# Memory Selectivity in Younger and Older Adults:

# The Role of Conative Factors in Value-Directed Remembering

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**CRediT Author Statement**

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**Abstract**

Memory selectivity refers to our ability to flexibly prioritize and remember important information over less important information. In three studies, we investigated the roles of various conative factors (i.e., task-specific motivation, memory self-efficacy, and self-determined learning goals) as mechanisms that might support intact, if not superior, memory selectivity in older age. Specifically, all three studies assessed efficacy beliefs (in younger and older adults) before participants completed a standard value directed remembering (VDR) task. Measures of task-specific motivation (Studies 1-3) and self-determined learning goals (Studies 2-3) were also included. Results suggested that older adults were generally more selective and more motivated to perform well on the VDR task compared to younger adults, even though they were also less confident in their memory abilities and tried to remember fewer words on each list. Critically, though, heightened task-specific motivation was associated with a tendency to recall a greater proportion of the to-be-remembered material but was not consistently associated with selectivity. A weak negative correlation between motivation and selectivity was only found in Study 3. However, inefficacious beliefs and lower self-determined learning goals were reliably associated with superior memory selectivity. Path analyses further revealed that memory self-efficacy and self-determined learning goals accounted for older adults' tendency to selectively remember important information. Collectively, these results are consistent with the idea that awareness of current memory limitations encourages older adults to focus on less material, which helps older adults more efficiently allocate attention to important information.

*Keywords*: selectivity; memory; motivation; self-efficacy; goals

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**Public Significance Statement**

Older adults often show memory impairments but may selectively remember high-value information. The present studies suggest that older adults prioritize valuable information by strategically focusing on less material during learning, because they recognize their limitations in remembering large amounts of information. This narrow focus seemingly helps older adults more efficiently allocate limited attentional resources to the most important information, resulting in memory performance similar to that of younger adults.

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**Memory Selectivity in Younger and Older Adults:**

**The Roles of Conative Factors in Value-Directed Remembering**

We often encounter more information than we can process at a given moment, and this information varies in its relevance to our lives. Memory selectivity—the ability to prioritize and successfully remember more important information over less important information—enables us to function more effectively in a variety of environments. For example, during a doctor's appointment, a patient might receive a wealth of information about their health, including test results, medication instructions, lifestyle recommendations, and preventive measures. Selectivity allows patients to focus on critical information that directly impacts their well-being (e.g., a new medication schedule or specific dietary restrictions necessary for managing conditions like diabetes or arthritis) while filtering out less immediately relevant details (e.g., information about screenings for low-risk conditions or a reminder to get a flu shot).

A key method for studying memory selectivity, and age-related differences therein, is the value-directed remembering (VDR) paradigm (see Castel, 2024 for review). In this paradigm, participants typically study multiple lists of stimuli, with each to-be-remembered (TBR) item paired with a specific point (Castel et al., 2002) or monetary (Adcock et al., 2006) value. Participants earn points or money if they correctly remember the accompanying item during test and are instructed to maximize their total earnings on each list. Both younger and healthy older adults are sensitive to value (for review, see Knowlton & Castel, 2022), such that they remember information associated with higher value better than information associated with lower value.

Critically, while younger adults typically outperform older adults in *overall* episodic memory performance, age-related differences in memory performance often diminish or disappear for high-value information (Castel et al., 2002, 2007, 2013); hence older adults may be more sensitive to information that is useful or has some contextual meaning (Hess, 2005; Hess & Emery, 2012). Yet, it remains unclear how the ability to prioritize and successfully remember important information is preserved in older age, especially when opportunities for self-regulated study are limited. The present study sought to fill in this gap by investigating the potential roles of various conative factors[1]—volitional aspects of behavior like task-specific motivation, memory self-efficacy, and self-determined learning goals—as mechanisms that might support intact, or superior, memory selectivity in older age.

## Background

Enhanced memory selectivity is largely achieved by differential encoding of high-value information. For example, when study time is self-paced, both younger and older adults spend more time studying TBR items paired with higher values (Castel et al., 2013). Both age groups also report using effective strategies (e.g., mental imagery) to learn high-value information and often choose not to study low-value information at all (Ariel et al., 2015). Relative to ineffective strategies (e.g., rote rehearsal) or the absence of a strategy, employing effective encoding strategies requires additional attentional resources (i.e., effort; Craik & Byrd, 1982; Miller & Unsworth, 2020). Even when study time is controlled, pupil dilation—a physiological index of attentional effort (see Kahneman, 1973)—is largest when younger adults study high-value items (Ariel & Castel, 2014; Kahneman & Peavler, 1969; Miller et al., 2019). Although research has not yet examined pupillary responses (during a VDR task) in older adults, recent work suggests that valuing the TBR material promotes consistent on-task focus under fixed study times for adults of all ages. Namely, both younger and older adults are less susceptible to lapses of

[1] Research has largely focused on cognitive factors as predictors of variation in memory selectivity (Elliot et al., 2020; Griffin et al., 2019; Robison & Unsworth, 2017). Cognitive factors deal with mental abilities, procedural skills, and knowledge. Conative factors, on the other hand, more so concern the drive and actions taken toward goal achievement (Corno et al., 2002; Kanfer, 1987; Snow, 1989; Wechsler, 1950).

attention (e.g., mind-wandering) when studying important information (Miller & Castel, 2025b). Compared to instances in which participants report experiencing an attentional lapse, on-task focus is associated with higher effort expenditure (larger pupillary responses) during encoding and superior subsequent memory at the within- and between-subject levels (Miller & Unsworth, 2021, 2025). These findings collectively suggest that learners flexibly allocate more attentional effort to the most important information (partly through use of elaborative encoding strategies), which results in a stronger memory representation that is likely to be better remembered across various retrieval conditions (Stefanidi et al., 2018).

Attention control abilities encompass, in part, the processes that allow us to sustain and regulate attentional effort both within and across tasks (Unsworth & Miller, 2021, 2024). Thus, in the context of VDR, attention control may be needed to consistently upregulate the amount of attention devoted to high-value information and downregulate the amount of attention given to low-value information, particularly in situations where study time is not under the participant's direct control and the TBR material is presented sequentially (see Middlebrooks & Castel, 2018). While it remains to be seen whether variation in attention control abilities predict memory selectivity, the most selective individuals—in younger adult samples—generally perform better on measures of episodic long-term memory (Elliot et al., 2020) and working memory (Griffin et al., 2019, Robison & Unsworth, 2017)[2]. As previously mentioned, episodic memory abilities typically decline in older age (Anderson & Craik, 2017; Craik & Byrd, 1982; Craik & Simon, 1980; Hultsch et al., 1990; Park et al., 2002; Rönnlund et al., 2003). Similar age-related declines are observed in working memory (e.g., Salthouse, 1990) and attention control (e.g., Braver &

[2] However, both the former (Table A2 in Miller et al., 2019) and latter (Elliot et al., 2020, Experiment 2 in Miller et al., 2019; Experiment 1 in Robison & Unsworth, 2017) relationships are not always found.

West, 2008; Hasher & Zacks, 1988)[3]. Yet, despite these various cognitive limitations, healthy older adults often exhibit intact (Castel et al., 2009; Miller & Castel, 2025b; Murphy & Castel, 2022) or superior (Castel et al., 2002, 2007, 2013) memory selectivity compared to younger adults. This puzzling pattern of results suggests that older adults rely on additional compensatory mechanisms to effectively attend to the most important information.

In terms of potential compensatory mechanisms, many metacognitive monitoring processes are spared by aging (Hertzog & Curley, 2018; Hertzog & Dunlosky, 2011; Castel et al., 2015). For instance, older adults are often just as accurate as younger adults in discriminating between which information has been learned vs not learned (Connor et al., 1997; Hertzog et al., 2002, 2010; Rhodes & Tauber, 2011). These monitoring processes play a crucial role in shaping beliefs about oneself as a rememberer (Dunlosky & Hertzog, 2000; Hertzog et al., 1990, 1994; Jopp & Hertzog, 2007). A component of these beliefs is one's memory self-efficacy, one's judgement about the ability to successfully perform memory-related tasks (Bandura, 1986). But note efficacy beliefs are not simply inert self-appraisals used to predict future performance; instead, they serve to motivate and guide the actions necessary to achieve one's goals (Bandura, 1989; Miller & Unsworth, 2025).

Older adults report lower memory self-efficacy than younger adults (e.g., Beaudoin & Desrichard, 2011; Lineweaver & Hertzog, 1998). While agist stereotypes likely influence these perceptions (Lineweaver et al., 2009; Vallet et al., 2015), older adults' self-efficacy beliefs also stem from realistic self-assessment and active performance monitoring. For instance, although

[3] Attention control (i.e., cognitive control, executive control, executive attention) is a broad construct that can be divided into several related but distinct processes, or types of control. Depending on the theoretical framework, types of control include updating, inhibition, and switching (Miyake et al., 2000); goal maintenance and conflict resolution (Engle & Kane, 2004); proactive and reactive control (Braver et al., 2007); and constraint, restraint, and sustained attention (Kane et al., 2016; Unsworth et al., 2020, 2021). Age-related declines typically emerge in prepotent response inhibition (i.e., active goal maintenance, proactive control, and attentional restraint; Braver, 2012; Braver & West, 2011; Butler & Zacks, 2006; Nicosia et al., 2021; Park & Reuter-Lorenz, 2009).

individuals often under- and overestimate their memory performance, Hertzog and colleagues (1990, 1994) demonstrated that older adults were more accurate than younger adults in predicting their performance on an upcoming episodic memory task. Furthermore, the accuracy of these predictions increased as a function of task experience for adults of all ages (see also Lachman et al., 1987; McDonald-Miszczak et al., 1994), suggesting both age groups become increasingly accurate in evaluating their memory abilities as they gain relevant task experience.

## Present Study

Knowlton and Castel (2022) proposed that older adults, recognizing they can no longer learn as much as they once did, compensate by directing their limited attentional resources to the most important information (see also Castel et al., 2012). However, direct evidence for this notion is lacking. The present study therefore examined whether memory self-efficacy underlies older adults' preserved or enhanced memory selectivity. Specifically, if older adults *believe* they are incapable of remembering all presented information, they may strategically focus on a select subset of TBR material. In a VDR paradigm, where the objective is to maximize earnings or points, this subset likely consists of items associated with the highest possible values.

For example, consider a list of 12 TBR items, each assigned a point value ranging from 1 to 12 (Castel et al., 2002; Watkins & Bloom, 1999). An individual who believes they can recall only four items might attempt to learn five, so they prioritize study of items worth eight or more points. Recalling words worth 8, 9, 11, and 12 points yields a total score of 40, close to the ideal score of 42 points (achieved by recalling items worth 9, 10, 11, and 12 points). Conversely, someone who believes they can remember most of the TBR items might still attend to value but also strive to maximize the total number of words recalled. They might recall words worth 4, 6, 7, 9, 11, and 12 points, earning 49 out of a possible 57 points. Although this second individual recalls more items and earns more points overall, they are less selective than the first individual.

