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Age-Related Differences in Overcoming Interference When Selectively Remembering Important Information

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ABSTRACT

We examined the effects of interference on value-based memory in younger and older adults by presenting participants with lists of words paired with point values counting toward their score if recalled. In Experiment 1, we created a situation where there was a buildup of interference such that participants could recall words from any studied list to earn points. However, to increase participants' motivation to combat interference, we told participants that if they recalled words from previously studied lists, those words would be worth double the original point value of the word. In Experiment 2, to examine age-related differences in the absence of any interference, participants studied and were tested on the same set of words throughout several study-test cycles. The buildup of interference caused by participants needing to recall both just-studied and previously studied words in Experiment 1 impaired selectivity in older adults relative to younger adults and this effect was particularly pronounced when considering the recall of just prior-list words. However, in the absence of interference, there was not an overall recall deficit or any selectivity impairments in older adults. Thus, proactive and retroactive interference seem to be largely responsible for age-related deficits in selective memory for important information.

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We are frequently presented with more information than we can remember and to maximize the utility of our memory, we should focus on and prioritize the most valuable information to prevent the negative consequences of forgetting. Additionally, throughout our lives, we accumulate more and more important information that needs to be remembered (e.g., we need to remember the birthdays and anniversaries of our friends and family). However, when examining a learner's ability to selectively remember important information, we often discount the potential role of interference from previously learned information and to-be-learned information.

To demonstrate selective memory in the lab, previous work has presented learners with lists of words paired with point values that count toward the participant's score if recalled on a recall test (e.g., Castel, Benjamin, Craik, & Watkins, 2002; see also Castel, 2008). Examining participants' recall on each test generally reveals that words paired with higher point values are better recalled than words paired with lower point values (e.g., Ariel, Dunlosky, & Bailey, 2009; Murphy, Agadzhanyan, Whatley, & Castel, 2021; Soderstrom & McCabe, 2011; see Knowlton & Castel, 2022; Madan, 2017 for a review). This selective

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memory for important information may help prevent the negative consequences of forgetting and may even be a form of adaptive memory (see Murphy & Castel, 2020, 2021a, 2021b, 2022a, 2022c; Murphy & Knowlton, 2022; Murphy, Hoover, & Castel, 2022; Murphy, Hargis, & Castel, in press).

While remembering the highest-valued words on separate recall tests can be beneficial, in daily life, we need to remember valuable information on a more continuous basis. For example, if a student learns some information from the just-assigned textbook chapter and then recalls that information on a quiz, that information still needs to be remembered later (i.e., on the final exam), even after the student continues to learn new information throughout the course of an academic term. Thus, the learning of new important information does not replace the need to remember old important information – it is crucial that all important information be remembered. However, most prior work examining value-based memory asks participants to study a list of information, take a test on that information, and then begin studying new information without testing the previously studied information again, thus ignoring the effects of interference on memory.

When previously learned information interferes with the ability to learn new information, this results in proactive interference (Underwood, 1957). For example, if you get a new cell phone number, your memory for your old cell phone number can make it more difficult to learn your new number. Similarly, when the learning of new information interferes with memory for previously learned information, this results in retroactive interference (Tulving & Psotka, 1971). For example, if you recently moved, remembering your new address can make it difficult to remember your old address. In the context of value-based memory, memory for important information can make it more difficult to learn new valuable information and the learning of new valuable information can interfere with memory for previously learned valuable information, and these effects of interference may be particularly harmful in older adults.

Older adults often experience cognitive declines as a product of normal aging (see Hess, 2005; Park & Festini, 2017; Salthouse, 2010, 2019; Thomas & Gutchess, 2020). Additionally, older adults tend to be more vulnerable to and less able to recover from the effects of proactive and retroactive interference (Andrés, Van der Linden, & Parmentier, 2004; Friedman & Castel, 2013; Hasher, Chung, May, & Foong, 2002; Hay & Jacoby, 1999; Jacoby, Wahlheim, Rhodes, Daniels, & Rogers, 2010; Lustig & Jantz, 2015; Solesio-Jofre et al., 2012). For example, an older adult may remember a maiden name of a friend long after they got married, and/or sometimes may recall the earlier learned maiden name when trying to retrieve the current last name.

In a value-based memory context, interference can impair older adults' ability to selectively remember valuable information. For example, Murphy and Castel (2022b) presented younger and older adults with lists containing words paired with point values counting toward participants' scores if recalled. However, in contrast to typical value-directed remembering procedures where each recall test covers only just-studied words (i.e., not words from previously studied lists), participants could recall words from any previously studied list to earn points. Thus, this procedure involved the buildup of interference. Although older adults' selective memory tends to be preserved in the typical one-list-at-a-time procedure of value-directed remembering (e.g., Castel, McGillivray, & Friedman, 2012; 2013Castel, Murayama, Friedman, McGillivray, & Link, 2013; McGillivray & Castel, 2011; Middlebrooks, Murayama, & Castel, 2016; Murphy & Castel, 2022d), Murphy and Castel (2022b) demonstrated impaired memory selectivity in older adults relative to younger adults when faced with this type of interference buildup. However, while older adults may not be able to inhibit the recall of current information to access prior-list items (cf., Lustig & Jantz, 2015), this ability may be preserved with increased motivation.

