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The Effect of Prior Task Success on Older Adults' Memory Performance: Examining the Influence of Different Types of Task Success

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Abstract

Background—Negative aging stereotypes can lead older adults to perform poorly on memory tests. Yet, memory performance can be improved if older adults have a single successful experience on a cognitive test prior to participating in a memory experiment (Geraci & Miller, 2012). The current study examined the effects of different types of prior task experience on subsequent memory performance.

Method—Before participating in a verbal free recall experiment, older adults in Experiment 1 successfully completed either a verbal or a visual cognitive task or no task. In Experiment 2, they successfully completed either a motor task or no task before participating in the free recall experiment.

Results—Results from Experiment 1 showed that relative to control (no prior task), participants who had prior success, either on a verbal or a visual task, had better subsequent recall performance. Experiment 2 showed that prior success on a motor task, however, did not lead to a later memory advantage relative to control.

Conclusion—These findings demonstrate that older adults' memory can be improved by a successful prior task experience so long as that experience is in a cognitive domain.

Keywords

memory; aging; memory improvement; task success; stereotypes

It is common for older adults to worry that they are losing their memory and to expect to perform poorly on memory tests (e.g., Berry, 1999; Halamish, McGillivray, & Castel, 2011; Lineweaver & Hertzog, 1998). There is evidence that these worries arise in part from societal and cultural expectations that memory and other abilities decline with age (see

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Heckhausen, Dixon, & Baltes, 1989; Hertzog, Lineweaver, & McGuire, 1999; Levy & Langer, 1994; Ryan, 1992; Ryan & Kwong See, 1993). Unfortunately, these negative stereotypes have consequences for older adults. Indeed, research shows that activation of negative aging stereotypes can cause older adults to perform more poorly on subsequent memory tests, relative to when positive stereotypes or no stereotypes of aging are activated (Hess, Auman, Colcombe, & Rahhal, 2003; Hess, Hinson, & Hodges, 2009; Hess & Hinson, 2006; Hess, Hinson, Statham, 2004; Levy, 1996; Stein, Blanchard-Fields, & Hertzog, 2002). Thus, we know that people hold negative stereotypes about aging, particularly relating to memory abilities, and that these stereotypes can themselves lead to poorer memory performance for older adults.

An important goal, then, is to determine ways to change older adults' negative stereotypes and performance expectations to improve memory performance. One approach to reducing older adults' negative performance expectations is to lead older adults to think more positively about aging. Unfortunately, this approach is not always effective. For example, in one study, participants read two newspaper articles that either contradicted or supported stereotypical views about aging and memory before participating in a memory experiment (Hess & Hinson, 2006). Results showed that memory performance was not statistically improved for any age group (ages 30 to 80) after reading positive aging stereotypes. In other studies, older adults undergo longer-term interventions designed to increase memory self-efficacy, or confidence, but often self-efficacy training alone does not lead to improvements in actual memory performance (see Rebok, Carlson, & Langbaum, 2007, for review).

Recent work shows that providing older adults with an opportunity to be successful on a cognitive task can lead to later memory improvements (Geraci & Miller, 2013). Before participating in a memory experiment, younger and older adults were given a cognitive task that they could either successfully complete (the task success condition), not successfully complete (the task failure condition), or they were given no prior task experience (the control condition). Task success was manipulated by asking participants to rearrange a series of scrambled words to make grammatically correct sentences. In the success condition, participants had unlimited time to unscramble the words; participants correctly solved almost 100 percent of the sentences. In the failure condition, participants were given a time constraint so that they could correctly rearrange less than 50 percent of the words to make sentences. A third group of participants did not have any task experience. Next, everyone studied a list of words and took a free recall test for those words.

Results showed that the prior task manipulation influenced older adults' subsequent memory performance. Older adults in the task success condition prior to participating in the memory experiment had significantly higher recall compared to older adults who had experienced task failure or no prior task experience. Prior task success benefited only older adults' memory performance—there was no effect of prior task experience on younger adults' subsequent memory performance. The results are noteworthy because they demonstrate that older adults' memory performance can be improved with a single successful prior task experience. The interpretation is that succeeding on a cognitive task provided older adults with direct information to counter negative age-related stereotypes about poor cognitive abilities. Having had this successful task experience, older adults performed better on the

subsequent memory experiment. Indeed, in the task success condition, there was no significant age deficit in memory—older adults performed similarly to younger adults if they had been successful on a prior cognitive task than if that had not.

