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Strategic value-directed remembering in younger and older adults

Kara M. Hoover, Dillon H. Murphy, Barbara J. Knowlton and Alan D. Castel

Department of Psychology, University of California, Los Angeles, Los Angeles, CA, USA

ABSTRACT

To examine potential age-related differences in controlled memory processes, we investigated whether strategic value-based processes can override the influence of information memorability and enhance memory performance for important information in younger and older adults. In three experiments, we manipulated the memorability (using word length, concreteness, and frequency in Experiments 1 and 2 and presentation time in Experiment 3) and the value of words to investigate the influence of item properties versus strategic processes on value-directed remembering in younger and older adults. Results revealed that older adults' selective memory (i.e. value-based memory) was preserved when high-value information was easier to remember. However, in Experiments 1 and 3, older adults' selective memory was impaired when high-value information was difficult to remember and low-value information was easier to remember, while younger adults' selectivity did not depend to as great of a degree as older adults on memorability. Collectively, these findings suggest that if some valuable words are inherently more difficult to remember, older adults may struggle to adapt their encoding strategy to remember these low-memorability words that are highly valuable. Thus, older adults can use strategic memory processes for high-value information, but the efficacy of this process may depend on the intrinsic and extrinsic salience of the information.

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Value; strategic processing; automatic processing; aging; selectivity

In our information-rich world, we are constantly bombarded with an overwhelming amount of information to remember. As a result, it becomes crucial to be strategic in how we allocate our limited cognitive resources to efficiently process and remember valuable information. This may be especially important for older adults whose age-related cognitive impairments further constrain their memory (Balota et al., 2000), and there might be important age-related differences in the ability to engage in value-based memory as a function of the memorial difficulty of the to-be-remembered information.

Value-based memory. To examine how value guides memory, researchers use value-directed remembering tasks where learners are presented with words paired with point values that contribute to their scores upon recall (e.g., Castel et al., 2002). Previous

CONTACT Dillon H. Murphy dmurphy8@ucla.edu Department of Psychology, University of California, Los Angeles, CA 90095, USA

research has demonstrated that younger and older adults facilitate the encoding of high-value information over low-value information, particularly after gaining task experience and becoming aware of the limitations of their memory capacity (Cohen et al., 2017; D. H. Murphy et al., 2021; D. H. Murphy & Castel, 2022c; Stefanidi et al., 2018; see; Knowlton & Castel, 2022 for a review). This prioritization of important information during encoding has numerous benefits such as avoiding the consequences of forgetting (see D. H. Murphy & Castel, 2020).

Although older adults may experience challenges in memory due to general cognitive impairments associated with healthy aging (Hess, 2005; Park & Festini, 2017; Salthouse, 2010, 2019; Thomas & Gutchess, 2020), prior work has shown that some forms of selective memory (i.e., value-based memory) are preserved in older adults (Ariel et al., 2015; Bowen et al., 2020; Castel, 2008, 2024; Castel et al., 2002, 2012; Hargis & Castel, 2018; Hargis et al., 2019; Mather & Schoeke, 2011; McGillivray & Castel, 2011; Miller & Castel, 2025, 2025; D. H. Murphy & Castel, 2022b; D. H. Murphy et al., 2023; D. H. Murphy & Castel, 2024; Spaniol et al., 2014; Swirsky & Spaniol, 2019; Whatley et al., 2021; for a meta-analysis, see; Swirsky et al., 2023). It is then possible that older adults may employ compensatory memory mechanisms, such as strategic memory processes, to offset certain forms of memory loss (Hertzog & Dunlosky, 1996).

When we focus on memory for valuable information, we likely employ strategic and selective encoding strategies such as mental imagery or sentence generation to facilitate the later recall of this information (Dunlosky, 1998; Hennessee et al., 2019; Hertzog et al., 2008). For instance, if you try a new coffee shop in your neighborhood and you enjoy its atmosphere, you may make a mental note to visit it again in the future. This “mental note” could take the form of associating the name of the coffee shop with other knowledge or generating a mental image of its location. These efforts are examples of the strategic encoding of valuable information, and individuals can learn to utilize these more effective encoding strategies as they gain experience (Storm et al., 2016). Moreover, people can update their encoding strategies based on observations of forgetting (Hertzog et al., 2008), such as forgetting someone’s name, and subsequently use more effective encoding strategies to ensure that this information is remembered in the future. Hence, the process of remembering important information involves both a metacognitive component – an awareness of the need to be selective (D. H. Murphy et al., 2021) – and a strategic component – the selective engagement of effective encoding strategies for high-value items (Hennessee et al., 2019, 2024).

While the strategic encoding of valuable information can contribute to selective memory, the effects of value on memory can also occur more automatically. Specifically, rewarding information (i.e., high-value information) tends to be more salient compared to low-value information, resulting in better memorability (Gruber et al., 2016; see; Schultz, 2015 for a review). For example, having a pleasant experience in a coffee shop can be memorable in the absence of intentionally trying to encode the experience. Specifically, this positive experience in the new café may result in the more automatic and effective encoding of the now valuable coffee shop without the need for strategic elaborative encoding. Such instances where valuable information is well remembered without the learner intentionally engaging in strategic processing exemplify the more automatic effects of value on memory.

Strategic and automatic effects of reward on memory are probably not independent mechanisms as both likely contribute to memory performance (Bijleveld et al., 2012). Specifically, valuable information may initially draw greater attention and engage automatic processes that benefit encoding (D. H. Murphy & Castel, 2025; D. H. Murphy et al., 2025). Later, individuals may further strengthen their memory for valuable items through strategic encoding. Thus, value-directed remembering can have both an automatic and strategic component, and although prior work has found that younger and older adults similarly and effectively encode and thus remember the highest-valued information (see Castel, 2008, 2024 for a more recent review and perspective), it remains unclear whether these mechanisms differ across the lifespan.

Age effects. Some researchers have hypothesized that the roles of automatic and strategic processing of value may change as we age such that younger adults engage in more automatic processing of high-value information, while older adults engage in more strategic processing (e.g., Knowlton & Castel, 2022; Samanez-Larkin et al., 2014; see also D. H. Murphy et al., 2025). This could be due to age-related changes in the reward system of the brain which may reduce the salience of valuable items (Chowdhury et al., 2013; Halfmann et al., 2016), potentially impairing older adults' ability to engage in automatic processing for such items. Consequently, older adults might compensate by engaging in more strategic processing of valuable information (see Bowen et al., 2020; Schwartz et al., 2023). This nuanced dynamic could explain how value-directed remembering is preserved with age, such that older adults may adopt a more effortful, demanding strategic process for selectively encoding important, high-value information compared to younger adults.

Information memorability. Value-directed remembering tasks usually try to control intrinsic characteristics of the to-be-remembered words to isolate the effects of value, but it is important to note that much information that we try to remember differs in inherent memorability. For example, some high-value information is inherently difficult to remember (e.g., a medication that has a complicated name but is very important for a person's health conditions), while low-value information may be easier to encode (e.g., a well-known and advertised medication that is not important for the person's health). Investigating how age impacts the ability to selectively remember high-value information when low-value information is more memorable may help delineate age-related differences in the role of strategic processing of value on memory and uncover whether there are age differences in the ability to engage in value-directed remembering under challenging and difficult conditions.

Manipulating information memorability may be an effective way to make low-value information inherently easier to remember than the high-value information, thus creating less than ideal conditions for value-directed remembering. One way that information memorability can be manipulated is via word characteristics. Specifically, prior work has found that words that are concrete (Paivio, 1966), short (Baddeley et al., 1975), and/or frequent (Hall, 1954) are highly memorable, while abstract, long, and/or infrequent words tend to be low in memorability. Past research has also found that older adults show a greater benefit of these word characteristics (e.g., frequency and concreteness) compared with younger adults, and these variables can reduce age-related differences in memory (Kausler, 1994; Rowe & Schnore, 1971).

Factors such as the conditions of the task may also affect the memorability of information and its likelihood of being remembered. For example, less study time results in worse recall (Hogan & Kintsch, 1971; Murdock, 1962; Roberts, 1972), and this effect of study time on recall has been replicated consistently through the years (see Unsworth, 2016). This effect may be even more pronounced in older adults whose slower processing speed (Salthouse, 1996) already lessens their ability to elaboratively encode to-be-remembered items when given sufficient time (Craik, 1983, 1986, 2002). Thus, it is possible that with general memory tasks when value is not manipulated, older adults depend more heavily on factors that make encoding easier (e.g., increased study time, word memorability) rather than using controlled, recollective processes for information that is more difficult to encode (e.g., Jennings & Jacoby, 1993).