Although interference may negatively impact selective memory in older adults relative to younger adults, if older adults are more motivated to overcome interference, they may be able to remember valuable information – despite the interference – as well as younger adults. For example, both younger and older adults can intentionally forget certain information if directed to do so (e.g., Biss, Campbell, & Hasher, 2013; Bowen, Gallant, & Moon, 2020; Castel, Farb, & Craik, 2007; Murphy & Castel, 2022c; Sahakyan, Delaney, & Goodmon, 2008; Sego, Golding, & Gottlob, 2006; Zacks, Radvansky, & Hasher, 1996; see Titz & Verhaeghen, 2010 for a meta-analysis) and this ability to strategically forget certain information can help reduce interference. Thus, if there is less interference, older adults' selective memory impairment may be reduced as point-value incentives could lead to strategically focusing on remembering more items from earlier lists.

The Current Study

In the current study, we were interested in the effects of interference on value-based memory in younger and older adults. We presented younger and older adults with words paired with point values counting toward their score if recalled. In Experiment 1, we created a situation where there was a buildup of interference such that participants could recall words from any study list to earn points (i.e., participants would experience both proactive and retroactive interference such that words from older lists interfere with the learning of new words and the learning of new words interferes with memory for previously learned words). However, to increase participants' motivation to combat interference, we told participants that if they recalled words from previously studied lists, those words would be worth double the original point value of the word.

In Experiment 2, to examine potential age-related differences in the absence of any proactive or retroactive interference (the standard one-at-a-time testing procedure employed by Castel, Benjamin, Craik, and Watkins (2002) and others still results in proactive interferences such that words studied on previous lists can interfere with the learning of new words), we created a situation where there should not be a buildup of interference. Specifically, participants studied and were tested on the same set of words throughout several study-test cycles.

When words from prior lists are worth more points, thus motivating participants to combat interference (Experiment 1), we expected older adults with double scoring to better prioritize high-value words than younger adults with double scoring as older adults may employ more strategic inhibition mechanisms to selectively forget most words except for the highest-valued items. In Experiment 2, since older adults' selectivity tends to be preserved despite proactive interference (e.g., Castel, Benjamin, Craik, & Watkins, 2002; Knowlton & Castel, 2022), in the absence of interference (which may impair older adults more than younger adults; see Andrés, Van der Linden, & Parmentier, 2004; Friedman & Castel, 2013; Hasher, Chung, May, & Foong, 2002; Hay & Jacoby, 1999; Jacoby, Wahlheim, Rhodes, Daniels, & Rogers, 2010; Lustig & Jantz, 2015; Solesio-Jofre et al., 2012), older adults may benefit from reductions in interference as much or even more so than younger adults.

Experiment 1

Prior work has shown that interference can impair selectivity in older adults when earlier items were given a similar value to items from a current list (Murphy & Castel, 2022b) but in Experiment 1, we wanted to further motivate participants to combat interference and recall items from earlier lists by doubling the value of these items to see if older adults will better engage selective memory in the face of interference when the incentive is higher. We were also interested in how much effort younger and older adults report when trying to combat interference by retrieving past items versus current-list items to enhance their scores. We expected older adults to report having had to exert more effort to recall prior-list words but to recall relatively fewer, whereas younger adults may not try as hard as older adults but recall relatively more past-list items as they have greater access to this information from long-term memory.

Younger and older adults studied six lists of words paired with point values with a recall test following the presentation of each list. On each test, participants could recall words from any studied list to earn points and their goal was to maximize their score. One group of participants received the value paired with the word when it was presented if recalled (normal scoring) while another group of participants received double the word's original value if it was from a prior list. For example, if a participant recalled the 10-point word from List 1 on the second test, they would receive 20 points for recalling that word.

Method

Participants

After exclusions, younger adults were 114 undergraduate students (age range: 18–31; *Mage* = 19.91, *SDage* = 1.94; 93 female, 16 male, 4 other; 50 Asian/Pacific Islander, 3 Black, 19 Hispanic, 31 white, 11 other/unknown; in terms of the highest level of education achieved, 1 Some High School, 34 High School Graduate, 58 some college but no degree, 16 Associates degree, 5 Bachelor's degree) recruited from the University of California Los Angeles (UCLA) Human Subjects Pool. Participants were tested online and received course credit for their participation. Older adults (n = 100; age range: 64–90; *Mage* = 72.76, *SDage* = 5.63; 66 female, 34 male; 1 American Indian/Alaskan Native, 5 Asian/Pacific Islander, 3 Black, 3 Hispanic, 88 white; 1 Some High School, 16 High School Graduate, 26 some college but no degree, 13 Associates degree, 26 Bachelor's degree, 18 graduate degree (Master's, Doctorate, etc.)) were recruited from Amazon's Cloud Research (Chandler, Rosenzweig, Moss, Robinson, & Litman, 2019), a Web site that allows users to complete small tasks for pay. Participants were excluded from analysis if they admitted to cheating (e.g., writing down answers) in a post-task questionnaire (they were told they would still receive credit if they cheated). This exclusion process resulted in the exclusion of five younger adults and 14 older adults. In each experiment, we aimed to collect around 50 participants per condition. The sample size was selected based on prior exploratory research and the expectation of detecting a medium effect size. With this sample size, we had an 80% chance of detecting a *medium* (Cohen's d = .39) difference between younger and older adults. Informed consent was acquired from all participants in each experiment, and the study was completed in accordance with the UCLA Institutional Review Board (approval number: 12–000617).

