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Responsible Remembering and Forgetting in Younger and Older Adults

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ABSTRACT

Although older adults are often concerned about instances of forgetting, forgetting can be a useful feature of our memory system. Specifically, strategically forgetting less important information can benefit memory for goal-relevant information (i.e., responsible remembering and responsible forgetting). In two experiments, we presented younger and older adults with a list of words (either unrelated words or items to bring on a camping trip) with a cue indicating whether participants ("You") or their "Friend" was responsible for remembering each item. Results revealed that both younger and older adults engaged in responsible remembering and forgetting by better remembering items they were responsible for remembering, indicating a strategic utilization of their limited memory capacity. Additionally, regardless of age and the cue indicating who was responsible for remembering each item, participants used importance to guide the encoding and retrieval of information. Thus, people may be able to engage strategic cognitive mechanisms to maximize memory utility for important, goal-relevant information, and responsible forgetting can enhance memory utility in both younger and older adults by using importance to drive memory and reduce consequences for forgetting.

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Older adults are often concerned about changes in memory and instances of forgetting (see Ginó et al., 2010). Although many memory deficits frequently accompany healthy aging (cf. Hess, 2005; Park & Festini, 2017; Salthouse, 2010, 2019; Thomas & Gutchess, 2020) and forgetting is often considered an undesirable memory failure, forgetting can be a useful feature of our memory system (see Bjork & Bjork, 2019). For example, remembering where you parked your car yesterday is not very helpful for finding your car today. Similarly, memory for old or outdated information, such as former phone numbers or addresses, can interfere with the memory of current information. Thus, there can be a functional quality of forgetting where forgetting may enhance memory for target information, termed *responsible forgetting* (Murphy & Castel, 2021a; see also Popov, Marevic, Rummer, & Reder, 2019; Storm, 2011).

If people strategically remember important information at the expense of outdated or unimportant information, this can reduce competition for said important information (cf. Anderson, Bjork, & Bjork, 1994; Bjork, Bjork, & Anderson, 1998; Fawcett & Hulbert, 2020). In the lab, the benefits of forgetting have been demonstrated through the use of directed

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forgetting tasks whereby participants are presented with a list of items with each word followed by a cue to either remember or forget the word (item method directed forgetting, Gardiner, Gawlik, & Richardson-Klavehn, 1994; see Bjork & Bjork, 1996; Sahakyan & Foster, 2009 for list method; see Castel, Farb, & Craik, 2007 for point-value method). In directed forgetting tasks, recall for information not expected to be tested tends to be worse than controls, exemplifying the costs of forgetting, while recall for information expected to be tested tends to be enhanced, exemplifying the benefits of forgetting (e.g., Bjork & Bjork, 1996; Friedman & Castel, 2011; MacLeod, 1999; Sahakyan, 2004; see Basden & Basden, 1998; Bjork, 1998; MacLeod, 1998 for reviews).

To examine directed forgetting in older adults, Zacks, Radvansky, and Hasher (1996) presented younger and older adults with to-be-remembered and to-be-forgotten items (and lists). Compared to younger adults, older adults recalled and recognized more to-be-forgotten items (see also Dulaney, Marks, & Link, 2004; Earles & Kersten, 2002; Sahakyan, Delaney, & Goodmon, 2008; see Titz & Verhaeghen, 2010 for a review; but see Zellner & Bäuml, 2006). While Zacks et al. (1996) explicitly instructed older adults to remember and forget certain words, Pavur, Comeaux, and Zeringue (1984) cued participants by instructing them to "get" certain items on a shopping list (e.g., "get shoelaces") but not to get other items (e.g., "don't get bread"). With these less explicit cues to remember or forget each item, there were no age-related differences in the effects of directed forgetting. Thus, different types of cues to remember or forget information can differentially impact learning outcomes in younger and older adults (see also Sego, Golding, & Gottlob, 2006).

Although older adults sometimes recall and recognize more items that they were instructed to forget relative to younger adults in directed forgetting tasks, prior work has indicated that selectivity for valuable information can be enhanced in older adults (e.g., Castel, 2008; Castel, Benjamin, Craik, & Watkins, 2002; Castel, McGillivray, & Friedman, 2012a). Additionally, when presented with real-world goals as contexts (such as packing for a camping trip), both younger and older adults selectively focus on remembering key items (e.g., tent) more than items that have minor consequences if forgotten (e.g., marshmallows; McGillivray & Castel, 2017). Thus, some forms of memory tend to be maintained in older adults (see Swirsky & Spaniol, 2019) and the importance of to-be-remembered information can drive memory.

Although remembering information is important, recent work has indicated that forgetting is an important component of remembering goal-relevant information. For example, Murphy and Castel (2021a) presented participants with a list of items to remember and after each item was presented, a cue indicated whether the participant or a hypothetical friend was responsible for remembering this piece of information. Results revealed that participants were sensitive to these cues and best remembered items they were responsible for remembering at the expense of items their friend was responsible for remembering, similar to standard directed forgetting tasks with remember and forget cues. Critically, participants were sensitive to information importance (both according to participants' judgments and normed ratings) in their memory for items both they and their friend were responsible for remembering. Thus, this adapted directed forgetting task exemplifies that while forgetting may seem like a memory nuisance, forgetting goal-irrelevant items could allow for better memory utility, especially if the irrelevant information could interfere with memory for the more important information.

