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Original Research Report

When Gist and Familiarity Collide: Evidence From False Recognition in Younger and Older Adults

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Abstract

Objectives: Aging is associated with decreased recollection required to offset misleading effects of familiarity, as well as an increased mnemonic reliance on gist-based over detail-based information. We tested the novel hypothesis that age-related decrements in overriding familiarity can be eliminated under conditions in which gist-based information facilitates retrieval.
Method: Twenty-seven younger adults and 27 older adults viewed scenes from two categories in an incidental encoding phase. In a recognition phase, old scenes were intermixed with new scenes from the studied categories and an unstudied category, with each new scene reappearing after 4, 18, or 48 intervening scenes. Participants were to respond "yes" to old scenes, and "no" to new scenes, including their repetitions.
Results: Despite encoding the scenes similarly, older adults made more false endorsements of new and repeated new scenes from studied categories. Both groups, however, were equally unlikely to falsely recognize new and repeated new scenes from the unstudied category.
Discussion: When helpful gist and misleading familiarity collide, gist wins, and eliminates age-related increases in false recognition.

Keywords: Aging, False Memory, Memory, Repetition Lag.

Psychological science has significantly advanced our understanding of age-related changes in episodic memory. One important discovery that has been replicated dozens of times is that aging has differential effects on episodic recollection (the ability to recognize a prior item bound to its episodic context) and familiarity (correct recognition of an item, without recovery of its episodic context). Compared to their younger counterparts, older adults have substantial reductions in recollection, but relatively small declines in familiarity (see Koen & Yonelinas, 2014, for a review).

When recollection and familiarity are put in opposition, older adults are less able to deploy recollection to offset the misleading effects of familiarity. For example, Jennings and Jacoby (1997) had younger and older adults learn lists of words, and then perform a recognition test with old and new words. Each new word was repeated once after a variable number of intervening items (the lag interval), and participants were to respond yes to studied words, and no to new words, including, critically, their repetitions. Older adults were more likely to respond yes erroneously to repeated new words, particularly as the lag interval increased. The authors argued that a repetition of an item increases its familiarity, and as recollection for an item's context (studied vs an already-presented new item) dissipates across lag, participants—especially older participants—are more likely to misattribute this sense of familiarity to the study phase. This age-related increase in the "repetition lag" effect has been replicated in many studies (e.g., Anderson et al., 2008; Jennings & Jacoby, 2003; Jennings, Webster, Kleykamp, & Dagenbach, 2005).

Another major finding in cognitive aging research is that older adults are more likely to rely on gist when retrieving information, compared to younger adults who are better able to retrieve verbatim details of prior information. The Deese-Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995) best illustrates this effect. After participants study lists of related words (e.g., pin, thread, sew), older adults are more likely to falsely endorse a critical unstudied related lure (e.g., needle) compared to their younger counterparts (e.g., Norman & Schacter, 1997; Tun, Wingfield, Rosen, & Blanchard, 1998). This age increase in false memory has been interpreted as reflecting an age-related increase in reliance on gist information, perhaps due to a "fuzzy trace" (see Brainerd & Reyna, 2015). In contrast, age-related differences in false recognition are diminished after elaborate semantic encoding (Pierce, Sullivan, Schacter, & Budson, 2005), and when older adults are encouraged to use more stringent decision criteria (Koutstaal, Schacter, Galluccio, & Stofer, 1999; LaVoie & Faulkner, 2000). None of these manipulations, however, has eliminated the age-related increase in false recognition.

In the current study, we asked how false recognition would be affected in younger and older adults when gist and familiarity collide. Specifically, we had younger and older adults incidentally study unique scenes from two categories (e.g., stores and offices). After a filled delay, they then performed a recognition test consisting of old and new scenes from the studied categories, as well as new scenes from an unstudied category (e.g., restaurants). Each new scene was presented a second time, after a lag of 4, 18, or 48 intervening scenes. Participants were instructed to respond "yes" only to studied scenes. Following the logic of the repetition lag paradigm, repeated new scenes would be familiar, but the effective retrieval strategy to override familiarity would depend on whether the repeated new scenes were from a studied or an unstudied category. We reasoned that recollection of an item's context would be needed to reject new scenes from the studied categories and their repetitions, in order to distinguish them from studied exemplars. Based on the literature reviewed above, we expected more false recognition of these new and repeated new scenes for older than younger adults. A gist-based retrieval strategy, by contrast, would be effective to reject new and repeated new scenes from the unstudied category ("I didn't study any restaurants"). Based on other evidence that age-related decrements in memory are minimized when gist is helpful (e.g., Reder, Wible, & Martin, 1986; Walsh, Baldwin, & Finkle, 1990), we hypothesized that when misleading familiarity (from repeated new items) and helpful gist (based on the categories studied) collided, younger and older adults would display comparably few instances of false recognition.