Materials and Procedure

Participants were told that they would be presented with six lists of to-be-remembered words with each list containing 12 words. On each list, each word was paired with a unique, randomly assigned value between 1 and 12 indicating how much the word was "worth." Each point value was used only once within each list and the order of the point values within lists was randomized. The stimulus words were presented for 3 s each with a 500 ms inter-stimulus interval. Lists were comprised of unrelated words (e.g., vase, stool, clam) that were between 4 and 7 letters ($M = 5.46$, $SD = 1.10$). On the log-transformed Hyperspace Analogue to Language frequency scale (with lower values indicating lower frequency in the English language and higher values indicating higher frequency), words ranged from 5.48–7.62 and averaged a score of 6.85 ($SD = .55$). In terms of concreteness (with lower values indicating lower concreteness and higher values indicating higher concreteness), words ranged from 2.50–5.00 and averaged a score of 4.62 ($SD = .43$). Frequency and concreteness ratings were generated using the English Lexicon Project website (Balota et al., 2007).

Participants were told that they would score points for recalling words on the test and that they should try to maximize their scores. Specifically, on each recall test, participants were told that they could recall words from any studied list to score points. However, one group of participants received the listed point values from the study phase for each recalled word (57 younger adults, 51 older adults) while another group of participants received double points for recalling a prior-list word (57 younger adults, 49 older adults). For example, if a participant recalled the 5-point word from List 1 on the second test, they would receive 10 points for that word.

After the presentation of all 12 word-number pairs in each list, participants were given a self-paced free recall test in which they had to recall as many words as they could (they did not need to recall the point values). Participants recalled words by typing them into an on-screen text box. To account for typographical errors in participants' responses, we employed a real-time textual similarity algorithm where responses with at least 75% similarity to the correct answer were counted as correct. Immediately following the recall period, participants were told their score for that list but were not given feedback about specific items. This procedure was repeated for a total of six study-test trials. Additionally, after Lists 2–6, we asked participants how hard they tried to remember/recall words from prior lists. Participants responded on a 10-point Likert scale ranging from 1 (not at all) to 10 (tried very hard to recall words from prior lists).

Results

Recall as a function of age, scoring, and list (current, prior) is shown in Figure 1. A 2 (age: young, old) × 2 (scoring: normal, double) × 2 (list: current, prior) mixed ANOVA revealed that younger adults recalled more words throughout the task ($M = 64.69$, $SD = 34.38$) than older adults ($M = 44.30$, $SD = 32.17$), [$F(1, 210) = 19.83$, $p < .001$, $\eta_p^2 = .09$]. However, participants with normal scoring recalled a similar number of words throughout the task ($M = 51.14$, $SD = 31.05$) as participants with double scoring ($M = 59.26$, $SD = 37.98$), [$F(1, 210) =$

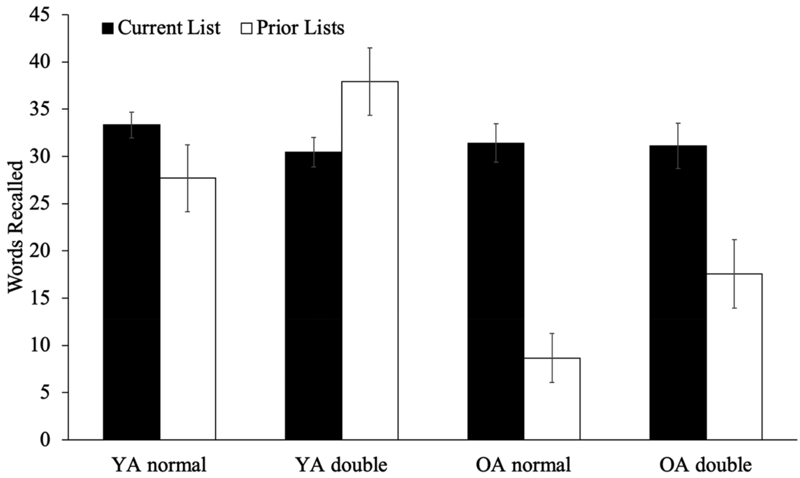

Figure 1. The number of words recalled as a function of age (YA = younger adults, OA = older adults), scoring, and list in Experiment 1. Error bars reflect the standard error of the mean.