Engaging in adaptive memory strategies to remember valuable information at the expense of low-value information is known as *responsible remembering*: the strategic prioritization of memory for important information with consequences if forgotten (Murphy & Castel, 2020, 2021b). Having experienced more instances of forgetting, older adults may have adapted to become responsible remembers and this may extend to the strategic forgetting of goal-relevant information, a form of responsible remembering we termed *responsible forgetting* (Murphy & Castel, 2021a). Thus, possibly to compensate for declines in memory, older adults may have learned to employ strategies such as responsible forgetting, whereby there is less concern about the remembering of lower value information, and this could ensure that more attention is directed to better remember important, goal-relevant information.

The Current Study

Most previous work using directed forgetting tasks has employed a paradigm in which participants were explicitly instructed to forget specific information. However, to investigate age-related differences in responsible remembering and forgetting, we presented younger and older with a list of words (either unrelated words or items to bring on a camping trip) with a cue indicating whether participants ("You") or their "Friend" was responsible for remembering each item (adapted from Murphy & Castel, 2021a). Additionally, we asked participants to evaluate the importance of remembering each presented item to elucidate how importance drives memory in older adults.

Since older adults are notorious for source monitoring deficits (see Hashtroudi, Johnson, & Chrosniak, 1989; Henkel, Johnson, & De Leonardis, 1998; Mitchell & Hill, 2019; see also Spencer & Raz, 1995), we expected older adults to remember fewer items overall than younger adults; however, we expected older adults to be more strategic in their remembering indicating that responsible remembering may be intact in old age. Specifically, we expected older adults to engage responsible remembering mechanisms by rating items they were responsible for remembering as more important than items their friend was responsible for remembering, indicating the strategic utilization of their more limited memory capacity. As a result, older adults may prioritize memory for items they were responsible for remembering at a greater expense of the items their friend was responsible for remembering in comparison to younger adults. However, information importance may also drive memory in older adults such that important items are better remembered than items judged as less important to remember, even if their friend was responsible for remembering them.

Experiment 1

In Experiment 1, younger and older adults were presented with a list of unassociated words to remember for a later test with the participant responsible for remembering half of the words and their hypothetical "friend" responsible for remembering the other half. We expected responsible remembering to be intact or even enhanced in older adults (cf. Knowlton & Castel, 2021; Murphy & Castel, 2020) such that older adults may demonstrate a greater tendency to selectively remember words they were responsible for remembering whereas younger adults' recall may be less sensitive to who was responsible for

remembering each word. Specifically, given their more limited cognitive resources, we expected older adults to be more selective in choosing what to remember in contexts that emphasize responsible remembering. In terms of information importance, since the words were unassociated, we expected participants' importance ratings to largely correspond with who was responsible for remembering each word, and for recall to map on to these judgments. Specifically, we expected younger and older adults to indicate that words they were responsible for remembering are more important to remember compared with words their friend was responsible for remembering, indicating a strategic prioritization of memory.

Method

Participants

Younger adults (n = 42; M_{age} = 20.48, SD_{age} = 1.66) were 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 = 42; M = 72.67, SD = 5.43) were recruited from Amazon's Cloud Research, a Web site that allows users to complete small tasks for pay. Older adults received $1.50 for completing the experiment, which took approximately 15 minutes. Participants were excluded from analysis if they admitted to cheating (e.g., writing down answers) in a post-task questionnaire (they were told they would still receive credit if they cheated). This exclusion process resulted in zero exclusions from the younger adult group and four exclusions from the older adult group. A power analysis indicated that for a 2 (age: young, old) x 2 (cue: Friend, You) mixed ANOVA, with a high correlation between repeated-measures, assuming alpha = .05, power = .80, a total of 74 participants would be needed to reliably detect a medium effect size ($\eta 2$ = .10). Informed consent was acquired, and the study was completed in accordance with the UCLA Institutional Review Board.

Materials and Procedure

Participants were informed that they would be presented with a list of words that they and a (hypothetical) friend needed to remember (adapted from Murphy & Castel, 2021a). After each word was presented, a cue indicated whether the participant ("You") or their friend ("Friend") was responsible for remembering the word. For each participant, half of the words were randomly designated as to-be-remembered words for the participant, and half were designated as words their friend was responsible for remembering. Each word was preceded by a 1 second fixation cross, then appeared on the screen, one at a time, in random order, for 3 seconds followed by the cue for an additional 2 seconds. After the presentation of each word, participants were asked to evaluate how important it was to remember each item (on a scale from 0 to 100 with 0 being not important and 100 being very important). Participants were given as much time as needed to provide their ratings. After the presentation of all 20 words, participants were given a 1 minute free recall test in which they were asked to recall all of the words that both they and their friend needed to remember from the just-presented list.

Following the immediate recall test, participants completed a surprise recognition test. Participants were shown the words from the just-presented list as well as 20 lures (in random order) and asked to indicate whether each item was on the list of presented words.

Participants also provided confidence judgments on a scale from 0 to 100 (with 0 being not at all confident and 100 being very confident) and were given as much time as they needed for this portion of the task. Stimuli (see Appendix) were normed for word length, log-frequency, and concreteness using the English Lexicon Project website.