Our analyses focused primarily on accuracy data, but based on reaction time data reported in a study on the effects of aging in the DRM paradigm (Tun et al., 1998), we expected larger age-related increases in the time needed to reject new and repeated new scenes when a gist-based strategy would be unhelpful (for new scenes from studied categories and their repetition) than when a gist-based strategy would be helpful (for new scenes from the unstudied category and their repetition).

Method

Participants

Twenty-nine young adults (aged 18–22, M = 18.6) and 27 older adults (aged 64–85, M = 72.3) participated in this study. G*Power (v. 3.1; Faul, Erdfelder, Buchner, & Lang, 2009) was used to determine sample size based on data from a previous repetition lag study (Anderson et al., 2008), which indicated that 16 participants per group were needed to detect an age-related increase in false endorsement of repeated new items, given an effect size of f = .117, and an average r = .654 correlation amongst false endorsements across lags. For counterbalancing purposes, however, we aimed for 27 participants per group; the data from two younger participants were replaced with data from new participants because their accuracy was < 2 SD relative to the rest of their age group, in a pattern indicating that they had not understood or had not attended to the instructions.

Older adults were recruited from the research participant pool at Baycrest and were paid $10 for their participation. Younger adults volunteered for the study and were recruited from the University of Western Ontario. All participants were screened via interview. To be included in the study, participants had to be native English speakers or to have learned English before starting primary school. Older adults were also assessed using the modified Telephone Interview of Cognitive Status using the recommended cut-off score of 30/50 (m-TICS; Welsh, Breitner, & Hagruder, 1993). Exclusion criteria included: a history of head injury with a loss of consciousness; neurological disorder, current psychiatric or medical conditions affecting cognition; previous or current medications or treatment for medical or psychiatric illness that are likely to affect cognitive functioning; and, alcohol or substance abuse.

The older adults had acquired more years of formal education ($M = 16.1$, $SD = 2.3$) compared to the younger adults ($M = 14.2$, $SD = 0.7$), $F(1,52) = 16.66$, $p < .001$, $\eta^2_p = .243$. Older adults were also administered the Shipley Vocabulary test (Zachary, 1986) and Digit Symbol subtest from the Wechsler Adult Intelligence Scale, 3rd edition (Wechsler, 1997) as indicators of cognitive health; scaled scores for both tests ($M = 12.0$, $SD = 2.2$ and $M = 13.1$, $SD = 1.8$, respectively) were above average ($M = 10$, $SD = 3$).

Materials

The stimuli consisted of 216 scenes with 72 images from each of the following categories: offices, restaurants, and stores. All images were obtained from web-based search engines, and sized to 500 × 375 pixels. Nine versions of the experiment were created to ensure proper counterbalancing, reflecting the crossing of three different study combinations (office/restaurants, office/stores, and restaurants/stores) and three different, nonrandom test item presentation orders. The presentation orders were created such that there were not more than three consecutive instances of the same condition during the test period, and such that the repetition lag conditions were roughly equally distributed across the test trials. Three participants per age group were assigned to each version. E-Prime software (v. 1.1, Psychological Software Tools, Inc.) and an E-Prime response box were used for the presentation of stimuli and collection of responses.

Procedure

Each session consisted of three sequential phases: an incidental study phase, a filler task phase, and then a recognition test phase. For the study phase, 72 scenes (36 from each of two categories) were presented sequentially for 2,250 ms in the center of the screen, followed by a 2,750 ms fixation cross. An incidental encoding task was used to ensure that all participants would use a similar encoding strategy (Koustaal & Schacter, 1997). Participants were required to rate the relative wealth of the "company" displayed in each scene using the response box buttons 1–5 where 1 was well below average and 5 was well above average. Responses were recorded while the scene was visible and during the subsequent fixation period. Immediately after completing the study session, participants worked on a word search task for five minutes as a filler task.

For the test session 216 scenes were presented. Seventy-two of these scenes were from the previously studied list and 72 (24 from each of the three categories) were new scenes which were each presented twice. The three counterbalanced test orders of the scenes were designed such that the new scenes were repeated after lags of 4, 18, or 48, with eight scenes per category repeated at each lag. Participants were instructed to respond to the scenes by pressing the leftmost response box button if they believed the scene was old (from the studied list), and the rightmost response box button if they believed it was new or repeated but not from the studied list. They were explicitly told that the old scenes would be presented once and that the new scenes would be presented two times. Participants were also told that the new and repeated scenes were to be treated the same and should be categorized as new.