Thus, although strategic processing may remain intact or even enhanced in older adults under standard conditions (i.e., when memorability characteristics of high-value and low-value information are controlled), it is currently unknown whether older adults can engage in strategic processing of value under challenging conditions (e.g., when they must overcome the influence of information memorability to remember the most valuable information). It is also important to investigate how this ability compares with younger adults under similar conditions. Compared to younger adults, older adults' experience with relying on strategic processing instead of automatic processing of valuable information (D. H. Murphy & Castel, 2024; D. H. Murphy et al., 2025) may allow them to leverage their experience with effective strategies (Hertzog & Dunlosky, 1996; Swirsky & Spaniol, 2019) to remember the most valuable information even if it is inherently difficult to encode. However, it is also possible that older adults will not be able to overcome the ease of encoding more memorable, but less valuable information as well as younger adults given their increased reliance on information memorability under general memory tasks (e.g., Kausler, 1994; Rowe & Schnore, 1971). This would result in older adults' already limited memory capacity (Balota et al., 2000) consisting of comparatively low-value information rather than the high-value, but more difficult to remember information. Lastly, due to younger and older adults' similar engagement in value-directed remembering under standard conditions (see Swirsky et al., 2023), younger and older adults may also exhibit a similar tendency to either overcome information memorability to remember the most valuable information or, conversely, be influenced by information memorability to the detriment of remembering the most valuable information.

The current study

To test these hypotheses and investigate the influence of information memorability versus strategic processes on value-directed remembering in younger and older adults, we manipulated the memorability of to-be-remembered words and their associated point values. In Experiments 1 and 2, this was manipulated by some to-be-remembered words being highly memorable (concrete (Paivio, 1966), short (Baddeley et al., 1975), and frequent (Hall, 1954)), while other words were low in memorability (abstract, long, and infrequent). Low- and high-memorability words were then paired with either low values (1, 2, 3) or high values (10, 11, 12). In Experiment 3, we manipulated study time of to-be-remembered words as a different way to manipulate information memorability with words presented for only 1 second being lower in memorability than words presented for 5 seconds which are easier to encode due to increased study time. With these designs, strategic processing likely contributes to the encoding of the high-value words when they are high in memorability, but strategic encoding might be more difficult when valuable words are less memorable.

We expected that older adults – who may engage in more strategic processing due to their cognitive experience (see Hertzog & Dunlosky, 1996) and the potential need to compensate for impairments in automatic processing (Knowlton & Castel, 2022; Samanez-Larkin et al., 2014) – would effectively engage in the strategic processing of the high-value /high-memorability words but struggle to engage in the strategic processing of high-value words when they are harder to remember. Specifically, older adults may still process and encode the highly memorable/low-value words, resulting in the nonstrategic encoding and recall of these low-value words at the expense of memory for less-memorable /highly valued words.

Experiment 1a

In Experiment 1a, younger and older adults studied eight lists of words with each word either paired with a low value (1, 2, 3) or a high value (10, 11, 12). However, low-value words were high in memorability (i.e., short, high-frequency, high concreteness) and high-value words were low in memorability (i.e., long, low frequency, low concreteness) – we refer to these as incongruent trials. Thus, low-value words should be easier to remember relative to high-value words. Although prior work suggests that older adults might be better at strategically allocating attention to high-value items (Knowlton & Castel, 2022), considering the greater influence of information memorability on older adults' memory under general memory tasks (e.g., Kausler, 1994; Rowe & Schnore, 1971), we expected younger adults to demonstrate greater selective memory for high-value words when these items are low in memorability. We hypothesize that older adults may face challenges in overriding the easier encoding of highly memorable (but low-value) words instead of strategically prioritizing the high-value words that are harder to remember.

Method

Transparency and openness

We report an analysis of our sample size and describe all data exclusions, manipulations, and measures in this study. All data and research materials are available on OSF (D. H. D. H. Murphy, 2023). Data were analyzed using JASP, and all information needed to reproduce the analyses is available. This study's design and its analysis were not preregistered. Informed consent was acquired, and the study was completed per the UCLA Institutional Review Board (Memory, Attention, Emotion and Aging: IRB#12–000617).

Participants

Data in each experiment were collected from March 2023 to April 2023. In each experiment, younger adults ($n = 57$; age range: 18–28; $M_{age} = 20.67$, $SD_{age} = 1.87$; 44 female, 13 male; 24 Asian/Pacific Islander, 3 Black, 15 Hispanic, 14 White, 1 other/unknown) were recruited from the University of California Los Angeles (UCLA) Human Subjects Pool, tested online, and received course credit for their participation. Older adults ($n = 51$; age range: 64–85; $M_{age} = 72.04$, $SD_{age} = 4.75$; 38 female, 13 male; 1 Asian/Pacific Islander, 1 Black, 1 Hispanic, 47 White, 1 other/unknown) were recruited from Amazon's Cloud Research (Chandler et al., 2019), a website that allows users to complete small tasks for pay. We note that we used different recruitment and compensation methods for young and older adults but this is standard in cognitive aging research and such differences do not typically bias results as long as methodological rigor is maintained (see Greene & Naveh-Benjamin, 2022 for information regarding online data collection's generalizability, motivation differences between age groups, and the reliability of using distinct compensation approaches in mixed-age studies).

Participants were excluded from analysis if they admitted to cheating (e.g., writing down answers) in a post-task questionnaire (they were told they would still receive credit if they cheated). This exclusion process resulted in no exclusions from the younger adult group and one exclusion from the older adult group. In each experiment, we aimed to collect around 50 younger and 50 older adults per condition. This sample size was based on prior work using a similar design (e.g., D. H. Murphy & Knowlton, 2022), prior exploratory research, and the expectation of detecting a medium effect size.

Materials

Each list contained nine easier-to-remember words (i.e., more memorable) and nine harder-to-remember words (i.e., less memorable). The easier words were between 3 and 6 letters ($M = 4.08$, $SD = .55$), while the harder words were between 7 and 12 letters ($M = 7.89$, $SD = 1.25$), and an independent samples *t*-test indicates these word sets significantly differ in length [$t(142) = -23.63$, $p < .001$, $d = -3.94$]. On the log-transformed Hyperspace Analogue to Language frequency scale (with lower values indicating lower frequency in the English language and higher values indicating higher frequency), easier words ranged from 7.78 to 12.88 and averaged a score of 10.78 ($SD = .96$), while harder words ranged from 4.73 to 9.64 and averaged a score of 7.55 ($SD = 1.30$), [$t(142) = 16.90$, $p < .001$, $d = 2.82$]. In terms of concreteness (with lower values indicating lower concreteness and higher values indicating higher concreteness), easier words ranged from 4.11 to 5.00 and averaged a score of 4.83 ($SD = .18$), while harder words ranged from 2.59 to 5.00 and averaged a score of 4.42 ($SD = .58$), [$t(142) = 5.73$, $p < .001$, $d = .95$]. Frequency and concreteness ratings were generated using the English Lexicon Project website (Balota et al., 2007).

Procedure

Participants were told that they would be presented with lists of to-be-remembered words with each list containing 18 words. On each list, each word was paired with a value indicating how much the word was "worth." Point values were either 1, 2, 3, 10, 11, or 12, and there were three words paired with each value on each list (i.e., three 12-point words). Words that were paired with low values (1, 2, 3) were highly memorable (i.e., short, high-frequency, high concreteness) and words that were paired with high values (10, 11, 12) were low in memorability (i.e., long, low frequency, low concreteness). The low and high point values were randomly paired with words (after sorting according to memorability), and the order of the point values within lists was randomized. Thus, any word could appear in any serial position within a list. Participants were not given any instructions regarding memorability.

The stimulus words were presented for 3 seconds each with a 500 ms inter-stimulus interval. Participants were told that they would score points for recalling words on the test such that if a word was correctly remembered on the test, they would gain the points paired with the word. Participants were instructed that they should try to maximize their scores – thus, participants' goal was to maximize their scores by remembering as many valuable words as possible. After the presentation of all 18 word-number pairs in each list, participants were given a self-paced free recall test (but were required to spend at least 30 seconds on each recall test) in which they had to recall as many words as they could remember from the just-studied list (they did not need to recall the point values). Participants recalled words by typing them into an on-screen text box. To account for typographical errors in participants' responses, we employed a real-time textual similarity algorithm where responses with at least 75% similarity to the correct answer were counted as correct. Immediately following each recall test, participants were told their score for that list as well as the maximum score but were not given feedback about specific items (displaying the maximum score alongside the participant's score after each recall test aims to benchmark performance, motivate improvement by highlighting the gap between current and optimal performance, and enhance metacognitive awareness by encouraging participants to reflect on and adjust their memory strategies). This procedure was repeated for a total of eight study-test trials.

Following the conclusion of the task, participants reported what encoding strategies (if any) they had used to remember the words. Specifically, participants indicated whether they simply read each word as it appeared, repeated the words as much as possible, developed rhymes for the words, used sentences to link the words together, developed mental images of the words, grouped the words in a meaningful way, or utilized no strategy (participants could select some, all, or none).

