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Dissociations between directly and generatively retrieved autobiographical memories: evidence from ageing

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ABSTRACT

Autobiographical memory research has largely focused on effortful, generative retrieval processes, particularly in cognitive ageing literature. However, recent evidence has shown that autobiographical memories are often retrieved directly, without effortful retrieval processes. In the present study, we examined the retrieval characteristics and the phenomenological qualities of directly and generatively retrieved memories in younger and older adults. Participants recalled autobiographical memories in response to word-cues and reported whether each of their memories was retrieved directly (i.e., memory popped into mind) or generatively (i.e., they actively searched for it), and provided ratings for several retrieval and phenomenological characteristics. Overall, directly retrieved autobiographical memories were recalled faster and with less effort, were more recent, more frequently rehearsed, more vivid, and more positive in valence than generatively retrieved memories. Importantly, while younger adults recalled a higher number of generatively retrieved autobiographical memories than older adults, there were no age effects on the number of directly retrieved memories. We also established the parallel-form reliability of the word-cue method in eliciting autobiographical memories by comparing two sets of word-cues. The results provide novel insights on the dissociable effects of retrieval type and ageing on autobiographical memories. Theoretical and practical implications of these findings are discussed.

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Ageing; autobiographical memory; retrieval processes; memory cueing paradigm

Autobiographical memory (AM) lies at the core of the human declarative memory system and includes memories from one's own personal past (Conway, 2005; Tulving, 2002). Episodic AM entails recollecting personally experienced past events with a specific spatio-temporal context (e.g., *having coffee and cake with friends last Sunday at my place*) and differs from autobiographical semantic memory, which involves decontextualised autobiographical facts (e.g., *walnut cakes are my favourite cakes*; for a review see Renoult et al., 2012). AMs can vary largely in terms of their content, temporal distance from the present, and various phenomenological characteristics like vividness or emotional valence.

AMs have also been classified as voluntary or involuntary, based on the nature of the retrieval processes involved. Voluntary memories refer to intentionally and deliberately retrieved memories, while involuntary memories refer to memories that come to mind without a deliberate intention to retrieve them (Berntsen, 1998; 2010; Mace, 2007; Schlagman & Kvavilashvili, 2008). Studies employing word-cue paradigms have shown that participants need on average about 10–15 s to deliberately recall an autobiographical past event in response to a word-cue, which is assumed to reflect the degree of cognitive effort needed for strategic search processes (Rubin & Schulkind, 1997; Schlagman & Kvavilashvili, 2008). By contrast, diary and laboratory studies have shown that involuntary AMs are recalled when engaged in unrelated ongoing activities and, often, in response to incidental cues in the environment or in one's thoughts. Although involuntary AMs are not preceded by an intention to recall a particular event, they are remembered significantly faster (i.e., in 3–5 s) than voluntary AMs (Barzykowski & Staugaard, 2018; Barzykowski et al., 2019; Schlagman & Kvavilashvili, 2008).

However, there is now growing evidence to show that even when using a standard word-cue paradigm to study voluntary AMs, some memories are retrieved much faster than 10–15 s, with very little effort involved (Barzykowski et al., 2019; Barzykowski & Staugaard, 2016; Barzykowski et al., 2021; Harris et al., 2015; Uzer & Brown, 2017; Uzer et al., 2012). This reflects an important distinction between "generative" versus "direct" retrieval proposed by Conway and Pleydell-Pearce (2000) in their self-

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memory system model of AM (see also Addis et al., 2012; Conway, 2005). Generative retrieval of AMs is slower than direct retrieval, and often involves an active, top-down and effortful search process to retrieve them (Conway & Pleydell-Pearce, 2000; Uzer et al., 2012). Search processes in generative retrieval may take a variety of forms, such as hierarchical, temporal, or visualisation search strategies, among others (e.g., Mace et al., 2017; Mace, Petersen, et al., 2021; Mace, Staley, et al., 2021). By contrast, directly retrieved memories are thought to bypass this active and effortful search process, and, similarly to involuntary memories, the retrieval is non-strategic, with the memory arising into awareness very quickly and effortlessly (Barzykowski et al., 2021; Barzykowski & Staugaard, 2016; Uzer et al., 2012).