Results

In the present analyses, we investigated differences in recall, importance ratings, recognition, and confidence as a function of age (young, old) and cue (Friend, You) using mixed ANOVAs. Additionally, to examine the strength of the evidence for each effect, we computed a Bayes Factor (a ratio of the marginal likelihood of the null model and a model suggesting group differences) compared to a null model using JASP (Love et al., 2019; see Marsman & Wagenmakers, 2017; Wagenmakers et al., 2017, 2018a, 2018b for a review of the benefits of Bayesian hypothesis testing in psychological science and example applications with JASP). We provide BF_{01} when inferential statistics favor the null hypothesis (which would be supported by a large BF_{01}) and BF_{10} when inferential statistics favor the alternative hypothesis (which would be supported by a large BF_{10}; for more information on interpreting Bayes factors, see Jeffreys, 1961; Kass & Raftery, 1995; Lee & Wagenmakers, 2013).

Recall performance as a function of age and cue is shown in Figure 1. A 2 (age: young, old) x 2 (cue: Friend, You) mixed ANOVA on recall performance revealed that participants recalled more You words (M = .36, SD = .26) than Friend words (M = .18, SD = .17), [$F(1, 82) = 33.67$, $p < .001$, $\eta 2 = .29$, $BF_{10} > 100$]. Additionally, younger adults recalled a greater proportion of words (M = .35, SD = .16) than older adults (M = .19, SD = .15), [$F(1, 82) = 22.99$, $p < .001$, $\eta 2 = .22$, $BF_{10} > 100$]. However, age did not interact with cue [$F(1, 82) = 1.73$, $p = .192$, $\eta 2 = .02$, $BF_{01} < .01$].

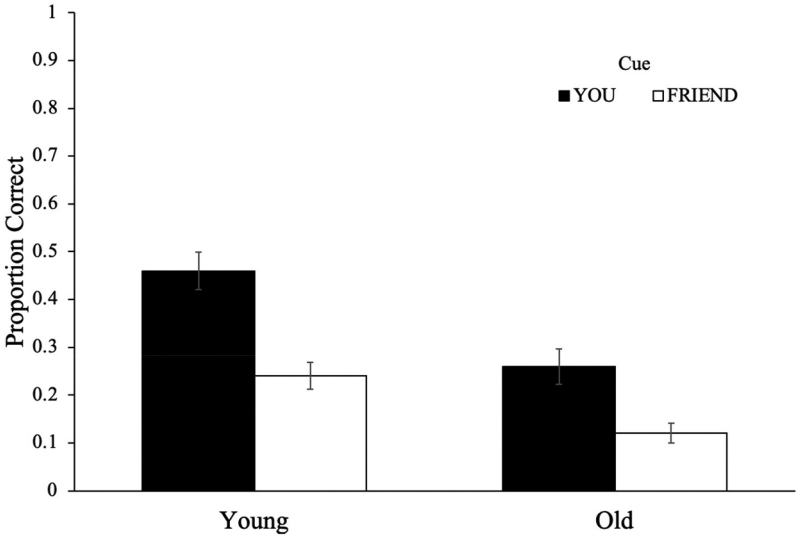

Figure 1. Recall performance as a function of age and cue in Experiment 1. Error bars reflect the standard error of the mean.

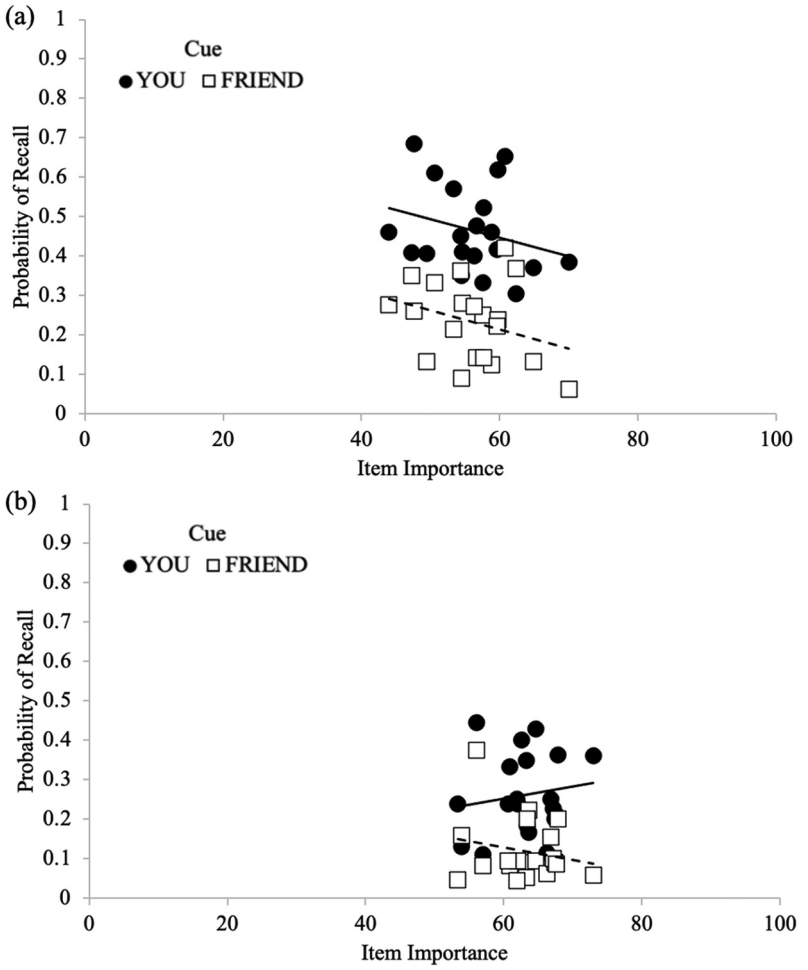

Figure 2. Probability of recall as a function of cue and item importance with regression lines in for younger adults (a) and older adults (b) in Experiment 1.