While the finding that prior task success can improve memory performance in older adults is promising, several questions remain. For example, one might wonder whether any type of prior task success (even success on a very different task) could improve subsequent memory performance. In the previous study by Geraci and Miller (2013), the prior task had some similarities to the free recall task. For example, both the prior task and the memory experiment used verbal materials; participants were given words to unscramble to make sentences and were given a list of words (albeit unrelated to the words they had unscrambled) to study and recall. In the present experiments, we examined whether prior task success could improve subsequent memory performance when task success occurred in a different domain from the memory test. In Experiment 1, participants completed one of two types of cognitive tasks prior to participating in the verbal free recall experiment. As in prior research (Geraci & Miller, 2013), participants completed a verbal cognitive task in which they were asked to unscramble words to make sentences. Note, that we did not include a failure condition in the current experiments, as the Geraci and Miller study has already demonstrated a memory advantage following success compared to failure on that same task. We used a second task success condition, in which participants completed a visual task that was designed to have little overlap with the types of materials or processes involved in the verbal free recall experiment. In the visual task condition, participants were shown photographs of common scenes and asked to find items (e.g., 6 chairs in a classroom scene). Both the verbal and the visual tasks were designed so that participants could complete close to 100% of trials correctly. We compared recall performance in the two task success conditions (the verbal and the visual tasks) to performance for participants who had no prior task experience (the control condition). Of interest was whether older adults could benefit from prior success on a cognitive task that has little or no resemblance to the subsequent memory task. Would success on the visual search task yield similar memory benefits as success on the verbal sentence task?

Experiment 2 examined whether the prior task success effect would occur if older adults experienced success in another non-cognitive domain. In Experiment 2, participants were given a motor task that they could successfully complete or they were given no task (control condition) prior to participating in a verbal free recall experiment. Participants in the motor task success condition were asked to throw a bean bag into a bucket at varying distances. As in the cognitive success conditions in Experiment 1, the motor success condition in Experiment 2 was designed so that participants could successfully complete the task at near 100% accuracy. We compared memory performance for participants in the motor success condition to memory performance for participants in the control condition. Of interest was whether older adults' memory performance would benefit from success on a prior task that was from a non-cognitive domain. Would success on the bean bag task lead to a subsequent memory advantage?

In both Experiments we also examined potential mediators of the task success effect. Geraci and Miller (2013) provided preliminary evidence that prior task success reduced older

adults' self-reported anxiety levels, and some studies have shown that stereotype threat increases anxiety in older adults under some conditions (Abrams, Eller, & Bryant, 2006; Hess, Hinson, & Hodges, 2009; but see Hess, et al., 2003; Hess & Hinson, 2006). Given the potential role of anxiety in the related stereotype threat literature, we sought to examine the role of prior task success on anxiety, using a more standard measure of anxiety (the State-Trait Anxiety Inventory; Spielberger, 1983). In addition, we examined other potential mediators that have been suggested to play a role in the relevant stereotype threat literature, including performance predictions (Desrichard & Kopetz, 2005; Hess et al., 2009; see also Barber & Mather, in press, for review), memory self-efficacy (as measured using the MSEQ; West, Bagwell, & Dark-Freudeman, 2005), and mood (as measured using the PANAS, Positive Affect Negative Affect Schedule; Watson & Clark, 1994). Finally, we sought to directly test the hypothesis that prior task success improves memory performance by countering participants' negative stereotypes. To do this, we assessed negative and positive stereotype activation using a lexical design task that contained negative and positive aging stereotyped words (e.g., fragile and wise), as well as neutral words (e.g., daily), and nonwords (e.g., woogs). In addition, we asked people questions about their aging stereotypes using a questionnaire (see Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005).

Experiment 1

Method

Participants—Ninety older adults (46 female; M age = 73.54, SD = 6.50, age range 64–89) were semi-randomly assigned to one of the three prior task experience conditions (with an eye towards matching groups on average age). There were 30 older adults in the verbal task success condition, 30 in the picture task success condition, and 30 in the no prior task (control) condition. All participants completed a demographic questionnaire, a vocabulary test, and a Mini-Mental Status Exam (MMSE; Folstein, Folstein, & McHugh, 1975). The three groups of older adults did not differ in average MMSE score ($F(2, 87) = 1.48$, $MSE = .93$, $\eta^2_p = .03$), age ($F(2, 87) < 1$), years of education ($F(2, 87) < 1$), or vocabulary ($F(2, 87) = 1.73$, $MSE = 12.20$, $\eta^2_p = .03$) (see Table 1). Only participants who scored at least 27 out of a possible 30 points the MMSE were included in the data analyses and are characterized above and in Table 1. Approximately 13% of all participants did not meet the MMSE cutoff. These participants were replaced in the analyses with participants who did meet the cutoff. To control for potential time of day effects in memory performance for younger and older adults (see May, Hasher, & Stoltzfus, 1993), we equated the number of participants who participated in the study in the morning and afternoon across conditions. All participants completed the study in a laboratory on the campus of Texas A&M University. The majority of participants had never been to the laboratory before (only 3 had been to the laboratory previously).