Importantly, recent evidence has shown that the subjectively effortless, direct retrieval of AMs is as common as generative retrieval in cueing paradigms (Barzykowski & Staugaard, 2016; Harris et al., 2015; Jeunehomme & D'Argembeau, 2016; Uzer et al., 2012). In fact, direct retrieval can be even more frequent than effortful retrieval when using concrete rather than abstract word-cues (Uzer, 2016; Uzer et al., 2012) or personally-relevant cues to trigger AMs (Harris & Berntsen, 2019; Uzer & Brown, 2017). For example, Uzer et al. (2012) conducted three experiments in which participants' retrieval processes were examined by a self-report or a retrieve-aloud procedure. In the self-report method, participants had to indicate if a memory came to mind immediately in response to a word-cue (direct retrieval) or if they had to actively search for it (generative retrieval). In the retrieve-aloud procedure (Experiment 1), direct retrieval was inferred when the presentation of a word-cue was followed by a fairly rapid recall of a memory without any verbalisation of strategic search processes (*cf.* Mace et al., 2017; Mace, Petersen, et al., 2021; Mace, Staley, et al., 2021; Wank et al., 2021). Results showed that the percentages of directly retrieved memories in response to concrete word-cues (e.g., "bread", "radio") was consistently high across the experiments (55%-67%). Similar rates of directly retrieved memories have been documented in several other AM studies with young adults using retrieve-aloud (Jeunehomme & D'Argembeau, 2016, Experiment 3; Mace et al., 2017; Mace, Petersen, et al., 2021) and self-report methods (Barzykowski & Staugaard, 2016; Harris et al., 2015; Harris & Berntsen, 2019; Jeunehomme & D'Argembeau, 2016, Experiment 1). Relatively few studies have examined potential differences between direct and generative AM retrieval. Documented differences suggest that directly retrieved AMs are often rated as more vivid, rehearsed, and personally significant than effortfully retrieved memories (Barzykowski & Staugaard, 2016; Harris et al., 2015; Harris & Berntsen, 2019).

Generative, effortful retrieval was perceived as the default process by which AMs are retrieved (Conway & Pleydell-Pearce, 2000). As a result, most studies investigating age effects on voluntary AM have not examined potential differences between age-related changes in directly versus generatively retrieved memories (Dijkstra & Kaup, 2005; Ford et al., 2014; Holland et al., 2012; Luchetti & Sutin, 2018; Schlagman et al., 2009; *cf.* Wank et al., 2021). Typically, age effects on episodic memory recall are particularly large when intentional, effortful retrieval processes are involved, across different types of information (Korkki et al., 2020; Kvavilashvili et al., 2009; Markostamou & Coventry, 2021; Tanguay et al., 2022). Similarly, significant age-related changes in voluntary AM have also been observed across several studies. For example, older adults tend to retrieve fewer AMs in response to word-cues and take significantly longer to recall them than younger adults (e.g., Ford et al., 2014; Schlagman et al., 2009). Older individuals also tend to recall fewer AMs of specific events compared to young adults, and, instead, tend to recall more categoric memories of repetitive or extended events (Schlagman et al., 2009). In addition, in studies using the Autobiographical Interview where participants are asked to recall specific AMs in as much detail as possible, older adults tend to recall fewer episodic details from autobiographical events (Gaesser et al., 2011; Jacques et al., 2012), exhibiting a shift from episodic to semantic memory contents (Piolino et al., 2002). These age-related changes in episodic memory and AM recall have been associated with declines in strategic retrieval processes mediated by executive prefrontal brain areas (Ford et al., 2014; Holland et al., 2012; Jacques et al., 2012; Spreng et al., 2018; Tromp et al., 2015).