Accordingly, memory self-efficacy should negatively predict memory selectivity, regardless of the accuracy of these beliefs. Still, with sufficient experience, both younger and older adults can accurately gauge their task-specific memory abilities (Hertzog et al., 1990, 1994). This accuracy, coupled with ageist stereotypes, likely contributes to older adults' lower confidence in their memory abilities (Beaudoin & Desrichard, 2011; Lineweaver & Hertzog, 1998). Low self-efficacy may prompt older adults to focus on a narrower subset of the TBR material (i.e., set lower learning goals; West et al., 2003), which may help them more efficiently allocate attention to the most important information. Thus, self-determined learning goals should also negatively correlate with memory selectivity.

Another related yet theoretically distinct conative factor is task-specific motivation—one's desire to perform well on a given task (Kanfer, 1987). Compared to younger adults, older adults report higher motivation to succeed on laboratory memory tasks[4] (Miller & Castel, 2025b), even though they feel less confident in their task-specific memory abilities (Beaudoin & Desrichard, 2011; Lineweaver & Hertzog, 1998) and set easier learning goals (Price et al., 2009; West et al., 2003). These findings raise the possibility that older adults' preserved or enhanced memory selectivity is also driven by heightened task-specific motivation (Swirsky & Spaniol, 2019). That is, perhaps older adults, in their effort to maximize performance and compensate for existing memory limitations, are simply more motivated to prioritize and attend to high-value information.

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[4] Similar results arise when younger and older adults complete laboratory attention control tasks (Frank et al., 2015; Jackson & Balota, 2012; Moran et al., 2021; Niscosia & Balota, 2021; Robison et al., 2022; Seli et al., 2017, 2021).

Overall, the present study addressed two main questions: (1) Do the conative factors show reliable and differential associations with age and memory selectivity? (2) Do the conative factors explain older adults' intact—or superior—selectivity? Three studies were conducted to address these questions. Each study assessed task-specific motivation and efficacy beliefs in younger and older adults. In Studies 2 and 3, participants also reported their self-determined learning goal (i.e., the number of words they intended to learn and correctly recall) for each wordlist. Studies 2 and 3 primarily differed in the amount of feedback provided after each list, but Study 3 also featured a larger sample to more reliably assess the correlations of interest[5].

## Study 1

Our first objective was to replicate the finding that memory selectivity is preserved (Castel et al., 2009; Miller & Castel, 2025b), if not superior (Castel et al., 2002, 2007, 2013), in healthy older adults. We also sought to replicate research suggesting older adults are more motivated to perform well on laboratory memory tasks (Miller & Castel, 2025b) despite having less confidence in their memory abilities (Beaudoin & Desrichard, 2011; Lineweaver & Hertzog, 1998).

Second, we sought to examine whether the conative factors correlate with memory selectivity when controlling for age. We expected individuals with lower self-efficacy to show increased selectivity, but we made no specific prediction about the correlation between task-specific motivation and selectivity. Because the goal of the task is to maximize one's total points, higher motivation could enhance the encoding of high-value information by encouraging individuals to allocate more attention to these specific items (positive correlation). Alternatively, heightened motivation could improve overall recall without affecting selectivity (no correlation),

[5] Strategy use and negative affect were also examined in all three studies. Our interest in these constructs was exploratory in nature, so all methods and analyses concerning these variables are in Supplementary Materials.

if the desire to succeed encourages individuals to consistently ramp up the amount of attention devoted to all TBR material, regardless of value. A final possibility is that increased motivation might prompt individuals to prioritize recalling the maximum number of items at the expense of value (negative correlation).

Finally, we aimed to test whether conative factors can explain why older adults tend to prioritize and better remember important information. Using path-analytic techniques, we expected an indirect effect of age on selectivity to arise through self-efficacy, consistent with the idea that one's awareness of task-relevant memory limitations may be critical for older adults to experience the need to be selective (Castel, 2024; Castel et al., 2015). While we anticipated that older adults would be more motivated to perform well than younger adults, we did not have a specific hypothesis regarding an indirect effect of age on selectivity via motivation.

# Method

## ***Transparency and Openness***

The data and task stimuli are all publicly available on the Open Science Framework (https://osf.io/953dh; see Miller & Castel, 2025a). All figures were created in *R* using the *tidyverse* (Wickham, 2017). Path models were analyzed using the *lavaan* package in *R* (Rosseel, 2012). All other analyses were conducted in IBM SPSS Statistics (Version 29). We report how we determined our sample sizes, all data exclusions, all manipulations, and all measures throughout the present study. The present study was not preregistered.

## **Participants**

The sample included 50 younger adults and 50 older adults. We determined that approximately 85 participants in total would be required to detect a partial correlation of .30 (controlling for one covariate: age group) with 80% power at $\alpha$ =.05. We selected .30 as our benchmark for the largest plausible partial correlation, following updated effect size guidelines for individual differences research (Funder & Ozer, 2019; Gignac & Szodorai, 2016) which classifies $r$ =.10 as a small effect, $r$ = .20 as a medium effect, and $r$ = .30 as a large effect. Since data were collected online, we opted to recruit 50 participants per age group to ensure a sufficient sample.

**Table 1**
*Participant demographics for each age group in Study 1*

| **Demographic variable** | **Younger adults (Sona)** | **Older adults (Prolific)** |
|---|---|---|
| Mean age | 20.15 | 70.76 |
| (*SD* age) | (1.35) | (4.41) |
| Gender | | |
| Female | 67.5% | 63.0% |
| Male | 30.0% | 37.0% |
| Non-Binary or Other | 2.5% | .0% |
| Race | | |
| Asian | 35.0% | .0% |
| Black | 2.5% | 4.3% |
| Hispanic or Latino/a/x | 27.5% | .0% |
| White | 27.5% | 95.7% |
| Other or Unknown | 7.5% | .0% |
| Health | | |
| Poor | 2.5% | .0% |
| Fair | .0% | 8.7% |
| O.K. | 15.0% | 28.3% |
| Good | 50.0% | 43.5% |
| Excellent | 32.5% | 19.6% |
| Education | | |
| High school diploma | 15.0% | 8.7% |
| Some college, no degree | 65.0% | 19.6% |
| Associate degree | 15.0% | 4.3% |
| Bachelor's degree | 2.5% | 37.0% |
| Professional degree (Master's, PhD, MD, etc) | 2.5% | 30.4% |

*Note*. Most participants reported themselves to be in good health ($M$ = 3.91, $SD$ = .88; range 1-5) and to have obtained an associate degree ($M$ = 2.92, $SD$ = 1.34; range 1-5). A Mann-Whitney $U$ test revealed younger adults had significantly lower levels of education than older adults ($z$ = -4.89, $p$ < .001), which is not surprising given our younger adult sample was comprised of undergraduate students. Younger adults also self-reported significantly higher levels of current health quality than older adults ($z$ = -2.06, $p$ = .039).

Younger adult participants were recruited through the human subject pool at the University of California, Los Angeles (UCLA)—a large public university in an urban setting—and were compensated with course credit. Older adult participants were recruited using Prolific and were paid for their participation ($10/hr). To participate in the study, younger adults had to be no more than 34 years old, and older adults had to be at least 64 years old. All participants were required to be fluent speakers of English, and all data was collected online during the Spring Quarter of 2023. Ten younger adults (final $N = 40$) and four older adults (final $N = 46$) were excluded from analyses. See Appendix A for detailed description of exclusions across studies.

**Procedure**

Participants first provided informed consent and demographic information (see Table 1). They then completed a short practice version of a delayed free recall (DFR) task—without any value-directed remembering (VDR) component—to gauge how much information they could remember when no competing task goal was present. After this initial practice, participants completed a memory self-efficacy questionnaire. Next, participants were informed about the VDR manipulation and completed another short practice that included point values. Throughout the experimental trials, participants reported their task-specific motivation. Upon task completion, they filled out questionnaires assessing encoding strategy use and affect (see Supplementary Materials). Finally, participants were presented with a few questions regarding potential experimental issues (e.g., technical difficulties), cheating, or other reasons for which their data should be excluded from analyses. Participants were reassured that, regardless of their responses, they would be compensated for their time. The study protocol was approved by the Institutional Review Board of UCLA (project title: Memory, Attention, Emotion, and Aging;

protocol number: 12-000617). All participants were treated in accordance with the ethical standards of the American Psychological Association and were debriefed following the session. The entire online session lasted roughly 45 minutes.

## Materials

### *DFR with VDR Manipulation*

Participants were told that they would be studying lists of words for a subsequent memory test. The task began with two practice lists of ten words each, presented *without* point values and with *no* feedback. Next, participants completed an assessment of memory self-efficacy. Afterwards, they were informed that the upcoming experimental trials would include word-value pairs indicating how many points each TBR word would be worth at test. Their goal was to recall as many of the words in each list as possible while achieving a maximal score, a sum of the points associated with each word that was accurately recalled.

Participants then completed a third practice list containing ten words, each paired with a point value from 1 to 10. The experimental phase followed, consisting of eight lists of 12 words each. Although participants knew each list would contain 12 words with values ranging from 1 to 12, they were not told how many lists they would complete overall. No TBR words repeated within or across lists. The stimuli were randomized nouns drawn from the Toronto word pool (Friendly et al., 1982) and ranged in length from four to six letters (averaging 4.58 to 4.67 letters per list). Each point value appeared once within a list, and the order of these values within lists was pseudo-randomized. Each word was displayed for 2 s with a 500 ms interstimulus interval.

At the end of each list, a 30 s distractor task began: participants saw a series of three-digit numbers for 2.5 s each and were instructed to identify via key press whether the first digit (on the left) or the last digit (on the right) in each sequence was larger. Participants were encouraged to respond as quickly and accurately as possible. Following the distractor task, participants had 70 s to recall as many words as possible from the corresponding list. Participants typed their answers into a response field at the center of the screen. The screen advanced automatically once time elapsed. Participants were shown their total point score for that list, but they did not receive feedback on specific words or the total number of words recalled.

### ***Memory Self-Efficacy***

We administered an adapted version of the Memory Self-Efficacy Questionnaire (MSEQ; Berry, 1999). Participants reviewed statements such as, "If studying a list of 12 words, I could remember at least 2 words total," "If studying a list of 12 words, I could remember at least 4 words total," and "If studying a list of 12 words, I could remember all 12 words." For each statement, participants indicated "No" or "Yes." We summed the number of "Yes" responses to create a self-efficacy *level* score. Next, participants rated their confidence in each statement using a scale from 1 (lowest) to 10 (highest), and we averaged these ratings to derive a self-efficacy *strength* score. Participants then provided a *performance prediction* by answering, "If presented with a list of 12 words, how many words do you think you'll remember?" Consistent with Miller and Unsworth (in press, 2025), we entered the level, strength, and performance prediction measures into a principal component analysis to create an overall memory self-efficacy factor score. For details regarding correlations among these measures and factor loadings across studies, see Appendix B.

### ***Task-Specific Motivation***

Participants rated their motivation level eight times. The first rating occurred after the final practice list but before the experimental trials, when participants were asked, "How motivated are you to perform well on this memory task?" Ensuing ratings took place immediately before each new list, after participants received feedback on their point total from the previous list. At these times, they were asked, "How motivated are you to perform well on the next list?" In all cases, participants responded using a 7-point scale (1 = "Not at all motivated" to 7 = "Extremely motivated").

