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Stereotype Threat Can Both Enhance and Impair Older Adults' Memory

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Abstract

Negative stereotypes about aging can impair older adults' memory via stereotype threat; however, the mechanisms underlying this phenomenon are unclear. In two experiments, we tested competing predictions derived from two theoretical accounts of stereotype threat: executive-control interference and regulatory fit. Older adults completed a working memory test either under stereotype threat about age-related memory declines or not under such threat. Monetary incentives were manipulated such that recall led to gains or forgetting led to losses. The executive-control-interference account predicts that stereotype threat decreases the availability of executive-control resources and hence should impair working memory performance. The regulatory-fit account predicts that threat induces a prevention focus, which should impair performance when gains are emphasized but improve performance when losses are emphasized. Results were consistent only with the regulatory-fit account. Although stereotype threat significantly impaired older adults' working memory performance when remembering led to gains, it significantly improved performance when forgetting led to losses.

Keywords

stereotype threat, aging, memory, regulatory fit, executive control, stereotyped attitudes, social cognition

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People often associate aging with becoming forgetful, incompetent, and senile (Kite & Johnson, 1988). Although research reveals clear age-related declines in memory functioning (see Hedden & Gabrieli, 2004), negative expectations about aging can exacerbate these deficits via *stereotype threat*. Stereotype threat is a disruptive concern that occurs when people know that if they perform poorly, they will confirm a negative self-relevant stereotype (Steele, 1997). In response to this threat, people underperform compared with their potential, thereby confirming the stereotype. For example, when older adults (aged 60 years and older) are confronted with negative stereotypes about age-related cognitive declines, they underperform on memory tests (for a review, see Barber & Mather, in press). Memory impairments related to stereotype threat have serious clinical implications. In one study, 70% of older adults scored below the clinical cutoff for dementia on a cognitive test when assessed under stereotype threat compared with approximately 14% when assessed under no stereotype threat (Haslam et al., 2012).

Why stereotype threat negatively affects older adults' memory is unclear. In the current experiments, we tested predictions derived from two theoretical accounts of stereotype threat: regulatory fit and executive-control interference. These accounts are often complementary and predict similar outcomes. However, to differentiate between them, we examined a situation in which they offer competing predictions.

The Role of Regulatory Fit

According to regulatory-focus theory, people differ in how they pursue goals. People with a *promotion focus* are concerned with the presence or absence of gains, whereas people with a *prevention focus* are concerned with the presence or absence of losses (Higgins, 1997, 1999). Although people differ in their long-term focus, short-term variations can occur (e.g., Freitas & Higgins, 2002; Higgins, 1997). That is, the current context can

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influence whether people are in a promotion or prevention state (e.g., Shah, Higgins, & Friedman, 1998). Stereotype threat is one situation that may invoke a prevention focus. More specifically, under stereotype threat, people become vigilant not to be their worst rather than eager to be their best (Seibt & Förster, 2004). Because of this increased prevention focus, people under stereotype threat should also be more sensitive to the presence or absence of losses, rather than gains, within their environment.

Situation-based fluctuations in regulatory focus can, in turn, affect task performance. People tend to perform better at tasks when their current regulatory state matches the tasks' reward structure (i.e., when there is regulatory fit; Higgins, 2000). That is, people with a promotion focus perform better on tasks that emphasize gains, whereas people with a prevention focus perform better on tasks that emphasize losses (Maddox, Baldwin, & Markman, 2006; Shah et al., 1998). However, most stereotype-threat research has assessed performance on gain-based tasks (e.g., how many hits were made?) rather than on loss-based tasks (e.g., how many false alarms were avoided?). Thus, stereotype-threat impairments reported in previous studies may have been due to the poor fit between the task and the threat-induced prevention focus rather than to an overall impaired ability to perform (Grimm, Markman, Maddox, & Baldwin, 2009).

The regulatory-fit account has not been tested in older adults but is supported by research with younger adults. When undergraduate students are primed with negative stereotypes, their self-reported levels of prevention focus increase (Seibt & Förster, 2004). Furthermore, for younger adults, stereotype-threat effects disappear, and sometimes even reverse, when the task has a loss-based structure rather than a gain-based structure (Grimm et al., 2009).