Results

To examine the strength of the evidence for each effect in our inferential tests, we computed a Bayes Factor (a ratio of the marginal likelihood of the null model and a model suggesting group differences) compared to a null model using JASP. We provide BF01 when inferential statistics favor the null hypothesis (which would be supported by a large BF01) and BF10 when inferential statistics favor the alternative hypothesis (which would be supported by a large BF10; for more information on interpreting Bayes factors, see Kass & Raftery, 1995).

Recall as a function of age and memorability/value is shown in Figure 1. A 2 (age: young, old) × 2 (memorability/value: high memorability/low-value, low memorability/high-value) mixed ANOVA revealed that younger adults recalled a greater proportion of words ($M = .45$, $SD = .16$) than older adults ($M = .31$, $SD = .16$), [$F(1, 106) = 21.61$, $p < .001$, $\eta_p^2 = .17$, $BF_{10} > 100$]. Additionally, despite being longer, lower in frequency, and lower in concreteness, participants recalled more high-value words ($M = .48$, $SD = .20$) than the shorter, more frequent, and more concrete low-value words ($M = .29$, $SD = .22$), [$F(1, 106) = 77.08$, $p < .001$, $\eta_p^2 = .42$, $BF_{10} > 10$]. Critically, age interacted with memorability/value [$F(1, 106) = 22.11$, $p < .001$, η_p^2

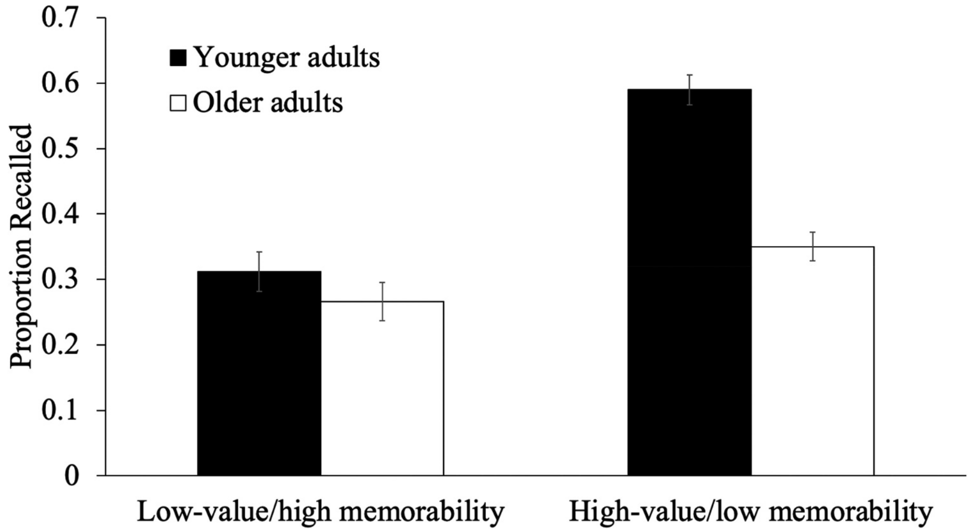

Figure 1. The proportion of words recalled as a function of age for words that were high in memorability but low in value, and words that were low in memorability but high in value, in Experiment 1a. Error bars reflect the standard error of the mean.

= .17, $BF_{10} > 100$] such that younger and older adults recalled a similar proportion of low-value/high-memorability words [$p_{holm} = .427$, $d = .24$] but younger adults recalled more high-value/low-memorability words than the older adults [$p_{holm} < .001$, $d = 1.25$]. We also note that both groups were selective such that younger [$p_{holm} < .001$, $d = 1.45$] and older adults [$p_{holm} = .018$, $d = .44$] recalled high-value words better than low-value words.

To examine the learning strategies employed by younger and older adults, we examined participants' self-reported encoding strategies. Previous research indicates that memory performance improves with the use of effective encoding strategies such as creating interactive imagery, generating sentences, and organizing information into groups, while less effective strategies include passively reading the material or engaging in simple repetition (Hertzog et al., 1998; Richardson, 1998; Unsworth, 2016). In our analysis, we categorized the encoding strategies reported by participants based on their effectiveness, distinguishing between less effective methods and those facilitating deeper processing. Specifically, we calculated the proportion of effective strategies employed by each participant, blind to age group, which included techniques such as linking words together through sentences, forming mental images of the words, and organizing the words into meaningful groups. For example, if a participant indicated linking words together through sentences and forming mental images of the words but did not organize the words into meaningful groups, their effective strategy use would be 2/3 = .67. An independent samples *t*-test indicated that younger adults reported using a greater proportion of effective strategies ($M = .56$, $SD = .34$) than older adults ($M = .24$, $SD = .28$), [$t(106) = 5.33$, $p < .001$, $d = 1.03$, $BF_{10} > 10$].

Experiment 1b

In Experiment 1b, we changed the paradigm to produce optimal conditions for value-directed remembering and potentially replicate prior work that has found similar selectivity in younger and older adults (e.g., Castel, 2008; Castel et al., 2002, 2012; Knowlton & Castel, 2022). Thus, we examined younger and older adults' selective memory when highly valued words were more memorable, while lower valued words were less memorable (we refer to these as congruent trials), thus eliminating any dissonance between value and memorability. In this paradigm, participants do not need to forsake ease of encoding to selectively remember the high-value, less memorable words (as in Experiment 1a). As such, we expected younger and older adults to demonstrate similar selective encoding of the highly memorable/high-value words compared to the less memorable/low-value words (similar to prior work; e.g., Castel et al., 2002).

Method

Participants

Younger adults ($n = 59$; age-range: 15–32; $M_{age} = 20.07$, $SD_{age} = 2.08$; 50 female, 6 male, 3 other; 26 Asian/Pacific Islander, 1 Black, 10 Hispanic, 20 White, 2 other/unknown) were recruited from the UCLA Human Subjects Pool, tested online, and received course credit for their participation. Older adults ($n = 50$; age range: 66–92; $M_{age} = 73.24$, $SD_{age} = 5.40$; 31 female, 19 male; 1 Asian/Pacific Islander, 1 Black, 1 Hispanic, 46 White, 1 other/unknown) were recruited from Amazon's Cloud Research. No younger adults but one older adult were excluded for admitting to cheating. Data were collected separately from Experiment 1a in April 2023.

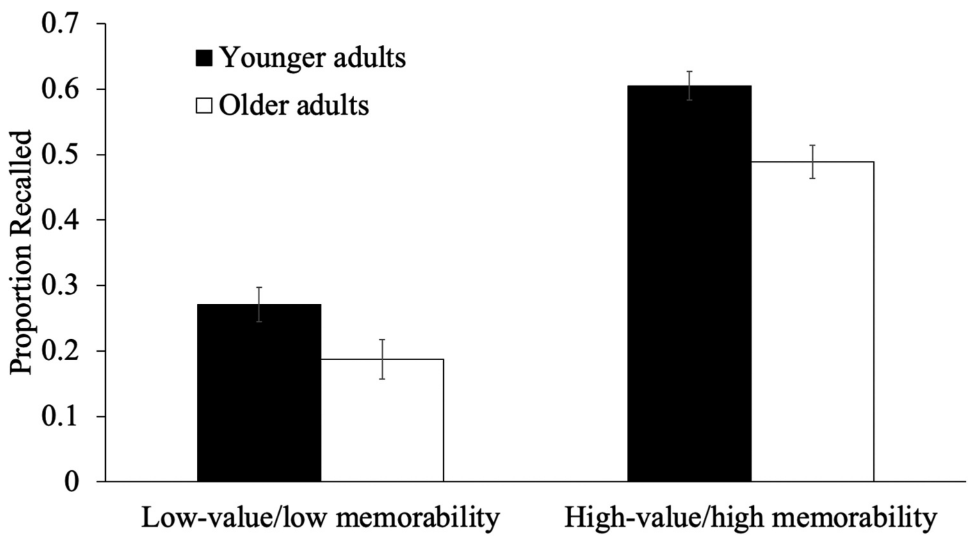

Figure 2. The proportion of words recalled as a function of age for words that were high in memorability and high in value, and words that were low in memorability and low in value in Experiment 1b. Error bars reflect the standard error of the mean.

Materials and procedure

The materials and procedure in Experiment 1b were similar to Experiment 1a. However, the words characterized as harder to remember (i.e., long, low frequency, low concreteness) were paired with low values (1, 2, 3), and easier to remember words (i.e., short, high frequency, high concreteness) were paired with high values (10, 11, 12).

