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## MEMORY SELECTIVITY IN OLDER AGE

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### Abstract

Memory often declines with age, but older adults can off-set memory challenges by selectively remembering important information. When encountering large amounts of information and knowing that memory is limited, older adults may choose to focus on what is most important and forget less relevant details. Prioritizing what to remember becomes essential when memory is limited, and influences what information can be off-loaded. While forgetting can be frustrating and consequential, a lifetime of these experiences may help older adults learn to focus on strategically remembering important information and life events. Curiosity and emotion may also guide what older adults remember, such that selective remembering can be an adaptive way to use memory efficiently in older age.

### Keywords

memory; aging; selectivity; metacognition; curiosity

### 1. Introduction

We are often overwhelmed with information and need focus on what is important to remember. As memory may decline in older age, the ability to selectively remember what is most important can be a critical and adaptive way for older adults to efficiently use memory, as older adults may face a clutter of information in memory [1]. When one is overcome with large amounts of information, and we are aware that memory is limited, we might engage in selective learning to prioritize what is most important to remember. Despite the frustration of forgetting, not remembering inessential details or forgetting outdated information may be an adaptive process. These selective memory processes may be especially relevant for older adults who are concerned about and aware of memory limitations and forgetting.

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Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## 2. Metacognition and Selective Memory

Our awareness of how our memory works, and when it might fail, is a form of metacognition, our awareness of our own cognitive abilities [2]. We often rely on metacognition to guide learning, and some forms of metamemory may be intact in older age [3]. Older adults may be able to accurately monitor memory abilities and predict what information might be soon forgotten [4]. Knowing that we cannot remember everything, and that memory does not work like a video camera, is an important observation about memory. For example, an eyewitness of a crime may misremember certain smaller details but selectively remembers some central information [5]. Thus, we might remember the gist, or general information about a past event, and quickly forget less relevant details. This may be even more pronounced in older age, where gist-based information is retained and less relevant details are often forgotten [6,7,8]. Although older adults may not spontaneously use strategies to remember information in lab-tasks (e.g., imagery, mnemonics), when instructed to do so, this can reduce age-related differences in memory [9]. As we get older, we may become more attune to the processes that guide memory and adaptive strategies that can help us remember (e.g., writing lists, using calendar reminders, repeating and/or visualizing a name). Metacognition can help older adults selectively remember important information and forget things that are no longer relevant.

## 3. Value-Directed Memory and Aging

How do we focus on what is important? Value-directed remembering is a process that allows people to prioritize what will be remembered by focusing attention on important information [10,11]. For example, a student needs to study important facts and concepts for an upcoming exam and an older adult, knowing that memory is limited, may want to focus on what is important to remember from a recent conversation. We have studied this by using a selectivity memory task whereby to-be-remembered words are paired with point values and participants' goal is to maximize their score, which is the sum of the point values of the words that are later recalled (see Figure 1A). Several studies have shown that despite remembering fewer words than younger adults, older adults can selectively remember high-value words to maximize memory efficiency (Figure 1B) [12]. People with differing memory abilities often show this tendency to prioritize high-value words at the expense of lower-value words after experiencing several lists of words [13]. Thus, after some task experience and awareness that not all of the words will be remembered, both younger and older adults learn to selectively remember the highest-value words, but older adults may be especially focused on remembering higher value words due to concerns about forgetting important information.

Value-directed remembering has been studied across the lifespan (age ranges from 5–96 years old) [14]. Impairments in selectivity have been found in those with different forms of ADHD [15], early stages of Alzheimer's disease [16], and schizophrenia [17], suggesting attention cognitive control may play an important role in value-directed remembering. When people are rushed, this may also engage selectivity [18]. However, when older adults are placed under stereotype threat that activates more extreme concerns about changes in memory ability, this can consume goal-based attention that limits both memory and selectivity,

although value-directed remembering may be employed as a compensatory strategy [19, 20]. Engaging value-directed remembering may activate brain regions that promote selective learning, semantic processing, and recollection, facilitating healthy older adults' ability to remember high-value words [21, 22]. While automatic processing of potential reward may play a larger role in memory selectivity among younger adults, older adults may engage more controlled and effortful strategic processes to selectively remember information [23].