The Role of Executive-Control Interference

Although the regulatory-fit account has been supported in younger adults, across previous studies there are other affective, cognitive, and motivational factors that have also been implicated in modulating younger adults' stereotype-threat effects. To reconcile these results, it has been proposed that *executive-control interference* is the common distal mediator linking all of these factors (Schmader, Johns, & Forbes, 2008). More specifically, stereotype threat is thought to induce physiological stress and to create negative mood states that people try to suppress. Stereotype threat is also thought to increase task monitoring, in part because of the induced prevention focus. Together, these factors place demands on the executive-control component of working memory. This in turn leaves fewer executive-control resources available to perform the critical task.

Direct evidence supports this account for younger adults (e.g., Beilock, Rydell, & McConnell, 2007; Rydell, McConnell, & Beilock, 2009; Schmader & Johns, 2003; Schmader et al., 2008). For example, younger adults' performance on a working memory task is impaired when under stereotype threat (e.g., Johns, Inzlicht, & Schmader, 2008; Schmader & Johns, 2003). Likewise, younger adults with high working memory capacities show fewer effects of stereotype-threat cues than those with low working memory capacities (Régner et al., 2010). This is presumably because people with high capacity have sufficient resources to perform the critical task even after experiencing declines in working memory resources as a result of stereotype threat.

Although executive-control interference is generally accepted as the key factor underlying stereotype threat in younger adults, evidence has been mixed in older adults. In favor of this account, although stereotype threat preferentially decreases older adults' ability to use controlled memory processes, which depend on executive-control resources, it does not affect older adults' ability to use automatic memory processes, which do not rely on executive-control resources (Mazerolle, Régner, Morisset, Rigalleau, & Huguet, 2012). However, performance on working memory measures is not impaired under stereotype threat for older adults (Hess, Hinson, & Hodges, 2009) unless the task is described as a test of memory abilities (Mazerolle et al., 2012; see also Abrams, Eller, & Bryant, 2006; Desrichard & Kopetz, 2005). The failure of stereotype threat to uniformly impair working memory (irrespective of how it is described) challenges the validity of the executive-control-interference account.

Overview of the Current Experiments

Across two experiments, we tested the roles of regulatory fit and executive-control interference in modulating older adults' working memory performance under stereotype threat. To do so, we asked older adults to perform a working memory task either under stereotype threat about their memory abilities or not under such threat. We also manipulated the reward structure of the working memory test. Half of the participants received a monetary reward for each word recalled (i.e., a gain-based reward structure). The remaining participants lost part of an initial monetary endowment for each word forgotten (i.e., a loss-based reward structure).

The regulatory-fit account predicts that stereotype threat should induce a prevention focus and thereby impair performance when gains are emphasized. However, when losses are emphasized (i.e., when there

is regulatory fit), this effect should be eliminated and perhaps even reversed. In contrast, the executive-control-interference account predicts that stereotype threat diverts executive-control resources away from the critical task (in part because of an induced prevention focus). Therefore, such threat should impair working memory performance; furthermore, this deficit should be greater for people with low (rather than high) baseline working memory abilities, because they should be less able to withstand interference from the threat-related processing (e.g., Régner et al., 2010). Improvements in working memory performance under stereotype threat cannot be explained by the executive-control-interference account.

Finally, we note that ensuring the replicability of research results in psychological science is an increasing concern (Pashler & Wagenmakers, 2012). To address this concern, we evaluated our hypotheses in two independent samples of older adults.

Method

Participants and design

Fifty-six older adults (average age = 69.29 years, *SD* = 5.48, range = 60–79; 61% male, 39% female) participated in Experiment 1a. The group was 18% Black, 4% Asian, 3% biracial, 66% White, 2% multiracial, and 2% East Indian (9% did not state their race or ethnicity). They had completed an average of 15.77 years of education (*SD* = 2.35, range = 11–22) and had an average score of 44.02 on the Wechsler Test of Adult Reading (*SD* = 5.31, range = 31–50; Wechsler, 2001).