3.05, $p = .082$, $\eta_p^2 = .01$]. Moreover, participants recalled more words from the current list ($M = 31.60$, $SD = 13.44$) than prior lists ($M = 23.57$, $SD = 26.88$), [$F(1, 210) = 33.24$, $p < .001$, $\eta_p^2 = .14$]. Scoring did not interact with age [$F(1, 210) = .02$, $p = .887$, $\eta_p^2 < .01$] but list interacted with scoring [$F(1, 210) = 13.92$, $p < .001$, $\eta_p^2 = .06$] such that both scoring groups recalled a similar number of current-list words [$p_{holm} = .560$, $d = .08$] but participants with double scoring recalled more prior-list words [$p_{holm} = .002$, $d = .48$]. List interacted with age group [$F(1, 210) = 40.72$, $p < .001$, $\eta_p^2 = .16$] such that younger and older adults recalled a similar number of current-list words [$p_{holm} > .999$, $d = .03$] but younger adults recalled more prior-list words than older adults [$p_{holm} < .001$, $d = .99$]. There was not a three-way interaction between scoring, age, and list [$F(1, 210) = .43$, $p = .514$, $\eta_p^2 < .01$].

To examine differences in selectivity for valuable information, we computed multilevel models (MLMs) where we treated the data as hierarchical or clustered (i.e., multilevel) with items nested within individual participants. Since recall at the item level was binary (correct or incorrect), we conducted logistic MLMs. In these analyses, the regression coefficients are given as logit units (i.e., the log odds of correct recall). We report exponential betas (e^B), and their 95% confidence intervals ($CI_{95\%}$), which give the coefficient as an odds ratio (i.e., the odds of correctly recalling a word divided by the odds of not recalling a word). Thus, e^B can be interpreted as the extent to which the odds of recalling a word changed. Specifically, values greater than 1 represent an increased likelihood of recall while values less than 1 represent a decreased likelihood of recall.

To examine overall memory selectivity (see Figure 2), we conducted a logistic MLM with item-level recall modeled as a function of value (we used the word's original value) with scoring (normal, double) and age (young, old) as between-subjects factors. Results revealed that value significantly predicted recall [$e^B = 1.11$, $CI_{95\%} = 1.10–1.11$, $z = 29.91$, $p < .001$] such that high-value words were better recalled than low-value words. Additionally, age significantly predicted recall [$e^B = 1.64$, $CI_{95\%} = 1.33–2.03$, $z = 4.56$, $p < .001$] such that younger adults recalled more words than older adults. Scoring did not predict recall [$e^B = .86$, $CI_{95\%} = .69–1.06$, $z = −1.39$, $p = .165$] such that changing the scoring of words did not

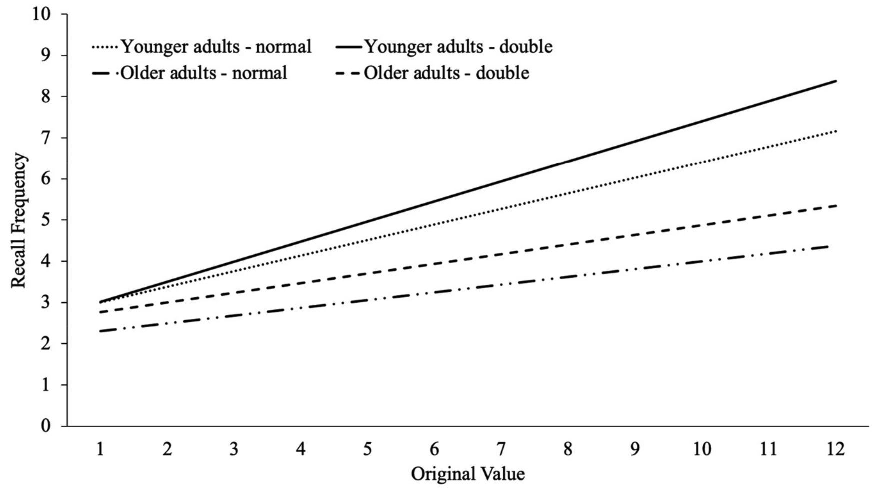

Figure 2. Linear trendlines for recall frequency as a function of each word's original value, age, and scoring in Experiment 1.

significantly impact recall. However, value interacted with age [$e^B = 1.05$, $CI_{95\%} = 1.03–1.06$, $z = 6.59$, $p < .001$] such that younger adults more selectively recalled high-value words than older adults (i.e., value was a stronger predictor of recall for younger adults). Scoring interacted with value [$e^B = .98$, $CI_{95\%} = .97–1.00$, $z = −2.70$, $p = .007$] such that participants with double scoring were more selective toward high-value words than participants with normal scoring. Scoring did not interact with age [$e^B = 1.06$, $CI_{95\%} = .69–1.62$, $z = .27$, $p = .787$] and there was not a three-way interaction between value, age, and scoring [$e^B = .98$, $CI_{95\%} = .96–1.01$, $z = −1.26$, $p = .207$].