Value-directed remembering can be helpful when learning a new language, such that one wants to selectively learn frequently used words (e.g., greetings) or useful phrases (e.g., asking for directions) that are relevant to an upcoming trip [24]. In addition, older adults may use gist information when engaging in value-directed remembering. For example, when evaluating the prices of two comparable products (e.g., two types of juice), older adults may remember which of the two has a better price and/or is on sale [25]. When viewing an upcoming weather forecast, older adults may remember the gist as it pertains to a goal, such as what day to plan a picnic, and when it will rain, but not precise temperatures [26]. Thus, gist may be a useful way to limit and organize what is remembered to focus on what is most useful and relevant.

Selectivity involves motivational factors as well as focused cognitive processes that can be differentially influenced by aging [27,28,29]. While reward-based learning may involve dopamine, a neurotransmitter that tends to decline with older age [30], older adults can recruit other more intentional strategic processes that allow for efficient reward-based learning [31]. Thus, value-directed remembering involves a strategic metacognitive process that invokes an awareness of the need to learn more efficiently, using cognitive control processes [32] and attention to selectively bind features of important information in working memory [33].

#### 4. Goal-Based Selective Memory in Older Age

The goals we have influence what needs to be remembered. Imagine you are grocery shopping and forget your list at home (or do not even have a list). You could just try to remember every item you need to buy or you could focus on the most important/pressing items (food for dinner tonight, etc.). When people are given goals, such as planning a party or a camping trip, both younger and older adults can selectively remember important, central information, but this type of selectivity is subjective in nature [34]. For example, when planning a camping trip, packing a sleeping bag may be essential but some people may feel marshmallows (or an air mattress) are also important to remember. Older adults often do remember the most important information when these schematic goals are presented [35]. For instance, imagine you are taking care of a child who is allergic to some foods. You need to remember this allergy information, but you may also want to remember what foods the child likes and dislikes. Older adults may have some initial difficulty with remembering the specific foods, but with task experience (after seeing and forgetting some of the allergies on earlier lists), older adults may selectively remember the more important allergies at the expense of the other, less critical, food information [36].

When presented information about medications, one may also feel overwhelmed, especially when medication names are unfamiliar or confusing. Memory for this information can be important as there are instances where certain medication interactions can be harmful. Older adults generally exhibit memory challenges when remembering specific associations such as medication interactions [37]. However, when the relative severity (i.e., importance) of potential interaction outcomes is made clear during learning, older adults are able to selectively remember the interactions that are associated with the most severe outcomes [38].

Offloading information to external devices (or to other people) can also facilitate effective use of memory. Older adults can benefit from offloading [39], and may seek to off-load important information if it can easily be accessed at a later time [40]. This presents a useful way to supplement memory in older age and, if used effectively [41], could also reduce anxiety related to having large amounts of information to remember.

## 5. Responsible Remembering

When one remembers what they said they would remember, especially when information is important, then one may be engaging in responsible remembering [42]. Prior research used a task similar to Figure 1A but required people to first bet on which word-point pairs would be remembered on a later test (with the consequence of losing the associated points if the word that was bet on was later forgotten). Older adults remembered less and learned to bet on fewer but higher value items on later lists. These high-value words were, in turn, best remembered [43].

Although having consequences if something important is later forgotten can make encoding a stressful event, it may also engage future responsible remembering. For example, remembering a severe allergy may have a greater impact on one's health than remembering a wedding anniversary, but both may still hold serious consequences if forgotten. Thus, being aware of what needs to be remembered based on the consequences of forgetting, and using appropriate techniques to remember this information (calendars, reminders, off-loading, or sharing with another person), can be essential ways to be responsible when remembering [44].