A different sample of 56 older adults (average age = 65.61 years, *SD* = 5.18, range = 59–78; 20% male, 80% female) participated in Experiment 1b. This group was 34% Black, 9% Asian, 5% biracial, 48% White, 5% multiracial, and 2% other race or ethnicity (2% did not state their race or ethnicity). They had completed an average of 15.85 years of education (*SD* = 2.35, range = 12–20) and had an average score of 40.36 on the Wechsler Test of Adult Reading (*SD* = 9.25, range = 17–50; Wechsler, 2001).

All participants were selected from a list of research volunteers recruited via newspaper and online advertisements, fliers posted at senior centers and public places, and letters sent to University of Southern California alumni. Stereotype threat (threat vs. no threat) and reward structure of the working memory task (gain based vs. loss based) were manipulated between subjects. Participants were paid $15 per hr in addition to a performance-based monetary reward.

The sample size used in these experiments was based on an a priori power analysis conducted in G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). Assuming an effect size of Cohen's d = 0.79—derived from the following previously published studies: Abrams et al., 2008, Experiment 1; Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005; Coudin & Alexopoulous, 2010; Desrichard & Kopetz, 2005; Grimm et al., 2009, Experiments 1 and 2A; Hess, Auman, Colcombe, and Rahhal, 2003; Hess, Emery, & Queen, 2009; Hess, Hinson, & Hodges, 2009; Kang & Chasteen, 2009; Mazerolle et al., 2012; Seibt & Förster, 2004; and Thomas & Dubois, 2011—a significance level of α = .05, four participant groups, and one covariate (baseline task performance), we determined that a total sample size of 52 participants (n = 13 per group) would provide 80% power to detect effects. To exceed this criterion and achieve greater than 80% power, we recruited 56 participants (n = 14 per group).

Procedure

As a baseline measure of working memory capabilities, participants completed a sentence span task (modeled after the sentence span task used by Turner & Engle, 1989). During this task, participants read sentences that either made sense syntactically and semantically (e.g., "A hen pecks in a bowl and next to it crouches a coyote") or did not make sense (e.g., "A cat sits on a cage and a flutters her above sparrow"). Nonsense sentences were constructed by rearranging the order of the last four to six words within the sentence. Participants indicated, using a computer keyboard, whether each sentence that they read made sense. Participants were also asked to remember the last word from each sentence.

The stimuli consisted of 146 unique sentences randomly distributed into four sets: one set of 5 practice sentences and three sets each of 47 task sentences. The sentences in each set always appeared in the same order across participants, and the assignment of the task sets was counterbalanced across participants. In each set, the number of sentences that made sense or were nonsense was approximately equal (i.e., sometimes 23, sometimes 24).

Before beginning the baseline task, participants completed the 5 practice sentences (one block with 2 sentences and one block with 3 sentences). Each participant then responded to one of the sentence task sets. Sentences were presented in blocks in which the number of sentences gradually increased: There were four blocks with 2 sentences each, three blocks with 3 sentences each, and two blocks each of 4, 5, and 6 sentences. Participants read each sentence one at a time. At the end of each block, participants were prompted to speak the last word from each of the sentences in that block in the order in which they had appeared (e.g., "coyote," "sparrow"). Working memory performance was scored as the total number of words correctly recalled during the critical blocks, regardless of the order in which they were recalled.

We next manipulated stereotype threat by asking participants to read fictitious news articles taken from Hess et al. (2003). In the stereotype-threat condition, the articles described research confirming that memory declines with age. In the no-threat condition, the articles described preservation and improvements in memory with age. Participants were told that the study in which they were participating was designed to test these findings. In the stereotype-threat condition, participants were also asked to state their age aloud.

Participants in both threat conditions then completed a second sentence span task (the "critical task"). The procedure was identical to that of the baseline sentence span task except that there were no practice sentences, and participants were shown a different sentence task set than during the baseline task. In addition, participants were given a performance-based reward in the form of poker chips. The reward structure was modeled after the structure used by Grimm et al. (2009). For half of the participants, the reward was gain-based: Participants gained 2 poker chips for each word correctly recalled. For the other half of the participants, the reward was loss-based: Participants were initially given 100 poker chips and lost 3 poker chips for each word forgotten. At the end of the experiment, participants were given 5¢ for every chip accrued (in the gain-based task) or remaining (in the loss-based task). As in the baseline task, working memory performance was scored as the number of words correctly recalled, regardless of the order in which they were recalled.