Results

Recall as a function of age and memorability/value is shown in Figure 2. A 2 (age: young, old) × 2 (memorability/value: high memorability/high-value, low memorability/low-value) mixed ANOVA revealed that younger adults recalled a greater proportion of words ($M = .44$, $SD = .14$) than older adults ($M = .34$, $SD = .18$), [$F(1, 107) = 10.53$, $p = .002$, $\eta_p^2 = .09$, $BF_{10} = 5.11$]. Additionally, participants recalled more high-value words ($M = .55$, $SD = .18$) than low-value words ($M = .23$, $SD = .21$), [$F(1, 107) = 253.84$, $p < .001$, $\eta_p^2 = .70$, $BF_{10} > 100$]. Critically, age did not interact with memorability/value [$F(1, 107) = .59$, $p = .446$, $\eta_p^2 = .01$, $BF_{01} = 3.96$]. However, we note that both groups were still selective such that younger [$p_{holm} < .001$, $d = 1.75$] and older adults [$p_{holm} < .001$, $d = 1.59$] recalled high-value words better than low-value words. In terms of strategy use, younger adults reported using a greater proportion of effective strategies ($M = .42$, $SD = .34$) than older adults ($M = .29$, $SD = .32$), though this effect did not reach significance [$t(107) = 1.95$, $p = .054$, $d = .38$, $BF_{01} = .91$].

Cross-experiment comparison

In Experiments 1a and 1b, we crossed memorability and value in isolated experiments and reported them separately in the temporal order of data collection because participants were not randomly assigned to either the conditions of Experiment 1a or the conditions of 1b. However, due to the manipulations being impossible to interpret in isolation, a cross-experiment comparison is necessary to detect and interpret a possible three-way interaction between age, memorability, and value. As such, we conducted a 2 (Experiment 1a, Experiment 1b) × 2 (age: young, old) × 2 (memorability: high, low) mixed ANOVA. Results did not yield a main effect of Experiment [$F(1, 213) = .15$, $p = .701$, $\eta_p^2 = .13$, $BF_{01} = 6.68$], but there was an effect of age [$F(1, 213) = 31.17$, $p < .001$, $\eta_p^2 = .13$, $BF_{10} > 100$] such that younger adults recalled more words than older adults. There was an effect of memorability [$F(1, 213) = 22.72$, $p < .001$, $\eta_p^2 = .10$, $BF_{10} = 11.31$] such that high-memorability words were better recalled than low-memorability words.

Experiment did not interact with age [$F(1, 213) = 1.00$, $p = .318$, $\eta_p^2 = .01$, $BF_{01} = 4.55$] but memorability interacted with age [$F(1, 213) = 8.11$, $p = .005$, $\eta_p^2 = .04$, $BF_{10} = .78$] such that younger adults recalled high- and low-memorability words at a similar rate [$p_{holm} = .161$, $d = .14$] but older adults recalled high-memorability words better than low-memorability words [$p_{holm} < .001$, $d = .57$]. Memorability also interacted with Experiment [$F(1, 213) = 302.38$, $p < .001$, $\eta_p^2 = .59$, $BF_{10} > 100$] such that in Experiment 1a, low-memorability words (which were high-value words) were recalled better than high-memorability words (which were low-value words), [$p_{holm} < .001$, $d = .95$] but in Experiment 1b, high-memorability words (which were

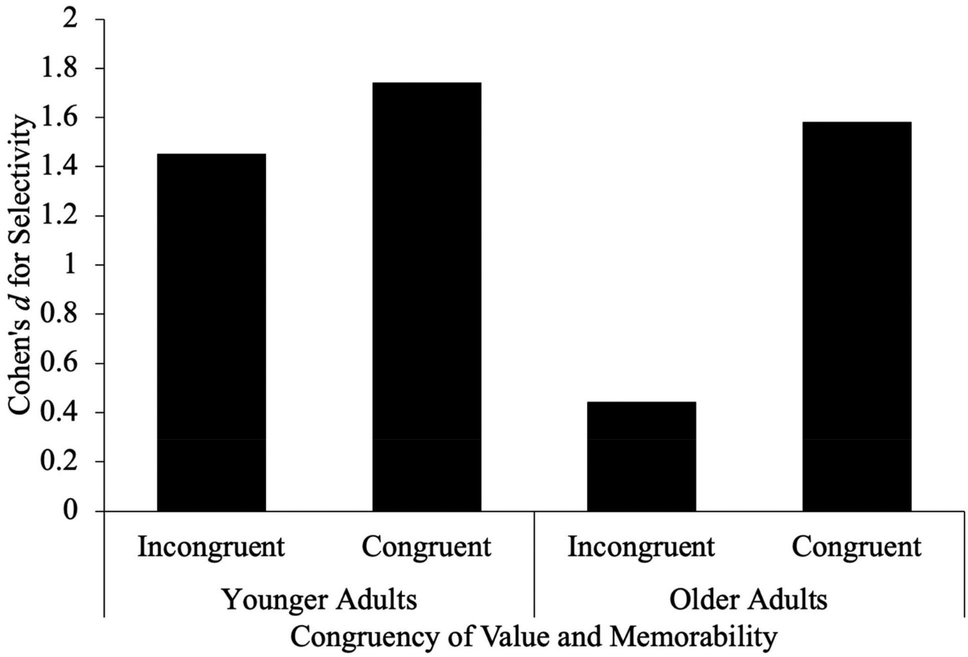

Figure 3. Cohen's *d* from posthoc tests probing the three-way interaction comparing the recall of high-value items to low-value items (i.e., memory selectivity) as a function of the congruency of value and memorability (incongruent (Experiment 1a) = high-value/low-memorability – low-value/high-memorability; congruent (Experiment 1b) = high-value/high-memorability – low-value/low-memorability) and age in the cross-experiment comparison of Experiments 1a and 1b.

high-value words) were recalled better than low-memorability words (which were low-value words), [$p_{holm} < .001$, $d = 1.66$].

Finally, we observed the critical three-way interaction between memorability, age, and Experiment [$F(1, 213) = 15.31$, $p < .001$, $\eta_p^2 = .07$, $BF_{10} = 3.34$] such that younger adults better recalled high-value items relative to low-value items when valuable words were harder to remember and low-value words were easier to remember (Experiment 1a; incongruency of value and memorability), [$p_{holm} < .001$, $d = 1.45$] as well as when valuable words were easier to remember than low-value words (Experiment 1b; congruency of value and memorability), [$p_{holm} < .001$, $d = 1.74$], and the size of these effects was similar [$p = .497$]; however, while older adults still recalled high-value items better than low-value items when valuable words were harder to remember (Experiment 1a; incongruency), the magnitude of this effect was small [$p_{holm} = .048$, $d = .44$] relative to when valuable words were easier to remember than low-value words (Experiment 1b; congruency), [$p_{holm} < .001$, $d = 1.58$], and the size of these effects was different [$p < .001$]. For an illustration of these effect sizes contributing to the interaction, see Figure 3. As can be seen, while younger and older adults were similarly selective when the high-value words were also highly memorable (i.e., congruency), younger adults were more selective than older adults when low-memorability words were more valuable (i.e., incongruency). Put differently, both younger and older adults were selective when high-value words were highly memorable (congruency) relative to when high-value words were harder to remember (incongruency). However, older adults struggled to override the high-memorability of low-value words and thus did not as effectively encode high-value words that were less memorable (incongruency) relative to younger adults.

Discussion

Across two experiments, we examined the ability of younger and older adults to overcome item memorability when pitted against value. A cross-experiment comparison found that younger and older adults' memory for high-value words at the expense of low-value words was differentially affected by item memorability as revealed by a significant three-way interaction between memorability, age, and experiment. This finding indicates that older adults' ability to engage in strategic processing relative to younger adults may depend on the intrinsic properties of the stimuli. Specifically, if highly memorable items are low in value (as in Experiment 1a), older adults have a difficult time (relative to younger adults) overcoming the encoding of these low-value items (which may cause interference for high-value items that are more difficult to remember) and struggle to strategically encode the less memorable, high-value items. In contrast, when the high-value words are also highly memorable, younger and older adults are similarly able to engage in the strategic encoding of valuable items. This suggests that older adults engage in strategic processing of valuable information similarly to younger adults when value and memorability are consistent, but when these cues are discordant, older adults are overly influenced by the ease of encoding the memorable items at the expense of strategically encoding the most valuable items.

Experiment 2

In Experiment 2, we directly compared the relative effects of item memorability and value on memory performance in younger and older adults. Specifically, participants studied six lists of 24 words with six low-value words that were low in memorability, six low-value words that were high in memorability, six high-value words that were low in memorability, and six high-value words that were high in memorability. As seen in Experiment 1, we expected older adults to struggle to overcome the memorability effects such that their memory for low-value, high-memorability words may interfere with their ability to strategically encode high-value words, particularly when said high-value words are low in memorability.

Method

Participants

Younger adults ($n = 61$; age range: 18–32; $M_{age} = 20.54$, $SD_{age} = 2.41$; 50 female, 9 male, 2 other; 31 Asian/Pacific Islander, 2 Black, 9 Hispanic, 16 White, 3 other/unknown) were recruited from the UCLA Human Subjects Pool, tested online, and received course credit for their participation. Older adults ($n = 56$; age range: 65–87; $M_{age} = 72.71$, $SD_{age} = 4.94$; 38 female, 18 male; 1 Asian/Pacific Islander, 3 Black, 52 White) were recruited from Amazon's Cloud Research. No younger adults but three older adults were excluded for admitting to cheating.