## Results and Discussion

Descriptive statistics appear in the Supplementary Materials (see Table S1). Apart from older adults' mean motivation levels, all measures were approximately normally distributed (i.e., skewness < 2; kurtosis < 4; Kline, 2016). For older adults, motivation was near ceiling. A normal distribution was obtained with a log10 transformation, but re-running analyses with the transformed data did not change any interpretations of the results. Therefore, we report analyses using the untransformed data.

### *Recall Accuracy*

We first sought to replicate established effects of value and age on recall performance. Given each wordlist contained one trial for each possible point value, we grouped lists into blocks to examine performance across the task (Castel et al., 2013; Hoover et al., 2024; McGillivray & Castel, 2011). Block 1 consisted of lists 1-2, block 2 included lists 3-4, block 3 contained lists 5-6, and block 4 comprised lists 7-8. Accordingly, we submitted recall accuracy to a repeated measures ANOVA with value (1-12) and block (1-4) as within-subject factors. All omnibus tests treated value as a continuous variable with 12 levels. To simplify interpretations of results, we report pairwise comparisons obtained after rerunning the corresponding analysis with a categorical value variable. Points 1-4 were considered low, points 5-8 were considered mid, and points 9-12 were considered high.

As expected, the analysis revealed a significant main effect of value, $F(11, 935) = 56.00$, $p < .001$, $MSE = .24$, partial $\eta^2 = .40$, indicating words associated with higher points were best remembered. Specifically, high-value words ($M = .73$, $SE = .02$) were remembered better than mid-value words ($M = .53$, $SE = .02$), which were better remembered than low-value words ($M = .31$, $SE = .03$), all *ps* $< .001$. A main effect of block also emerged [$F(3, 255) = 4.99$, $p = .002$, $MSE = .05$, partial $\eta^2 = .06$], which was qualified by an interaction with value, $F(33, 2805) = 4.25$, $p < .001$, $MSE = .07$, partial $\eta^2 = .05$. Pairwise comparisons revealed a significant negative linear effect of block among *low*-value words [$F(1, 85) = 13.37$, $p < .001$, $MSE = .02$, partial $\eta^2 = .14$], suggesting participants recalled fewer of these words with increased task experience (see Table 2 for means and standard errors). Turning to *mid*-value items, a significant main effect of block emerged that was quadratic in nature [$F(1, 85) = 8.55$, $p = .004$, $MSE = .02$, partial $\eta^2 = .09$], insofar that recall accuracy increased across the first half of the task then decreased over the remainder. Finally, examining recall accuracy for *high*-value words revealed no significant effect of block, $p = .816$. These results are consistent with the idea that, while participants reliably prioritized high-value words at the expense of low-value words, increased task experience primarily served to help participants de-emphasize study of words associated with the lowest values.

**Table 2**
*Pairwise comparisons for the main effect of Block (levels 1-4) at each level of Point Value (Low vs Mid vs High) across all studies.*

| | Block 1 | Block 2 | Block 3 | Block 4 |
|---|---|---|---|---|
| Study 1 | | | | |
| Low | .36[a] (.03) | .34[a] (.03) | .27[b] (.03) | .29[b] (.03) |
| Mid | .51[b] (.03) | .57[a] (.02) | .54[ab] (.02) | .51[b] (.03) |
| High | .73[a] (.02) | .73[a] (.02) | .75[a] (.02) | .73[a] (.02) |
| Study 2 | | | | |
| Low | .43[a] (.03) | .33[bc] (.02) | .32[b] (.03) | .36[c] (.03) |
| Mid | .50[a] (.02) | .61[b] (.02) | .55[c] (.02) | .54[ac] (.02) |
| High | .66[a] (.02) | .69[a] (.02) | .73[b] (.02) | .73[b] (.02) |
| Study 3 | | | | |
| Low | .42[a] (.02) | .38[b] (.02) | .34[c] (.02) | .38[b] (.02) |
| Mid | .51[a] (.01) | .59[b] (.01) | .56[c] (.02) | .57[bc] (.02) |
| High | .68[a] (.01) | .71[b] (.01) | .75[c] (.01) | .74[c] (.01) |

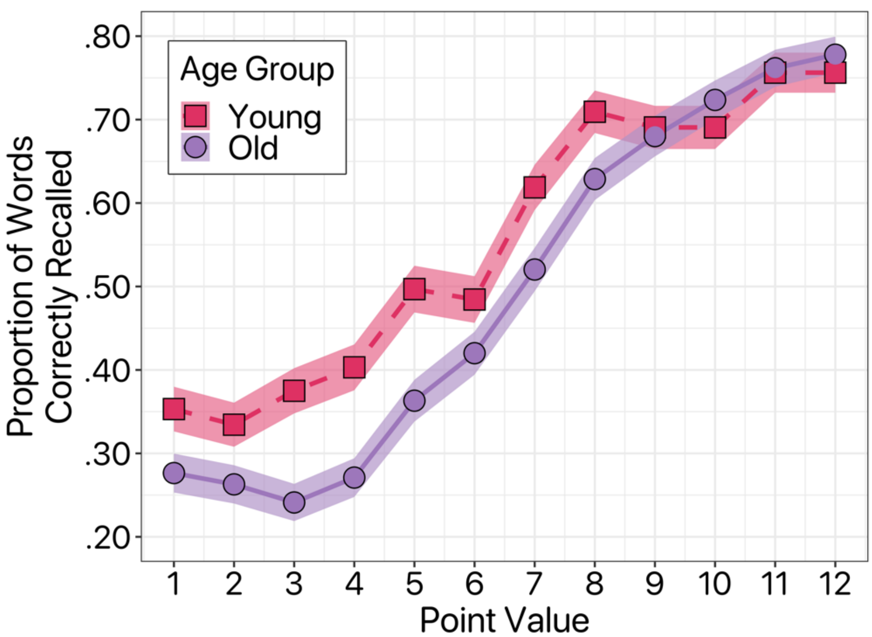
*Note*. Values denote mean recall accuracy with standard errors in parentheses. Different subscripted letters in a row indicate the means are significantly different at $p < .05$. Low = points 1-4; Mid = points 5-8; High = points 9-12. In Study 1, the difference between Block 2 and Block 4 (among low-value items) was just approaching conventional levels of significance at $p = .058$. In Study 3, the difference between Block 1 and Block 2 (among high-value items) was similarly approaching conventional levels of significance at $p = .064$.

Adding age group as a between-subjects factor to the repeated measures ANOVA revealed the main effect of age was not quite significant [$F(1, 84) = 3.10$, $p = .082$, $MSE = .92$, partial $\eta^2 = .04$]. However, an interaction arose between age group and value, indicating the effect of age on recall accuracy depended on value, $F(11, 924) = 2.04$, $p = .022$, $MSE = .24$, partial $\eta^2 = .02$. As demonstrated in Figure 1, younger adults ($M_{Low\text{-}value} = .37$, $SE_{Low\text{-}value} = .04$;

$M_{Mid\text{-}value}$ = .58, $SE_{Mid\text{-}value}$ = .03) outperformed older adults ($M_{Low\text{-}value}$ = .27, $SE_{Low\text{-}value}$ = .04; $M_{Mid\text{-}value}$ = .49, $SE_{Mid\text{-}value}$ = .03) when studying information of low and moderate value, but older adults ($M_{High\text{-}value}$ = .74, $SE_{High\text{-}value}$ = .03) performed as well as younger adults ($M_{High\text{-}value}$ = .73, $SE_{High\text{-}value}$ = .03) when studying information of high value. All other age-related effects in the omnibus test were non-significant ($ps > .16$). Taken altogether, both age groups showed better memory for high-value information than low-value information. But, relative to younger adults, older adults' memory performance was more strongly influenced by the value of the TBR information (Castel et al., 2002, 2007, 2013); hence older adults were more selective than younger adults.

**Figure 1**

*Proportion of words correctly recalled (recall accuracy) as a function of value and age group.*




*Note*. Shaded regions represent one standard error of the mean.

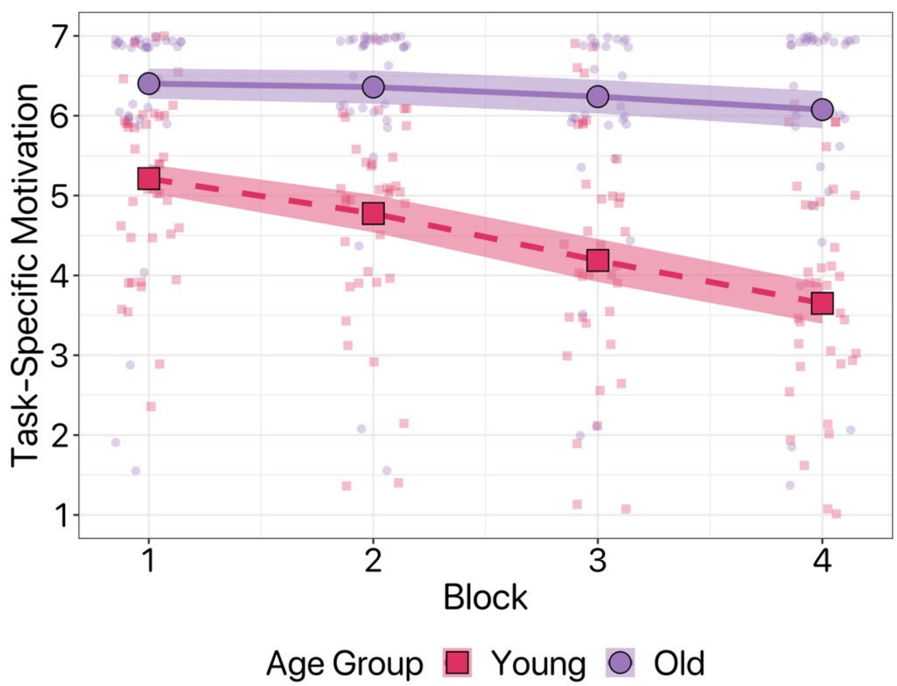
***Conative Factors***

We also sought to replicate research suggesting older adults are more motivated to perform well on laboratory tasks (Frank et al., 2015; Jackson & Balota, 2012; Moran et al., 2021;

Niscosia & Balota, 2021; Robison et al., 2022; Seli et al., 2017, 2021). Like the analyses examining recall accuracy, we grouped motivation judgments across lists into blocks. A repeated measures ANOVA with block (1-4) as a within-subject factor revealed a significant main effect of block [$F(3, 255) = 30.55$, $p < .001$, $MSE = .44$, partial $\eta^2 = .26$], suggesting motivation declined from the beginning to the end of the task. Specifically, motivation to perform well on the memory task was higher on the first block ($M = 5.85$, $SE = .15$) than the second ($M = 5.62$, $SE = .18$), third ($M = 5.29$, $SE = .20$), and fourth ($M = 4.95$, $SE = .22$) blocks. All pairwise comparisons were significant, *ps* < .003.

**Figure 2**

*Task-specific motivation as a function of block and age group.*




*Note*. Shaded regions represent one standard error of the mean. The jittered points reflect individual participant scores for a given block.

