turk-Browne & Ryan, 2007; Fulton & Bartlett, 1991; also see Bartlett & Memon, 2007 for a review). However, like young adults, older adults can adjust their response criterion following information about the accuracy of their performance (da Silva & Sunderland, 2010). Both older and young adults can adjust their response criterion in relation to task difficulty, with both older and young adults adopting a more conservative response standard as test difficulty increases (Pendergrass, Olfman, Schmalstig, Seder & Light, 2012) and under conditions of stereotype threat (e.g., Barber & Mather, 2013b).

We drew from regulatory focus theory (Higgins, 1997; 1998) to make predictions about how negative and positive information about memory ability would influence response criterion placement. According to the theory, people adopt one of two strategies to achieve their goals, which include a promotion focus, where they are focused on achieving positive outcomes (e.g., the presence or absence of gains), and a prevention focus, where they are focused on avoiding negative outcomes (e.g., the presence or absence of losses). We surmised that the FN group would adopt a prevention focus, and thus, the FN group would set a higher response criterion on the recognition test compared to the control group in order to avoid errors of commission (i.e., positively recognizing a face that they did not actually previously encounter). We expected that false negative information would especially impact older adults, owing to the fact that negative stereotypes about aging and memory abound in Western society (Boduroglu, Luo, & Park, 2006; Levy & Langer, 1994), which is the culture in which the current study was conducted. Also based on the regulatory focus framework, we hypothesized that positive feedback would induce a promotion focus orientation, wherein people are concerned with maximizing gains and, therefore, engage in greater risk taking (Higgins, 1997; 1998). Thus, we predicted that the FP group would be more liberal in their responding (i.e., positively recognizing a face that they did not actually previously encounter) compared to the control group.

We were also interested in whether participant's own beliefs about their memory ability would moderate the effects of information about memory ability on recognition accuracy. Soederberg Miller and West (2010) have shown that while positive feedback (i.e., told they had performed at the 84th percentile for their age group) is associated with increased effort and greater task engagement, this effect is only evident in older adults who possess a strong sense of memory control. Therefore, we hypothesized the effect of information about memory ability on face recognition performance would depend on age as well as personal beliefs about memory ability. Specifically, we predicted that positive information would promote more liberal responding resulting in a higher hit rate for both younger and older adults. Similarly, we expected negative feedback would be associated with more conservative responding for both younger and older adults, with the effects being larger in older adults perceiving greater memory control.

Finally, we examined how feedback influenced retrieval processes. First, we assessed the influence of positive and negative information on response times during the recognition test. Older adults generally take longer to respond than do younger adults. One explanation for this is that older adults are often reluctant to make mistakes and are therefore more cautious and slower in their responding (Rabbitt, 1979; Salthouse, 1979; Smith and Brewer, 1985, 1995; Starns and Ratcliff, 2010). In addition, according to regulatory focus theory (Higgins, 1997; 1998), under conditions were individuals become increasingly concerned with avoiding errors (prevention focus), such as when older adults experience negative aging stereotypes, response times should increase. Consequently, we predicted that older adults' response times would be overall slower compared to younger adults following negative information about face recognition ability, In contrast, we predicted that positive feedback should induce a promotion focus, resulting in increased risk taking and decreased response times in both younger and older adults compared to control participants.

Second, we examined whether the information that we gave to participants affected item-specific versus familiarity-based processing. With item-specific processing, a test item is endorsed as having been previously seen when it has distinctive features that the participant remembers. Familiarity-based processing refers to endorsing a test item as having been previously seen because the item feels generally familiar. Research has shown that participants engage in more item-specific compared to familiarity-based processing when they have adopt a relatively conservative response criteria at test (Israel & Schacter, 1997; Schacter, Israel, & Racine, 1999). Additionally, older adults are more likely to engage in familiarity-based processing rather than item-specific processing during memory retrieval (Badham et al., 2012; Bastin & Van der Linden, 2003; Edmonds et al, 2011; Howard et al., 2006; Jennings & Jacoby, 1997; Schacter, Koutstaal, Johnson, Gross, & Angell, 1997). Therefore, we expected that older adults in the present study would engage in more familiarity-based processing than item-specific processing compared to young adults. We also expected that information about face recognition ability would affect face processing. Specifically, we surmised participants would engage in more item-specific compared to familiarity-based processing if they were prevention focused, whereas they would engage in more familiarity-based processing if they were promotion focus. Thus, we predicted that participants in the FN group would engage in more item-specific processing, and participants in the FP group in more familiarity-based.