Materials and Procedure—During recruitment and during the consent process, participants were told they would receive a series of cognitive tests and that they may complete a memory test. After giving consent, participants completed a demographic questionnaire and the MMSE. Next, participants in the sentence condition received a packet containing 30 sentence scramble problems. Each problem contained five scrambled words

and participants were asked to rearrange four of the five words to form a grammatically correct sentence (e.g., can, the, open, was, fun). Participants in the picture condition were given a packet that contained 50 pictures of everyday scenes. For each scene, participants were asked to circle a set number of common objects (e.g., in a classroom picture participants had to find and circle six chairs). There was no time limit for completing either the sentence scramble or the picture search task. The picture and the sentence tasks were normed ($N = 21$) so that participants could perform them nearly perfectly (98% success rate for each task during norming, $t(20) < 1$). Also, the tasks were normed so that, on average, it took participants the same amount of time to complete them (8.7 mins for the sentence task and 7.8 mins for the picture task; $t(20) = 1.00$, $SE = .89$, $d = .45$). Study participants showed equally high levels of accuracy on the tasks and performed similarly to the norming participants (98%). Despite equally reaction time during norming, study participants completed the sentence task (9.4 min) more slowly than they completed the picture search task (7.8 min), $t(57) = 2.22$, $SE = .72$, $d = .59$. However, to anticipate our results, we found the same effect of task success condition on recall even when time on task was used as a covariate $F(3,85) = 4.61$, $MSE = .02$, $\eta^2_p = .140$. Participants in the control condition did not engage in any task before participating in the memory experiment. They simply participated in the test directly after completing the demographic form and the MMSE.

Next, all participants were given a list of 30 categorizable words (average category rank = 10.6; Shapiro & Palermo, 1970) to study for an unspecified memory test. The study list was comprised of five nouns from six semantic categories (musical instruments, professions, beverages, flowers, tools, and geographic features) that were presented in a fixed random order. There was no overlap between the words participants studied for the memory test with the words used in the sentence scramble task or the items in the search task. Before studying the words, participants predicted how many words they would recall on an upcoming test. Immediately after making their predictions, participants were given the list of words to study for two minutes. After a brief (1 min) conversational delay, participants were then given a sheet of paper with 30 numbered blanks and were asked to recall as many words as they could in any order. They were given three minutes to recall the words.

After the recall test, participants completed a lexical decision task (LDT) designed to assess activation of positive and negative aging stereotypes. Participants viewed 150 strings of letters displayed on a computer screen and were instructed to decide whether or not the string formed a word. Of the 150 letter strings, 99 formed words and 51 formed nonwords (e.g., skrures). Unbeknownst to the participants, the words fell into one of three categories: one third of the words were positive aging stereotype words (e.g., wise), one third were negative aging stereotype words (frail), and one third were neutral words (purple). Letter strings remained on the screen for 2 seconds, after which participants could no longer respond; we instructed participants to respond as quickly as possible. Reaction time was averaged for all correct trials. Because an upper limit of 2 seconds was applied to the stimuli, there were no outliers on the long side. We removed outliers that were exceptionally fast (more than 2 SDs below the mean) for all analyses. The rationale for using a lexical decision task as a proxy for stereotype threat activation is that participants would have faster reaction times when reporting that positive aging words were in fact words in conditions in which stereotypes are countered by prior task success.

Following the LDT phase, participants were given a variety of questionnaires designed to assess other potential mediators of the task success effect on memory. These measures were presented in a random order to control for potential order effects. Participants completed the Memory Self-Efficacy Questionnaire (MSEQ) (West, et al., 2005), Positive Affect Negative Affect Schedule (PANAS) (Watson & Clark, 1994), the State-Trait Anxiety Inventory (STAI) (Spielberger, 1983), and a Stereotype Threat questionnaire (Chasteen, et al., 2005). After completing the questionnaires, participants completed a vocabulary test (Zachary, 1986) that served as proxy for general crystallized intelligence.

Results and Discussion

Memory performance—Significance was set at $p < .05$ for all analyses. We hypothesized that participants who had success on either task (the sentence or picture task) would perform better on a subsequent memory experiment than participants who had no task experience prior to participating in the memory experiment. Our results supported this hypothesis. Mean recall performance is presented in Table 2, left panel. A one-way ANOVA showed that the prior task condition affected recall, $F(2, 87) = 3.38$, $MSE = .02$, $\eta^2_p = .07$ (see Figure 1). Planned comparisons demonstrated that the older adults in the sentence condition ($M = .54$, $SD = .15$) had higher recall than older adults in the control condition ($M = .45$, $SD = .15$), $t(58) = 2.20$, $SE = .04$, $d = .58$, replicating previous findings (Geraci & Miller, 2013). Additionally, older adults in the picture condition ($M = .54$, $SD = .14$) had higher recall than older adults in the control group, $t(58) = 2.28$, $SE = .04$, $d = .60$. Memory performance for the participants in the sentence and picture conditions did not differ, $t(58) < 1$. False alarms were low ($M = .01$) and did not differ between conditions, $F(2, 87) = 1.59$, $MSE = .00$, $\eta^2_p = .04$. Thus, the recall data demonstrate that completing a prior task successfully, regardless of the type of cognitive task, improves older adults' later memory performance.