Results

Within each experiment, we examined performance on the second sentence span task via a 2 (stereotype threat: threat, no threat) × 2 (reward structure: gain, loss) analysis of covariance (ANCOVA), controlling for baseline performance on the sentence span task. Inclusion of baseline performance as a covariate is common in the stereotype-threat literature and allowed us to adjust for the large amount of variance in older adults' memory performance; baseline scores ranged from 14 to 42 (M = 22.66, SD = 6.01) in Experiment 1a and from 9 to 38 (M = 22.84, SD = 6.75) in Experiment 1b. The following analyses report adjusted means. An identical pattern of results was obtained when change scores (i.e., calculated using the change in performance between baseline and the second version of the task) were used as the unit of analysis. A significance level of $\alpha = .05$ was used for all analyses.

The role of executive-control interference

The executive-control-interference account predicts that stereotype threat should be associated with an overall reduction in working memory performance, but our results did not support this hypothesis. A 2 × 2 ANCOVA on critical sentence-span performance revealed no main effect of stereotype threat in Experiment 1a; performance of participants in the stereotype-threat condition (M = 28.21) was not significantly different than performance of those in the no-threat condition (M = 28.25), $F < 0.01$. This pattern was replicated in Experiment 1b (stereotype-threat condition: M = 27.60; no-threat condition: M = 27.90), $F = 0.07$.

The executive-control-interference account also predicts that stereotype-threat effects should vary as a function of baseline working memory performance (Régner et al., 2010). More specifically, people with high working memory capacity should have sufficient resources to perform the critical task, even after experiencing declines in those resources under stereotype threat. Because of this, people with high working memory capacity should be less affected by stereotype threat than those with low working memory capacity. To test this prediction, we collapsed the baseline data across experiments and used a median split to classify each participant as having either low or high baseline working memory abilities (i.e., before threat was induced in either group). We then repeated the 2 × 2 ANCOVA separately for each of the working-memory-ability groups. We found no support for the executive-control-interference account. Participants with low baseline working memory performance (threat condition: M = 29.00; no-threat condition: M = 29.14), $F = 0.00$, showed no significant reduction in working memory performance under stereotype threat. Likewise, participants with high baseline working memory performance (threat condition: M = 26.99; no-threat condition: M = 27.00), F = 0.01, showed no significant reduction in working memory performance under stereotype threat.

The role of regulatory fit

We next evaluated the role of regulatory fit in modulating older adults' stereotype-threat effects. In contrast with the executive-control-interference account, which predicts an overall reduction in working memory performance, the regulatory-fit account predicts an interaction between stereotype-threat condition and reward structure. Stereotype threat should lead to a reduction in performance when the reward structure is gain-based, but this reduction should be absent (or even reversed) when the reward structure is loss-based. The results of Experiment 1a were consistent with this prediction. A 2 × 2 ANCOVA revealed that there was a significant and large interaction between stereotype threat and reward structure, $F(1, 51) = 12.35$, $MSE = 16.07$, $\eta_p^2 = .20$. As can be seen in Figure 1, stereotype threat significantly impaired performance for participants exposed to a gain-based