Probability of recall as a function of cue and item importance for younger and older adults is shown in Figure 2. An analysis of importance ratings revealed that participants rated You words (M = 77.94, SD = 27.82) as more important than Friend words (M = 40.96, SD = 36.26), [$F(1, 82) = 63.68$, $p < .001$, $\eta 2 = .43$, $BF_{10} > 100$]. However, younger adults' importance ratings (M = 55.94, SD = 21.05) were similar to older adults' (M = 62.97, SD = 26.91), [$F(1, 82) = 1.78$, $p = .186$, $\eta 2 = .02$, $BF_{01} = 2.98$]. Additionally, age did not interact with cue [$F(1, 82) = 1.76$, $p = .188$, $\eta 2 = .02$, $BF_{01} < .01$]. Thus, younger and older adults generally rated words they were responsible for remembering as more important to remember and better remembered these words, although older adults recalled fewer words overall.

To supplement these findings and further elucidate how a word's cue (You, Friend) and importance judgment predicts younger and older adults' memory, we computed a multilevel model (MLM) 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 and in these analyses, the regression coefficients are given as logit units (i.e., the log odds of being correct). We report exponential betas (e^B), and their 95% confidence intervals, which give the coefficient as an odds ratio (i.e., the odds of being correct by the odds of being incorrect). Thus, e^B can be interpreted as the extent to which the odds of being correct changed. Specifically, values greater than 1 represent an increased likelihood of being correct while values less than 1 represent a decreased likelihood of being correct. Additionally, with this approach, the effect of one predictor occurs while controlling for the other predictors.

Results revealed that cue (coded as 0 = Friend, 1 = You) significantly predicted recall [e^B = 1.63, CI: 1.20–2.21, z = 3.14, p = .002] such that You words were recalled better than Friend words. Additionally, importance judgments significantly predicted recall [e^B = 1.02, CI: 1.01–1.02, z = 6.68, p < .001] such that words judged as more important to remember were better recalled. Furthermore, age (coded as 0 = young, 1 = old) significantly predicted recall [e^B = .34, CI: .22 – .53, z = −4.84, p < .001] such that younger adults recalled more words than older adults. However, cue did not interact with age [e^B = .93, CI: .50–1.70, z = −.25, p = .805], importance judgments did not interact with age [e^B = 1.00, CI: .99–1.01, z = .55, p = .585], cue did not interact with importance judgments [e^B = 1.01, CI: 1.00–1.01, z = 1.19, p = .232], and there was not a three-way interaction between cue, importance judgments, and age [e^B = 1.00, CI: .98–1.02, z = −.06, p = .955].

To investigate potential differences in participants' ability to distinguish between studied and novel words, A′ was calculated for each participant using hit rates (i.e., correct identifications of studied words; M = .78, SD = .17) and false alarm rates (i.e., instances in which participants incorrectly identified a new item as having been studied; M = .09, SD = .15). An independent samples t-test revealed that A′ for younger adults (M = .90, SD = .10) was similar to A′ for older adults (M = .92, SD = .05), [$t(82)$ = 1.11, p = .270, d = .24, BF_{01} = 2.57]. Additionally, to examine differences in A′ as a function of cue, we conducted a 2 (age: young, old) x 2 (cue: Friend, You) mixed ANOVA. Results revealed that A′ for You words (M = .92, SD = .09) was greater than A′ for Friend words (M = .90, SD = .08), [$F(1, 82)$ = 11.34, p = .001, η2 = .12, BF_{10} = 24.40]. However, results did not reveal a main effect of age [$F(1, 82)$ = 1.31, p = .256, η2 = .02, BF_{01} = 1.84], and age did not interact with cue [$F(1, 82)$ = .04, p = .845, η2 < .01, BF_{01} = .26].

An analysis of participants' confidence on the recognition test revealed that confidence for You words (M = 86.32, SD = 16.69) was greater than confidence for Friend words (M = 81.69, SD = 16.88), [$F(1, 82)$ = 12.62, p < .001, η2 = .13, BF_{10} = 40.57]. However, younger adults were similarly confident (M = 78.53, SD = 12.69) as older adults (M = 79.56, SD = 21.68), [$F(1, 82)$ = 1.31, p = .255, η2 = .02, BF_{01} = 1.76]. Additionally, age did not interact with cue [$F(1, 82)$ = .27, p = .607, η2 < .01, BF_{01} = .13].

Discussion

In Experiment 1, we presented younger and older adults with a list of unassociated words with each word followed by a cue indicating whether the participant ("You") or a hypothetical friend ("Friend") was responsible for remembering the word. Although older adults displayed an overall recall deficit, both younger and older adults were sensitive to the You and Friend cues in their recall. Specifically, regardless of age, participants selectively remembered words they were responsible for remembering at the expense of

words their friend was responsible for remembering. Additionally, there were no age-related differences in recognition, consistent with prior work (Bowen, Gallant, & Moon, 2020; Craik & Schloerscheidt, 2011; Danckert & Craik, 2013). However, both younger and older adults better recognized and were more confident in their recognition of You words compared with Friend words.