Note that in the related stereotype threat literature age sometimes moderates threat effects (e.g., Eich, Murayama, Castel, & Knowlton, 2015; Hess & Hinson, 2006; Hess, et al., 2009). Although we did not manipulate threat per se, readers may wonder whether age moderated the task success effect in the current study. We did not find that age moderated the task success benefit (moderation coefficient was $-.002$, 95% CI = $[-.008, .004]$, and the R-squared change resulting from the interaction was not significant, $R^2 = .006$, $F(1, 86) = .57$, $p = .45$).

An alternate interpretation of the task success benefit to later recall is that the prior task primed a more effective strategy of category clustering during recall. If so, one might predict that there would be more category clustering of recall for participants in the verbal task success condition, where some organizational strategy might have been used. One might also predict that participants in the task success conditions might show more category clustering because they have experienced a reduction in stereotype threat, which reduces category clustering in recall for some older adults (Hess, et al., 2010). To examine these possibilities, we analyzed whether participants clustered their responses into categories during recall, as measured by the adjusted ratio of clustering (ARC; Roenker, Thompson, & Brown, 1971). Results showed that ARC scores did not differ by condition, $F(2, 87) = 2.42$, $MSE = .12$, $p = .10$. Participants in the sentence condition ($M = .68$, $SD = .31$) and the visual search

condition ($M = .78$, $SD = .23$) did not both cluster their responses more than participants in the control condition ($M = .68$, $SD = .36$). Further, ARC scores did not mediate the effect of condition on memory performance ($-.009$, 95% CI = $[-.065, .004]$).

Potential Mediators—We carried out analyses to investigate possible mechanisms that may mediate the task success effect. Only one previous study has demonstrated the benefits of prior task success on memory performance for older adults (Geraci & Miller, 2013), which showed that anxiety was lower for older adults in the task success condition compared to those in the control condition. Other than anxiety, we did not have strong reasons to predict which other factors would mediate the task success effect for older adults. We took inspiration for choosing the potential mediators to examine from the stereotype threat literature, although we note we did not manipulate threat per se. The means for the various mediators are presented in Tables 2 and 3. To anticipate, while there was some evidence that condition affected memory predictions and reaction times in the lexical decision task, none of the variables showed evidence for mediation, which is consistent with what has been found in the stereotype threat literature with older adults (see Barber & Mather, 2014; Hess, et al., 2009). First we examined the effect of task experience on each of the hypothesized mediators. Across conditions, there was no difference in memory predictions, $F(2,87) = 1.59$, $MSE = .03$, $\eta^2_p = .04$, although there were some numerical differences showing that participants in the sentence condition predicted that they would recall more words than those in the picture condition who predicted that they would recall more than those in the control condition (see Table 2). As expected predictions were positively correlated with recall performance overall, $r(88) = .25$. As can be seen in Table 2, there was no effect of condition on Memory Self-efficacy ($F(2,87) < 1$), positive affect ($F(2,87) = 1.22$, $MSE = 58.28$, $\eta^2_p = .03$), negative affect ($F(2,87) = 1.27$, $MSE = 8.60$, $\eta^2_p = .03$), or state anxiety ($F(2,87) = 1.03$, $MSE = 81.35$, $\eta^2_p = .02$). There was a borderline significant difference ($p = .06$) for trait anxiety, $F(2,86) = 2.942$, $MSE = 74.30$, $\eta^2_p = .04$, showing that participants in the sentence had higher levels of trait anxiety than participants in the picture condition ($t(57) = 2.24$, $SE = 2.11$, $d = .59$ and participants in the control condition had higher trait anxiety than participants in the picture condition, $t(58) = 2.11$, $SE = 2.20$, $d = .55$, but these differences do not readily explain the differences in recall showing superior recall for both sentence and picture participants compared to control participants. We examined whether prior task experience affected older adults' stereotype activation by examining performance on the LDT and the stereotype threat questionnaire (see Table 3). For the LDT, we were interested in whether participants in the prior task success conditions would show less activation of negative aging stereotypes (slower RTs) and greater activation of positive stereotypes (faster RTs), relative to participants in the control condition. There were no differences in reaction times between prior task experience conditions to respond to nonwords ($F(2,81) = .65$, $MSE = 6457.77$, $\eta^2_p = .02$), stereotype neutral words ($F(2,83) = 1.68$, $MSE = 8850.68$, $\eta^2_p = .19$), or stereotype negative words ($F(2,83) = 1.35$, $MSE = 11598.38$, $\eta^2_p = .03$). However, prior task experience did affect participants' reaction times to respond to stereotype positive words, $F(2,81) = 3.98$, $MSE = 39958.33$, $\eta^2_p = .09$. Planned t -tests showed that participants in the sentence group responded faster than participants in the control group, $t(53) = 2.98$, $p < .01$, $SE = 24.27$, $d = .82$, and participants in the picture group responded faster than participants in the control group, $t(54) = 1.90$, $SE = 30.20$, $d = .52$, although this difference

was just shy of significance ($p = .06$). There was no difference in response times between participants in the sentence and the picture groups, $t(55) < 1$. We note that, numerically, it appears that participants in both task success groups had slightly faster reaction times to all type of items, relative to those in the control condition. When we used reaction time to neutral and nonwords as covariates, the success groups are still faster to respond to positive words than the control group, although the effect is again just shy of significance ($F(2, 80) = 2.96$, $MSE = 8914.67$, $p = .06$, $\eta^2_p = .07$). The finding that participants in the control condition generally responded more slowly than participants in the control condition could be consistent with research showing that stereotype threat activation is associated with slower responding on other tasks (see Popham & Hess, 2013; Barber & Mather, 2013). There was no group difference in perceived stereotype threat (see Chasteen et al., 2005), $F(2, 87) = 1.50$, $MSE = 18.19$, $\eta^2_p = .03$.