Next, we conducted a similar model to examine memory selectivity for the recall of only words from the just-studied list (see Figure 3a). Results revealed that value significantly predicted recall [$e^B = 1.16$, $CI_{95\%} = 1.15–1.17$, $z = 27.23$, $p < .001$] such that high-value words were better recalled than low-value words. However, age did not significantly predict recall [$e^B = .98$, $CI_{95\%} = .76–1.27$, $z = −.14$, $p = .891$] such that younger and older adults recalled a similar number of current-list words. Scoring did not predict recall [$e^B = 1.12$, $CI_{95\%} = .86–1.45$, $z = .85$, $p = .393$] such that changing the scoring of prior-list words did not significantly impact the recall of current-list words. However, value interacted with age [$e^B = 1.05$, $CI_{95\%} = 1.03–1.08$, $z = 4.90$, $p < .001$] such that, compared with older adults, younger adults demonstrated a greater tendency to recall high-value items better than lower-value items when recalling current-list words. Scoring did not interact with value [$e^B = 1.01$, $CI_{95\%} = .99–1.03$, $z = .68$, $p = .499$] or age [$e^B = 1.20$, $CI_{95\%} = .72–2.00$, $z = .68$, $p = .494$], and there was not a three-way interaction between value, age, and scoring [$e^B = .99$, $CI_{95\%} = .95–1.03$, $z = −.52$, $p = .600$].

We conducted another similar model to examine memory selectivity for the recall of only words from the prior-list words (see Figure 3b). Results revealed that value significantly predicted recall [$e^B = 1.10$, $CI_{95\%} = 1.09–1.11$, $z = 16.81$, $p < .001$] such that high-value words were better recalled than low-value words. Additionally, age significantly predicted recall [$e^B = 5.85$, $CI_{95\%} = 3.46–9.89$, $z = 6.59$, $p < .001$] such that younger adults recalled more words from prior lists than older adults. Scoring also predicted recall [$e^B = .32$, $CI_{95\%}$

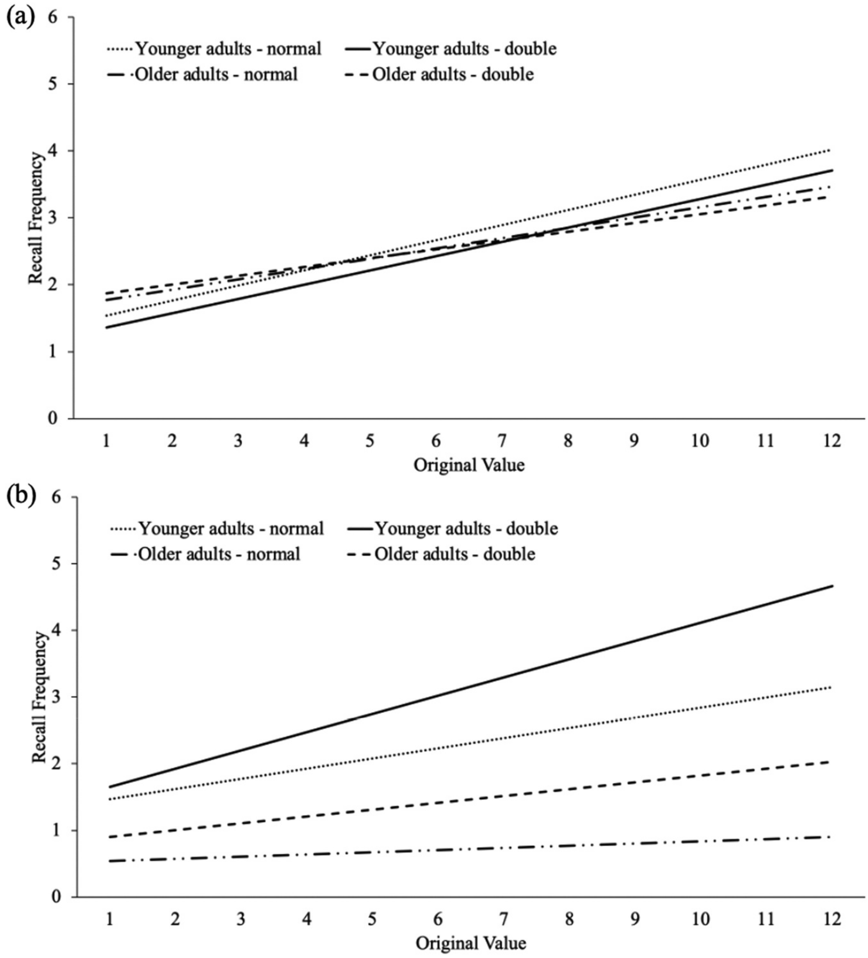

Figure 3. Linear trendlines for recall frequency as a function of each word's original value, age, and scoring for current-list words (a) and prior-list words (b) in Experiment 1.

= .19–.55, $z = -4.20$, $p < .001$] such that recall increased when prior-list words were worth double points. Moreover, value interacted with age [$e^B = 1.03$, $CI_{95\%} = 1.01–1.06$, $z = 2.69$, $p = .007$] such that younger adults were more likely to better recall high- relative to low-value words compared with older adults. Scoring also interacted with value [$e^B = .96$, $CI_{95\%} = .94–.98$, $z = -3.27$, $p = .001$] such that when prior-list words were worth double points, participants were more likely to prioritize high-value words. Age did not interact with scoring [$e^B = 1.21$, $CI_{95\%} = .43–3.41$, $z = .37$, $p = .714$] and there was not a three-way interaction between value, age, and scoring [$e^B = 1.00$, $CI_{95\%} = .96–1.05$, $z = .18$, $p = .859$].