To summarize, our hypotheses were: First, we predicted that older adults would evaluate their face recognition ability as poorer compared to younger adults. Second, we expected that older adults would be slower and more liberal in their responding than younger adults. Third, we hypothesized that participants receiving negative information would be more conservative and slower to respond than participants receiving no information. However, we expected the impact of negative information to be greater for older compared to younger adults, and for those who believed that their memory ability was poor. In contrast, we expected that positive information would lead to faster and more liberal responding compared to the control condition, wherein no information about ability was provided. Fourth, we expected that older adults would report more familiarity-based processing than item-specific processing compared to younger adults. Fifth, we expected that the reporting of item-specific processing would be greater following negative information, whereas familiarity-based processing would be reported more frequently following positive information.

Method

Design. A 2 (participant age: young and older) x 3 (information: control, FP, and FN) x 2 (test face status: old or new) mixed design was employed. Information was manipulated between subjects by varying the type of information that participants received regarding their ability to recognize faces compared to the rest of the young adult population (please see below). Test face status was a within subjects variable and manipulated by whether the test face was presented at study (old) or a lure (new).

Participants. A total of 186 older adults (*M* age = 70.57 years, *SD* = 5.07; 74% female) were recruited from the University of Leicester and the University of the Third Age. A total of 318 young adults (*M* age = 37.32 years, *SD* = 17.46; 67% female) were recruited from the University of Leicester. All participants had normal or corrected to normal vision. The samples were similar with respect to educational attainment level, with 68% of young adults and 62% of older adults reporting that they had earned an undergraduate degree or higher. Due to time constraints, only a 1/3 of the older adult participants were given the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). A score of 26 or lower is considered to indicate significant cognitive impairment (Whitlatch, Feinberg, & Tucke, 2005). All participants completing the MMSE scored above 26.

Materials and Procedure. The experiment occurred in 3 phases: study phase, information phase, and recognition test phase. In the study phase, participants completed two general questions. The first asked them to rate how accurate they thought they would be at making a correct lineup identification (1= very likely to be inaccurate, 7 = very likely to be accurate), and the second to rate how accurate their testimony would be as an eyewitness to a bank robbery (1=

very likely to be inaccurate, 7 = very likely to be accurate). Next, participants were shown a total of 30 black and white head and shoulder, forward-facing profile, neutral expression shots of young and older adult males and females for 3 s each on a computer monitor. The older adult faces were taken from the Productive Aging Laboratory (PAL) Face Database (Minear & Park, 2004) and the young adults from the Tredoux's Face Database (Tredoux, n.d.). We utilized faces of both young and older adults in an attempt to control for possible own age bias effects.[1] Participants were instructed before the study period commenced to study each face carefully because they would be tested on them later.

During the information phase, participants were administered information about their face recognition ability. Information was provided based on performance on a face perception task, which required people to judge whether two photos were of the same person. Participants were (incorrectly) informed that the test was a valid measure of face recognition ability. There were 20 test trials in total. A test trial consisted of showing 2 photographs, one at a time, each portraying a close-up shot of a person's face. A response screen appeared next, and participants were asked whether the photographs portrayed the same person or different people. Participants indicated their response by pressing a response key. In actuality, two different people were always shown, one celebrity and a celebrity look-alike. After the 20 trials were completed, the participant received information about their performance on the test. Participants were randomly assigned to an information condition, which was presented via written information presented on the computer screen. The format and wording of the information that was given to older and younger adults was the same in each information condition. In the FP condition, participants were told that they scored in the 92nd percentile of the young adult population with respect to their face recognition ability, whereas in the FN condition participants were told that they scored in the 32^{nd} percentile of the young adult population. Participants were also provided with a graphical illustration of their performance, which indicated the location of their score within the young adult population, and the percentage of people scoring worse/better than they did. Additionally, performance was described in practical terms, such as how good/bad they were at remembering people's faces, recognizing movie stars by name, etc. In the no information control condition, no information about their performance was given. Immediately thereafter, participants rated the accuracy of the information (1= completely inaccurate, 7 = completely accurate). We elected to use a perceptual task rather than a memory task during the information phase to reduce any possible fatigue or interference effects of the information test on the final recognition test.

