Biss, R.K., Campbell, K.L., & Hasher, L. (2013). Interference from previous distraction disrupts older adults' memory. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *68(4)*, 558–561, doi:10.1093/geronb/gbs074. Advance Access publication August 28, 2012

Interference From Previous Distraction Disrupts Older Adults' Memory

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Objectives. Previously relevant information can disrupt the ability of older adults to remember new information. Here, the researchers examined whether prior irrelevant information, or distraction, can also interfere with older adults' memory for new information.

Method. Younger and older adults first completed a 1-back task on pictures that were superimposed with distracting words. After a delay, participants learned picture-word paired associates and memory was tested using picture-cued recall. In 1 condition (high interference), some pairs included pictures from the 1-back task now paired with new words. In a low-interference condition, the transfer list used all new items.

Results. Older adults had substantially lower cued-recall performance in the high- compared with the low-interference condition. In contrast, younger adults' performance did not vary across conditions.

Discussion. These findings suggest that even never-relevant information from the past can disrupt older adults' memory for new associations.

Key Words: Aging—Associative memory—Attention—Cued recall—Inhibition—Interference.

Introduction

Older adults tend to maintain access to information from the past even when that information is no longer relevant (Hamm & Hasher, 1992; May & Hasher, 1998). Sustained access to prior information among older adults may be due to reduced inhibitory control, which should optimally function to delete old, irrelevant information (Hasher, Zacks, & May, 1999). Moreover, poor inhibitory control may disrupt new learning by introducing competition between relevant current information and irrelevant responses from the past.

Evidence of disruption from previous information comes from interference studies. Older adults are more vulnerable to interference in verbal working memory (Bowles & Salthouse, 2003; Lustig, May, & Hasher, 2001; Zeintl & Kliegel, 2010), visuospatial working memory (Cornoldi, Bassani, Berto, & Mammarella, 2007), and even implicit memory (Ikier, Yang, & Hasher, 2008) tasks. Similarly, disruption from past learning can be seen in classic paired-associates tasks in which two successive lists are learned and recall of the second list is tested (Kausler, 1994; Kliegl & Lindenberger, 1993; Winocur & Moscovitch, 1983).

In those studies, interference came in the form of previously relevant and often intentionally encoded information. Recent evidence shows that older adults tacitly encode and remember distraction (Campbell, Hasher, & Thomas, 2010; Rowe, Valderrama, Hasher, & Lenartowicz, 2006), raising the possibility that interference could also come from information that was present but never task relevant. For example, in one study (Rowe et al., 2006), older adults showed greater implicit memory for previous distraction, which had occurred on an earlier 1-back task as irrelevant words superimposed on relevant pictures. Given older adults' greater access to previously irrelevant information, an intriguing question is whether never-relevant information can disrupt new learning and memory.

To this end, the researchers examined age differences in the degree to which previously irrelevant information disrupts new learning when the target information to which it was paired is carried forward to a new task. Younger and older adults first performed a 1-back task on pictures superimposed with distracting words and subsequently learned a list of picture-word paired associates, which included all new words. In the high-interference condition, half of the picture cues had occurred in the 1-back task; in the low-interference condition, all picture cues were new. If interference from prior distraction is disruptive for older adults, then their cued-recall performance should be worse in the high-interference condition compared with the low-interference condition. The researchers predicted that younger adults, being less susceptible to interference from the past, would perform equally well across conditions.

Method

Participants

Forty-seven younger (ages 17–25, M = 18.9, standard deviation [SD] = 1.5; 17 male participants) and 47 older

Received March 15, 2012; Accepted July 9, 2012
Decision Editor: Dr. Bob Knight

adults (ages 60–77, $M = 68.6$, $SD = 4.8$; 17 male participants) participated in this experiment. Younger adults participated for course credit, and older adults were recruited from the community and paid for their participation. All had learned English by age five, and were free of any psychiatric or neurological illness. Data from three younger and seven older adults were replaced: One older and one younger adult were outliers on 1-back task accuracy (>3 *SD*s below the group mean), four older adults did not understand instructions, and two older and two younger adults in the high-interference condition were aware of the critical connection between tasks (removal of these participants did not change the outcome of any analyses). Older adults had more years of education ($M = 17.9$, $SD = 4.3$) than younger adults ($M = 12.9$, $SD = 1.2$), $t(53) = 7.65$, $p < .001$, $d = 1.52$, and higher vocabulary scores (Shipley, 1946; $M = 36.7$, $SD = 2.7$) than younger adults ($M = 29.5$, $SD = 3.1$), $t(90) = 11.70$, $p < .001$, $d = 2.44$.