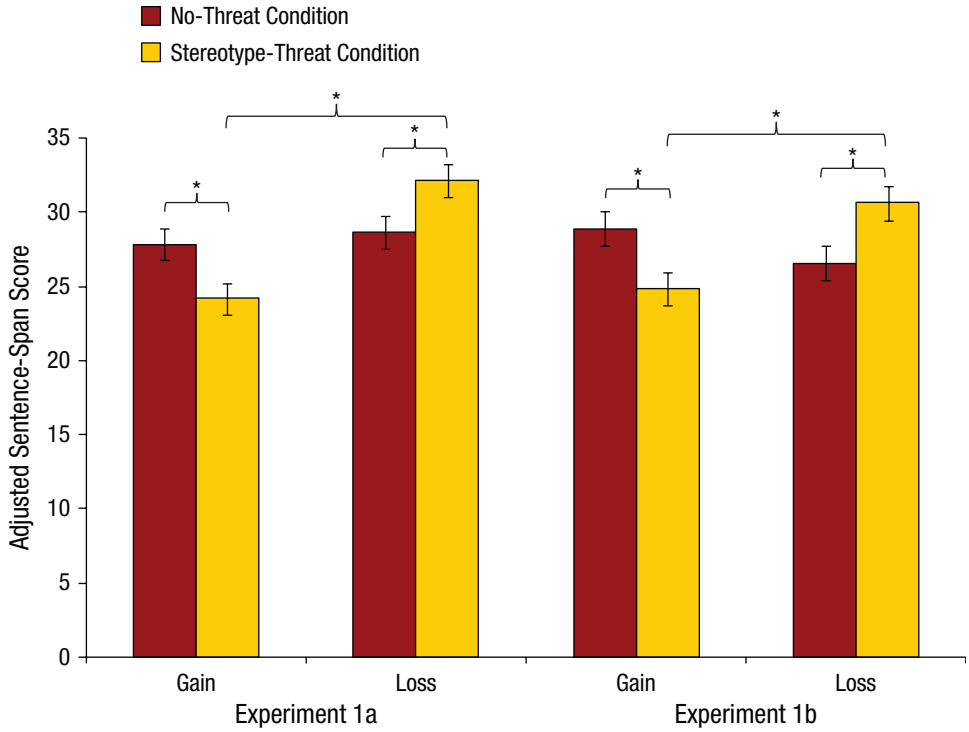

Fig. 1. Mean score on the second sentence span task (adjusted for baseline performance) as a function of reward structure and threat condition in Experiments 1a and 1b. Error bars represent standard errors of the mean. An asterisk indicates a significant difference between conditions ($p < .05$).

reward structure (threat condition: $M = 24.21$; no-threat condition: $M = 27.87$), $F(1, 25) = 6.02$, $MSE = 15.21$, $\eta_p^2 = .19$. In contrast, for participants exposed to a loss-based reward structure, stereotype threat significantly improved performance (threat condition: $M = 32.17$; no-threat condition: $M = 28.68$), $F(1, 25) = 4.29$, $MSE = 16.80$, $\eta_p^2 = .15$. Furthermore, performance in the no-threat condition did not significantly vary as a function of reward structure, $F(1, 25) = 2.63$, $MSE = 17.86$, $p = .12$, $\eta_p^2 = .10$. In contrast, participants under threat did significantly better in the loss-based condition rather than the gain-based condition, $F(1, 25) = 10.82$, $MSE = 14.92$, $\eta_p^2 = .30$.

As can be seen in Figure 1, this pattern of results was replicated in Experiment 1b. Within this independent sample, there was once again a significant interaction between stereotype threat and reward structure, $F(1, 51) = 11.77$, $MSE = 18.35$, $\eta_p^2 = .19$. As in Experiment 1a, stereotype threat significantly impaired performance for participants exposed to a gain-based reward structure (threat condition: $M = 24.85$; no-threat condition: $M = 28.93$), $F(1, 25) = 5.97$, $MSE = 19.11$, $\eta_p^2 = .19$, but significantly improved performance for participants exposed to a loss-based reward structure (threat condition: $M = 30.64$; no-threat condition: $M = 26.57$), $F(1, 25) = 6.39$, $MSE = 17.05$, $\eta_p^2 = .20$. Furthermore, whereas performance for participants in the no-threat condition did not vary as a function of reward structure, $F(1, 25) = 2.11$, $MSE = 23.04$, $p = .16$, $\eta_p^2 = .08$, participants under stereotype threat did significantly better in the loss-based condition than in the gain-based condition, $F(1, 25) = 13.12$, $MSE = 14.35$, $\eta_p^2 = .34$.