Adding age group as a between-subject factor revealed a main effect of age group [$F(1, 84) = 37.73$, $p < .001$, $MSE = 7.45$, partial $\eta^2 = .31$] as well as an interaction between age group and block, $F(3, 252) = 16.93$, $p < .001$, $MSE = .37$, partial $\eta^2 = .17$. Younger adults were less motivated to perform well on the DFR-VDR task ($M$ = 4.46, $SE$ = .22) compared to older adults ($M$ = 6.27, $SE$ = .20) in general, but age-related differences in task-specific motivation became larger in magnitude as time on task ensued (see Figure 2).

Next, we sought to replicate the finding that younger adults report higher memory self-efficacy than older adults (Beaudoin & Desrichard, 2011; Lineweaver & Hertzog, 1998). Indeed, an independent samples $t$-test revealed that older adults were less confident in their task-specific memory abilities ($M$ = -.28, $SE$ = .13) than younger adults ($M$ = .22, $SE$ = .15), $t(84) = -2.49$, $p$ = .015, 95% CI [-.89, -.10], Cohen's $d$ = .54. To examine potential age differences in metacognitive monitoring, we also examined the accuracy of these judgments, using simple difference scores (Accuracy = Performance Prediction – Mean Recall Accuracy). Critically, the accuracy of performance predications did not vary across age groups, $t(84) = .48$, $p$ = .630, 95% CI [-.04, .07], Cohen's $d$ = .11. Both younger ($M$ = -.07, $SE$ = .03) and older ($M$ = -.08, $SE$ = .01) adults tended to slightly underestimate their performance. Similar results emerged when comparing one's predicted performance to their actual performance on the first list ($p$ = .831).

***Correlations***

Given age-related differences emerged in both conative factors, we next examined whether these factors correlate with selectivity when controlling for age. To do so, we computed a selectivity index (SI) for each participant, which represents an individual's total point score relative to a chance score and an ideal score (Castel et al., 2002). Higher SI scores indicate increased sensitivity to value (see also Cohen et al., 2014). Table 3 lists partial correlations among all variables controlling for age group. Age group was recoded such that younger adults were 0 and older adults were 1. Notably, the most selective individuals tended to be individuals who believed they were incapable of remembering many words (i.e., individuals with low memory self-efficacy). Increased motivation to perform well was associated with superior recall accuracy but was not associated with variation in SI scores.

**Table 3**

*Partial correlations between all measures in Study 1 (controlling for age group)*

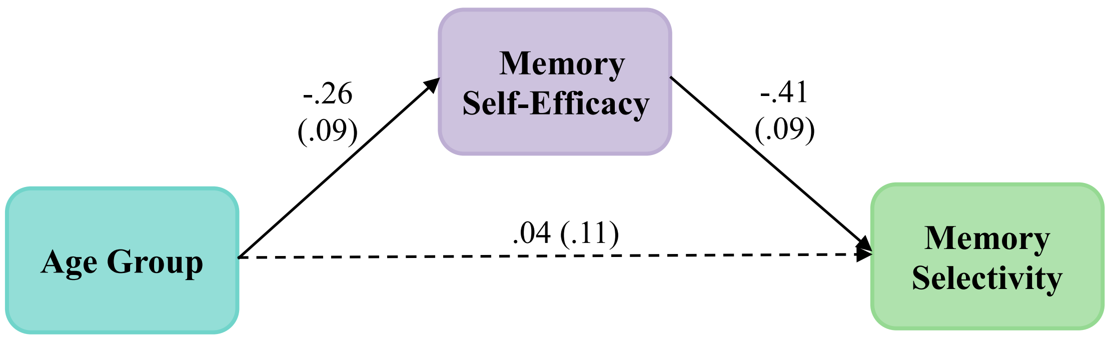
| Measure | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| (1) Recall accuracy | – | | | |
| (2) Selectivity index | $-.40^{***}$ | – | | |
| (3) Mean motivation | $.39^{***}$ | -.01 | – | |
| (4) Memory self-efficacy | $.60^{***}$ | $-.40^{***}$ | $.34^{**}$ | – |

*Note*. * $p$ <.05, ** $p$ <.01, *** $p$ <.001; Age was recoded so that younger adults were 0 and older adults were 1; Recall accuracy = proportion of correctly recalled words; Memory self-efficacy = memory self-efficacy factor composite score obtained pre-task (using scores from adapted MSEQ and performance prediction).

Finally, we tested the notion that efficacy beliefs explain older adults' tendency to prioritize and remember important information. We specified a path model where age group predicted self-efficacy. Age group and self-efficacy each predicted SI scores (memory selectivity). Shown in Figure 3 is the resulting model. Age group negatively predicted self-efficacy, and self-efficacy had a significant (negative) direct effect on SI scores. The indirect effect of age group on SI scores through self-efficacy was significant ($\beta$ = .11, $SE$ = .05, $p$ = .011, 95% CI [.03, .19]). Thus, the tendency for older adults to selectivity remember the most important information was largely explained by the belief that they are less capable of accurately remembering a large amount of material.

In sum, older adults recognized they were less likely to remember all the TBR material, and their recall was more sensitive to value. Path analytic techniques indicated that this awareness of existing memory limitations (manifested in lower self-efficacy beliefs) accounted for older adults' tendency to selectively attend to the most important information. Older adults were also more motivated to perform well, and age-related differences in motivation became larger in magnitude as time on task increased. Yet, task-specific motivation was unrelated to memory selectivity. Increased task-specific motivation was, however, associated with a tendency to recall a greater proportion of the TBR material. These results suggest that the desire to perform well primarily encouraged individuals to allocate more attentional effort to all TBR material, regardless of an item's value.

**Figure 3**
*Path model predicting overall memory selectivity (as indexed by the selectivity index) in Study 1.*




*Note*. Single-headed arrows connecting manifest variables (rectangles) to each other represent standardized path coefficients, indicating the unique contribution of the manifest variable. Solid lines indicate significant paths at $p < .005$, whereas dashed lines represent non-significant paths. Age was treated as a binary variable (younger adults = 0, older adults = 1); Memory self-efficacy = memory self-efficacy factor composite score obtained pre-task (using scores from adapted MSEQ and performance prediction); Memory selectivity = mean selectivity index.

## Study 2

Study 2 was conducted to accomplish two main objectives. First, we sought to replicate the effects observed in Study 1 as well as the finding that individuals with low efficacy beliefs, particularly older adults, set lower learning goals (Price et al., 2010; West et al., 2003). Our second, primary goal was to investigate whether self-determined learning goals, like self-efficacy, contribute to older adults' intact or superior memory selectivity. We reasoned that, when learning conditions offer limited opportunities to self-regulate study, individuals with low self-efficacy might compensate for their perceived limitations by focusing on a smaller subset of items they believe they can remember. When studying information of varying value, this subset of material is likely to consist of the highest-value items. Therefore, setting lower learning goals may similarly reflect an accurate self-assessment of one's abilities, facilitating a more efficient allocation of attention towards the most important information.

We expected older adults to set easier learning goals than younger adults (Price et al., 2010; West et al., 2003) and for self-determined learning goals to positively correlate with memory self-efficacy (Miller & Unsworth, 2025; West & Thorn, 2001). We also anticipated indirect effects of age on selectivity to emerge through self-efficacy and self-determined learning goals, suggesting spared or enhanced memory selectivity in older age is driven by personal memory beliefs and adaptive goal-setting behaviors.

# Method

## Participants

The sample included 67 younger adults and 63 older adults. We sought to recruit a larger sample than in Study 1, in line with recent research that used path analytic techniques to examine age-related differences in other constructs (Robison et al., 2022). Participants were recruited and compensated in the same manner described in Study 1. All data was collected online during the Fall Quarter of 2023. Seven younger adults (final $N = 60$) and nine older adults (final $N = 54$) were excluded from analyses (see Appendix A). A power analysis indicated that, with a total sample size of 114 participants, we could detect partial $rs \geq .26$ (controlling for one covariate: age group) with 80% power and $\alpha = .05$. Participant demographics appear in Table 4.

**Table 4**
*Participant demographics for each age group in Study 2*

| **Demographic variable** | **Younger adults (Sona)** | **Older adults (Prolific)** |
|---|---|---|
| Mean age | 20.27 | 67.74 |
| (*SD* age) | (1.31) | (4.02) |
| Gender | | |
| Female | 83.3% | 61.1% |
| Male | 15.0% | 38.9% |
| Non-Binary or Other | 1.7% | .0% |
| Race | | |
| Asian | 41.7% | 1.9% |
| Black | 1.7% | 1.9% |
| Hispanic or Latino/a/x | 11.7% | 1.9% |
| White | 38.3% | 94.4% |
| Other or Unknown | 6.7% | .0% |
| Health | | |
| Poor | .0% | 3.7% |
| Fair | 8.3% | 22.2% |
| O.K. | 11.7% | 24.1% |
| Good | 55.0% | 42.6% |
| Excellent | 25.0% | 7.4% |
| Education | | |
| Some high school | .0% | 1.9% |
| High school diploma | 13.3% | 7.4% |
| Some college, no degree | 56.7% | 22.2% |
| Associate degree | 21.7% | 13.0% |
| Bachelor's degree | 8.3% | 35.2% |
| Professional degree (Master's, PhD, MD, etc) | .0% | 20.4% |

*Note*. Most participants reported themselves to be in good health ($M = 3.64$, $SD = .99$; range 1-5, with "Poor" coded as 1 and "Excellent" coded as 5) and to have obtained an associate degree ($M = 2.76$, $SD = 1.21$; range 0-5, with "Some High School" coded as 0 and "Professional Degree" coded as 5). Younger adults had significantly lower levels of education than older adults ($z = -4.67$, $p < .001$). Younger adults also self-reported being in better health than older adults ($z = -3.74$, $p < .001$).

## Procedure

Study 2 adopted the same procedure as Study 1, with three key differences. (1) Rather than assess motivation on a list-by-list basis, we assessed goals. Motivation was now measured twice during the DFR-VDR task: one item appeared before beginning the first experimental list, whereas the other item appeared immediately upon completion of the final experimental list. (2) Participants no longer completed a third practice list with point values before beginning the experimental trials on the DFR-VDR task. (3) We modified the feedback provided following completion of each experimental list. Participants were now informed of both their point totals and the number of words recalled for a given list. Since all other materials are identical to Study 1, we only describe new materials below.

## Materials

### *Self-Determined Learning Goals*

Participants were asked to indicate their personal goal for each list. Before beginning the experimental trials, participants saw the following: "My goal for the first list is to accurately remember __ words out of the 12 possible words." Ensuing self-report items appeared immediately before beginning the next list but after receiving feedback for the just completed list. In each case, participants were asked to fill in the blank by clicking on the answer (1-12) that best reflected the number of words they would try to learn and correctly remember.

## Results & Discussion

Descriptive statistics for each age group are listed in Supplementary Materials (see Table S2).