Meanwhile, accumulating evidence suggests that there are either no age effects or that the effects of age are small in spontaneous retrieval processes which are effortless and often supported by environmental cues, including involuntary AMs (Berntsen et al., 2017; Schlagman et al., 2009; Warden et al., 2019; for reviews, see Kvavilashvili et al., 2020; Maillet & Schacter, 2016). These findings of an absence of age effects on involuntary AMs are robust across both laboratory studies and in the context of daily life (Berntsen et al., 2017; Jakubowski et al., 2023; Schlagman et al., 2009; Warden et al., 2019). This contrasting pattern of age effects on deliberate and effortful retrieval processes versus more spontaneous and effortless processes may be attributed to the dissociable neural regions supporting these different processes. Indeed, the emerging neuroimaging evidence on involuntary episodic memories (e.g., Hall et al., 2014) and intrusive AMs (e.g., Gvozdanovic et al., 2017) indicates that stimulus-dependent spontaneous retrieval processes are consistently associated with posterior areas of the brain's default mode network (DMN) (for a recent review, see Kvavilashvili et al., 2020). By contrast, deliberate, and strategic memory retrieval processes are additionally supported by executive control areas of the prefrontal cortex, which are subject to age-related functional changes (Jacques et al., 2012; Spreng et al., 2018; Tromp et al., 2015).

The present study

The main objectives of the present work were to examine potential dissociations in the retrieval characteristics and the phenomenological qualities of directly and generatively retrieved AMs and whether ageing has a differential effect on AM depending on the retrieval processes involved. To this end, a group of younger and a group of older adults recalled personal memories in response to 20 word-cues and reported whether each of their memories was retrieved directly or generatively. Such self-report procedure has been used in most previous studies on younger adults, who did not seem to experience any difficulties in assessing whether they retrieved a memory directly or generatively (for example, the *"Don't know"* response was chosen in only 6% trials in a study by Uzer et al., 2012, Experiment 3). The self-report method may be particularly appropriate for older adults because asking them to think aloud while trying to recall memories in response to word-cues (Wank et al., 2021) may place disproportionate demands on their cognitive resources and disrupt the natural flow of the retrieval process. It is, however, necessary to corroborate reports of direct or generative retrieval with additional subjective and objective measures. Therefore, in the present study, participants provided additional ratings of subjective retrieval effort for each memory, while retrieval latencies were also recorded as an objective measure of retrieval effort.

Regarding retrieval characteristics, we expected that direct retrieval of AMs would be more frequent than generative retrieval across the 20 trials, and with shorter retrieval latencies and lower ratings of subjective retrieval effort (Barzykowski et al., 2021; Barzykowski & Staugaard, 2016; Harris et al., 2015; Jeunehomme & D'Argembeau, 2016; Uzer et al., 2012). Importantly, given that effortful retrieval processes decline with increasing age while effortless processes do not (Kvavilashvili et al., 2020; Schlagman et al., 2009; Spreng et al., 2018), we expected to observe a negative age effect on the number of generatively retrieved memories but not on directly retrieved memories. Such a finding would provide strong evidence indicating that the two retrieval modes of AMs are supported by dissociable neural regions that are differentially affected by typical ageing.

To compare the phenomenological qualities of directly and generatively retrieved AMs, participants provided ratings for several qualitative characteristics of each memory, including vividness, emotional valence, temporal distance, rehearsal frequency, and event specificity. In line with previous findings, we expected that direct retrieval would result in more pleasant and vivid memories than generative retrieval (Barzykowski & Staugaard, 2016; Harris & Berntsen, 2019; Harris et al., 2015). Since more recent and more frequently retrieved memories tend to be more accessible and clearer than distant and less frequently retrieved memories, we expected that direct retrieval would be more common for the former kind of memories (Harris & Berntsen, 2019; Jeunehomme & D'Argembeau, 2016). Nevertheless, our results may deviate from these predictions because some previous studies found that directly and generatively retrieved AMs do not differ in terms of memory recency (e.g., Harris et al., 2015; Harris & Berntsen, 2019). We also expected that, overall, participants would recall specific memories rather than general ones regardless of retrieval type (Uzer & Brown, 2017). However, we did not make more particular predictions regarding memory specificity, because some previous studies reported no differences between directly and generatively retrieved AMs (e.g., Barzykowski & Staugaard, 2016) while others found that directly retrieved AMs were less likely to be of specific events than generatively recalled memories (e.g., Harris & Berntsen, 2019).

We also expected to observe significant differences between younger and older adults in the phenomenological characteristics of their memories. Specifically, we predicted that older adults would rate their memories as more vivid (Johnson et al., 2015; Luchetti & Sutin, 2018), more positive in valence (Schlagman et al., 2006), and more temporally distant (Schlagman et al., 2009) compared to younger adults. Such phenomenological differences have previously been ascribed to age-related shifts in the information that drives subjective ratings of memory characteristics like vividness or emotional valence, with older adults relying more on the semantic and positive socio-emotional aspects of a past event (Levine et al., 2002; Mather & Carstensen, 2005) rather than on relevant visual information (Johnson et al., 2015). Older adults' AMs were also expected to be less specific compared to memories of younger individuals (Schlagman et al., 2009).