Lastly, we examined participants' ratings of how hard they tried to remember/recall the words from prior lists via a mixed MLM with effort ratings modeled as a function of list with scoring (normal, double) and age (young, old) as between-subjects factors. Results revealed that list significantly predicted effort ratings [$t(857) = 3.46$, $p < .001$] such that participants reported trying harder to recall prior-list words on later lists. Additionally, age significantly predicted effort ratings [$t(210) = -2.36$, $p = .019$] such that older adults reported trying harder to recall prior-list words ($M = 7.60$, $SD = 2.51$) than younger adults ($M = 6.87$, $SD = 1.96$). Scoring did not predict effort ratings [$t(210) = .83$, $p = .407$] such that participants with normal ($M = 7.34$, $SD = 2.36$) and double scoring ($M = 7.09$, $SD = 2.16$) reported a similar effort to recall prior-list words. However, list interacted with age [$t(857) = -3.36$, $p < .001$] such that older adults increased their effort to recall prior-list words on later lists while younger adults did not. Scoring did not interact with list [$t(857) = -1.72$, $p = .086$] or age [$t(210) = -.60$, $p = .548$], and there was not a three-way interaction between list, age, and scoring [$t(857) = 1.28$, $p = .200$].

Moreover, effort ratings did not correlate with total recall [$r = .07$, $p = .334$], selectivity (as measured by the selectivity index, see Castel, Benjamin, Craik, & Watkins, 2002), [$r = .05$, $p = .455$], current-list recall [$r = .08$, $p = .255$], or prior list recall [$r = .05$, $p = .494$]. We also note that for participants in the double scoring condition, average effort ratings and the number of current-list items recalled were positively (but not significantly) correlated [$r = .18$, $p = .066$].

Discussion

In Experiment 1, younger adults were better at combating retroactive interference to recall prior-list words relative to older adults, despite older adults reporting having tried harder to recall prior-list words (particularly on later lists). Furthermore, the proactive interference from previously learned words similarly impacted younger and older adults' ability to recall just-studied words. Critically, although doubling the value of previously studied words increased selectivity for prior-list words, this did not differ as a function of age. Although younger adults were more selective than older adults when considering recall from both current-list words and previous-list words, this difference was particularly pronounced when recalling words from previously studied lists (see Figure 3). Thus, Experiment 1 generally supports previous work demonstrating interference effects in value-directed remembering (Murphy & Castel, 2022b), and in the present task, we found that motivating participants to combat interference did not specifically benefit selectivity in older adults.

Experiment 2

In Experiment 2, to prevent the buildup of interference, we presented participants with words to remember for a test, but learners studied the same words on each list. Specifically, we presented younger and older adults with a list of 40 words with each word paired with a point value (between 1 and 10) counting toward their score if recalled. There were four study-test cycles, but the same 40 words were studied and tested on each list. Thus, items from past lists were the same as the current list, reducing any potential interference effects and providing repletion and repeated testing of the same items, perhaps helping older adults remember higher-value items. As a result, rather than the buildup of interference reducing older adults' selectivity as observed in Experiment 1, we expected older adults to demonstrate preserved or even enhanced selectivity relative to younger adults as the cognitive resources needed to combat interference could potentially be allocated toward engaging the mechanisms of selective memory.

Method

Participants

After exclusions, younger adults were 51 undergraduate students (age range: 18–36; *Mage* = 21.04, *SDage* = 3.50; 42 female, 9 male; 17 Asian/Pacific Islander, 3 Black, 14 Hispanic, 14 white, 3 other/unknown; in terms of the highest level of education achieved, 10 High School Graduate, 26 some college but no degree, 11 Associates degree, 4 Bachelor's degree) recruited from the UCLA Human Subjects Pool. Participants were tested online and received course credit for their participation. Older adults ($n = 49$; age range: 65–91; *Mage* = 72.76, *SDage* = 6.07; 30 female, 19 male; 1 American Indian/Alaskan Native, 2 Asian/Pacific Islander, 1 Black, 45 white; 2 Some High School, 5 High School Graduate, 14 some college but no degree, 8 Associates degree, 9 Bachelor's degree; 11 graduate degree) were recruited from Amazon's Cloud Research. Participants were excluded from analysis if they admitted to cheating (e.g., writing down answers) in a post-task questionnaire (they were told they would still receive credit if they cheated). This exclusion process resulted in the exclusion of three younger adults and 10 older adults. With this sample size, we had an 80% chance of detecting a *medium* (Cohen's $d = .57$) difference between younger and older adults.

Materials and Procedure

Participants were told that they would be presented with a list of words to remember for a later test and that each word would be paired with a point value between 1 and 10 (randomly assigned but there were an equal number of each point value (i.e., there were four 10-point words)) counting toward their score if recalled; participants' goal was to maximize their point score. Words were presented one at a time for 3 s each. Following the presentation of all 40 words, participants were given a self-paced free recall test in which they had to recall as many words as they could. As in Experiment 1, responses were typed into an on-screen text box, we accounted for typographical errors in participants' responses, and participants were given feedback after each list. This procedure was repeated for four study-test cycles with the same words being studied and tested on each list; words were studied in random order during each study phase.