In the third phase, an old/new recognition test was administered. Participants made recognition judgments for 24 faces (half old and half new) on scale that ranged from 1 (100% sure new) to 20 (100% sure old), similar to other studies in the recognition memory literature (e.g., Mickes, Wixted, & Wais, 2007; Mickes, Wais, & Wixted, 2009; Mickes, Hwe, Wais, & Wixted, 2011). The word 'new' appeared above scale numbers 1-10, whereas the word 'old' appeared above scale number 11-20. For each face they rated as 'old', they also made a remember-know judgment, selecting either "I remember specific features of this face" or "I know I studied this face because it feels familiar". The time that it took participants to submit their recognition judgment on each trial was also obtained.

Measures. Recognition responses were coded as 'old' if the participant assigned a confidence rating to the face that was greater than 10; otherwise, the response was coded as 'new'. From these data, the positive identification rate (i.e., the rate at faces were positively identified as 'old') was computed for old faces (i.e., targets) and new faces (i.e., lures). Note that the positive identification rate for old faces is the hit rate, whereas the positive identification rate for new faces is the false alarm rate.

The proportion of ‘remember’ responses given to faces that were identified as ‘old’ was calculated for each participant to measure how often faces were recognized on the basis of specific features. Additionally, the mean length of time that it took across trials for participants to submit their recognition judgment was also computed, conditioning the data on recognition accuracy.

Self-assessed face recognition ability was determined by summing across the ratings given to the face identification and eyewitness testimony items; higher scores on this variable indicated higher ratings of self-assessed ability.

Results

The data were analysed with the general linear model, with alpha set to .05; follow-up tests were conducted using Bonferroni t-tests (two-tailed).

Preliminary Results. First we assessed whether participants thought the information was accurate, and whether perceptions of accuracy varied depending on information condition and participant age. Information accuracy scores were entered into a 2 (age) x 2 (information: FP versus FN) ANOVA, and no significant effects emerged. Mean information accuracy ratings were all above the scale midpoint, indicating there was a tendency for participants to think that the information was accurate (young M = 4.58, SE = .10 and older M = 4.68, SE = .13; positive information M = 4.76, SE = .12 and negative information M = 4.46, SE = .12).

Age and Beliefs about Face Memory. We examined the hypothesis that older adults would not rate their memory ability as highly as young adults by comparing self-assessments of face memory accuracy across age. Self-assessment scores were entered into a 2 (age) x 3 (information) ANOVA. In keeping with the hypothesis, older adults rated their abilities as significantly poorer compared to young adults (*M* = 8.47, *SE* = .17 and *M* = 9.58, *SE* = .13, respectively), $F(1, 498) = 27.08$, $p < .001$, $\eta_p^2 = .02$. The main effect for information and the information x age interaction did not approach statistical significance.

Next we correlated the positive identification rate for targets and lures with self-assessments of face recognition ability to test the hypothesis that beliefs about memory are associated with memory performance. Here, we examined performance in the control condition, where people did not receive information. Self-assessments of face recognition ability were not significantly related to memory performance for either young (hits: $r = -.05$, false alarms: $r = -.01$, p's > .70) or older adults (hits: $r = -.14$, false alarms: $r = -.08$, p's > .16, two-tailed). Hence, the hypothesis that self-assessments of face recognition ability would be associated with memory performance, especially for older participants, was not supported.

Information about Memory and Memory Performance. The next set of analyses tested the hypothesis that information would lead participants to adopt a more conservative response strategy, especially for older adults in the negative information condition. Toward this end, the positive identification rate data were entered into a 2 (age) x 3 (information) x 2 (test face status) mixed ANOVA; descriptive data for this analysis are shown in Table 1. The positive identification rate was larger for old compared to new faces (*M* = .69, *SEM* = .01, versus *M* = .30, *SEM* = .01, respectively), a significant main effect for test face status, $F(1, 498) = 1074.97$, $\eta_p^2 = .68$. The positive identification rate also significantly varied depending on information, $F(2, 498) = 4.66$, $p < .05$, $\eta_p^2 = .02$. These main effects were qualified: The two-way interaction for test face status and information, $F(2, 498) = 2.90$, $p = .06$, $\eta_p^2 = .01$, and the three-way interaction for test face status, information, and age were marginally significant, $F(2, 498) =$