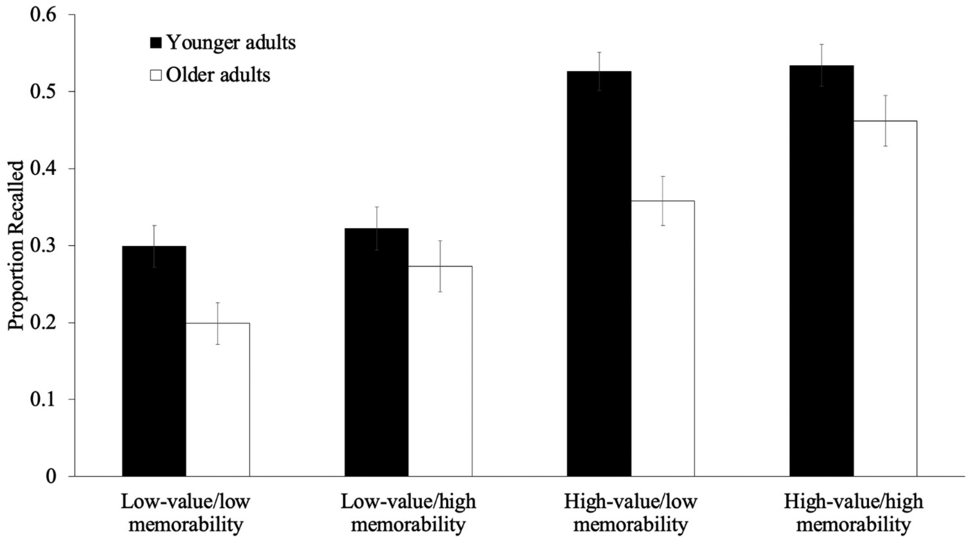

Figure 4. The proportion of words recalled as a function of age for words that were high in memorability and high in value, high in memorability and low in value, words that were low in memorability and high in value, and words that were low in memorability and low in value in Experiment 2. Error bars reflect the standard error of the mean.

Materials and procedure

The materials in Experiment 2 were the same as in Experiment 1. However, rather than studying eight lists of 18 words, participants studied six lists of 24 words with six low-value words (1, 2, 3; each value was presented twice in a list) that were low in memorability (i.e., long, low frequency, low concreteness), six low-value words that were high in memorability (i.e., short, high frequency, high concreteness), six high-value words (10, 11, 12; each value was presented twice in a list) that were low in memorability, and six high-value words that were high in memorability.

Results

Recall as a function of age and memorability/value is shown in Figure 4. A 2 (age: young, old) × 2 (memorability: high, low) × 2 (value: high, low) mixed ANOVA revealed that younger adults recalled a greater proportion of words ($M = .42$, $SD = .17$) than older adults ($M = .32$, $SD = .19$), [$F(1, 115) = 8.78$, $p = .004$, $\eta_p^2 = .07$, $BF_{10} = 9.36$]. Additionally, participants recalled more high-memorability words ($M = .40$, $SD = .20$) than low-memorability words ($M = .35$, $SD = .19$), [$F(1, 115) = 26.39$, $p < .001$, $\eta_p^2 = .19$, $BF_{10} > 100$]. Participants also recalled more high-value words ($M = .47$, $SD = .22$) than low-value words ($M = .28$, $SD = .21$), [$F(1, 115) = 85.18$, $p < .001$, $\eta_p^2 = .43$, $BF_{10} > 100$].

Memorability interacted with age [$F(1, 115) = 13.35$, $p < .001$, $\eta_p^2 = .10$, $BF_{10} = 62.50$] such that younger and older adults recalled a similar proportion of high-memorability words [$p_{holm} = .245$, $d = .27$] but younger adults recalled more low-memorability words [$p_{holm} < .001$, $d = .61$]. However, value did not interact with age [$F(1, 115) = 1.15$, $p = .287$, $\eta_p^2 = .01$, $BF_{01} = 1.69$], and memorability did not interact with value [$F(1, 115) = .29$, p

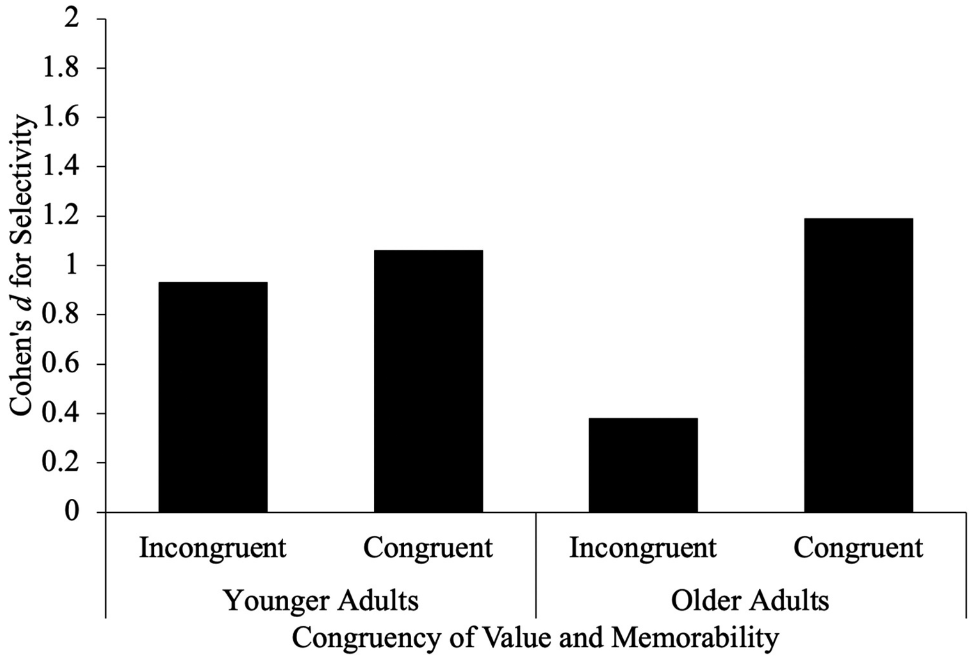

Figure 5. Cohen's *d* from posthoc tests probing the three-way interaction comparing the recall of high-value items to low-value items (i.e., memory selectivity) as a function of the congruency of value and memorability (incongruent = high-value/low-memorability − low-value/high-memorability; congruent = high-value/high-memorability − low-value/low-memorability) and age in Experiment 2.

= .588, $\eta_p^2 < .01$, $BF_{10} = 6.21$]. The three-way interaction between age, memorability, and value did not reach significance [$F(1, 115) = 3.10$, $p = .081$, $\eta_p^2 = .03$, $BF_{01} = 1.42$], but we still probed the interaction given our relevant research question and the findings from the earlier experiments.

In our analysis of the post hoc tests, we examined the same comparisons as the cross-experiment comparison of Experiment 1—we compared the recall of high- vs. low-value items when value and memorability were incongruent (akin to Experiment 1a) as well as when value and memorability were congruent (akin to Experiment 1b). Results revealed that, for younger adults, high-value words were better recalled than low-value words even when the low-value words were more memorable (incongruency), [$p_{holm} < .001$, $d = .93$] as well as when the high-value words were more memorable (congruency), [$p_{holm} < .001$, $d = 1.06$], and the size of these effects was similar [$p = .654$]; however, for older adults, high- and low-value words were recalled at a similar rate when the high-value words were low in memorability compared with low-value words high in memorability (incongruency), [$p_{holm} = .138$, $d = .38$], but older adults were selective (better recall of high-value words relative to low-value words) when value and memorability were congruent (high-memorability/high-value vs. low-memorability/low-value), [$p_{holm} < .001$, $d = 1.19$], and the size of these effects was different [$p < .001$]. To help visualize this potential interaction via these different effect sizes, see Figure 5. Note that the pattern is similar to the cross-experiment comparison of Experiment 1 (the effect size of selectivity is invariant of congruency for younger adults but selectivity for older adults is greater when value and memorability are congruent), though the magnitude of all of the effects is smaller in the mixed-list design of Experiment 2 compared with Experiment 1.

In terms of strategy use, younger adults reported using a greater proportion of effective strategies ($M = .59$, $SD = .36$) than older adults ($M = .30$, $SD = .32$), [$t(115) = 4.58$, $p < .001$, $d = .85$, $BF_{10} > 100$].