Results

Recall on each test as a function of age is shown in Figure 4. A 2 (age: young, old) × 4 (test) mixed ANOVA revealed that younger adults recalled a similar proportion of words ($M = .39$, $SD = .18$) as older adults ($M = .34$, $SD = .22$), [$F(1, 98) = 2.00$, $p = .161$, $\eta_p^2 = .02$]. Moreover, there was an effect of test [$F(3, 294) = 114.56$, $p < .001$, $\eta_p^2 = .54$] such that the proportion of words recalled increased as the task endured. However, age did not interact with test [$F(3, 294) = 1.13$, $p = .338$, $\eta_p^2 = .01$].

To examine memory selectivity (see Figure 5), we conducted a logistic MLM with item-level recall modeled as a function of value and test with age (young, old) as a between-subjects factor. Results revealed that value significantly predicted recall [$e^B = 1.14$, $CI_{95\%} = 1.12–1.15$, $z = 19.20$, $p < .001$] such that high-value words were better recalled than low-value words. Age did not significantly predict recall [$e^B = 1.28$, $CI_{95\%} = .82–2.00$, $z = 1.08$, $p = .278$]. Test predicted recall [$e^B = 1.47$, $CI_{95\%} = 1.43–1.52$, $z = 22.70$, $p < .001$] such that recall

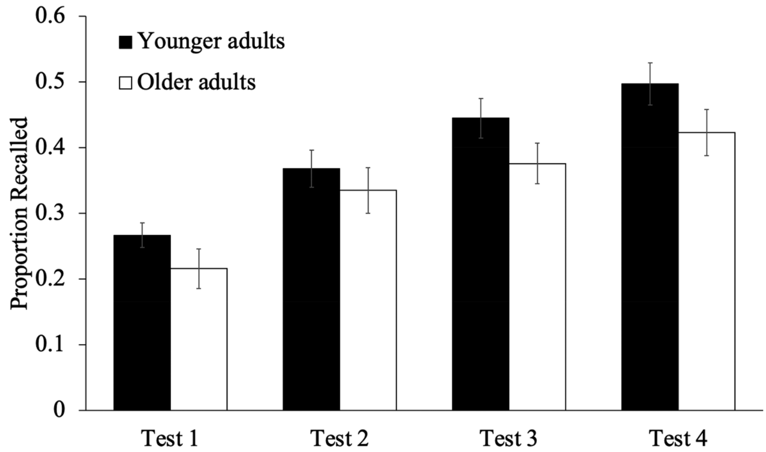

Figure 4. The proportion of words recalled as a function of age on each test in Experiment 2. Error bars reflect the standard error of the mean.

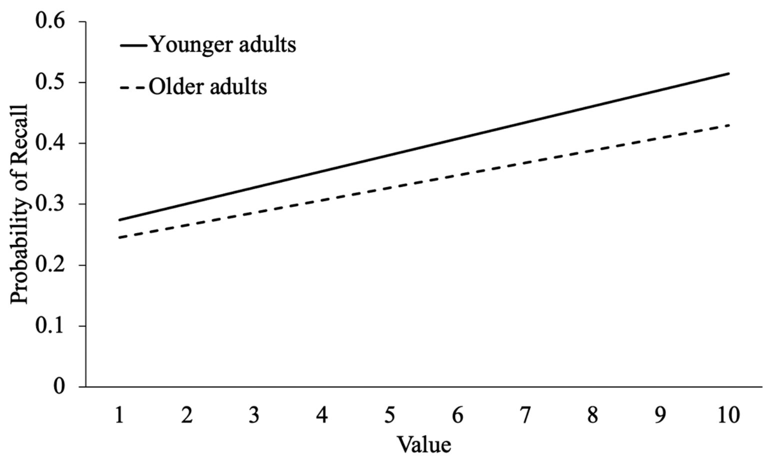

Figure 5. Linear trendlines for the probability of recall as a function of value for younger and older adults in Experiment 2.

increased as the task endured. However, value did not interact with age [$e^B = 1.02$, $CI_{95\%} = .99–1.05$, $z = 1.42$, $p = .155$] such that younger and older adults were similarly selective toward high-value words. Age did not interact with test [$e^B = 1.01$, $CI_{95\%} = .94–1.08$, $z = .25$, $p = .901$] such that the increase in recall on later tests did not differ as a function of age. Value interacted with test [$e^B = 1.01$, $CI_{95\%} = 1.00–1.02$, $z = 2.13$, $p = .033$] such that participants were more selective toward high-value words on later lists. Finally, there was not a three-way interaction between value, age, and scoring [$e^B = .99$, $CI_{95\%} = .97–1.01$, $z = −.81$, $p = .418$].