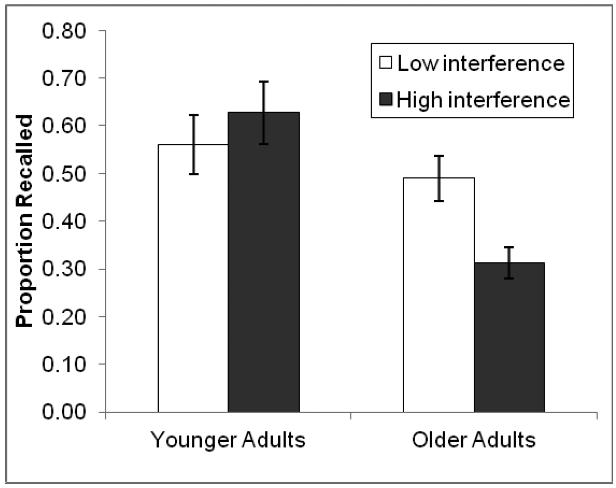

Figure 1. Proportion of items correctly recalled on the cued-recall task for younger and older adults in the low- and high-interference conditions. Error bars represent the standard error of the mean.

Materials

Thirty-six nameable line drawings were selected from Snodgrass and Vanderwart (1980) and colored red. Twenty-four critical pictures were divided into three sets of eight. In the low-interference condition, one set appeared in the 1-back task, and the other two served as new cues in the memory test. In the high-interference condition, one picture set occurred in both the 1-back and memory tasks (old pictures), and the other served as new cues in the memory task. Picture sets were matched based on word frequency ($M = 22$, $SD = 24$) and number of letters ($M = 6.3$, $SD = 2.8$) in their names. Remaining pictures served as fillers in the 1-back task.

Thirty-six 2-syllable nouns were selected; 24 served as critical words, and were divided into three counterbalanced lists. In both the high- and low-interference conditions, one critical word list was presented with critical pictures in the 1-back task, and the other two occurred as responses in the memory task. All critical words served equally as distractors in the 1-back task or as response words for old/new-picture pairs. Word lists were matched based on Kucera–Francis frequency ($M = 15$, $SD = 12$) and number of letters ($M = 6.1$, $SD = 0.9$). Twelve filler words appeared in the 1-back task only. All pictures and words were selected so that pairs were neither semantically nor phonologically related.

Procedure

Participants were randomly assigned to an interference condition. During the 1-back task, participants viewed a sequence of target pictures superimposed with irrelevant words. They were instructed to make a key press whenever consecutive pictures were identical, and to ignore the superimposed words. Among a total of 60 picture-word combinations, there were 10 consecutive picture pairs: Accuracy and latency of responding were recorded. Each picture-word pair appeared in the center of the screen for 1,000 ms, with an ISI of 500 ms. The sequence began and ended with six filler trials. All items occurred 3 times during the 1-back task: Critical pictures always co-occurred with the same critical word, others occurred together only once.

After a 10-min interval, 16 picture-word pairs were shown for study, with no mention of the previous task but with the instruction that after the study trial, recall of the paired words would be cued by the pictures. The presentation and test rates were 4,000 ms per item, with a 500 ms ISI. In the low-interference condition, all 16 pairs included picture cues that had not been presented earlier in the experiment. In the high-interference condition, eight of the picture-word pairs contained an old picture that had appeared in the 1-back task, and the remaining eight pairs contained completely new pictures.

Following this task, participants were asked whether they noticed a connection between any of the tasks, and if so, to describe the connection. Finally, participants filled out a background questionnaire and the Shipley (1946) vocabulary scale.

Results

Accuracy on the 1-back task was entered into an analysis of variance (ANOVA) with age and interference condition (low, high) as between subject factors. Younger adults ($M = 97\%$, $SD = 4\%$) were more accurate than older adults ($M = 86\%$, $SD = 18\%$), $F(1,90) = 17.04$, $p < .001$, $\eta_p^2 = .16$. As age differences in accuracy are rarely found on traditional 1-back tasks that do not include superimposed distraction (e.g., Mattay et al., 2006), this suggests that older adults were more distracted by the irrelevant words than younger adults. No other effects were significant, $F < 1$. Latency on the 1-back task was also entered into an age × condition ANOVA. Older adults responded more slowly to repeated pictures ($M = 638$ ms, $SD = 107$) than younger adults ($M = 551$, $SD = 104$), $F(1,90) = 15.76$, $p < .001$, $\eta_p^2 = .15$. No other effects were significant, $p > .23$.