Finally, we conducted a mediational analysis using PROCESS for SPSS (Preacher & Hayes, 2008) on each of the hypothesized variables. As mentioned previously, there was no evidence of mediation for any of the variables considered (state anxiety, $-.006$, 95% CI = $[-.03, .002]$; trait anxiety, $.000$, 95% CI = $[-.008, .008]$; positive affect, $.0002$, 95% CI = $[-.004, .007]$; negative affect, $-.003$, 95% CI = $[-.02, .005]$; MSEQ, $-.002$, 95% CI = $[-.01, .003]$; stereotype threat, $-.01$, 95% CI = $[-.03, .002]$; memory prediction, $-.01$, 95% CI = $[-.02, .001]$; non-word RT, $.0001$, 95% CI = $[-.01, .01]$; positive word RT, $.004$, 95% CI = $[-.02, .04]$; neutral word RT, $-.004$, 95% CI = $[-.03, .003]$; negative word RT, $-.01$, 95% CI = $[-.05, .001]$). With the exception of RT to positive words (35.95 , 95% CI = $[8.51, 63.39]$), there was no evidence of a significant effect of condition on any potential mediators, including state anxiety, 1.68 , 95% CI = $[-.61, 3.98]$; trait anxiety, $-.01$, 95% CI = $[-2.31, 2.28]$; positive affect, $.27$, 95% CI = $[-1.72, 2.25]$; negative affect, $.60$, 95% CI = $[-.11, 1.30]$; MSEQ, -2.12 , 95% CI = $[-6.75, 2.50]$; stereotype threat, $.72$, 95% CI = $[-.39, 1.83]$; non-word RT, 30.25 , 95% CI = $[-5.39, 65.90]$; neutral word RT, 17.50 , 95% CI = $[-7.95, 42.95]$; negative word RT, 24.69 , 95% CI = $[-3.89, 53.87]$. Stereotype threat did have a significant effect on recall, $-.01$, 95% CI = $-.015$ to $-.001$, but no other mediator significantly affected recall; state anxiety, $-.004$, 95% CI = $-.01$ to $.002$; trait anxiety, $.002$, 95% CI = $-.002$ to $.01$; positive affect, $.0004$, 95% CI = $-.004$ to $.01$; negative affect, $-.01$, 95% CI = $-.02$ to $.01$; MSEQ, $.001$, 95% CI = $-.001$ to $.003$; non-word RT, $.00$, 95% CI = $-.0003$ to $.0003$; positive word RT, $.0001$, 95% CI = $-.001$ to $.001$; neutral word RT, $-.0002$, 95% CI = $-.001$ to $.0003$; negative word RT, $-.001$, 95% CI = $-.001$ to $.0002$. Note that the results are unchanged by collapsing the two success conditions. Although stereotype threat was not manipulated in the current study, the lack of evidence for mediation of threat on performance for these variables is consistent with previous results from that literature showing no evidence of mediation (Hess et al., 2009).

In sum, Experiment 1 demonstrated that older adults' memory performance can benefit from success on different types of cognitive tasks. Participants who completed the sentence or the visual search tasks showed better subsequent memory performance compared to those in the control group. There was some evidence that task experience might influence memory predictions, activation of positive stereotypes, and overall speed of responding, but the mediational analyses did not suggest that any of the variables mediated the effect of task success on recall performance.

Experiment 2 sought to determine whether task success could influence recall performance when participants were successful on a non-cognitive task. The general question was: Does recall performance benefit from any kind of prior task success, such as playing the piano well or throwing a ball? Experiment 2 was designed to answer this question by examining whether recall performance can be affected by success on a prior motor task. Participants either successfully tossed bean bags in a bucket or did not engage in any prior task (the control condition) and then took part in a free recall experiment. Would successfully tossing a bean bag into a bucket lead to a similar task success effect as was observed in Experiment 1?

Experiment 2

Method

Participants—Fifty-six older adults (29 female; M age = 74.14, SD = 6.73, age range 65–90) were randomly assigned to either the motor task success or the control condition. All participants completed a demographic questionnaire, a vocabulary test, and the MMSE. There was no difference between the two groups for average MMSE score ($t(54) < 1$), age ($t(54) < 1$), years of education ($t < 1$), or vocabulary ($t(54) < 1$). Only participants who scored at least 27 out of a possible 30 points the MMSE were included in the data analyses and are characterized above and in Table 1. Approximately 8% of the participants failed to score 27 and were replaced. As in Experiment 1, we equated the number of participants who participated in the study in the morning and afternoon across conditions. All participants completed the study in a laboratory on the campus of Texas A&M University. The majority of participants had never been to the laboratory before (only 5 had been to the laboratory previously).