## 6. Forgetting: A Reminder to be Selective

While older adults can selectively remember important things, there are situations in which older adults may struggle to remember important information. People of all ages have often experienced memory failures, such as leaving an important object behind, and in some rare cases, even leaving an infant in a car [45]. An awareness of forgetting may be useful to promote strategic encoding and adaptive memory [46]. When one feels they cannot remember most of the information in question, then metacognition may be activated such that selective learning is engaged to an optimal level. Task experience and one's awareness of limited memory are critical for older adults to experience the need to be selective. This experience in the real world likely happens due to years of memory challenges and an awareness of greater forgetfulness with age. However, in laboratory-based memory

tasks, developing awareness of one's memory limitations may require several trials/lists to make older adults aware of the need to be selective. Thus, being aware of the possibility of forgetting important information may activate the need to be selective in the future—something many healthy older adults may be doing naturally in response to memory changes and challenges that accompany healthy aging. However, different forms of dementia may impact awareness and selective learning [47].

## 7. Curiosity, Emotion, and Selectivity

What is the only food that never spoils? Curiosity can guide selective memory, such that people may better remember information they are curious about which can drive future learning [48]. For example, hummingbirds can remember every flower they have visited, as well as how long it takes for a certain type of flower to refill with nectar. This may be of interest to some but not others, showing that curiosity is subjective in nature and can guide selective memory and learning (curious about the answer to the first example? Honey never spoils). A life-long baseball or soccer fan may remember events and detailed statistics that less interested individuals might find irrelevant, incomprehensible and useless. Older adults can remember information they are curious about as well as related information and skills [49], stimulating engagement and future learning [50, 51].

Emotional events may be selectively remembered in older age, with older adults often focusing attention on positive information or experiences [52], and this can lead to greater happiness and life satisfaction [53]. Older adults may strategically focus on positive information at the expense of less important information [54]. Salient events may also link related memories, providing ways to enhance memory in older age [55]. However, in terms of remembering financial information, older adults may sometimes selectively focus on gains more than losses, leading to some biases in memory [56]. Distraction and arousal can also influence memory and reduce focus [57]. Thus, curiosity and emotional selectivity can be a double-edged sword, as one may be curious about enticing offers, helping someone in need, and making romantic connections, which could facilitate scams and fraud, suggesting that we need to harness our selective focus and curiosity in some situations.

Broadly speaking, the notion that memory becomes more selective with age fits with more general lifespan theories of aging, including selective optimization with compensation [58] and socioemotional selectivity theory [59]. When memory is limited, one may optimize performance by compensating in various ways (e.g., using strategies, more attentional focus and/or study time for important information), and when future time in life is viewed as limited, older adults may prioritize what is most important (e.g., family, relationships, hobbies, what is most interesting).

## 8. Future Directions

There may be differences in terms of when older adults engage in selectivity, and who is more likely to use adaptive strategies. Accordingly, future research can examine individual differences [60, 61, 62], changes in frontal lobe function [63] as well as cultural, ethnic and socioemotional factors that can influence how people selectively remember and how

this may change with age [64]. Future research can also examine how technology (such as smartphones) record information such that people choose what is important to store off-line and revisit later [65]. Thus, it is critical for people to accurately judge what information and events are important to remember and what will be forgotten [66], such that judgements of importance [67] and evaluative processing may be essential to help older adults remember what matters the most.

## 9. Summary

Despite changes in memory, older adults can remember certain details from long ago, likely because these events were important, forming cherished and defining memories of the past. The present review suggests that older adults remember selectively and strategically to focus on what is most important and may also forget less relevant information. However, a selective memory also can be prone to biases and misremembering of details. Thus, in many ways a selective memory is a blessing and a curse, but for older adults it can be an adaptive way to focus on remembering important information.

**N.B.** Much like how selective memory may work in older age, this article is meant to be a concise review of relevant research themes and ideas that are most pertinent, emphasizing both foundational and more recent work, but is also prone to the shortcomings of a selective memory.