Cued recall (Figure 1) was entered into an age × condition between subjects ANOVA. The main effect of condition was not significant, $F(1,90) = 1.02$, $p = .32$. There was a reliable main effect of age, $F(1,90) = 12.69$, $p < .001$, $\eta_p^2 = .12$, qualified by a significant interaction, $F(1,90) = 5.13$, $p = .03$, $\eta_p^2 = .05$. Planned comparisons indicated that younger adults' cued-recall performance did not differ across high- and low-interference conditions, $t(45) = 0.74$, $p = .46$, $d = 0.22$. For older adults, cued recall was poorer in the high-interference condition than in the low-interference condition, $t(45) = 3.04$, $p = .004$, $d = 0.89$. Thus, older, but not younger adults showed a general interference effect.

To test for a specific interference effect, recall was compared for words cued by old versus new pictures in the high-interference condition. Younger adults showed no difference (old pictures: $M = 0.66$, $SD = 0.33$, new pictures: $M = 0.60$, $SD = 0.34$), $t(23) = 1.49$, $p = .15$, and neither did older adults (old pictures: $M = 0.33$, $SD = 0.17$, new pictures: $M = 0.30$, $SD = 0.18$), $t(22) = 0.89$, $p = .38$.

Discussion

What is the effect of previous distraction on memory for new associations? For older adults, it is negative: Older adults' cued recall was worse in the high-interference condition than low-interference condition. In contrast, younger adults' performance did not differ between conditions. These results are consistent with evidence that older adults are generally more vulnerable to interference from past learning (e.g., Cornoldi et al., 2007; Kliegl & Lindenberger, 1993; Lustig et al., 2001; Winocur & Moscovitch, 1983), and extend this effect to include interference from previous distraction. It should be noted that older adults show a general interference effect that extends to words paired with old pictures as well as to words paired with new pictures.

Older adults' performance in the high-interference condition was disrupted across the entire list, suggesting that interference associated with these old cues may have generalized to the new pairs. Classic paired-associates studies with young adult participants demonstrate that interference can generalize across a response set (Postman & Underwood, 1973), and that the presence of old stimuli in a study list can influence recall of novel pairs (Battig, 1966; Slamecka, 1967). Interference associated with old cues may overwhelm older adults' memory in a similar manner as other item-non-specific interference effects, such as those associated with the carryover of interference from past trials in working memory tasks (e.g., Bowles & Salthouse, 2003; Lustig et al., 2001).

Why was older adults' performance on the high-interference condition so poor? Although the exact mechanism is unclear, recent work suggests a number of processes may together set the stage for greater interference effects. First, older adults' reduced ability to ignore concurrent distraction (e.g., Campbell et al., 2010; Rabbitt, 1965; Rowe et al., 2006) likely contributed to the present findings. Second, older adults are more likely to carry forward irrelevant information from previous tasks, as they maintain access to once-relevant information as tasks change (Hamm & Hasher, 1992; May & Hasher, 1998). Third, older adults have difficulty constraining retrieval to currently relevant information (e.g., Anderson, Jacoby, Thomas, & Balota, 2011). Finally, prior distraction brought forward by older adults can compete with relevant responses (i.e., the new words) at retrieval, and older adults are known to have difficulty resolving competition (Cohen, 1990; Healey, Campbell, Hasher, & Ossher, 2010; Ikier et al., 2008).

Whatever the precise mechanisms, the present findings demonstrate that irrelevant information can serve as a source of interference for older adults, differentially lowering their memory for new associations. These findings may have important implications for aging and memory research, as any repetition of information within an experimental setting, regardless of whether it was previously attended, may be differentially disruptive to older adults' subsequent performance. Moreover, as the generalized nature of the effect suggests, only a few past associations may be enough to disrupt older adults' performance across an entire memory task.

Funding

This work was supported by a grant from the Canadian Institutes of Health Research (grant number MOP89769) to L. Hasher and fellowships from the Natural Sciences and Engineering Research Council of Canada to R. K. Biss and K. L. Campbell.

Acknowledgments

We thank Elizabeth Howard for her assistance with data collection.

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