2.95, $p = .05$, $\eta_p^2 = .01$. To follow-up on these results, we carried out within each age group a 3 (information) x 2 (test face status) mixed ANOVA on the positive identification data. For young adults, a significant main effect for test face status was obtained, $F(1, 315) = 668.92$, $p < .001$, $\eta_p^2 = .68$, indicating that the positive identification rate for targets was significantly larger for targets compared to lures (target $M = .69$, $SEM = .01$ versus lure $M = .29$, $SEM = .01$). A main effect for information was also obtained, $F(2, 315) = 3.52$, $p < .05$, $\eta_p^2 = .02$. Bonferroni *t*-tests were carried out to examine the main effect of information. When compared to the control condition, the positive identification rate was not higher for the FP group ($M = .47$, $SEM = .02$ versus $M = .48$, $SEM = .02$, respectively), whereas the positive identification rate was higher for the FN group ($M = .53$, $SEM = .02$) compared to the control group. The interaction between test face status and information was not significant ($p = .37$). Thus, contrary to predictions, false negative information caused young adults to adopt a more liberal response criterion on average. In addition, false positive information had no effect on the response criterion employed.

For older adults, a significant main effect was obtained for test face status, $F(1, 183) = 518.15$, $p < .001$, $\eta_p^2 = .74$, which was qualified by a significant test face status x information interaction effect, $F(2, 183) = 4.74$, $p < .05$, $\eta_p^2 = .05$. Bonferroni t-tests indicated that compared to the control group, false negative information significantly increased the hit rate (control $M = .66$, $SEM = .02$ versus negative $M = .76$, $SEM = .02$ versus), but produced no effect on the false alarm rate (control $M = .66$, $SEM = .02$ versus positive $M = .66$, $SEM = .02$ versus). Additionally, when compared to the control group, false positive information did not affect the hit or the false alarm rate. Thus, the hypothesis that false negative information would cause older adults to adopt a more conservative criterion was not supported, as false negative information increased the hit rate and did not affect the false alarm rate. Instead, false negative information increased older adults' ability to recognise previously seen faces, suggesting that the false negative information led them to more effectively process familiar test faces. Additionally, contrary to prediction, false positive information had no effect on the decision criterion that participants adopted.

We assessed for both young and older adults whether the effects above reported were mediated by beliefs about memory ability. A 3 (information) x 2 (test face status) ANCOVA was carried out, including beliefs about memory ability as the covariate. The pattern of results did not change as a result: For young adults, beliefs about memory ability was significantly related to the positive identification rate ($p < .05$). Beliefs about memory was negatively related to the hit rate and the false alarm rate ($r = -.11$ and $r = -.09$, respectively, p's $< .10$). The main effects for test face status and information, however, remained statistically significant when beliefs about memory was included in the model as a covariate (p's $< .05$). For older adults, beliefs about memory ability was not significant ($p = .23$), and the interaction between test face status and information remained statistically significant after it was included as a covariate ($p < .05$). Thus, beliefs about memory ability did not mediate any of the relationships reported.

Remember Judgments. We hypothesized that older adults would be less likely to use item-specific processing. We also hypothesized that negative information would lead participants to use item-specific processing more often compared to the control condition, and positive information would lead participants to use familiarity-based processing. To test this, the remember response data were analyzed with a 2 (participant age) x 3 (information) ANOVA. Age was the only significant effect to emerge in the analysis, $F(1, 495) = 10.87$, $p < .001$, $\eta_p^2 = .02$ (see Figure 1). Young adults were more likely to make remember responses compared to older adults ($M = .52$, $SE = .01$ versus $M = .44$, $SE = .02$, respectively), a finding which is in keeping with past research. Contrary to prediction, face processing was not affected by information.

Response Times. Response time data were recorded for only the first 216 participants due to a data recording error. The response time data for these participants were analyzed with a 2 (participant age) x 3 (information) ANOVA. Separate analyses were conducted for accurate and inaccurate responses. The response time data were square root transformed before submitting them to inferential statistical analysis because they were positively skewed. However, the results of the inferential statistical analysis were the same for both the raw data and the transformed data. Therefore, the descriptive statistics reported in Figure 2 are based on the raw response time data for ease of interpretation. As can be seen in Figure 2, young adults responded significantly faster than older adults, on both accurate ($F(1, 210) = 84.96$, $p < .05$, $\eta_p^2 = .29$) and inaccurate ($F(1, 210) = 85.31$, $p < .05$, $\eta_p^2 = .29$) test trials. Although the data reported in Figure 2 suggest that older adults tended to respond more slowly in the control condition compared to the information conditions, the apparent differences are not statistically significant, as response times for accurate and inaccurate responses for neither older nor young adults significantly varied depending on information condition. Thus, the results were contrary to prediction, with response times unaffected by information about face recognition ability.