Both younger and older adults' recall and recognition sensitivity to cue manifested in their judgments of the importance of remembering each word such that both younger and older adults rated words they were responsible for remembering as more important than words their friend was responsible for remembering. Additionally, both younger and older adults recalled words they determined were important to remember better than words they rated as less important, even when controlling for the cue indicating who was responsible for remembering it. Collectively, Experiment 1 illustrates that both younger and older adults can engage responsible remembering mechanisms by forgetting information that does not need to be remembered and remembering important information.

Experiment 2

In Experiment 1, we compared younger and older adults' tendency to strategically forget information by evaluating group differences in the proportion of You and Friend words remembered. Results revealed a retrieval advantage for words participants were responsible for remembering compared with words their friend was responsible for remembering. Additionally, both younger and older adults better recalled words they rated as important to remember, even when controlling for the cue indicating who was responsible for remembering it. In Experiment 2, rather than presenting younger and older adults with a list of unassociated words, we investigated the effects of schematic support on responsible forgetting. Schematic support occurs when prior knowledge enhances recall and older adults often strategically utilize the benefits of schematic support to increase memory outcomes (Castel, 2005; Craik, 2002; Craik & Bosman, 1992; McGillivray & Castel, 2017). Additionally, schematic support may influence how importance shapes memory such that remembering important information may supersede the potential benefits of strategically forgetting it. Thus, relative to younger adults, we expected older adults to demonstrate less strategic forgetting as a result of the benefits of prior knowledge but for older adults' recall to be more sensitive to item importance.

Method

Participants

Younger adults (n = 62; M_{age} = 20.34, SD_{age} = 2.06) were recruited from the UCLA Human Subjects Pool. Participants were tested online and received course credit for their participation. Older adults (n = 59; M = 72.05, SD = 5.30) were recruited from Amazon's Cloud Research. Older adults received $1.50 for completing the experiment, which took approximately 15 minutes. 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 zero exclusions from the younger adult group and three exclusions from the older adult group. A power analysis

indicated that for a 2 (age: young, old) x 2 (cue: Friend, You) mixed ANOVA, with a high correlation between repeated-measures, assuming alpha = .05, power = .80, a total of 74 participants would be needed to reliably detect a medium effect size (η2 = .10).

Materials and Procedure

The task in Experiment 2 was similar to the task in Experiment 1 except participants studied a list of items offering schematic support rather than unassociated words. Specifically, participants were told to imagine that they and a hypothetical friend were going on a camping trip and that they would be presented with a list of items to pack for the camping trip (see Appendix for stimuli).

Results

Recall performance as a function of age and cue is shown in Figure 3. A 2 (age: young, old) x 2 (cue: Friend, You) mixed ANOVA on recall performance revealed that participants recalled more You items (M = .46, SD = .20) than Friend items (M = .41, SD = .19), [F(1, 119) = 6.43, p = .013, η2 = .05, BF_{10} = 3.10]. Additionally, younger adults recalled a greater proportion of items (M = .50, SD = .14) than older adults (M = .37, SD = .15), [F(1, 119) = 27.75, p < .001, η2 = .19, BF_{10} > 100]. However, age did not interact with cue [F(1, 119) = .03, p = .867, η2 < .01, BF_{01} < .01].

Figure 4 displays the probability of recall as a function of cue and item importance for younger and older adults. An analysis of importance ratings revealed that participants rated You items (M = 68.23, SD = 20.79) as more important than Friend items (M = 62.48, SD = 23.28), [F(1, 119) = 7.92, p = .006, η2 = .06, BF_{10} = .45]. However, younger adults' importance ratings (M = 63.22, SD = 17.07) were similar to older adults' (M = 67.60, SD = 23.28), [F(1, 119) = 1.60, p = .208, η2 = .01, BF_{01} = 2.03]. Additionally, age did not interact with cue [F(1, 119) = 2.19,

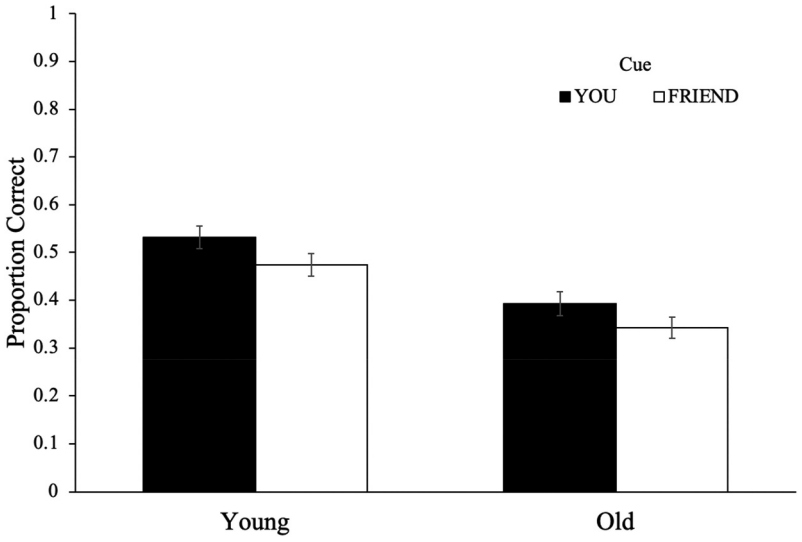

Figure 3. Recall performance as a function of age and cue in Experiment 2. Error bars reflect the standard error of the mean.