### *Recall Accuracy*

Using the same analysis described in Study 1, a main effect of value arose [$F(11, 1243) = 66.69$, $p < .001$, $MSE = .20$, partial $\eta^2 = .37$], indicating high-value words ($M = .70$, $SE = .01$) were remembered better than mid-value words ($M = .55$, $SE = .02$), which were better remembered than low-value words ($M = .36$, $SE = .02$), all *ps* < .001. The main effect of block was non-significant [$F = .95$, $p = .418$], but an interaction between block and value arose, *F*(33,

3729) = 17.54, $p < .001$, *MSE* = .07, partial $\eta^2 = .13$. Pairwise comparisons revealed a negative linear [$F(1, 113) = 8.40$, $p = .005$, *MSE* = .03, partial $\eta^2 = .07$] and quadratic [$F(1, 113) = 27.22$, $p < .001$, *MSE* = .02, partial $\eta^2 = .19$] effect of block among *low*-value items. That is, recall accuracy for the least valuable words decreased across the first three blocks then slightly increased on the final block (see Table 2 for means and standard errors). Turning to *mid*-value items, a main effect of block emerged that was quadratic in nature, $F(1, 113) = 17.73$, $p < .001$, *MSE* = .02, partial $\eta^2 = .14$. Recall accuracy for words of moderate value increased across the first half of the task then slightly declined and reached asymptote. Finally, examining recall accuracy for *high*-value items revealed a positive linear trend in which the most valuable items were recalled better across blocks, $F(1, 113) = 14.76$, $p < .001$, *MSE* = .03, partial $\eta^2 = .12$. Overall, these results broadly replicate Study 1 and are consistent with the idea that participants were increasingly able to prioritize high-value words at the expense of low-value words with additional task experience (Castel et al., 2002, 2007; McGillivray & Castel, 2011).

Adding age group as a between-subjects factor to the repeated measures ANOVA revealed a main effect of age [$F(1, 112) = 21.08$, $p < .001$, *MSE* = 1.02, partial $\eta^2 = .16$], suggesting younger adults (*M* = .60, *SE* = .02) accurately remembered more information in general relative to older adults (*M* = .47, *SE* = .02). All other age-related effects in the omnibus test were non-significant (*p*s > .69). Thus, unlike Study 1, no age-related differences emerged in sensitivity to value, suggesting memory selectivity was intact but not superior in older adults (Castel et al., 2009; Miller & Castel, 2025b; Murphy & Castel, 2022). These results collectively suggest that advanced age seemingly led to a decline in the amount of information that could be remembered overall. But, all individuals, regardless of age, displayed enhanced memory for high-value information at the expense of memory for low-value information.

***Conative Factors***

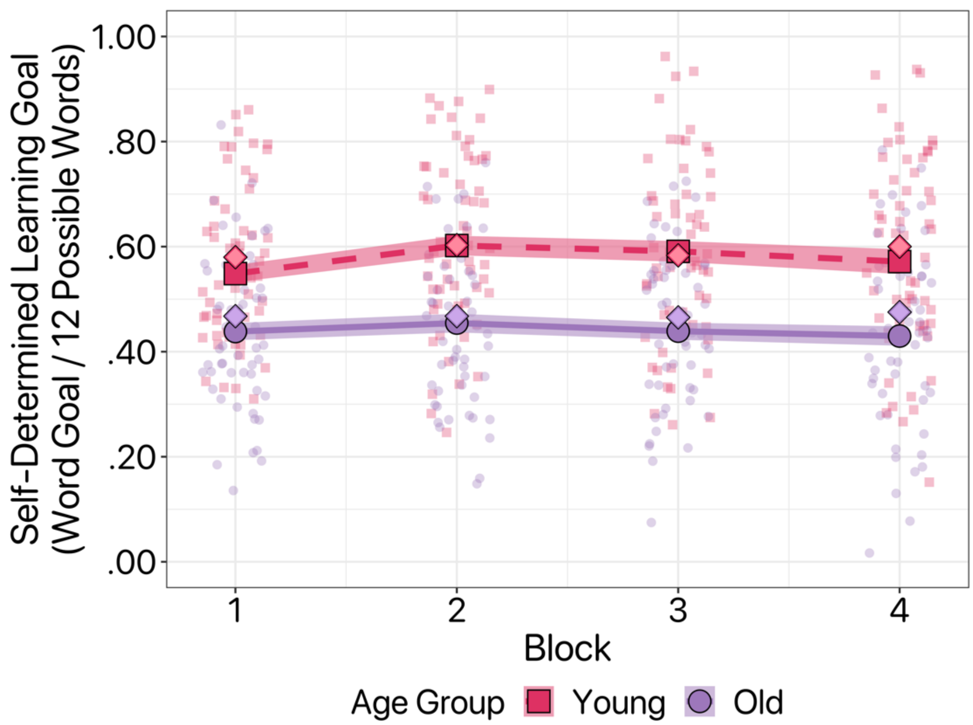
Further replicating Study 1, older adults were less confident in their task-specific memory abilities (*M* = -.35, *SE* = .12) compared to younger adults (*M* = .28, *SE* = .13), $t(112) = -3.67$, $p < .001$, 95% CI [-.97, -.29], Cohen's *d* = .69. The accuracy of performance predications did not vary across age groups, $t(112) = -.20$, $p = .840$, 95% CI [-.06, .05], Cohen's *d* = .04. Both younger (*M* = -.071, *SE* = .02) and older (*M* = -.066, *SE* = .02) adults tended to slightly underestimate their performance. Results remain unchanged when comparing predicted performance to actual performance on the just the first list ($p = .770$).

Despite exhibiting lower self-efficacy for the task at hand, older adults were again significantly more motivated to perform well overall (*M* = 5.78, *SE* = .16) relative to younger adults (*M* = 5.16, *SE* = .12), $t(112) = 3.18$, $p = .002$, 95% CI [.23, 1.01], Cohen's *d* = .60. But age-related differences in motivation did not vary as a function of time ($F = 1.51$, $p = .221$). For all individuals, motivation was higher at the beginning (*M* = 5.69, *SE* = .10) than at the end (*M* = 5.25, *SE* = .14) of the task.

Next, we examined age-related differences in self-set goals. Like the analyses examining recall accuracy, we grouped goals across lists into blocks. We also converted each goal into a proportion score to more easily compare goals with performance. The repeated measures ANOVA revealed a main effect of block [$F(3, 339) = 5.38$, $p = .001$, $MSE = .01$, partial $\eta^2 = .05$], suggesting individuals set increasingly more challenging goals across the first few lists then set progressively easier goals across the final few lists. Specifically, self-set goals were slightly easier on the first block (*M* = .50, *SE* = .01) than the second (*M* = .53, *SE* =.02) and third (*M* = .52, *SE* = .02) blocks, $ps < .023$. The first block did not differ from the fourth block (*M* = .51, *SE* = .02; $p = .526$), but goals on this final block of lists were significantly easier than goals on the second block of lists, $p = .008$. The difference between the third and fourth blocks was not quite significant, $p = .058$.

Critically, adding age group as a between-subjects factor revealed a main effect of age group [$F(1, 112) = 34.10$, $p < .001$, $MSE = .06$, partial $\eta^2 = .23$] but no interaction between age group and block, $F = 1.79$, $p = .149$. Therefore, younger adults set more challenging learning goals ($M = .58$, $SE = .02$) than older adults ($M = .44$, $SE = .02$) in general, and the magnitude of these age differences remained relatively stable as time on task ensued (see Figure 4).

**Figure 4**
*Self-determined learning goals as a function of block and age group.*




*Note*. Shaded regions represent one standard error of the mean. The jittered points reflect individual participant goals for a given block. The overlayed diamonds reflect the corresponding group's mean recall accuracy for a given block.

### ***Correlations***

As demonstrated in Table 5, higher selectivity, as indexed by SI scores, was again associated with lower efficacy. Importantly, higher SI scores were also associated with the tendency to set less ambitious learning goals. As previously mentioned, older adults judged themselves to be less capable of remembering all the TBR material and—despite being more motivated to perform well—tried to remember fewer words on each list. Accordingly, we next sought to test the notion that preserved memory selectivity in older age is driven by personal memory beliefs and adaptive goal-setting behaviors. Note, however, that self-set goals were especially highly correlated with self-efficacy—consistent with previous research adopting similar methods (Miller & Unsworth, 2025). To reduce issues of multicollinearity, we created an efficacy-goal composite for each participant by entering self-efficacy factor scores and mean self-determined learning goals into a factor analysis[6].

**Table 5**

*Partial correlations between all measures in Study 2 (controlling for age group)*

| Measure | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| (1) Recall accuracy | – | | | | |
| (2) Selectivity index | -.38*** | – | | | |
| (3) Mean motivation | .15 | -.11 | – | | |
| (4) Memory self-efficacy | .63*** | -.19* | .19* | – | |
| (5) Mean goal difficulty | .75*** | -.27** | .21* | .64*** | – |

*Note*. * $p$ <.05, ** $p$ <.01, *** $p$ <.001; Age was recoded so that younger adults were 0 and older adults were 1; Recall accuracy = proportion of correctly recalled words; Memory self-efficacy = memory self-efficacy factor composite score obtained pre-task (using scores from adapted MSEQ and performance prediction); Mean goal difficulty = mean self-determined learning goal (aggregated across lists) / 12 possible words.

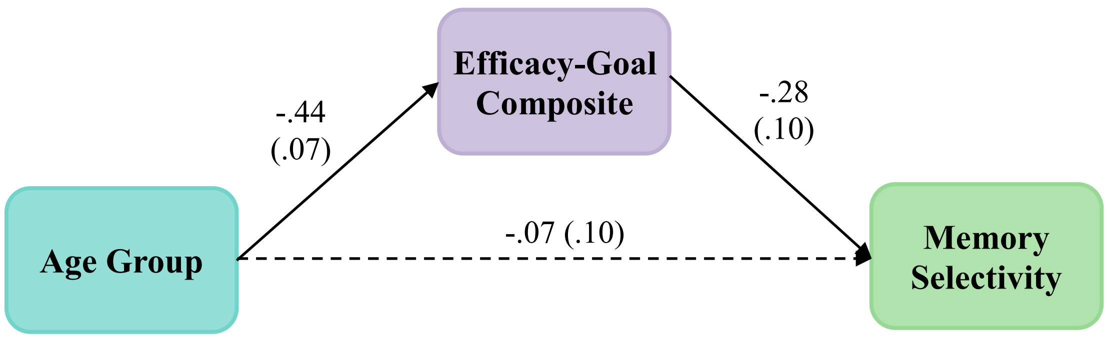
A path model was specified where age group predicted the efficacy-goal composite. Age group and the efficacy-goal composite each predicted SI scores. Shown in Figure 5 is the resulting model. Age group negatively predicted the efficacy-goal composite, which in turn had a significant negative direct effect on SI scores. Critically, the indirect effect of age group on SI

[6] The factor loadings for the first unrotated factor were as follows: self-efficacy (.92) and self-set goal difficulty (.92).

scores through the efficacy-goal composite was significant ($\beta$ = .13, *SE* = .05, *p* = .008, 95% CI [.03, .22]). This finding suggests that the tendency for older adults to selectivity remember the most important information was largely explained by their tendency to strategically focus on a smaller subset of words, driven by their belief in (or awareness of) their inability to remember a large amount of information.

**Figure 5**

*Path model predicting overall memory selectivity (as indexed by the selectivity index) in Study 2.*




*Note*. Single-headed arrows connecting manifest variables (rectangles) to each other represent standardized path coefficients, indicating the unique contribution of the manifest variable. Solid lines indicate significant paths at $p < .005$, whereas dashed lines represent non-significant paths. Age was treated as a binary variable (younger adults = 0, older adults = 1); Memory selectivity = mean selectivity index.