Materials and Procedure—The design of Experiment 2 was identical to Experiment 1, with two notable exceptions. One, prior to participating in the recall experiment, participants in the task success condition were given a motor task (a bean bag toss) to complete. For this condition, participants were asked to toss bean bags into a bucket placed in front of them. Participants were seated and given three bean bags to toss into a bucket that was placed at increasing distances in front of the participant (starting at 6 inches in front of the participant and increasing 6 inches after three bean bag tosses). This process repeated a total of seven times (maximum of 42 inches), at which point the bucket was moved closer by 6 inches at a time for 7 more trials. In total, participants attempted 42 tosses (three tosses at seven lines moving away, then three tosses at seven lines moving closer). Norming participants ($N = 32$) were able to successfully toss the bean bag up to an average of 70.5 inches ($SD = 27.9$ in), or 11 lines. To ensure success on this task, we selected line 7 (42 inches) as our maximum distance, which was one standard deviation below the average maximum obtained during norming. Participants were given 42 trials, which together took an average of 10.4 minutes to complete. Note that participants in the experiment did not perform the task as accurately ($M = .89$, $SD = .08$), and they took less time to complete the task (7.9 minutes, $SD = 1.2$) than the norming participants. But, to anticipate our results, the recall data are the same even when only those participants with high levels of success on the bean bag task are analyzed. The second difference between Experiment 1 and Experiment 2 was that in Experiment 2 we

did not use the STAI as we did not find evidence of mediation using that anxiety measure in Experiment 1. We replaced this questionnaire with a one item measure that in previous work has revealed an effect of task success (Geraci & Miller, 2013). Immediately after recall, participants rated their anxiety level during the memory test on a 7 point Likert scale (1 – very anxious, 7 – not anxious at all).

Results and Discussion

Memory Performance—We sought to determine if success on a prior motor task would lead to later memory benefits. Mean recall is presented in Table 2. Contrary to the findings using prior cognitive tasks in Experiment 1, participants who successfully completed a prior bean bag toss did not have significantly higher recall ($M = .43$, $SD = .14$) than participants in the control condition who did not complete any prior task ($M = .42$, $SD = .11$), $t(54) < 1$. Additionally, the number of false alarms was low ($M = .02$) and did not significantly differ between groups, $t(53) = 1.32$, $SE = .01$, $p = .19$, $d = .36$. Thus, relative to control, success on the prior motor task did not affect later memory performance.

One might worry whether the lack of a memory benefit following motor task success was due to the relatively lower level of success on the motor task compared to the success levels reported on the other cognitive tasks in Experiment 1 and in previous research by Geraci and Miller that did show later memory benefits. Indeed, in Experiment 1, participants' accuracy level for the verbal and visual tasks was very high. For the verbal task, it was 96% (similar to 97% for that same condition reported in Geraci & Miller) and for the visual task, participants' accuracy was 99%. However, in Experiment 2, participants were only successful on 89% of the bean bag tosses. Therefore we examined whether higher success levels on the bean bag toss might yield subsequent memory benefits. To do this, we examined the recall performance of those participants who scored above 95% on the bean bag toss. We note that this subsample did not differ from the main sample on demographics (subsample M s, age = 73, education = 16.9 years, MMSE = 29, vocabulary = 34.6). When only high performing participants were included in the analyses, mean recall remained the same (.42 mean recall, compared with .43 when all participants were included in the analysis). Thus, it seems unlikely that the relatively lower levels of success on the motor task can explain the lack of an effect of motor task success on recall performance. We note that there could be problems selecting only those older adults from the task success condition who performed the task above 95% (we could be artificially creating an effect of task success by selecting older adults who are better overall and might simply have superior memory performance). However, because this analysis also showed no effect of task success, the results further demonstrate that motor task success did not affect later memory performance.

Because there was no effect of task success on recall, we did not examine the effects of potential mediators. We did, however, examine whether there were group differences in these variables. Mean performance on each measure is presented in Tables 2 and 3. Results showed that the groups differed in negative affect, $t(54) = 2.10$, $SE = .81$, $d = .57$, $p = .05$, with participants in the motor task condition actually showing higher negative affect than those in the control condition, a finding that we return to in the General Discussion. There

were no differences for positive affect, $t(54) = 1.47$, $SE = 2.02$, $p = .15$, $d = .40$, stereotype threat activation as measured by lexical decision times to positive age-associated words, $t < 1$, and negative age-associated words, $t < 1$, MSEQ, stereotype questions (Chasteen et al., 2005), $t < 1$, or anxiety, $t(54) = 1.07$, $SE = .40$, $p = .29$, $d = .29$.