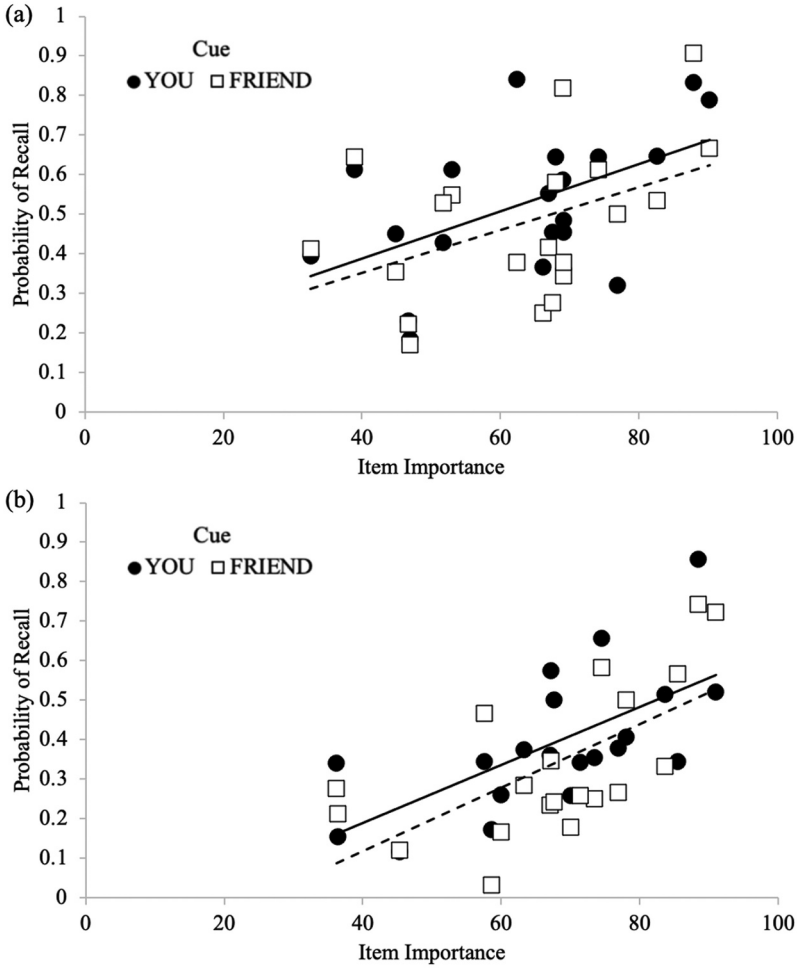

Figure 4. Probability of recall as a function of cue and item importance with regression lines in for younger adults (a) and older adults (b) in Experiment 2.

$p = .142$, $\eta 2 = .02$, $BF_{01} = 18.61$]. Thus, similar to Experiment 1, younger and older adults rated items they were responsible for remembering as more important to remember and better remembered these items, and older adults recalled fewer words overall.

Again, to supplement these findings, we computed a MLM with cue, importance judgments, and age predicting recall. Results revealed that cue significantly predicted recall [$e^B = 1.20$, CI: 1.01–1.42, $z = 2.03$, $p = .042$] such that You words were recalled better than Friend words. Additionally, importance judgments significantly predicted recall [$e^B = 1.01$, CI: 1.01–1.02, $z = 10.18$, $p < .001$] such that words judged as more important to remember were better recalled. Furthermore, age significantly predicted recall [$e^B = .52$, CI: .41 – .65, $z = -5.66$, $p < .001$] such that younger adults recalled more words than older adults. However, cue did not interact with age [$e^B = 1.10$, CI: .78–1.55, $z = .53$, $p = .599$], importance judgments did not interact with age [$e^B = 1.00$, CI: .99–1.01, $z = -.09$,

p = .931], cue did not interact with importance judgments [e^B = 1.00, CI: 1.00–1.01, z = .11, p = .913], and there was not a three-way interaction between cue, importance judgments, and age [e^B = .99, CI: .98–1.00, z = −1.56, p = .119].

To investigate potential differences in participants' ability to distinguish between studied and novel items, we again calculated A′ for each participant using hit rates (M = .93, SD = .11) and false alarm rates (M = .05, SD = .10). An independent samples t-test revealed that A′ for younger adults (M = .96, SD = .07) was similar to A′ for older adults (M = .97, SD = .04), [$t(119) = 1.06$, p = .292, d = .19, BF_{01} = 3.11]. However, to examine differences in A′ as a function of cue, we conducted a 2 (age: young, old) x 2 (cue: Friend, You) mixed ANOVA. Results revealed that A′ for You items (M = .97, SD = .05) was similar to A′ for Friend items (M = .96, SD = .07), [$F(1, 119) = 3.84$, p = .052, η2 = .03, BF_{01} = 1.15]. Additionally, results did not reveal a main effect of age [$F(1, 119) = 1.14$, p = .287, η2 = .01, BF_{01} = 1.85], and age did not interact with cue [$F(1, 119) = 1.73$, p = .191, η2 = .01, BF_{01} = 3.20].

An analysis of participants' confidence judgments revealed that confidence for You items (M = 96.31, SD = 7.65) was similar to confidence for Friend items (M = 95.40, SD = 10.72), [$F(1, 119) = 2.58$, p = .111, η2 = .02, BF_{01} = 2.16]. Additionally, younger adults were similarly confident (M = 89.94, SD = 13.32) as older adults (M = 94.41, SD = 10.36), [$F(1, 119) = .97$, p = .326, η2 = .01, BF_{01} = 1.99]. Moreover, age did not interact with cue [$F(1, 119) < .01$, p = .967, η2 < .01, BF_{01} = 18.76].