Discussion

Previous research has demonstrated that older adults are less accurate in recognizing faces than young adults. We tested whether beliefs about face recognition accuracy differentially affect the retrieval strategy employed during face recognition depending on age. Participants were randomly assigned to receive false information about their memory ability (i.e., they were randomly assigned to a false positive (FP), false negative (FN), or no information control group) and we examined the effects of information on performance on a subsequent recognition test. We predicted, based on regulatory focus theory (Higgins, 1997; 1998) that believing that one is poor at recognizing faces would lead to the adoption of a prevention focus, and a more conservative decision criterion at test. Furthermore, also based on regulatory focus theory, we predicted that believing one is good at recognizing faces would lead to the adoption of a promotion focus. What is more, we expected that negative information would have a larger effect on older compared to young adults, because negative stereotypes about memory and aging are ubiquitous in Western societies (Boduroglu, et al., 2006; Levy & Langer, 1994).

We found that older adults rated their ability to recognize faces as poorer compared to young adults, but the effect size was relatively small. Personal beliefs about memory, however, were not associated with memory performance. Additionally, older, but not young, adults in the FN group were more accurate in recognizing previously seen faces. In particular, the FN group correctly recognized previously seen faces at a higher rate compared to the control group. The false alarm rate did not vary across the FN and control groups. Young adults in the FN group had a larger hit and false alarm rate compared to the control condition, indicating that they adopted a more liberal decision criterion at test, but the effect size was relatively small. These results suggest that negative information caused young participants to become more promotion focused, leading them to endorse more faces as having been previously seen on the recognition test.

On the one hand, the fact that accuracy improved for older, but not younger, adults following negative information might mean that there were age-related differences in whether participants believed the information. This was probably not the case, however, as older adults were just as likely as young adults to believe that the information was accurate, and both age groups were above the scale midpoint in terms of their assessment of how accurate the information was that we gave them. Instead, the strength of the negative information may have been greater for older adults, as both younger and older adults were informed that they had scored in the 32nd percentile of the younger adult population. Arguably, therefore, negative information impacted older but not young adults because having performed poorly compared to young adults is in keeping with negative cultural expectations about aging and memory (Meisner, 2012). Hence, older adults may have been more likely to experience stereotype threat, which may have lead them to adopt a prevention motivational focus in which they become focused on avoiding errors of commission (i.e., positively recognizing a face that they did not actually previously encounter) (e.g., Barber & Mather, 2013b; Higgins, 1998; Van Dijk & Kluger, 2011). Further research is needed to address whether negative information promotes stereotype threat in younger and older adults.

It is important to note that this study was not a study of stereotype threat per se. Previous research has found that the activation of negative stereotypes leads to anxiety and cognitive performance deficits (Levy, 1996; Levy & Langer, 1994; Levy & Leifheit-Limson, 2009; Levy, et al., 2011, but see, Barber & Mather, 2013b). Theoretically, the activation of negative age stereotypes generates arousal, which in turn negatively impacts performance. The present study did not measure arousal; hence, we do not know if stereotype threat was operating. Moreover, our results are inconsistent with what would be predicted under arousal /executive control interference explanations of the stereotype threat theoretical framework. Namely, these theories predict that negative information would cause deficits in memory performance. Our findings were also inconsistent with the focus model of stereotype threat (Higgins 1997; 1998), which would predict an overall decrease in the positive identification rate following negative information. We found the opposite, as face recognition performance was enhanced by negative information. Instead, while it is possible that older adults' anxiety levels were higher following negative information, this did not seem to cause performance deficits (e.g., Schmader, Johns, & Forbes, 2008). Instead, negative information may have increased older adults' motivation to improve their performance so as to avoid confirming negative stereotypes about aging and memory (see Eysenck & Calvo, 1992; Inzlicht, Aronson, Good, & McKay, 2006).