General Discussion

The current experiments were designed to examine whether success on various cognitive and non-cognitive measures would affect later recall performance. In Experiment 1, participants completed one of two different tasks to perform prior to participating in a memory experiment: a sentence scramble task that has been shown to improve later memory performance, and a novel picture search task. Both tasks were designed so that participants could complete them successfully. In Experiment 2, participants were asked to toss a bean bag at a target. Results showed that, compared to a control condition in which participants did not participate in a prior task, older adults who completed the sentence and picture tasks had better subsequent memory performance. Thus, results from Experiment 1 replicated the previous finding showing that successfully performing a prior task improves older adults' memory performance (Geraci & Miller, 2013). The results demonstrate that the benefit of prior task success extends to other type of cognitive tasks, including a visual search task. Results from Experiment 2 demonstrated that successfully performing a motor task did not lead to later memory advantages relative to control.

We also examined potential reasons for the task success effect. However, we did not find any evidence for mediation of the task success effect in Experiment 1. The lack of mediation of anxiety for the task success effect is somewhat surprising given the fact that our previous research showed that completing a task successfully reduced self-reported anxiety in older adults (Geraci & Miller, 2013). In the current study, however, state anxiety levels were not lower in the task success conditions relative to the control condition and anxiety levels did not mediate the effect of task success on memory performance. The discrepancy between the anxiety results from Geraci and Miller and the current study may be due to the fact that Geraci and Miller asked participants to rate how anxious they felt while taking the memory test, whereas in the current Experiment 1 participants completed the standardized STAI form, which includes a broader measure of anxiety, and does not ask about anxiety during a specific task. Further, the STAI was given towards the end of the experimental session amongst several other questionnaires (rather than immediately after the memory test) and so it is possible that any differences in anxiety or other factors had abated over the course of the experimental session. Experiment 2 used the same measure as Geraci and Miller, but because there was no task success effect, we cannot determine the role of this measure of anxiety in mediating such an effect.

The results demonstrate that prior success on various cognitive tasks can lead to superior memory performance for older adults. Thus, successfully completing a task with little overlap in strategies or processes with the later memory test, lead to memory benefits for older adults. The finding that success on a verbal word scramble task and success on a visual search task both led to subsequent benefits on a verbal free recall task suggests that success on a variety of cognitive tests can potentially aid later memory performance. This finding

could be taken as inconsistent with the results from a recent study showing that stereotype threat about memory decline negatively influenced older adults' memory performance but not their general cognitive performance. Conversely, stereotype threat about general cognitive decline negatively influenced older adults' general cognitive performance but not their memory performance (Haslam, Morton, Haslam, Varnes, Graham, & Gamez, 2012). Thus, the study by Haslam et al. suggests some degree of specificity of threat domain in affecting subsequent performance. We did not directly manipulate stereotype threat in the current studies, so it is unclear whether our results should be directly compared to those of other studies that are investigating threat. We interpret our results as showing that success on a cognitive test helps counter older adults' negative performance expectations, and, in turn, leads to subsequent memory advantages. We found modest support for the idea that task success might lead to memory benefits by alleviating stereotype threat (by way of speeded responding to positive age-related words). For now, we simply note that the benefits of task success on memory performance appear to be somewhat general, at least within the cognitive domain.

The finding that success on two different cognitive tasks led to later memory benefits might lead one to imagine that prior success on any task could increase older adults' confidence and counter their negative performance expectations. Yet, results from Experiment 2 demonstrated that success on a prior motor task (simply tossing bean bags into a bucket) did not affect later memory performance. We examined the possibility that success on the motor task did not lead to later memory benefits because the rate of success was not as high in the present study for the bean bag task as it was in Experiment 1 or in prior work using the sentence scramble or visual search tasks. However, even when we examined memory performance for just those older adults with high levels of success on the bean bag task, we did not find a memory advantage relative to control. Thus, it seems reasonable to assume that it was the fact that the task was in a non-cognitive domain that explains the lack of an effect in Experiment 2. However, it is possible that there another important task difference that we are unaware of that might explain the different pattern of results from Experiment 1 to Experiment 2 that future studies could examine. What we do know is that, taken together, the data from both experiments provides evidence against the hypothesis that success on any prior task leads to the subsequent memory advantage. Interestingly, we found that participants in the motor condition reported higher levels of negative affect than those in the control condition. However, their level of negative affect was comparable to the levels of negative affect reported by participants in the task success conditions in Experiment 1, suggesting that mood may not have been responsible for the lack of an effect of the motor task on memory in Experiment 2. We interpret the lack of a task success effect in the motor task condition as evidence that the effect only carries over to the memory task when the prior task experience is in a cognitive domain.