Discussion

In Experiment 2, we presented younger and older adults with a list of items to pack for a camping trip with the participant ("You") and a "Friend" each responsible for remembering half of the items. Results revealed that younger adults recalled more items overall than older adults but both groups were similarly sensitive to the You and Friend cues. Specifically, both younger and older adults rated You items as more important to remember than Friend items and also better recalled You items (but there were no differences in recognition or confidence as a function of cue or age). Additionally, when controlling for the You and Friend cues, item importance drove memory in both younger and older adults, consistent with engaging in responsible remembering (Murphy & Castel, 2020, 2021a, 2021b). As such, younger and older adults may have adapted to be responsible rememberers as a product of experiences of a friend forgetting something important. For example, if a forgetful friend is responsible for remembering water (a crucially important item), it may be of adaptive benefit to remember water even if someone else was responsible for remembering it. Collectively, Experiment 2 indicates that both younger and older adults engage in forms of responsible remembering such that memory can be driven by importance.

General Discussion

Whether remembering items on a shopping list, a child's allergies, or packing for a camping trip, people often share memory responsibilities. This form of collaborative memory (see Rajaram & Pereira-Pasarin, 2010), or a group's shared memory and knowledge, may serve a functional benefit such that if everyone has less information to remember, each individual

may be more likely to remember information that they are responsible for remembering. Thus, engaging in responsible forgetting (see Murphy & Castel, 2021a) by strategically forgetting less important information to enhance the recall of target information may be a critical function of our memory system, and something that may be especially important when memory is impaired in older age.

In the current study, we presented younger and older adults with a list of words with each word followed by a cue indicating whether the participant ("You") or a hypothetical "Friend" was responsible for remembering it. Additionally, after studying each word, participants were asked to rate the importance of remembering it. Relative to younger adults, we expected older adults to demonstrate increased strategic forgetting behavior by demonstrating a greater tendency to remember items they were responsible for remembering at the expense of items their friend was responsible for remembering. Furthermore, we expected participants (particularly older adults) to rate items they were responsible for remembering as more important than items their friend was responsible for remembering, illustrating their strategic utilization of memory and intact responsible remembering mechanisms in older age.

In Experiment 1, younger and older participants demonstrated enhanced recall and recognition for words from the list (unassociated words) that they were responsible for remembering and recall was generally sensitive to participants' importance ratings. However, we hypothesized that in a more applied context (Experiment 2), older adults may use schematic support to also remember many of the items their friend was responsible for remembering. Consistent with prior work (see Salthouse, 2019; Thomas & Gutchess, 2020), older adults recalled fewer words than younger adults but when the to-be-remembered information benefited from schematic support, the ability to use prior knowledge or semantic memory to aid in the processing and memory of new information did not result in differential forgetting in younger and older adults. Specifically, regardless of age, participants used importance to guide the encoding and retrieval of information while also better recalling items they were responsible for remembering compared with items their friend was responsible for remembering.

Participants' better memory for information they were responsible for remembering compared with items their friend was responsible for remembering may be attributable to the *self-reference effect* whereby people better remember items that are arbitrarily associated with themselves rather than to others (see Gutchess, Kensinger, Yoon, & Schacter, 2007; Symons & Johnson, 1997; Zhang et al., 2020). Specifically, since the self is generally a well-elaborated concept in memory, it is easier to associate information with the self. For example, in the current study, a given participant may remember the tent or a pillow because they can think about packing their own tent or choosing which of their pillows to take. In contrast, thinking of someone else packing those items, even a particular friend, is unlikely to elicit such a rich memory network.

Since their "friend" was responsible for remembering half of the items, participants appear to have attempted to maximize memory utility by either inhibiting goal-irrelevant (Friend items) information to enhance the recall of target information (You items; see Anderson, 2003; Anderson et al., 1994; Storm & Levy, 2012; but see Lehman, McKinley-Pace, Leonard, Thompson, & Johns, 2001; MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003) or selectively encoded target information leading to the responsible forgetting of less relevant information (see Bjork, 1972; Johnson, 1994; MacLeod, 1975; Tan, Ensor,

Hockley, Harrison, & Wilson, 2020). Regardless of the mechanism, if older adults can engage in responsible remembering, despite impairments in memory, then we expected older adults' recall to be more to the judged importance of each item. Specifically, despite many memory deficits, prior work indicates that older adults can selectively remember important items that are task-relevant (McGillivray & Castel, 2017; see also Swirsky & Spaniol, 2019).

Results revealed that both younger and older adults were generally sensitive to item importance such that items judged as more important to remember were better recalled, consistent with engaging in responsible remembering (Murphy & Castel, 2020, 2021a, 2021b). Specifically, when remembering unassociated words and items to pack for a camping trip, both the cue indicating who was responsible for remembering the word as well as the judged importance of the word accounted for unique variance in performance. Thus, participants engaged in responsible remembering by best remembering information with consequences if forgotten, consistent with prior work demonstrating that younger and older adults better remember valuable information regardless of whether instructed to remember or forget it (Bowen et al., 2020).