## Study 3

Study 3 sought to replicate the prior studies while addressing methodological limitations. Although Study 2 included a larger sample than Study 1, it still only had sufficient power (80% at $\alpha$ = .05) to detect partial correlations (controlling for age group) of moderate to large magnitude (i.e., *rs* ≥ .26; Funder & Ozer, 2019; Gignac & Szodorai, 2016). Thus, the sample was not large enough to detect smaller motivational influences or a small residual direct effect of age group on selectivity after controlling for the efficacy-goal composite. To mitigate these issues, we recruited a larger sample in Study 3 so we could achieve more precise estimates of the correlations of interest and increase our ability to detect smaller effects.

Another issue—primarily with Study 2—is that we eliminated the need for active performance monitoring by providing participants with explicit feedback on how many words they correctly remembered on each experimental list. If self-determined learning goals accurately reflect one's self-assessment of their memory abilities, the results from Study 2 should replicate even when explicit word feedback is not provided. As such, Study 3 modified the feedback, informing participants only of the points earned on each list (like Study 1). This approach ensures that any age-related differences in learning goals are based on participants' efficacy beliefs and metacognitive monitoring, rather than external feedback. Like Study 2, we expected older adults to set easier learning goals than younger adults and for self-set goals to negatively correlate with selectivity. We also expected goals (and, by extension, self-efficacy) to explain preserved or superior memory selectivity in older age.

## Method

### Participants, Procedure, and Materials

The sample included 145 younger adults and 137 older adults. A power analysis indicated that a total of 242 participants (121 in each age group) would allow us to reliably detect small to moderate effects (*rs* $\geq$ .18; Funder & Ozer, 2019; Gignac & Szodorai, 2016) with 80% power ($\alpha$ = .05) when controlling for age group. Accordingly, we aimed to recruit at least 140 participants per age group by a fixed end date. Data collection took place during the Winter Quarter of 2024. Participants were recruited and compensated in the same manner as in the prior studies. A total of 14 younger adults (final $N$ =131) and 12 older adults (final $N$ = 125) were excluded from analyses (see Appendix A). With this sample size, we could reliably detect partial *rs* $\geq$ .174. Participant demographics are displayed in Table 6.

**Table 6**

*Participant demographics for each age group in Study 3*

| **Demographic variable** | **Younger adults (Sona)** | **Older adults (Prolific)** |
|---|---|---|
| Mean age | 20.85 | 68.74 |
| (*SD* age) | (2.32) | (4.69) |
| Gender | | |
| Female | 80.2% | 52.8% |
| Male | 17.6% | 47.2% |
| Non-Binary or Other | 2.3% | .0% |
| Race | | |
| American Indian or Alaskan Native | .8% | .8% |
| Asian | 36.6% | 1.6% |
| Black | 3.8% | 10.4% |
| Hispanic or Latino/a/x | 22.1% | .8% |
| White | 27.5% | 85.6% |
| Other or Unknown | 9.2% | .8% |
| Health | | |
| Poor | .8% | 4.0% |
| Fair | 9.9% | 16.8% |
| O.K. | 16.0% | 17.3% |
| Good | 54.2% | 48.8% |
| Excellent | 19.1% | 14.4% |
| Education | | |
| Some high school | .8% | 2.4% |
| High school diploma | 16.8% | 16.0% |
| Some college, no degree | 50.4% | 22.4% |
| Associate degree | 22.9% | 13.6% |
| Bachelor's degree | 8.4% | 37.6% |
| Professional degree (Master's, PhD, MD, etc) | .8% | 8.0% |

*Note*. Most participants reported themselves to be in good health ($M$ = 3.68, $SD$ = .98; range 1-5, with "Poor" coded as 1 and "Excellent" coded as 5) and to have obtained an associate degree ($M$ = 2.57, $SD$ = 1.18; range 0-5, with "Some High School" coded as 0 and "Professional Degree" coded as 5). A Mann-Whitney $U$ test revealed younger adults had significantly lower levels of education than older adults ($z$ = -4.46, $p$ < .001). Age-related differences in current health quality were likewise significant ($z$ = -1.99, $p$ = .047).

Study 3 adopted an identical procedure to Study 2, except we altered the feedback provided after each experimental list in the DFR-VDR task. Feedback now only informed participants of their point total (as was done in Study 1). Otherwise, all materials remained the same as Study 2.

## Results & Discussion

Descriptive statistics for each age group are in Supplementary Materials (see Table S3).

### *Recall Accuracy*

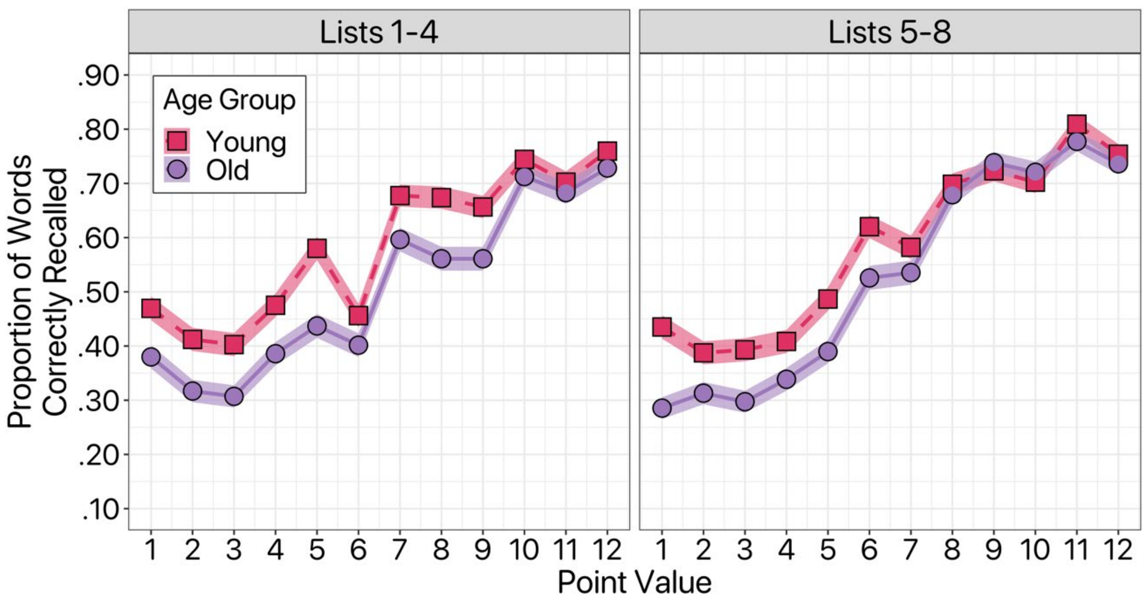
A significant main effect of value emerged [$F(11, 2805) = 140.46$, $p < .001$, $MSE = .20$, partial $\eta^2 = .36$], suggesting high-value words ($M = .72$, $SE = .01$) were remembered better than mid-value words ($M = .56$, $SE = .01$), which were better remembered than low-value words ($M = .38$, $SE = .02$), all *ps* < .001. The main effect of block was not significant [$F = 2.16$, $p = .091$], but an interaction arose between block and value, $F(33, 8415) = 21.70$, $p < .001$, $MSE = .08$, partial $\eta^2 = .08$. Pairwise comparisons revealed both a negative linear [$F(1, 255) = 8.59$, $p = .004$, $MSE = .03$, partial $\eta^2 = .03$] and quadratic [$F(1, 255) = 18.38$, $p < .001$, $MSE = .03$, partial $\eta^2 = .07$] effect of block among *low*-value items. Specifically, recall accuracy declined across the first three blocks, then showed a slight increase on the final block (see Table 2 for means and standard errors). Turning to *mid*-value items, a main effect of block emerged that was similarly linear [$F(1, 255) = 7.83$, $p = .006$, $MSE = .03$, partial $\eta^2 = .03$] and quadratic [$F(1, 255) = 16.30$, $p < .001$, $MSE = .02$, partial $\eta^2 = .06$] in nature. Recall accuracy for moderately valued words increased substantially during the first two blocks, then slightly declined in the third block, and remained unchanged in the final block. Finally, an examination of recall accuracy for *high*-value items revealed a positive linear effect of block [$F(1, 255) = 19.94$, $p < .001$, $MSE = .03$, partial $\eta^2 = .07$], indicating that accuracy for the most valuable words improved across blocks. These results collectively suggest that participants increasingly prioritized recall of high- (and mid-) value words at the expense of low-value words with additional task experience.

Adding age group as a between-subjects factor revealed a main effect of age [$F(1, 254) = 8.36$, $p = .004$, $MSE = 1.28$, partial $\eta^2 = .03$], suggesting younger adults ($M = .59$, $SE = .01$)

accurately remembered more information overall compared to older adults (*M* = .53, *SE* = .02). The three-way interaction between age group, block, and value was non-significant (*p* = .306). But, as demonstrated in Figure 6, an interaction arose between age group and value [$F(11, 2794) = 2.61$, $p = .003$, $MSE = .20$, partial $\eta^2 = .01$], indicating age-related differences in recall accuracy varied as a function of the importance of the TBR material. Consistent with Study 1, age differences emerged in memory performance for lower value information, but no age differences were found for higher value information.

**Figure 6**

*Proportion of words correctly recalled as a function of value, age group, and list.*




*Note*. Shaded regions represent one standard error of the mean.

### *Conative Factors*

Older adults were less confident in their memory abilities (*M* = -.24, *SE* = .09) compared to younger adults (*M* = .23, *SE* = .08), $t(254) = -3.82$, $p < .001$, 95% CI [-.70, -.22], Cohen's $d = .48$. No significant age differences emerged when examining the accuracy of performance predictions, $t(254) = -.34$, $p = .735$, 95% CI [-.04, .03], Cohen's $d = .04$. Both younger (*M* = -.09, *SE* = .01) and older (*M* = -.08, *SE* = .01) adults tended to underestimate their performance. Similar results were found when comparing predicted performance to actual performance on the first list alone ($p$ = .064), although older adults were marginally more accurate (*M* = -.05, *SE* = .01) than younger adults (*M* = -.09, *SE* = .02).

Older adults were more motivated to perform well overall (*M* = 6.28, *SE* = .08) relative to younger adults (*M* = 5.00, *SE* = .11), $t(254) = 9.58$, $p < .001$, 95% CI [1.01, 1.53], Cohen's $d$ = 1.20. A repeated measures ANOVA further revealed a main effect of time [$F(1, 254) = 24.71$, $p < .001$, *MSE* = .96, partial $\eta^2 = .09$], which was qualified by an interaction with age group, $F(1, 254) = 9.21$, $p = .003$, *MSE* = .96, partial $\eta^2 = .04$. Like Study 1, age-related differences in task-specific motivation became larger as a function of time. Namely, older adults exhibited relatively stable levels of motivation from pre- to post-task [$F(1, 124) = 2.93$, $p = .090$, *MSE* = .60, partial $\eta^2 = .02$], whereas younger adults demonstrated a more substantial decline in motivation from pre- to post-task [$F(1, 130) = 24.19$, $p < .001$, *MSE* = 1.31, partial $\eta^2 = .16$].