Discussion

In the current experiments, we tested two potential mechanisms underlying stereotype threat in older adults: regulatory fit and executive-control interference. According to the regulatory-fit account (Grimm et al., 2009; Seibt & Förster, 2004), stereotype threat induces a transitory state of prevention focus. Because people tend to perform better at tasks when their regulatory state matches the tasks' reward structure (i.e., when there is regulatory fit), stereotype threat should lead to better performance on loss-based tasks than on gain-based tasks. Consistent with this, our results showed that in two independent samples, stereotype threat impaired older adults' working memory performance when gains were emphasized but improved older adults' performance when losses were emphasized.

In contrast, our results did not support the executive-control-interference account. According to this model, stereotype threat reduces the amount of executive-control resources available to perform the critical task, and so performance should suffer (Schmader et al., 2008).

Furthermore, the executive-control-interference account predicts that this should be especially true for people with lower executive-control abilities, because they are less equipped than people with higher executive-control abilities to deal with stereotype-threat-related reductions in executive-control resources (Régner et al., 2010). However, our results did not support these predictions. In the current experiments, stereotype threat did not always impair older adults' working memory performance, and the pattern of effects did not depend on baseline levels of executive-control abilities. Although other research has also failed to support the executive-control-interference account of stereotype threat in older adults (e.g., Hess, Hinson, & Hodges, 2009), the current results are the first to directly contradict it. In the current experiments, stereotype threat actually improved working memory performance when losses were emphasized. This finding is incompatible with the executive-control-interference account and supports the conclusion that executive-control interference is not the key factor underlying older adults' stereotype-threat effects.

The conclusion that executive-control interference is not the key factor underlying older adults' stereotype-threat effects is important for many reasons. First, it changes when and how stereotype-threat effects are predicted to emerge for older adults. For instance, on the basis of the executive-control-interference account, one would predict larger stereotype-threat effects for tasks that more heavily rely on executive-control resources (e.g., greater effects of stereotype threat on recollection tasks requiring specific context memory than on simple memory tasks that rely on familiarity or schematic knowledge; Davidson & Glisky, 2002; Mather, Johnson, & De Leonardis, 1999). Our results suggest that this difference will not emerge. Furthermore, our results also suggest the novel theoretical concept that the mechanisms underlying stereotype threat vary with age. Although previous work has suggested that the mechanisms of threat effects vary as a function of who is being threatened (i.e., ones' group or ones' self; Shapiro & Neuberg, 2007), no one has yet examined the intriguing possibility that they also vary as a function of age. Given that executive-control interference clearly plays a strong role in modulating younger adults' stereotype-threat effects (e.g., Beilock et al., 2007; Régner et al., 2010; Rydell et al., 2009; Schmader & Johns, 2003; Schmader et al., 2008), but does not seem to do so for older adults, we propose that there are age differences in the mechanisms of stereotype threat. These age differences may arise from age-related improvements in emotion-regulation abilities. Previous research shows that regulating emotions while performing a cognitive task leads to performance decrements for younger adults but not for older adults (Scheibe & Blanchard-Fields, 2009). Therefore, if stereotype threat induces negative affective states that people try to regulate, doing so may be more cognitively costly for younger adults.

Finally, understanding the mechanisms underlying older adults' stereotype-threat effects has important clinical implications. In one study, 70% of older adults scored below the clinical cutoff for dementia on a cognitive test when assessed under stereotype threat about age-related cognitive declines, compared with approximately 14% when not assessed under threat (Haslam et al., 2012). Given that the number of older Americans is expected to more than double by 2060, from 43.1 million to 92.0 million (U.S. Census Bureau, 2010), and given that annual dementia screenings are now covered by Medicare, it will become increasingly important to ensure that diagnostic assessments for dementia are resistant to stereotype-threat-induced performance deficits. Our results indicate one potential way to do this. Most cognitive tasks (including clinical diagnostic tools) have either an implicit or explicit gain-based reward structure. For example, memory tests typically emphasize recalling (gaining) items rather than avoiding mistakes. Our results suggest that by reframing these assessments to emphasize losses, regulatory fit can be obtained, and stereotype-threat effects can be eliminated or perhaps even reversed.

Author Contributions

S. J. Barber conceived and designed the study, in collaboration with M. Mather, and analyzed and collected the data. The first draft of the manuscript was prepared by S. J. Barber and revised by M. Mather. Both authors approved the final version of the manuscript for publication.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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