In the present study, participants' memory for important information may be attributable to the *survival effect*: enhanced memory when to-be-remembered items are rated for survival versus pleasantness (e.g., Nairne & Pandeirada, 2008; Nairne, Thompson, & Pandeirada, 2007), and this survival benefit has also been shown in older adults (Stillman, Coane, Profaci, Howard, & Howard, 2014; Yang, Lau, & Truong, 2014). Specifically, when studying a list of items to pack for a camping trip, it is imperative to remember important items like the tent, a tarp, and water while forgetting things like cards, soap, or a clock is relatively inconsequential. Thus, when remembering a list of items, learners can maximize memory utility by remembering the most important information at the expense of less important information, even if this information could potentially be offloaded (i.e., externally recording information and memories to reduce cognitive demand; see Risko & Dunn, 2015; Risko & Gilbert, 2016; Sparrow, Liu, & Wegner, 2011; Storm & Stone, 2014). For example, if an irresponsible friend forgets the tent, a responsible rememberer could remember this item themselves and avoid sleeping in the cold. In the present study, we demonstrated that both younger and older adults generally remember the items they consider important to remember, even if their friend was responsible for remembering them, illustrating an adaptive form of responsible remembering.

In Experiment 1, when learners had little to base their importance judgments on, participants may have been more likely to relate the information to themselves. In contrast, in Experiment 2, importance ratings were likely driven more by the survival effect than the self-reference effect. Specifically, the importance of remembering items to survive a camping trip seemed to influence memory more than the cue that indicated who was responsible for remembering it. Thus, the different effects observed in Experiments 1 and 2 may have arisen from items of importance competing for cognitive resources and memory being differentially influenced by each item's importance in terms of personal relevance or its importance for surviving a camping trip.

To further elucidate responsible forgetting behavior in younger and older adults, future work could examine memory without asking participants to judge the importance of each item to see how importance drives memory without being explicitly evaluated. Additionally, there may be some difficulty interpreting recognition performance following a free recall

test (i.e., repeatedly testing memory could inflate recognition of the previously recalled words from the free recall test without affecting new items) and future research could benefit from examining recall and recognition separately. Furthermore, additional work could solicit importance ratings after retrieval (see Murphy & Castel, 2021a, Experiment 3) to determine whether younger or older adults demonstrate a forgetting bias, where they devalue information that has been forgotten (Castel, Rhodes, McCabe, Soderstrom, & Loaiza, 2012b; Rhodes, Witherby, Castel, & Murayama, 2017; Witherby, Tauber, Rhodes, & Castel, 2019). Older adults may believe that they are more likely to remember important information and forget less important information and subsequently demonstrate a larger forgetting bias relative to younger adults.

While the present work suggests that responsible forgetting can potentially aid memory for important information, we did not directly test if there was a trade-off between forgetting and enhanced memory. There may be benefits to forgetting irrelevant information (such as preventing interference), and this could be more directly tested in a paradigm in which there are consequences, or trade-offs, between memory for important information and remembering information that was marked for forgetting. As such, the present work does not unambiguously show that participants carried out willful forgetting (compared to selective encoding) that benefits overall memory performance. It may be that selective encoding plays more of a role than an active forgetting process, and also that the two processes are inter-related. For example, for older adults, there may be less concern about the remembering of lower value information, and this could ensure that more attention is directed to prioritize the recall of important, goal-relevant information. Thus, while the present work suggests that responsible forgetting could help memory efficiency, future research is needed to determine if there are clear benefits of forgetting certain outdated or unnecessary information that can then directly influence, and possibly enhance, the ability to selectively focus on important information.

The present study is consistent with responsible remembering, the self-relevance effect, and the survival effect. Although these phenomena are likely related, there are also several differences. First, we examined the "responsible" aspect of memory, both subjectively and objectively, in that the onus was placed on the participant to selectively and strategically remember goal-relevant items, allowing for novel insights regarding how importance guides those processes. Furthermore, we examined both remembering and forgetting, and how directed forgetting mechanisms may play a role. Specifically, unlike much prior work, we demonstrated how people (young and old) could selectively and strategically forget information that they were no longer responsible for remembering rather than directly instructed to forget.

In sum, the current study revealed that both younger and older adults engage strategic memory mechanisms to maximize memory utility for important, goal-relevant information. Specifically, when presented with lists of words that either they or a friend is responsible for remembering, both younger and older adults strategically remembered items they were responsible for remembering, recalling fewer items their friend was responsible for remembering while also using importance to drive memory. As such, both younger and older adults were sensitive to item importance by best recalling the items that they rated as most important to remember, regardless of who is responsible for remembering them. Thus, responsible forgetting can enhance memory utility in both

younger and older adults by using importance to drive both remembering and forgetting, reducing the potential consequences of forgetting important information.

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Appendix

Unassociated words	Camping items	Unassociated word lures	Camping item lures
actor	ax	bandage	batteries
cheek	backpack	beak	camera
chord	boots	beggar	candles
circus	cards	broom	cooler
cliff	chair	crumb	flares
dough	clock	decoy	gloves
fever	compass	drizzle	gun
lesson	cups	fable	honey
nerve	lantern	flannel	knife
palace	marshmallows	knuckle	lighter
prism	matches	napkin	map
receipt	pillow	noodle	pants
ribbon	shovel	racquet	radio
scholar	soap	skillet	shirts
sticker	tarp	slipper	socks
sunset	tent	sneeze	speaker
thorn	toothbrush	speck	spikes
tunnel	water	starch	sunscreen
venue	whistle	twig	swimwear
vitamin	wood	vase	towel