We were unable to identify any retrieval mechanism to account for why older adult performance improved in the face of negative information about their ability. If negative information increased older adults' prevention focus and was motivating them to avoid making errors, then one would expect to see an associated increase in response times; but, we did not find any evidence that this was the case. While older adults took longer to respond than younger adults, response times did not vary depending on the type of information received. Thus, while negative information led older adults to respond more accurately, this change was not reflected in increased response times. The impact that negative information has on motivation and decision strategies is in need of further research. Additionally, we replicated previous findings that older adults are more likely to engage in familiarity-based processing rather than item-specific processing during memory retrieval (Badham et al., 2012; Bastin & Van der Linden, 2003; Edmonds et al, 2011; Howard et al., 2006; Jennings & Jacoby, 1997; Schacter, et al., 1997). Increased use of item-specific information is associated with enhanced recognition performance (Engelkamp, Biegelmann, & McDaniel, 1998; McCabe, Presmanes, Robertson, & Smith, 2004), but the effect size was relatively small. Negative information about face recognition ability, however, was not found to increase older adults' use of item-specific information on the recognition test. On the one hand, perhaps older adults are simply unable to further increase their use of item-specific processing. Research suggests that the ability to engage in item-specific processing decreases with age, while familiarity-based processing remains relatively intact (Jacoby, 1991; Yonelinas, 2002). Additionally, research has found that priming negative aging stereotypes can result in more familiarity-based processing than item-specific processing in older adults (Hess, et al., 2009). On the other hand, other research has shown that item-specific information can be used by older adults during retrieval to improve memory accuracy (Thomas & Dubois, 2011; Thomas & Sommers, 2005). Perhaps older adults in our study did actually increase their use of item-specific processing following negative information, but they were not able to perceive and report that such a shift had occurred. Thus, the processing strategy that they had actually used might not have been reflected in the self-report data we obtained in measuring face processing style. Additional research to directly test this possibility seems warranted.

Interestingly, positive information did not influence memory performance in either age group. Research has shown that the impact of positive and negative information on performance is influenced by both task type and motivation. Positive and negative information differentially impact performance in different situations (Carver & Scheier, 1998; Kluger & DeNisi, 1996; Locke & Latham, 1990). Both negative and positive information can either increase or decrease overall performance (for a review, see, Kluger & DeNisi, 1996). Additionally, negative information has a larger impact on performance than positive information on tasks where attention and accuracy are important (e.g., Van Dijk & Kluger, 2011). In our older adults, the positive information we provided may have required a much stronger delivery to overcome negative stereotypes about aging and memory. Moreover, the beneficial effects of positive information may only be evident in older adults who possess a strong sense of memory control (Soederberg Miller & West, 2010). In the present, study, however, we were not able to examine the impact of beliefs about memory, as neither positive nor negative information was not found to impact performance. Further research should be directed towards examining how beliefs about memory impact memory performance.

Finally, we found that older adults evaluated their memory as poorer compared to young adults. Older adults, however, appeared to successfully adapt their recognition strategy to the demands of the task, whereas young adults did not. In particular, older adults seemed to adopt a recognition strategy that enabled them to recognize faces when they were told that their ability was poor. These findings suggest that the older adults were employing a meta-cognitive strategy to improve their memory performance. This is a rather tentative conclusion, however, as the improvement in recognition performance in the face of negative information was quite small relative to the control condition. Additionally, we could not determine how negative information affected the strategy that older adults adopted, as response times and item specific processing did not vary across the information conditions. Finally, it is also worth noting that we employed recognition tasks that had a small number of to-be remembered items. Consequently, these tests may not have been as sensitive to age-related differences in recognition memory compared to retrieval tasks which, for example, demand greater elaborative processes, or induce greater interference during retrieval (e.g. Carr, Castel, & Knowlton, 2015; Craik & Schloerscheidt, 2011). Thus, additional research is needed to examine the conditions in which older adults can modulate memory retrieval in order to improve their performance, and how this modulation occurs.

To summarize, this study adds to the growing body of literature demonstrating that older adults can adopt meta-cognitive strategies to improve their recognition performance (Barber & Mather, 2013b; da Silva & Sunderland, 2010; Pendergrass, et al., 2012). We also add to the literature the finding that providing older adults with bogus negative information about their face recognition ability seems to motivate them to employ a more effective recognition strategy, thereby increasing their actual ability to recognize faces. However, the specific strategy that older adults were using to increase their memory accuracy remains elusive, as the group that had received negative information did not differ from the control group with respect to response times or the use of item-specific processing on the face recognition test. Further research is needed to discover how beliefs about memory and motivation can affect the accuracy of everyday cognition in older adults.