Following the test session, a short postinterview was administered. Participants were asked what types of pictures they saw in the study and test sessions and how they used that information to help them during the test session. Responses were recorded verbatim by the experimenter.

Data Analysis

To ensure that younger and older adults were encoding the scenes similarly, we examined age-differences in average wealth ratings and time to make wealth ratings during encoding using one-way ANOVAs. For the recognition task, we compared hit rates (and reaction times) for studied scenes between younger and older adults. Our primary analyses compared younger and older adults' proportion of incorrect endorsements of lure scenes, and reaction times for correct responses to lure scenes from the studied and unstudied categories in mixed Age × Studied/Unstudied × Repeat Condition (New, Repeat 4, Repeat 18, and Repeat 48) ANOVAs. Greenhouse-Geisser corrected p values are provided when assumptions of sphericity were not met. The data from one older adult were not included in the RT analyses, as this participant was extremely slow relative to his older adult peers (average z across conditions > 3).

Results

Encoding Wealth Ratings

Mean wealth ratings did not differ between younger ($M = 3.20$, 95% CI: 3.08–3.32) and older adults ($M = 3.07$, 95% CI: 2.95–3.18), $F(1, 52) < 1$, $\eta^2_p = .05$, nor did standard deviations of wealth ratings differ between younger ($M = 1.05$, 95% CI: 0.98–1.13) and older adults ($M = 1.07$, 95% CI: 0.99–1.15), $F(1, 52) < 1$, $\eta^2_p < .01$. Younger and older adults also took comparable amounts of time to make their wealth ratings ($M = 1{,}799$ ms, 95% CI: 1,665–1,932, and $M = 1{,}913$ ms, 95% CI: 1,780–2,046), $F(1, 52) = 1.48$, $p = .230$, $\eta^2_p = .22$.

Recognition Accuracy

Younger and older participants' proportion of "Old" responses to old (studied) scenes from the studied categories, and to new and repeated new scenes from studied and unstudied categories are displayed in Figure 1. Hit rates

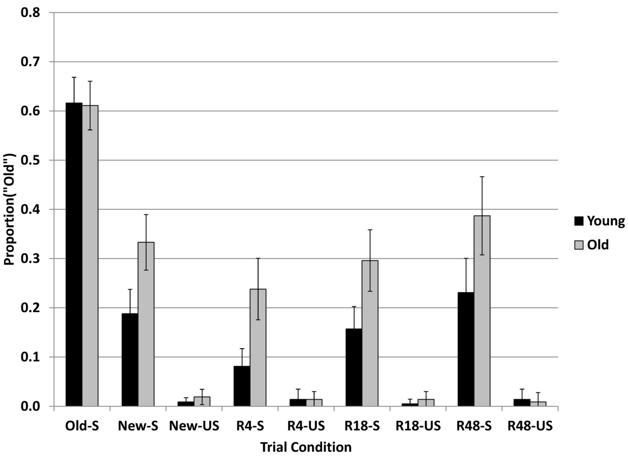

Figure 1. Mean proportion "old" responses in younger (black bars) and older adults (grey bars) as a function of trial condition. Old scenes were studied. New and repeated New scenes (at repetition lags of 4, 18, or 48) were presented from Studied (-S) and Unstudied (-US) categories. Error bars are 95% confidence intervals.

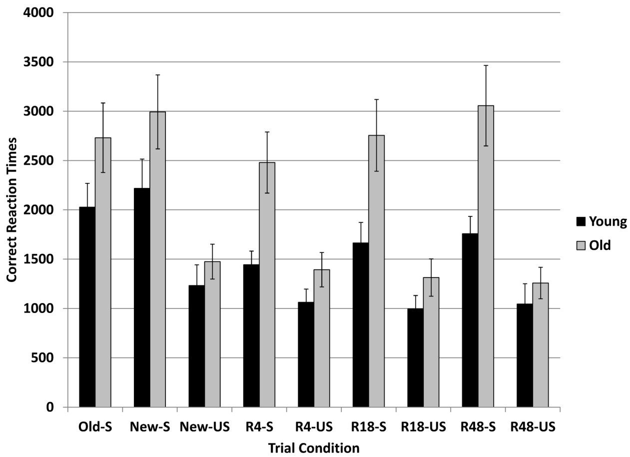

Figure 2. Mean correct reaction times in younger (black bars) and older adults (grey bars) as a function of trial condition. Old scenes were studied. New and repeated New scenes (at repetition lags of 4, 18, or 48) were presented from Studied (-S) and Unstudied (-US) categories. Error bars are 95% confidence intervals.

to studied items did not differ between younger and older adults, $F(1, 52) < 1$, $\eta^2_p < .01$.