Discussion

In Experiment 2, we directly compared the effects of both intrinsic memorability and value in younger and older adults. Results revealed that high-value words were more likely to be recalled than low-value words across younger and older adults. These findings support prior work that has found that younger and older adults engage in selective remembering of valuable words at the expense of less valuable words (for a review, see Knowlton & Castel, 2022). Regarding word memorability, younger and older adults recalled a similar proportion of highly memorable words; however, younger adults recalled a greater proportion of low memorability words than the older adults. These findings provide additional evidence for the differential impact that intrinsic word properties may have on younger and older adults. Specifically, older adults showed a greater benefit of word characteristics known to impact memory like frequency and concreteness compared with younger adults (see Kausler, 1994; Rowe & Schnore, 1971) such that high word memorability reduced age-related differences in memory for these words. However, without the benefit of highly memorable word characteristics, older adults showed a memory impairment for the low-memorability words compared to the younger adults. It is important to note that although the three-way interaction of age, memorability, and value in Experiment 2 did not reach statistical significance and the Bayes Factor (BF_{01}) of 1.42 provides only anecdotal evidence for no effect (Andraszewicz et al., 2015), the data trended in the hypothesized direction, consistent with the pattern observed in Experiment 1. Thus, it is possible that strategic processing, although potentially preserved in older adults (Knowlton & Castel, 2022; Samanez-Larkin et al., 2014), may be limited to contexts where the to-be-remembered information is easier to remember; however, a replication of these trends is needed to support this claim.

Experiment 3

In Experiment 3, we aimed to replicate the effects and trends observed in Experiments 1 and 2 with a different memorability manipulation. Similar to Experiment 2, participants studied six lists, each containing 24 words, and these words were paired with either low (1, 2, 3) or high (10, 11, 12) values. Half of these words (six low-value and six high-value) were presented for a brief period of 1 second each, while the remaining words (six low-value and six high-value) were given an extended study time of 5 seconds each.

Method

Participants

Younger adults ($n = 174$; age range: 18–34; $M_{age} = 19.97$, $SD_{age} = 1.89$; 139 female, 32 male, 3 other; 69 Asian, 3 Black or African American, 44 Hispanic or Latino, 1 Native Hawaiian or

Other Pacific Islander, 44 White, 13 Other/unknown) were recruited from the UCLA Human Subjects Pool, tested online, and received course credit for their participation. Older adults ($n = 146$; age range: 65–96; $M_{age} = 71.85$, $SD_{age} = 5.19$; 88 female, 57 male, 1 other; 3 Asian, 8 Black or African American, 1 Hispanic or Latino, 1 Native Hawaiian or Other Pacific Islander, 130 White, 3 Other/unknown) were recruited from Amazon's Cloud Research. Two younger adults and seven older adults were excluded for admitting to cheating.

With 174 younger adults and 146 older adults, we attempted to triple the sample size from Experiments 1 and 2. This is because although the three-way interaction in Experiment 2 did not reach statistical significance, it was in the hypothesized direction and consistent with the trends observed in Experiment 1 and the Bayes Factor (BF_{01}) of 1.42 only provided anecdotal evidence for no effect. Therefore, we may not have had enough statistical power to detect the three-way interaction in Experiment 2. Based on the effect size for the three-way interaction in our cross-experiment comparison of Experiment 1 ($\eta_p^2 = .07$), we conducted a power analysis to determine what the recommended sample size would have been. Given a significance level of .05 and a power of 80% in a 2 (age; between-subjects) × 2 (memorability; within-subjects) × 2 (value; within-subjects) ANOVA focusing on the three-way interaction, the power analysis would have suggested approximately 99 participants in total for the between-subjects factor. This means aiming for around 50 younger adults and 50 older adults to achieve the desired statistical power for detecting a medium-sized three-way interaction. However, despite exceeding this sample size, we did not detect a significant three-way interaction – the observed effect size was much smaller ($\eta_p^2 = .03$). With an effect size of .03 and total group sizes of 61 and 56 participants, the achieved power for detecting this effect at a significance level of .05 is approximately 21.6%. Thus, given the smaller effect size we observed, we may have been underpowered to detect this small effect. To achieve 80% power with an effect size of .03, we would have needed approximately 472 participants in total. Thus, we would have needed around 236 younger adults and 236 older adults to reach the desired statistical power for detecting this small three-way interaction. Given the power concerns in Experiment 2, we aimed to substantially increase the sample size in Experiment 3. While achieving the approximately 250 participants per age group required for 80% power to detect the smaller observed effect size ($\eta_p^2 = .03$) was not feasible, we tripled the sample size from Experiment 2, targeting around 150 participants in each age group.

Method

The words on each list were randomly selected from a pool of 690 unrelated words (e.g., deck, ruler, energy) that were between 4 and 7 letters ($M = 4.85$, $SD = .99$). On the log-transformed Hyperspace Analogue to Language frequency scale (with lower values indicating lower frequency in the English language and higher values indicating higher frequency), words ranged from 4.73 to 14.35 and averaged a score of 9.48 ($SD = 1.57$). In terms of concreteness (with lower values indicating lower concreteness and higher values indicating higher concreteness), words ranged from 1.19 to 5.00 and averaged a score of 4.16 ($SD = .84$). Frequency and concreteness ratings were generated using the English Lexicon Project website (Balota et al., 2007). Stimuli are available on OSF. Words were

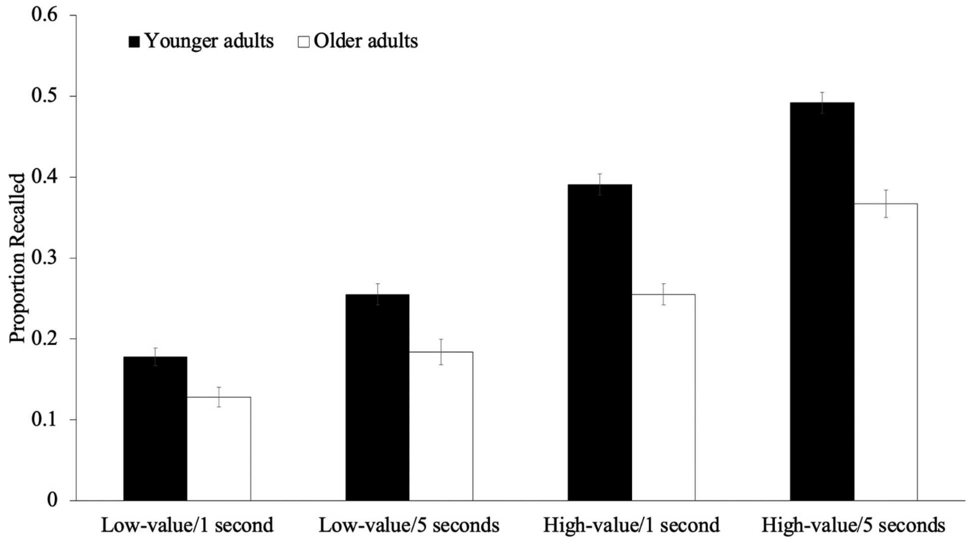

Figure 6. The proportion of words recalled as a function of age for words that were high in memorability and high in value, high in memorability and low in value, words that were low in memorability and high in value, and words that were low in memorability and low in value in Experiment 3. Error bars reflect the standard error of the mean.

shuffled such that, for each participant, any word from the pool could appear on any list, in any position, for any study time, and be paired with any value.

Procedure

Similar to Experiment 2, participants studied six lists of 24 words with six low-value words (1, 2, 3; each value was presented twice in a list) for 1 second each, six low-value words for 5 seconds each, six high-value words (10, 11, 12; each value was presented twice in a list) for 1 second each, and six high-value words for 5 seconds each. After the presentation of all 24 words in each list, participants completed a 30-second distraction task requiring them to rearrange the digits of several three-digit numbers in descending order (e.g., 123 would be rearranged to 321). Participants were given 3 seconds to view each of the 10 three-digit numbers and subsequently rearrange the digits. Following the distractor task, participants were asked to recall all the words they could remember from the just-studied list. The recall test was self-paced (with a minimum of 30 seconds) and participants recalled words by typing them into an on-screen text box. At the end of the recall test, participants were told their score and the maximum possible score for that list. This was repeated for six study-test cycles. Finally, participants were asked about the encoding strategies they used for the low- and high-value words.

Results

Recall as a function of age and study time/value is shown in Figure 6. A 2 (age: young, old) × 2 (study time: short, long) × 2 (value: high, low) mixed ANOVA revealed that younger adults recalled a greater proportion of words ($M = .33$, $SD = .13$) than older adults ($M = .23$,

$SD = .15$), [$F(1, 318) = 39.19$, $p < .001$, $\eta_p^2 = .11$, $BF_{10} > 100$]. Additionally, participants recalled more words that were presented for 5 seconds ($M = .33$, $SD = .17$) than words presented for 1 second ($M = .24$, $SD = .13$), [$F(1, 318) = 327.75$, $p < .001$, $\eta_p^2 = .51$, $BF_{10} > 100$]. Participants also recalled more high-value words ($M = .38$, $SD = .18$) than low-value words ($M = .19$, $SD = .16$), [$F(1, 318) = 356.67$, $p < .001$, $\eta_p^2 = .53$, $BF_{10} > 100$].