An examination of self-determined learning goals likewise revealed a main effect of block [$F(3, 765) = 9.23$, $p < .001$, *MSE* = .01, partial $\eta^2 = .04$], suggesting individuals set increasingly more challenging goals across the first few lists and progressively easier goals across the final few lists. Specifically, participants set easier goals on the first block (*M* = .51, *SE* = .01) than the second (*M* = .54, *SE* =.01) and third (*M* = .54, *SE* = .01) blocks, *ps* < .001. Goals on the first block did not differ from the fourth block (*M* = .52, *SE* = .01; $p$ = .228), but self-determined learning goals on these final lists were significantly lower than goals on the second and third blocks, *ps* < .006. Critically, adding age group as a between-subjects factor revealed a main effect of age group [$F(1, 254) = 7.62$, $p = .006$, *MSE* = .09, partial $\eta^2 = .03$] but no interaction between age group and block, $F = .893$, $p = .444$. Therefore, even in the absence of feedback, younger adults tried to remember a greater proportion of TBR words (*M* = .55, *SE* = .01) than older adults (*M* = .50, *SE* = .01), and the magnitude of these age differences remained relatively stable as time on task ensued.

***Correlations***

Higher SI scores were again associated with less efficacious beliefs and the tendency to set lower learning goals (see Table 7). Unlike Studies 1 and 2, a significant, albeit weak correlation also arose between SI scores and task-specific motivation. Individuals who were more motivated to perform well on the DFR-VDR task tended to recall more items overall, but their recall was slightly less sensitive to value.

**Table 7**

*Partial correlations between all measures in Study 3 (controlling for age group)*

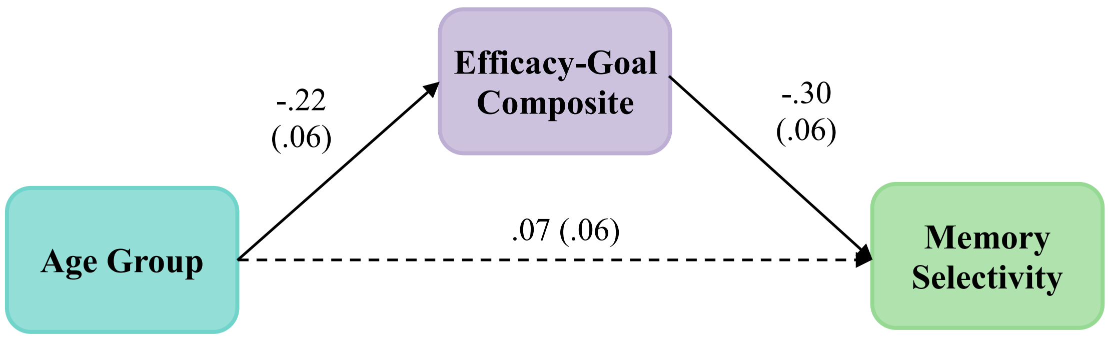
| Measure | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| (1) Recall accuracy | – | | | | |
| (2) Selectivity index | $-.31^{***}$ | – | | | |
| (3) Mean motivation | $.28^{***}$ | $-.15^{*}$ | – | | |
| (4) Memory self-efficacy | $.54^{***}$ | $-.25^{***}$ | $.34^{***}$ | – | |
| (5) Mean goal difficulty | $.72^{***}$ | $-.29^{***}$ | $.43^{***}$ | $.71^{***}$ | – |

*Note*. * $p$ <.05, ** $p$ <.01, *** $p$ <.001; Age was recoded so that younger adults were 0 and older adults were 1; Recall accuracy = proportion of correctly recalled words; Memory self-efficacy = memory self-efficacy factor composite score obtained pre-task (using scores from adapted MSEQ and performance prediction); Mean goal difficulty = mean self-determined learning goal (aggregated across lists) / 12 possible words.

Given increased task-specific motivation was associated with lower selectivity, motivation cannot explain why older adults demonstrated superior sensitivity to value in the present study. That is, increased task-specific motivation among older adults would seemingly promote less selectivity, potentially by encouraging individuals to emphasize recalling a greater number of words at the expense of attending to value. Therefore, to understand intact or superior memory selectivity in older age, factors such as self-efficacy and adaptive goal setting are more likely explanations. To test these notions more directly, we specified a path model where age group predicted an efficacy-goal composite[7]. Age group and the efficacy-goal composite each predicted SI scores. Shown in Figure 7 is the resulting model.

**Figure 7**

*Path model predicting overall memory selectivity (as indexed by the selectivity index) in Study 3.*




*Note*. Single-headed arrows connecting manifest variables (rectangles) to each other represent standardized path coefficients, indicating the unique contribution of the manifest variable. Solid lines indicate significant paths at $p < .001$, whereas dashed lines represent non-significant paths. Age was treated as a binary variable (younger adults = 0, older adults = 1); Memory selectivity = mean selectivity index.

Consistent with the prior studies, age group negatively predicted the efficacy-goal composite, which in turn had a significant negative direct effect on SI scores. Critically, the indirect effect of age group on SI scores through the efficacy-goal composite was significant ($\beta = .07$, $SE = .02$, $p = .001$, 95% CI [.03, .11]). These findings suggest that while older adults were more motivated to perform well, their increased sensitivity to value was largely explained by their strategic focus on a smaller subset of words (i.e., their tendency to set lower learning goals) which was seemingly driven by their belief in their limited ability to remember a large amount of information.

[7] Self-efficacy and mean self-set goal difficulty were again highly correlated (partial $r = .71$). Therefore, like Study 2, we created an efficacy-goal composite for each participant by entering self-efficacy factor scores and mean goal difficulty scores into a factor analysis. The factor loadings for the first unrotated factor were as follows: self-efficacy (.92) and goal difficulty (.92).

## General Discussion

Across three studies, younger adults outperformed older adults in *overall* memory performance when asked to study new information of varying value for a later memory test. Both age groups were highly sensitive to the value of the to-be-remembered (TBR) information, consistently remembering more important information better than less important information. In Study 1 and Study 3, age-related differences in memory performance were even eliminated for high-value information. Thus, older adults demonstrated spared memory selectivity in Study 2 but superior memory selectivity in Study 1 and Study 3. The present study aimed to advance our understanding of the mechanisms underlying this phenomenon by examining two key questions. First, do conative factors (i.e., task-specific motivation, self-efficacy, and self-determined learning goals) show reliable and differential associations with age and memory selectivity? Second, do these conative factors explain preserved or enhanced memory selectivity in older age?

Results across all three studies were consistent with prior work insofar that older age was reliably associated with higher task-specific motivation (Frank et al., 2015; Jackson & Balota, 2012; Moran et al., 2021; Niscosia & Balota, 2021; Robison et al., 2022; Seli et al., 2017, 2021), lower memory self-efficacy (Beaudoin & Desrichard, 2011; Lineweaver & Hertzog, 1998), and lower self-determined learning goals (Price et al., 2009; West et al., 2003). In other words, relative to younger adults, older adults were more motivated to perform well on the memory task even though they were also less confident in their task-relevant memory abilities and set easier learning goals.

While prior work suggests that age-related differences in memory self-efficacy might be influenced by agist stereotypes (Lineweaver & Hertzog, 1998; Lineweaver et al., 2009; Vallet et al., 2015), our results suggest that older adults' inefficacious beliefs (and lower learning goals) reflect a relatively accurate awareness of their abilities. Namely, all three studies demonstrated that the accuracy of performance predictions did not significantly differ across age groups. Furthermore, goals for both younger and older adults were highly associated with previous list performance, even when no explicit feedback was provided (see Figure 4 and Supplementary Materials). These results are consistent with the notion that metacognitive monitoring remains largely intact in older age (Hertzog & Curley, 2018; Hertzog & Dunlosky, 2011).

The present study expanded on prior work by revealing some, but not all, of the conative factors are consistently associated with memory selectivity. Studies 1 and 2 did not detect a significant correlation between selectivity and task-specific motivation. However, the sample sizes in these studies were not large enough to reliably detect small to moderate effects (Funder & Ozer, 2019; Gignac & Szodorai, 2016). In Study 3, we collected a larger sample (final $N$ = 256), which revealed a significant but weak negative correlation between task-specific motivation and memory selectivity. Individuals who were more motivated to perform well tended to display slightly *worse* selectivity. Therefore, heightened motivation among older adults cannot explain why they demonstrate spared (Study 2) or superior (Studies 1 and 3) sensitivity to value.

Apart from age differences, highly motivated individuals tended to recall a greater proportion of the TBR material (Miller & Castel, 2025b; Miller & Unsworth, 2021, 2025, in press). Since the goal of the VDR task was to maximize one's point total, a rationale strategy for participants would be to recall as many words as possible. Recalling words associated with even the lowest values would still increase one's score, so it's possible that heightened motivation drives individuals to adopt this strategy. Similarly, despite the goal of the task, highly motivated individuals may still characterize "good" performance in any memory task as being able to maximize recall output. Regardless, the desire to perform well on a memory task seemingly encourages individuals to emphasize recalling the maximum number of items, with a small expense to value sensitivity.

Critically, unlike task-specific motivation, self-efficacy and self-determined learning goals were reliably associated with memory selectivity. The most selective individuals tended to believe they were *less* capable of remembering all the TBR material and tried to remember *fewer* items on each list. Note, consistent with research adopting similar methods (Miller & Unsworth, 2025), incredibly large correlations were observed between self-efficacy and self-set goals. Although prior research suggests they are distinct constructs, the large correlations between the two is consistent with the notion that self-efficacy is related to performance partly because of its shared variance with goal setting (Bandura, 1997; Chen et al., 2000; Locke & Latham, 1990; Phillips & Gully, 1997).

Since inefficacious beliefs and low learning goals were each associated with older age and enhanced selectivity, path modeling techniques were used to examine whether these factors explain older adults' intact, or superior, memory selectivity. Notably, in all three studies, self-efficacy and self-determined learning goals significantly mediated the effect of age on memory selectivity (i.e., the indirect effect of age on selectivity through efficacy beliefs and goals was significant). These results suggest that although older adults were more motivated to perform well, their increased (or spared) sensitivity to value was largely explained by their strategic focus on a smaller subset of words. This tendency to set lower learning goals was seemingly driven by their belief in (or awareness of) their inability to remember a large amount of information.

Overall, these results align with research using VDR paradigms that allow for maximal self-regulated learning (Castel et al., 2013; McGillivray & Castel, 2011). For instance, Castel and colleagues (2013) presented participants with columns of numbers arranged by value. Participants could click on a value to reveal a word directly below it, which remained onscreen until another value was clicked. Although participants had two minutes to view the entire list, they could choose how long to study each item-value pair and were not required to view all items. Both younger and older adults more frequently selected high-value items to study and spent more time studying these items compared to low-value items. However, older adults selected fewer items overall and spent disproportionally more time studying high-value items. These findings suggest that older adults focused on a narrower subset of the TBR material comprised of the highest-value items, reflecting an easier learning goal that was likely driven by inefficacious beliefs. Therefore, under conditions of both maximal and minimal experimenter control, older adults' memory self-efficacy beliefs likely influence their personal learning goals, which determine how they regulate their study (Price et al., 2010).