Discussion

Although older adults typically display an overall recall deficit relative to younger adults (e.g., Balota, Dolan, & Duchek, 2000; also seen in Experiment 1), the absence of interference and the presence of multiple study test cycles allowed older adults to recall as many words as younger adults. Additionally, recall on each test improved as the task endured and participants also became more selective on later tests. This indicates that the repeated study test cycles provided participants with an opportunity to further prioritize and focus on high-value words. For example, if some of the high-value words were not recalled on the first test, participants could revisit these words during the following study phases (see also Murphy & Castel, 2022b). Finally, the lack of interference in Experiment 2 eliminated the selectivity impairment in older adults. Thus, Experiment 2 indicates that in the absence of interference, older adults perform just as well as younger adults in terms of overall recall and memory selectivity.

General Discussion

In the present study, we were interested in the effects of interference on selective memory in younger and older adults. In Experiment 1, we presented younger and older adults with words paired with point values counting toward their score if recalled and new words were presented in each study phase (thus causing a building up of both proactive and retroactive interference). Following each study phase, participants were asked to recall all words that had been studied (i.e., both current- and prior-list words), and some participants were told that they would receive double the original point value of the word for recalling it if it had been studied on a previous list. We expected that this increased motivation to recall previously studied words may help learners, particularly older adults, combat interference.

The results from Experiment 1 show that the buildup of interference caused by participants needing to recall both just studied and previously studied words to increase their score (their goal was to maximize their score) impaired memory selectivity in older adults relative to younger adults. This effect was particularly pronounced when considering the recall of just prior-list words (see Figure 3). Specifically, while younger adults were more selective than older adults in the recall of words from both current and prior lists, younger adults appear to be particularly more selective (relative to older adults) in their recall of words from previously studied lists. This finding may reflect greater access to, and selectivity of, long-term memory in younger adults while older adults may strategically focus on remembering more recent information despite not being able to control the access and retrieval of earlier information.

Although doubling the point value of previously studied words likely provided additional motivation for participants to combat the interference and focus on the retrieval of high-value words, the change in the scoring system did not differentially impact selectivity in younger and older adults. Interference often disproportionally impairs older adults (see Lustig & Jantz, 2015) and value-based learning may influence this process. We found that the interference from previously learned words when trying to learn new words (proactive interference) and the interference from newly learned information when attempting to retrieve previously learned information (retroactive interference) impairs older adults' ability to selectively encode and recall high-value words compared to younger adults, shedding light on how interference in a value-based learning task is influenced by age-related differences in memory.

In contrast to Experiment 1 which involved the buildup of interference, in Experiment 2 we employed a paradigm that freed learners from the burden of interference. Specifically, participants studied the same words across several study test cycles; thus, there was no previously studied information or new information to learn that could impair participants' memory for the to-be-remembered list of words. In the absence of interference, results revealed that the overall memory impairments typically displayed by older adults (e.g., Balota, Dolan, & Duchek, 2000) were eliminated. Furthermore, although older adults' selective memory was impaired in the presence of interference in Experiment 1 (see also Murphy & Castel, 2022b), in Experiment 2, older adults demonstrated a preserved ability to selectively encode and recall high-value words relative to younger adults. This may be attributable to older adults benefiting from a testing effect (Meyer & Logan, 2013; Roediger & Karpicke, 2006) as multiple free recall tests can potentiate strategy-driven effects (Cohen, Rissman, Hovhannisyan, Castel, & Knowlton, 2017) suggesting that repeated study opportunities and recall tests can help older adults remember important information. Thus, the present work shows situations in which reward-based memory may reveal age-related similarities and differences in terms of how interference influences selective memory for important information.

The mechanisms involved in selective memory under conditions of interference likely reflect both strategic control and more automatic encoding and retrieval of information (Knowlton & Castel, 2022). As such, each of the paradigms employed in the present experiments likely involves a different strategy to optimize performance. For example, in Experiment 1, participants may focus on a subset of words from each list (likely the highest-valued words) while ignoring the low-value words, resulting in the accumulation of more and more high-value words as the task endures. Older adults reported trying harder to remember prior-list words relative to younger adults, particularly as the task endured, but this did not correspond to a memory benefit for these words or greater selectivity. Thus, younger adults may have greater access to high-value information from earlier lists, while older adults may use more strategic processes but have poorer access to earlier information.

In contrast, in Experiment 2, participants could focus on the encoding of the same high-value words in each study cycle, and they got more chances to study the words that may have experienced a recall failure. This likely helped older adults overcome memory impairments from prior lists and prioritize memory for important information. In addition to the potential strategies seen in the present work, future research could examine measures of cognitive control such as working memory, inhibition, strategy use, and one's metacognition regarding the effects of interference to determine how younger and older adults may differ in terms of their approach to combatting interference.

In sum, the present study demonstrated that the interference experienced when being presented with new lists of to-be-remembered words impairs selectivity in older adults (see also Murphy & Castel, 2022b) even if the motivation to combat interference is increased. However, in the absence of interference, and with the presence of repetition and repeated retrieval via testing when learners can focus on the same high-value words across multiple studies test cycles, overall memory performance and memory selectivity is preserved in older adults. Thus, both proactive and retroactive interference seem to be largely responsible for age-related deficits in terms of selective memory of important information.

Disclosure statement

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