Study time did not interact with age [$F(1, 318) = .34$, $p = .559$, $\eta_p^2 < .01$, $BF_{01} = 7.20$]. However, value interacted with age [$F(1, 318) = 12.16$, $p < .001$, $\eta_p^2 = .04$, $BF_{10} = 47.93$] such that younger adults recalled more low-value words [$p_{holm} < .001$, $d = .35$] as well as more high-value words [$p_{holm} < .001$, $d = .76$] than older adults and the magnitude of these differences was greater for high-value items [$d = .76$] than for low-value items [$d = .35$]. Study time interacted with value [$F(1, 318) = 25.50$, $p < .001$, $\eta_p^2 = .07$, $BF_{10} > 100$] such that longer study times led to better recall for low-value items [$p_{holm} < .001$, $d = .99$] as well as high-value items [$p_{holm} < .001$, $d = 1.22$] and the magnitude of these differences was greater for high-value items [$d = 1.22$] than low-value items [$d = .99$].

The three-way interaction between age, study time, and value was significant [$F(1, 318) = 4.47$, $p = .035$, $\eta_p^2 = .01$, $BF_{10} = .93$] such that younger adults' selectivity was not as impacted by study time as older adults. In our analysis of the post hoc tests, we again compared the recall of high- vs. low-value items when value and study time were incongruent as well as when value and study time were congruent. Results revealed that, for younger adults, high-value words were better recalled than low-value words even when the low-value words were studied longer (incongruency), [$p_{holm} < .001$, $d = .79$] as

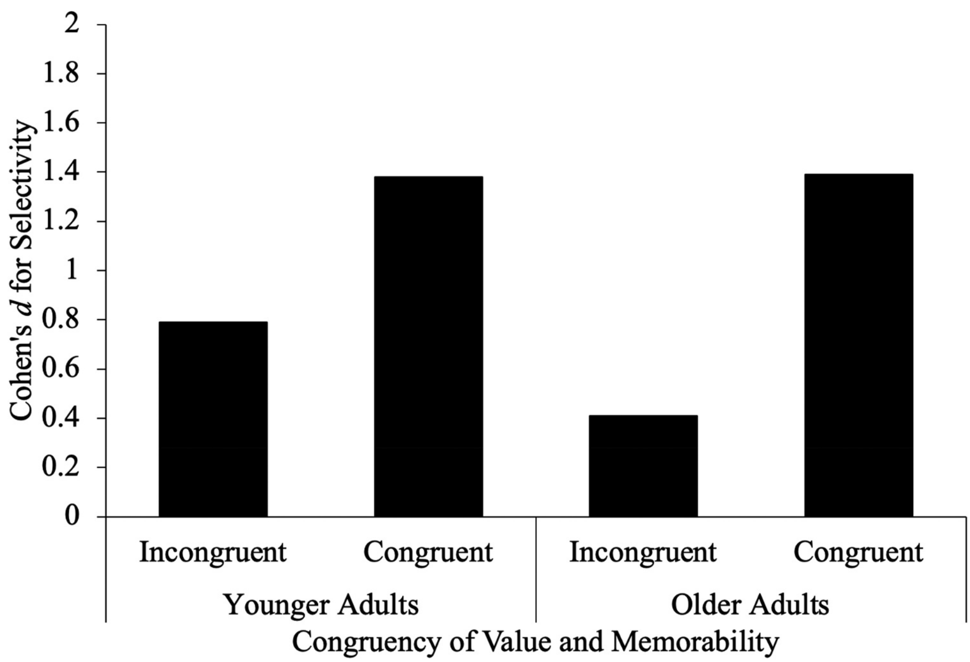

Figure 7. Cohen's d from posthoc tests probing the three-way interaction comparing the recall of high-value items to low-value items (i.e., memory selectivity) as a function of the congruency of value and memorability (incongruent = high-value/low-memorability – low-value/high-memorability; congruent = high-value/high-memorability – low-value/low-memorability) and age in Experiment 3.

well as when the high-value words were studied longer (congruency), [$p_{holm} < .001$, $d = 1.38$]. Importantly, the size of these effects was different [$p < .001$] with younger adults' recall more greatly influenced by value under congruent conditions than incongruent conditions. Similarly, for older adults, high-value words were better recalled than low-value words when the high-value words were only studied for 1 second compared with low-value words studied for 5 seconds (incongruency), [$p_{holm} < .001$, $d = .41$], and older adults were also selective (better recall of high-value words relative to low-value words) when value and study time were congruent (long study time/high-value vs. short study time/low-value), [$p_{holm} < .001$, $d = 1.39$]. Similarly to the younger adults, the size of these effects was different [$p < .001$] with congruent conditions facilitating greater selective memory for high-value items than incongruent conditions. Critically, the benefit of congruency (e.g., high-value words being presented for 5 seconds) over incongruency (e.g., high-value words being presented for 1 second) on selective memory for more valuable items was greater in magnitude for older adults than younger adults, indicating that incongruency had a more detrimental effect on the older adults' ability to selectively remember the high-value words than the younger adults. To help visualize this interaction via these different effect sizes, see Figure 7. Note that the pattern is similar to Experiments 1 and 2 (in conditions that do not support item memorability, older adults' ability to remember high-value items is impaired).

In terms of strategy use, we conducted a 2 (age: young, old) × 2 (value: high, low) mixed ANOVA on the proportion of effective strategies reported as employed. Results revealed that younger adults reported using a greater proportion of effective strategies ($M = .39$, $SD = .29$) than older adults ($M = .16$, $SD = .20$), [$F(1, 318) = 66.15$, $p < .001$, $\eta_p^2 = .17$, $BF_{10} > 100$]. There was an effect of value such that participants reported using a greater proportion of effective strategies for high-value items ($M = .33$, $SD = .33$) than low-value items ($M = .25$, $SD = .31$), [$F(1, 318) = 18.51$, $p < .001$, $\eta_p^2 = .06$, $BF_{10} > 100$]. Age interacted with value [$F(1, 318) = 8.17$, $p = .005$, $\eta_p^2 = .03$, $BF_{10} = 5.92$] such that older adults employed effective encoding strategies at a similar rate for low- and high-value items [$p_{holm} = .328$, $d = .09$] while younger adults employed effective encoding strategies at a higher rate for high-relative to low-value items [$p_{holm} < .001$, $d = .42$].

Discussion

In Experiment 3, we examined how information memorability affects younger and older adults' ability to selectively remember more valuable items over less valuable items by manipulating whether high- and low-value words were studied for 1 second (less memorable) or 5 seconds (more memorable). We found that younger and older adults were able to use value to guide their remembering regardless of whether study time and value were incongruent (i.e., 5 second low-value word, 1 second high-value word) or congruent (i.e., 5 second high-value word, 1 second low-value word), suggesting that even when value is pitted against information memorability (as manipulated by study time), younger and older adults are able to use strategic processing to overcome the memorial benefits of greater study time and better encode and thus recall the high-value words compared to low-value words. Critically, however, our analyses indicated that even though both age groups did overcome information memorability to remember more valuable words over less valuable words, younger adults were able to overcome the benefit of longer presentation time of low-value words on encoding to a greater degree than older adults whose memory was less affected by value under incongruent conditions. In line with the significant three-way interaction in Experiment 1 and the trends of Experiment 2, this suggests that older adults may experience more difficulty remembering more important items over less important items than younger adults under conditions that pit information memorability against value.

General discussion

In the present study, we investigated the influence of strategic processes on value-directed remembering in younger and older adults. In four experiments, we manipulated the memorability and value of words such that memorability and value were either congruent (i.e., high-memorability words were highly valued or vice versa) or incongruent (i.e., low-memorability words were highly valued or vice versa). In Experiments 1 and 2, information memorability was manipulated via word characteristics (i.e., concreteness, length, and frequency) while in Experiment 3, memorability was manipulated via study time (i.e., 5 seconds (high memorability) compared to 1 second (low memorability)). Results from Experiment 1a – which contained incongruent trials – demonstrated that younger adults better encoded and remembered the high-value/low-memorability words relative to older adults. Experiment 1b revealed that when the high-value words were also highly memorable (i.e., congruent trials), younger and older adults were similarly able to engage in the strategic encoding of valuable items. A cross-experiment comparison of Experiments 1a and 1b further demonstrated that older adults' selectivity is impaired when the to-be-remembered valuable information is difficult to remember while younger adults' selectivity is less impacted by memorability. Experiment 2 directly compared the effects of memorability and value in younger and older adults and showed similar trends as seen in Experiment 1, although the within-subjects/mixed-list design did not find the critical three-way interaction from Experiment 1 to be significant. Because Experiment 2 did not provide conclusive evidence toward our main finding from Experiment 1, we conducted a fourth experiment with a different information memorability manipulation (i.e., study time) to try to replicate the trends from Experiments 1 and 2 while also examining whether the significant three-way interaction from Experiment 1 is replicable (thus providing critical additional support for our claim). In Experiment 3, we did indeed find the critical three-way interaction from Experiment 1 such that younger adults were able to overcome the benefit of greater memorability (via longer presentation time) of low-value words on encoding to a greater degree than older adults whose memory was less affected by value under incongruent conditions. Thus, across four experiments, we found compelling evidence that older adults' selective memory is impaired when high-value information is difficult to remember and low-value information is easier to remember, while younger adults' selectivity does not depend as much on memorability.