While setting lower learning goals may facilitate a more efficient allocation of attention towards the most important information, there are, of course, important differences in how individuals achieve these goals based on different learning conditions (e.g., Castel et al., 2013; Hess, 2014; Middlebrooks & Castel, 2018). Regardless of the amount of control a learner has over their learning, high selectivity is largely obtained by differentially allocating more attention to high-value items, partly through use of more effective encoding strategies (Ariel et al., 2015; Castel et al., 2013; Cohen et al., 2014; Hennessee et al., 2019; Hess et al., 2009). However, when learners have maximal control over their learning, they are better equipped to maximize the difference in the amount of attention allocated to low- vs high-value items because they can ignore low-value items altogether and use that time to disproportionally process high-value items. In the present study, TBR items were presented sequentially, and learners had no control over study duration. Thus, unlike learning conditions that allow for maximal self-regulated study, learners must view every TBR item for an equal amount of time. This procedure requires participants to process every item to some degree, regardless of its value.

How to do participants maximize the difference in the amount of attention allocated to low- vs high-value items under conditions like those in the present study? One possibility is that learners flexibly upregulate the amount of attention devoted to the study of high-value information and downregulate the amount of attention given to low-value information (Unsworth & Miller, 2021). This could be partly achieved by elaboratively encoding high-value items and passively "encoding" low-value items (see Miller & Unsworth, 2021). Of course, participants may also downregulate attention indirectly by biasing attention allocation away from low-value items (Tozios & Fukuda, 2020). Like processes at play in item-method directed forgetting (Bjork, 1972; MacLeod, 1975), this indirect downregulation of attention could be achieved by selectively rehearsing previously shown high-value information (whereby low-value information is dropped from a cumulative rehearsal strategy) or by intentionally mind-wandering (i.e., thought substitution; Hubbard & Sahakyan, 2021). Future research should aim to directly test these possibilities and examine potential age-related differences in each approach.

### *Limitations and Future Directions*

The current findings shed new light on how conative factors contribute to memory selectivity and age-related differences therein. However, several limitations warrant consideration. First, we relied on correlational data to support hypothesized causal pathways, but such data cannot establish causality. Future research should use a combination of experimental and differential approaches or employ longitudinal designs to more effectively determine causal relationships. Second, like many cross-sectional studies of cognition and aging (e.g., Greene & Naveh-Benjamin, 2022; Schwartz et al., 2023), we recruited younger adults from a large public university, offering course credit for participation, whereas older adults were recruited via the community at large and received monetary compensation. Using different recruitment and compensation methods may introduce several potential issues. For example, monetary compensation may have motivated older adults to perform well out of concern that poor performance might jeopardize their payment. Although, age-related differences in task-specific motivation (on a VDR task) have still been observed when both age groups are recruited through Prolific and compensated monetarily (Miller & Castel, 2025b), suggesting that differences in compensation methods are unlikely to explain the higher task-specific motivation observed in older adults.

A more likely explanation is that increased motivation in older adults is driven by their desire to better understand their own memory functioning and to contribute to the broader scientific literature (Ryan & Campbell, 2021). These desires could translate into heightened enthusiasm for the task at hand. Conversely, younger adults may report lower motivation because they find studying words boring (i.e., they derive no pleasure from the activity itself) or unimportant (i.e., they are unconcerned about performing well on a task they consider trivial). This is not to say that younger adults do not engage with laboratory memory tasks. Younger adults generally outperform older adults, and they tend to report using as many, if not more, attentionally demanding encoding strategies (e.g., mental imagery; Ariel et al., 2015; Bailey et al., 2009; Hertzog et al., 1998; Zivian & Darjes, 1983). This tendency to employ more demanding strategies implies some level of task engagement and desire to succeed (Miller &

Unsworth, 2020, 2025). Thus, it's possible that task engagement in younger adults is influenced by different factors than those in older adults (see Hess et al., 2021). Future research is needed to test this possibility in more detail and to explore whether recruitment and compensation methods influence variability (both age-related and otherwise) in the variables examined here. A related issue is that recruiting older adults through online platforms like Prolific may attract individuals with above-average cognitive functioning (Greene & Naveh-Benjamin, 2022; see also Ogletree & Katz, 2021), specific personality traits (e.g., openness to new experiences; Miller & Castel, 2025b), and particular demographic backgrounds (see Tables 1, 4, and 6). Therefore, future research should also strive to replicate our findings using more representative and comparable samples.

Furthermore, a discrepancy arose across studies when examining age-related differences in motivation as function of time and feedback. In all three studies, older adults were more motivated to perform well overall compared to younger adults. However, in Study 1 and Study 3, motivation largely declined from pre-task to post-task for younger adults whereas little to no changes in motivation were observed for older adults. In these studies, participants were merely informed of their total point score for each list (e.g., "You got 42 points"). In Study 2, both younger and older adults demonstrated similar declines in motivation. Participants in this study knew how they performed relative to what was possible (e.g., "You correctly remembered 4 words out of 12 words possible and got 42 points out of 78 points possible"). Thus, the feedback was objective and likely reinforced the notion that memory performance is impaired in older age (West et al., 2001, 2003, 2005). In reinforcing inefficacious beliefs, older adults likely became more discouraged and less motivated to perform well over time (Bandura, 1989).

Among the three studies, only Study 2 showed spared selectivity in older adults rather than superior selectivity. Future work should explore whether, and how, different forms of feedback affect age-related differences in conative factors and, by extension, memory selectivity. More broadly, additional research is needed to clarify why some studies find spared selectivity (Castel et al., 2009; Miller & Castel, 2025b; Murphy & Castel, 2022) while others find enhanced selectivity (Castel et al., 2002, 2007, 2013) in healthy older age. Another important consideration for future research concerns the finding that individuals with mild cognitive impairment and dementia show reduced awareness of their memory limitations (e.g., Lin et al., 2010; Lehrner et al., 2015; Vogel et al., 2004). Thus, it will be crucial to investigate whether this diminished metacognitive awareness contributes to the impaired memory selectivity observed in pathological forms of aging (see Castel et al., 2009).

**Conclusion**

The current study investigated the roles of various conative factors (i.e., task-specific motivation, memory self-efficacy, and self-determined learning goals) as mechanisms that might support intact or superior memory selectivity in older age. Results from three studies demonstrated that older adults remembered less information overall compared to younger adults. However, older adults were generally more selective and more motivated to perform well on the VDR task, despite being less confident in their memory abilities and trying to remember fewer to-be-remembered items throughout the task. Follow-up analyses revealed no age-related differences in the accuracy of efficacy beliefs, and self-set goals were highly associated with previous list performance for all individuals. Therefore, older adults' lower self-efficacy beliefs and lower learning goals reflected a relatively accurate view of their task-specific memory abilities.

Individuals who were more motivated to perform well were slightly less selective but recalled a greater proportion of the learning material compared to less motivated individuals, suggesting that high task-specific motivation drove individuals to maximize recall output at the expense of attending to value. Conversely, individuals with inefficacious beliefs (and by extension those with lower self-determined learning goals) tended to display worse recall accuracy but better memory selectivity. Accordingly, the tendency for older adults to selectivity remember the most important information was largely explained by their strategic focus on a smaller subset of words, driven by their belief in (or awareness of) their inability to remember a large amount of information. These results collectively suggest that metamemory beliefs, particularly inefficacious beliefs, promote adaptive goal-setting behaviors that help older adults more efficiently allocate their limited attentional resources to the most valuable information.

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# Appendix A

## Detailed Description of Data Exclusions Across Studies

### *Study 1*

Two younger adults were excluded for not meeting the age criteria. Three other younger adults were excluded for being unable to remember any words (out of 12 possible) on multiple lists of the DFR-VDR task. Additional participants were excluded for completing the study on a cell phone ($n_{\text{younger}} = 1$) and for straight-lining responses on the post-task survey ($n_{\text{younger}} = 1$). On this survey, a variety of additional participants indicated their data should be dropped from analyses. Participants who were excluded admitted to: cheating ($n_{\text{younger}} = 1$, $n_{\text{older}} = 1$) and completing the study in an unexpectedly distracting environment ($n_{\text{younger}} = 1$). Another individual reported experiencing computer issues that resulted in them having to restart the memory task ($n_{\text{older}} = 1$). Given the online nature of the study, we also erred on the side of caution and removed individuals flagged as outliers (2 *SDs* above the mean) when inspecting boxplots and histograms of recall accuracy scores as a function of age group ($n_{\text{younger}} = 1$, $n_{\text{older}} = 2$). Like Schwartz et al. (2023), we reasoned that near perfect recall accuracy scores across lists indicated likely use of an external aid.

### *Study 2*

One younger adult and four older adults were excluded for not meeting the age criteria. On a post-task survey, a variety of additional participants indicated their data should be dropped from analyses. Participants who were excluded admitted to cheating ($n_{\text{younger}} = 2$, $n_{\text{older}} = 2$) and taking prolonged breaks (over 20 minutes) during the task ($n_{\text{younger}} = 2$). Like Study 1, we also erred on the side of caution and removed individuals flagged as outliers when inspecting boxplots and histograms as a function of age group ($n_{\text{younger}} = 2$, $n_{\text{older}} = 3$).

***Study 3***

One younger adult and four older adults were excluded for not meeting the age criteria. Two additional younger adults were excluded for being unable to remember any words (out of 12 possible) on multiple lists of the DFR-VDR task, and another younger adult was excluded for completing the study on a cell phone. On the post-task survey, a variety of additional participants indicated their data should be dropped from analyses. Participants who were excluded admitted to taking a prolonged break during the task ($n_{older} = 1$) or completing the study in an exceptionally distracting environment ($n_{younger} = 6$). Other individuals reported experiencing computer issues that resulted in them having to restart the memory task ($n_{younger} = 2$, $n_{older} = 2$). Finally, we again erred on the side of caution and removed individuals flagged as outliers when inspecting boxplots and histograms as a function of age group ($n_{younger} = 2$, $n_{older} = 5$).

# Appendix B

## Correlations and Factor Loadings for Memory Self-Efficacy Measures

### *Study 1*

Self-efficacy level correlated with self-efficacy strength ($r = .46$, $p < .001$) and performance predictions ($r = .82$, $p < .001$). Self-efficacy strength also correlated with performance predictions ($r = .60$, $p < .001$). A pre memory self-efficacy factor score was created by entering pre estimates of self-efficacy level, self-efficacy strength, and the performance prediction into a factor analysis using principal component analysis. The factor loadings were as follows: self-efficacy level (.89), self-efficacy strength (.77), and performance prediction (.94).

### *Study 2*

Self-efficacy level correlated with self-efficacy strength ($r = .51$, $p < .001$) and performance predictions ($r = .72$, $p < .001$). Self-efficacy strength also correlated with performance predictions ($r = .51$, $p < .001$). To create a self-efficacy factor composite score for each participant, scores from each assessment were entered into a factor analysis using principal component analysis. The factor loadings were as follows: self-efficacy level (.89), self-efficacy strength (.79), and performance prediction (.89).

### *Study 3*

Self-efficacy level correlated with self-efficacy strength ($r = .74$, $p < .001$) and performance predictions ($r = .81$, $p < .001$). Self-efficacy strength also correlated with performance predictions ($r = .73$, $p < .001$). To create a self-efficacy factor composite score for each participant, scores from each assessment were entered into a factor analysis using principal component analysis. The factor loadings were as follows: self-efficacy level (.93), self-efficacy strength (.89), and performance prediction (.92).