Future studies might examine the effects of other types of motor tasks, perhaps more age-associated motor tasks, such as ones that measure speed or grip strength. If older adults expect to perform poorly on these sorts of tasks, then it is possible that successful performance on such a motor task might lead to a subsequent memory benefit. Future studies might also examine the effects of other types of task success on subsequent memory performance. For example, studies might examine the effect of giving the MMSE at the

beginning of testing session. People are largely successful at completing this task so one prediction might be that simply taking this task would lead to better subsequent memory performance compared to not taking it. Another possibility is that taking the MMSE might actually lead to worse subsequent performance because taking the MMSE may reinforce for older adults the notion that they are not expected to perform well on cognitive tests in the lab (see Hughes, Geraci, & De Forrest, 2013 for a similar idea applied to standard memory testing contexts). Certainly, there are many other cognitive tasks that older adults perform well that might yield subsequent memory benefits that could be investigated.

In summary, we found that 1) success on a prior cognitive task can improve older adults' memory performance and that 2) the benefit of task success can be obtained even when the prior task is in a different cognitive domain from the memory test. But, several questions remain. Although we assumed that older adults felt successful after completing the sentence scramble and the picture search, we did not directly measure how successful they felt or provide feedback that they were in fact successful. Future research might examine whether the subjective feeling of success is necessary, or even sufficient, for older adults to benefit from prior task success. Future work might also examine how long the prior task success effect lasts and what other sorts of tests might benefit from prior task success. The current study also demonstrated that successfully completing a cognitive task improved subsequent memory performance. Future research might examine the benefits of other types of task success on subsequent memory performance. The answers to these questions would have theoretical value and they would be of great practical use as one looks for ways to implement task success in a variety of contexts to improve cognitive performance for older adults.

For now, the current study adds to our knowledge by demonstrating that older adults' memory performance can be improved by having them successfully complete a prior cognitive task—in the present case, the task success effect appears to be fairly robust showing that success on different types of cognitive tasks can improve memory performance. These findings suggest that older adults' memory, and perhaps other cognitive abilities, can be improved following prior task success. Future research will need to examine ways to implement task success in more naturalistic environments and testing situations and determine potential long-lasting benefits of task success.

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Figure 1.

Proportion of words correctly recalled for each prior task condition in Experiment 1.

Note: Error bars represent standard errors.

Table 1
Demographic Information for Participants in Each Prior Task Experience Condition

Task Condition	N	Age	MMSE	Education	Vocabulary
<u>Experiment 1</u>					
Verbal	30	73.2 (7.1)	28.8 (1.0)	16.7 (3.2)	35.3 (3.0)
Visual	30	73.4 (6.2)	28.8 (1.0)	16.7 (3.2)	34.0 (3.2)
Control	30	74.1 (6.4)	28.4 (1.0)	16.0 (2.6)	33.8 (4.2)
<u>Experiment 2</u>					
Motor	28	73.8 (6.6)	28.8 (1.1)	16.5 (2.4)	34.3 (2.9)
Control	28	74.5 (6.6)	29.0 (0.9)	15.7 (3.7)	34.7 (4.7)

Note. Standard errors in parentheses; MMSE = Mini Mental State Examination; Education is measured in years.

Table 2

Performance for Participants in Each Prior Task Experience Condition

Task Condition	Recall	Prediction	Anxiety		MSEQ	Affect	
			<u>State</u>	<u>Trait</u>		<u>Positive</u>	<u>Negative</u>
<u>Experiment 1</u>							
Verbal	.54 (.15)	.47 (.16)	30.00 (8.02)	35.14 (8.79)	61.03 (16.02)	34.83 (8.71)	11.20 (2.87)
Visual	.54 (.14)	.44 (.15)	29.83 (8.97)	30.41 (7.36)	58.95 (16.15)	37.82 (6.65)	12.37 (3.46)
Control	.45 (.15)	.40 (.17)	32.80 (9.96)	35.06 (9.57)	57.38 (21.28)	35.67 (7.40)	12.03 (2.37)
<u>Experiment 2</u>							
Motor	.43 (.14)	.46 (.13)	5.18 (1.44) [/]		60.21 (16.91)	37.21 (6.71)	12.58 (4.09)
Control	.42 (.11)	.47 (.16)	4.75 (1.55) [/]		60.24 (20.25)	34.25 (8.33)	10.89 (1.34)

Note. Standard errors in parentheses.[/] Single anxiety question used in Experiment 2.

Table 3

Measures of Stereotype Threat Activation for Participants in Each Prior Task Experience Condition

Task Condition	Perceived Threat	Lexical Decision Task Reaction Time			
		Positive	Negative	Neutral	Nonwords
Experiment 1					
Verbal	13.07 (3.81)	772.42 (68.24)	799.39 (82.06)	727.76 (86.59)	812.83 (174.42)
Visual	12.60 (4.30)	780.48 (120.96)	805.91 (131.27)	718.89 (95.49)	857.19 (102.72)
Control	14.43 (4.64)	844.68 (108.02)	849.01 (98.87)	763.10 (735.85)	873.15 (113.43)
Experiment 2					
Motor	12.21 (4.16)	1062.93 (1454.32)	814.45 (127.18)	822.42 (164.87)	885.06 (149.14)
Control	13.00 (3.47)	803.16 (135.40)	817.74 (127.81)	812.28 (95.27)	982.93 (605.47)

Note. Standard errors in parentheses; reaction time in ms.