These findings suggest that the preservation of value-directed remembering with age may depend on the memorability of the stimuli. While older adults' memory can benefit from higher frequency and more concrete words (Kausler, 1994) as well as greater study time (e.g., M. D. Murphy et al., 1987), these benefits may also come at a cost when these variables are placed in opposition to the goals of the memory task (i.e., incongruency). Specifically, older adults may struggle to overcome the encoding of low-value items that are highly memorable, potentially interfering with their ability to selectively encode high-value items when they are low in memorability (and prior work shows that older adults are more susceptible to interference in value-directed remembering tasks; see D. H. Murphy & Castel, 2022a, 2023). Stated another way, the ability to engage in the elaborative encoding of high-value items by older adults may be dependent on the memorability of the to-be-remembered information.

After completing the memory task, participants self-reported the strategies they used to remember the words and results revealed that younger adults reported using more effective encoding strategies than older adults, though this effect was mitigated in Experiment 1b which employed congruent trials. These findings may provide insight into how the mechanisms of value-directed remembering change with age – when valuable items are more memorable, it should be easier for younger and older adults to engage in elaborative encoding strategies (e.g., mental imagery) to strategically remember these items. This is supported by the smaller difference in the reported use of effective encoding strategies between younger and older adults (in Experiment 1b, this difference did not reach significance). Thus, in this congruent value/memorability context, older adults' strategic selective memory is preserved. In contrast, when valuable items are more difficult to remember, younger adults reported using more effective encoding strategies than older adults. This is supported by Experiment 3 in which older adults reported employing effective encoding strategies at a similar rate for low- and high-value items, while younger adults employed effective encoding strategies at a higher rate for high-relative to low-value items. Thus, younger adults may be better at adjusting their memory strategies to suit different contexts. Therefore, while strategic processing might still be intact in older adults (Knowlton & Castel, 2022; Samanez-Larkin et al., 2014), its effectiveness could be confined to situations in which it is relatively easy to apply effective encoding strategies.

In the present paradigm, the encoding of high-value words that are also highly memorable is likely aided by strategic processing, whereas encoding high-value words with low memorability may require a greater emphasis on automatic processing. Thus, it is possible that younger adults were aided by a heightened sensitivity to value (Chowdhury et al., 2013; Halfmann et al., 2016) which may have contributed to their greater selectivity when words were harder to remember. This could provide support for the theory that older adults have impaired automatic processing of valuable stimuli compared to younger adults (see Knowlton & Castel, 2022). However, further research directly investigating the role of automatic processing in value-directed remembering is necessary to delineate any age-related differences in the ability to use this mechanism to be selective (see D. H. Murphy et al., 2025). Here, both younger adults' enhanced automatic processing of value, along with older adults' age-related cognitive deficits, may account for our findings of differences in memory for the high-value/less memorable information.

In Experiments 1 and 3, the older adults' impaired value-directed remembering compared to younger adults when important items were low in memorability may be related to changes in cognitive abilities that occur with age, such as a decrease in working memory capacity, processing speed, and executive functioning (Hess, 2005; Park & Festini, 2017; Salthouse, 2010, 2019; Thomas & Gutchess, 2020), all of which may impact the ability to use effective encoding strategies for less memorable but more valuable information. Additionally, due to age-related impairments in cognitive control, it may be harder for older adults to disengage attention from highly memorable/lower-value words and reallocate attention to highly valued information that is more difficult to process. There may also be important metacognitive differences in how younger and older adults monitor and control their learning when faced with competing cues of value and memorability.

The present results may be in line with some relevant work on how older adults have difficulty overcoming other forms of competing information (such as proactive interference) in opposition paradigms (see Jacoby & Rhodes, 2006), suggesting that mechanisms that can combat highly accessible interference may be impaired in older age (see D. H. Murphy & Castel, 2022a, 2023). This aligns with the inhibitory theory of aging which hypothesizes that as we age, our ability to inhibit competing but irrelevant (or, in this case, less important) information worsens (Hasher & Zacks, 1988; Hasher et al., 1999). The present work extends this to situations in which more easily remembered information is of lower value, putting learning goals in direct conflict with stimulus characteristics.

However, there are limitations of the current study that need to be acknowledged and addressed. For example, it is important to note that in Experiment 2, the critical three-way interaction of memorability, value, and age group was not significant, although we were able to detect this interaction in Experiments 1 and 3. This lack of a significant interaction in Experiment 2 introduces some skepticism to our claim that older adults' selective memory is impaired when high-value information is difficult to remember and low-value information is easier to remember, while younger adults' selectivity does not depend as much on memorability. However, when considering the small effect size of the interaction in Experiment 2 ($\eta_p^2 = .03$) and power analyses based on this effect size, it seems possible that we simply did not have a large enough sample to detect such an effect, particularly when using the within subjects/mixed lists design. This is supported by Experiment 3 where we greatly increased the sample size and found significant interactive effects as found in Experiment 1. Additionally, the memorability manipulation in Experiment 3 (study time) may be inherently stronger than the word characteristic-based manipulation used in Experiments 1 and 2. This more potent manipulation likely increased the sensitivity of the task, enabling us to detect the critical three-way interaction with a smaller sample size than the estimation derived from Experiment 2's effect size. Due to the convergence in findings between Experiments 1 and 3 and the data trending in that direction in Experiment 2 (although not significant), we believe that there is sufficient and compelling enough evidence to support our claim that under challenging value-directed remembering conditions (e.g., when value and memorability are pitted against one another), older adults have impaired selective remembering compared to younger adults.

Another limitation of the present study is that the tasks used do not allow us to identify why younger adults were more selective than older adults when information memorability and value were conflicting. The observed limitations in older adults' value-directed remembering could have resulted from a myriad of factors such as declines in working memory, processing speed, and executive functioning. Future research could explore tasks specifically designed to tease apart the contributions of working memory, processing speed, and executive functioning to memory selectivity, incorporating conditions that isolate the impact of each factor on the encoding and recall processes. Additionally, studies could investigate interventions or strategies that may enhance older adults' ability to selectively remember valuable information, particularly when such information is not inherently memorable, potentially addressing the cognitive deficits that become more pronounced with age. In addition, another potential limitation is the assertion that the observed effects are primarily due to encoding rather than retrieval processes. Without direct measures of encoding, the results could reflect disparities in retention or retrieval capabilities. For instance, if older adults aim to recall all presented information rather than selectively focusing on maximizing points via the strategic encoding of high-value words, the words more likely to be forgotten or challenging to retrieve – regardless of their associated value – would inherently be those of low memorability. It could be interesting to further examine how memorability and value influence the dynamics of younger and older adults' retrieval dynamics such as the lag-conditional response probabilities (which measure the lag-recency effect) or the probability of first recall (how participants initiate retrieval; see D. H. Murphy & Castel, 2022c for age-related differences in retrieval dynamics when engaging in value-directed remembering). An additional consideration for future research is the potential influence of mixed-list versus blocked-list presentation on strategic processing and memory performance, as prior work (e.g., Talmi et al., 2007) suggests that list composition can impact the distinctiveness and relatedness of encoded information. Investigating how different presentation formats interact with value-directed encoding could provide further insight into the mechanisms underlying strategic memory enhancement. Another potential limitation of our study is that the assigned value of the words does not correspond to any tangible outcomes or rewards, which may not fully replicate the effects of actual value or reward on memory prioritization (but see Horn & Freund, 2022). This discrepancy could influence how participants perceive and facilitate memory for high-value words, possibly affecting the generalizability of our findings to real-world scenarios where rewards are concrete.

In conclusion, the present study provides evidence that strategic memory processing plays an important role in age-related differences in value-directed remembering under certain conditions. Specifically, older adults may be able to effectively use strategic memory processes for high-value information, but this becomes more difficult when the memorability of the lower-value information competes with the goals of the task. Overall, this study sheds light on the complex interplay between value and memorability in selective memory processes and highlights how strategic processing impacts memory utility across the lifespan.

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ORCID

Kara M. Hoover http://orcid.org/0000-0001-8396-4734
Dillon H. Murphy http://orcid.org/0000-0002-5604-3494
Barbara J. Knowlton http://orcid.org/0000-0002-1532-5081
Alan D. Castel http://orcid.org/0000-0003-1965-8227

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, some of the authors (K.H., D.M.) used ChatGPT to revise the manuscript for clarity and word choice. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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The ideas and data appearing in the manuscript have not been disseminated before. The experiments reported in this article were not formally preregistered. The stimuli and data have been made available on the Open Science Framework: https://osf.io/eya6g/?view_only=b21dcbd18bf04bbda7913b62bd350522.

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