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Footnote

[1] We used photographs of older and young adults to control for possible effects of own age bias, which refers to the phenomenon whereby memory for faces of one's own age group is better compared to memory for faces outside one's age group (for a meta-analytic and theoretical review see Rhodes & Anastasi, 2012). The own-age bias effect was not observed in the present study, however. In fact, young adults better remembered the older compared to young adult photographs, whereas for older adults, memory for the older compared to the young photographs did not differ. One possible reason why own age bias effects were not observed is because the young adult photographs were more homogenous with respect to age and clothing compared to the older adult stimuli. For the young adult stimuli, the age range of the individual pictured was narrower and they all wore the same clothing, whereas for the older adult stimuli, the individuals were drawn from a larger age range and each individual wore unique clothing. Perhaps the young adult sample demonstrated better memory for the older compared to young photographs because they were utilizing distinctiveness with respect to age and clothing to make their recognition judgments, whereas older adults were not. As such, we could not examine own age bias because target age was confounded with distinctiveness. Additionally, the effects of information were consistent across the face databases. Therefore, we collapsed across the face databases in the analysis presented.

Table 1. Mean positive identification rates (+1 SEM) as a function of participant age, information, and test face status.

Condition			*Mean*	*SEM*
Control	Young	Old	0.66	0.02
		New	0.29	0.02
	Older	Old	0.66	0.03
		New	0.32	0.02
False Negative (FN)	Young	Old	0.72	0.02
		New	0.33	0.02
	Older	Old	0.76	0.03
		New	0.30	0.02
False Positive (FP)	Young	Old	0.69	0.02
		New	0.27	0.02
	Older	Old	0.66	0.03
		New	0.30	0.02

Figure 1. Mean proportion of remember responses (±1 SEM) by age and information type.

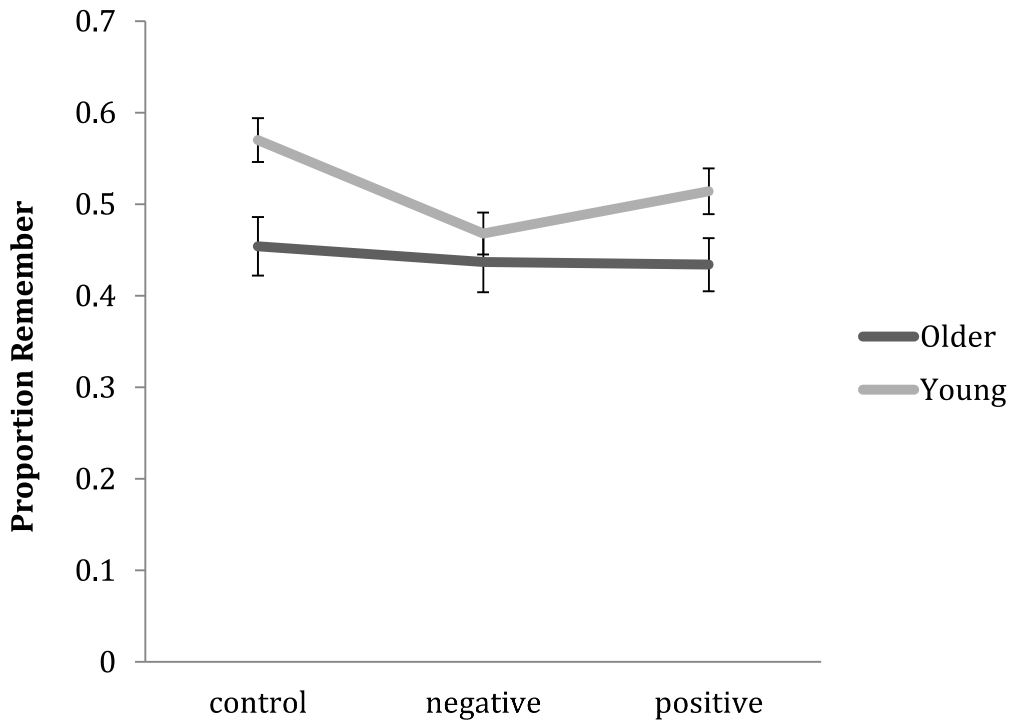

Figure 2. Mean response time (+1 SEM) *as a function of response accuracy, information condition, and age.*