More critically, the observation that every participant (in both groups) falsely endorsed at least one new item from the studied categories provides evidence of the robustness of the false memory effect in this paradigm. Older adults made more false alarms overall compared to their younger counterparts, $F(1, 52) = 19.11$, $p < .000$, $\eta^2_p = .27$. False alarms were higher for studied ($M = 0.24$, 95% CI: .21–.27) than unstudied categories $M = 0.01$, 95% CI: .01–.02), $F(1, 56) = 219.33$, $p < .001$, $\eta^2_p = .81$, and, importantly, this effect was significantly greater for older (M difference = .30) than younger adults (M difference = .15), $F(1, 52) = 22.62$, $p < .001$, $\eta^2_p = .30$. False alarms varied across the repeat condition, $F(3, 156) = 15.17$, $p < .001$, $\eta^2_p = .22$, but only for scenes from studied, and, critically, not from unstudied categories, $F(3, 168) = 18.79$, $p < .001$, $\eta^2_p = .26$.

On the post-test interview, all of the participants correctly identified the categories in the study and test sessions. All of the young adults and 21 of the older adults indicated that they used their knowledge of the categories to reject scenes from the unstudied category. Older adults who did or did not use their knowledge of the studied categories did not differ in hit rates, false alarms to new items from studied categories, or false alarms to new items from unstudied categories, regardless of Lag, all $F < 1$. Likewise, the pattern of results was the same when the analyses were repeated including only those participants who reported using their knowledge of the studied categories to reject scenes from the unstudied categories.

Recognition Reaction Times

Younger and older participants' correct reaction times for "Old" responses to old (studied) scenes from the studied category, and for "New" responses to new and repeated new scenes from studied and unstudied categories are displayed in Figure 2. The reader should note that whereas the data in Figure 1 for new and repeated new scenes reflect the proportion of incorrect endorsements (i.e., false recognitions), the reaction time data displayed in Figure 2 are for correct rejections of these items.

Older adults took longer than younger adults to correctly endorse studied scenes, $F(1, 51) = 11.64$, $p = .001$, $\eta^2_p = .19$. Reaction times to correctly reject new and repeated new items were longer for older than younger adults (M = 2,090 ms, 95% CI: 1,916–2,264], and M = 1,427 ms, 95% CI: 1,257–1,598, respectively), $F(1, 51) = 29.81$, $p < .001$, $\eta^2_p = .37$. Reaction times were reliably longer for correctly rejected scenes from Studied compared to Unstudied categories (M = 2,296 ms, 95% CI: 2,125–2,466, and M = 1,222 ms, 95% CI: 1,116–1,327, respectively), $F(1, 51) = 222.68$, $p < .001$, $\eta^2_p = .81$, and, critically, more so for older (M diff = 1,461 ms) than for younger adults (M diff = 687 ms), $F(1, 51) = 28.91$, $p < .001$, $\eta^2_p = .36$. Correct rejection reaction times varied across Repeat conditions, $F(3, 153) = 16.98$, $p < .001$, $\eta^2_p = .25$, but only for studied and not unstudied categories, $F(3, 153) = 13.70$, $p < .001$, $\eta^2_p = .21$. No other effects were significant.

Discussion

We compared false recognition in younger and older adults for lures and repeated lures from studied and unstudied categories. We reasoned that correct rejection of repeated lures from studied categories would require item-based recollection, and thus we anticipated that older adults would be more likely to falsely recognize these items compared to their younger counterparts. Conversely, we predicted that gist-based memory could be used to correctly reject lures from unstudied categories, and we thus expected that younger and older adults would have similarly low rates of false recognition to these items.

Our data confirmed these predictions. Age-related increases in false recognition were present for new and repeated new scenes from studied categories, but not for new and repeated new scenes from an unstudied category. The age-related increase in false recognition of lures from studied categories occurred despite the fact that younger and older adults seemed to have encoded the scenes equally well, as indicated by their wealth ratings and comparable hit rates. Furthermore, age-related increases in the time needed to reject new and repeated new scenes were larger for lure scenes from studied categories, relative to the unstudied category. These results support the consistently reported mnemonic effects of age-related decreases in recollection (cf., Koen & Yonelinas, 2014). More interesting is what happened to age differences in false recognition when a gist-based strategy, which older adults rely on more heavily (Brainerd & Reyna, 2015), could be utilized to counteract false memory. Our results showed that strong gist information can eliminate age-related increases in false recognition under these circumstances. This finding contrasts with the outcome of previous attempts to eliminate the effect in other paradigms, including through deep encoding (Pierce et al., 2005) and encouragement of use of more stringent decision criteria (Koutstaal et al., 1999; LaVoie & Faulkner, 2000). Moreover, helpful gist information minimized the age-related slowing in correctly rejecting repeated new items, which is consistent with the findings of Tun et al. (1998), where older adults were slower to reject the critical DRM lures when the experimental task promoted a gist-based strategy, but not when a gist-based strategy was less effective.