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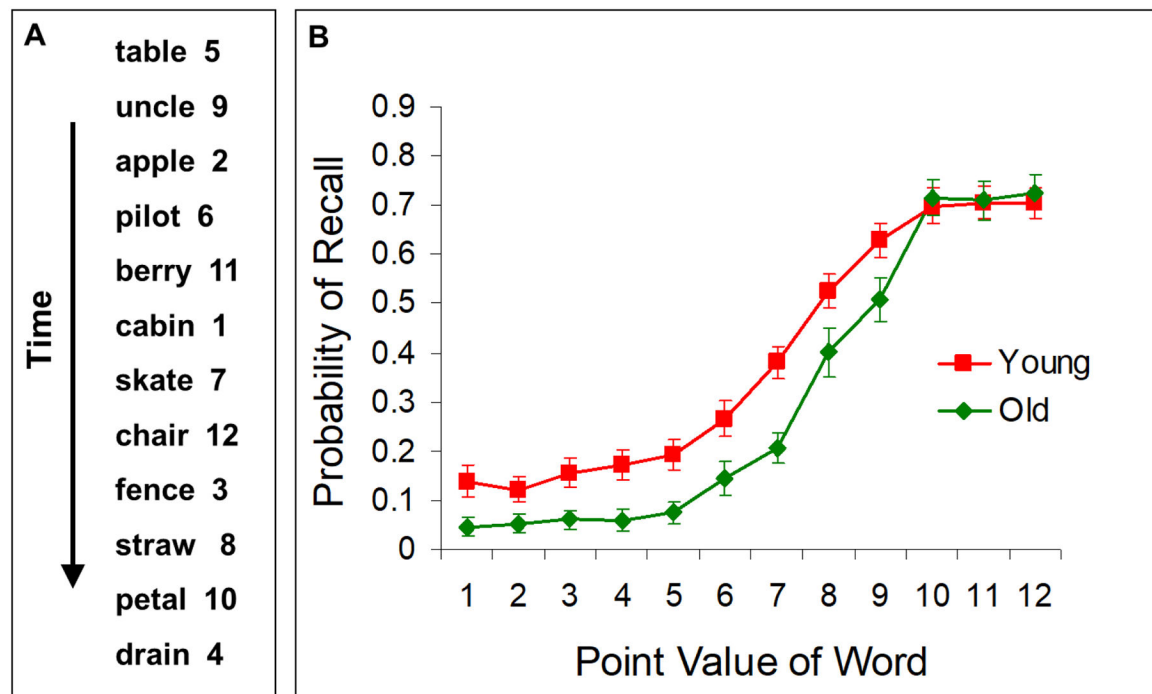
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**Highlights**

- Despite memory decline, older adults can selectively remember important information.
- Awareness of memory limits and forgetting may encourage selectivity in older age.
- Older adults may focus on remembering gist/main themes and positive emotional events.
- Curiosity, emotion, and interests can strongly guide what older adults remember.



**Figure 1.**

**A)** The selectivity memory task whereby words are presented one-at-a-time (in this case, each word is shown for 2 seconds and randomly paired with a point value ranging from 1–12). The participant is told that the goal is to recall as many words as possible in order to achieve a high score, which is the sum of the point values paired with the recalled words. After the all words are presented, the participant is asked to recall the words. After receiving feedback about their score, a new list is presented with different words, and the participant again tries to achieve a high score. This cycle is repeated such that participants become familiar with the task.

**B)** The results from the selectivity task, in terms of the probability of recalling a word based on the point value of the word, averaging across all of the lists. These results are from younger adults (university students, average age approximately 20 years old) and healthy older adults (who live in the community, average age approximately 70 years old). There are age-related differences in overall memory recall such that younger adults recall more words, but both age groups are more likely to recall higher value words. Age-related difference in memory are reduced or eliminated for the highest value words, as older adults selectively remember these words in order to maximize their score, despite recalling fewer words than younger adults.