The results also demonstrate a repetition lag effect for lures from the studied categories—as the lag interval between a new scene and its repetition increased, participants were more likely to misattribute the scene to the study phase, and they required more time to correctly reject repeated lures. False recognition rates of lures repeated after four intervening items was lower than the false recognition rate of new scenes, and both groups were quicker to reject these items than new scenes. Other studies have shown similar dips in false recognition at low repetition lag intervals (e.g., Jennings & Jacoby, 1997), likely because it is easier to remember the episodic context of recently repeated lures, a suggestion that is supported by the relatively faster correct rejections of repeated new items at shorter relative to longer lags. False recognition of scenes that were repeated after 18 intervening items, however, was on par with that for new scenes, and even higher when repeated after 48 intervening scenes. Importantly, this repetition lag effect was present only for lure scenes from studied and not unstudied categories. Thus, for lures from the unstudied category, a gist-based retrieval strategy was effectively deployed by both age groups to oppose the misleading influence of familiarity.

One unexpected aspect of our results was that the repetition lag effect was of comparable magnitude for younger and older adults. This pattern contrasts with previous reports of an age-related increase in the repetition lag effect, which is thought to reflect an increasing influence of familiarity with diminishing recollection over longer lag intervals (Anderson et al., 2008; Jennings & Jacoby, 1997; Jennings & Jacoby, 2003; Jennings et al., 2005). Unlike the current work, to our knowledge, all prior studies deploying a repetition lag paradigm involved study lists of unrelated words, and the lure stimuli in the recognition test were unrelated words as well. The false recognition rates to the first presentation of new scenes from studied categories in the present study (M = .19 and M = .33 for younger and older adults, respectively [This difference was significant, $F(1, 52) = 16.00$, $p < .001$, $\eta^2_p = .24$, consistent with much prior work showing elevated false alarm rates in older compared to younger adults.]) were considerably higher than false recognition of new words in previous repetition lag studies (e.g., M = .08 and M = .09 in Jennings & Jacoby, 1997, Experiment 1). Indeed, our new scenes from the studied categories were very similar to studied content, and as such were more akin to DRM lures, leading to higher base rates of false recognition. This may have diluted the age-related increase in repetition lag effects. It would be interesting for future research to compare directly age-related differences in repetition lag effects for words versus scenes that are related or unrelated to studied items.

The vast majority of cognitive aging research has focused on the negative consequences of age-related changes in cognitive processes, but the focus is shifting towards their beneficial consequences (see Amer, Campbell, & Hasher, 2016, for a recent review). For example, although it has long been known that there is an age-related decrease in the ability to ignore irrelevant information (Rabbitt, 1965), older adults have better implicit memory for previously irrelevant information (Weeks & Hasher, 2017), and when this information later becomes to-be-remembered information, older adults show less forgetting in a delayed free recall task (Biss, Ngo, Hasher, Campbell, & Rowe, 2013, Weeks, Biss, Murphy, & Hasher, 2016).

Our data bolster the view that age-related cognitive "deficits" (in this case, a greater reliance on gist-based relative to item-based information) can have beneficial mnemonic consequences for older adults. We found an age-related increase in false recognition of new and repeated lures, but only from studied and not unstudied categories. Gist can be unhelpful or helpful, depending on the context, which in turn modulates age-related differences in memory performance. The gist signal in the current study was very strong, as the unstudied items were from a distinct category. It would be interesting for future research to examine false recollection in this paradigm when gist signals are made weaker, by varying category set sizes (cf., Koutstaal & Schacter, 1997), or when unstudied scenes are from subcategories of studied categories (e.g., studied offices are all commercial, new scenes are of home offices). Regardless, the current results set the boundary conditions under which gist is no longer harmful for older adults' memory. When the helpful effects of gist and the misleading effects of familiarity collide, gist wins, and eliminates age-related increases in false recollection.

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Conflict of Interest

N. D. Anderson is Associate Editor of this journal but had no role in the review of this manuscript. The authors report no other conflicts of interest.

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