Finally, a complementary aim of the present study was to examine the parallel-forms reliability of the word-cue paradigm in eliciting both directly and generatively retrieved AMs. The word-cue method (Crovitz & Schiffman, 1974; Galton, 1879) has been extensively used in AM research. While the psychometric properties of different versions of this paradigm have been previously examined with respect to memory specificity (e.g., Griffith et al., 2009; Takano et al., 2017), little is known regarding whether this method can produce consistent results with respect to the prevalence of directly versus generatively retrieved memories. Apart from establishing the reproducibility of the findings, having two parallel sets of word-cues may be useful for future experimental, clinical, and neuropsychological studies with longitudinal or repeated testing designs. For this reason, we developed two sets of word-cues, with each word-list consisting of 10 words. An absence of word-list effects on the number of directly and generatively recalled memories across both age groups along with positive correlations between all memory measures in the two lists would provide evidence of the parallel-forms reliability of our paradigm.

Method

General procedure

Ethical approval was obtained by the local Ethics Committee and all study procedures were carried out in accordance with the British Psychological Society guidelines and the Declaration of Helsinki. Participants were recruited through social clubs in the local community and social media platforms. All participants participated voluntarily and provided written informed consent prior to data collection. Participants were tested in a single session lasting approximately one hour on an individual (one-to-one) basis. At the outset of each testing session, participants provided background and demographic information and were provided information about the study aims and procedures.

In the experimental task (for details, see below), participants recalled memories in response to 20 word-cues across two separate blocks of word-lists (each containing 10 words). After completing the first word-list trials, participants were administered the Montreal Cognitive Assessment (MoCA) screening tool (Nasreddine et al., 2005), and then they completed the second word-list of the AM task. Finally, participants completed the PHQ-9 (Kroenke et al., 2001) and GAD-7 (Spitzer et al., 2006) questionnaires for depressive mood and anxiety, respectively. All materials were presented in a printed format.

Participants

A total of 26 younger and 29 older adults participated in the study. The size of the sample was determined by a power analysis using G*Power (Faul et al., 2007) with a power of .8, an alpha level of .05, 2 groups, 2 measurements, a .5 correlation between repeated measures (default), and a nonsphericity correction of 1 (default) for the estimation, which indicated that a sample of 22 participants would be required to obtain at least a conservative effect size (Cohen's $f = .33$) on each measure separately and a sample of 48 participants to obtain a conservative interaction effect size (Cohen's $f = .33$).

Table 1. Participants' characteristics in each age group.

	Age group			
	Younger adults	Older adults	$F(1,51)$ value	Effect size (η_p^2)
N	26	27		
Age range (years)	18–32	60–90		
Age (years)	22.54 (3.80)	72.79 (8.22)		
Gender (% female)	69%	66%		
Education (years)	13.77 (2.03)	11.48 (2.68)	12.22 ($p = .001$)	.19
General cognitive functioning (MoCA)	27.38 (1.36)	27.19 (1.47)	0.26 ($p = .610$)	<.01
Depression (PHQ)	4.42 (3.02)	3.22 (3.79)	1.62 ($p = .209$)	.03
Anxiety (GAD)	3.42 (3.05)	2.37 (3.21)	1.49 ($p = .227$)	.03

Note. Values represent means (standard deviations).
MoCA = Montreal Cognitive Assessment; PHQ = Patient Health Questionnaire; GAD = Generalized Anxiety Disorder.

All participants spoke English as their first language and reported no active neurological, psychiatric, or other medical condition affecting cognitive functioning, nor prior history of head injury. Exclusion criteria for older adults included a score lower than 25 on the MoCA (Nasreddine et al., 2005), a brief measure of general cognitive functioning, to ensure the absence of cognitive decline among our participants. Data from two older adults were excluded for not meeting the inclusion criteria, thus, the final sample consisted of 26 younger and 27 older adults.

Participants' characteristics within each age group are presented in Table 1. The two groups were matched in gender distribution, $\chi^2(1) = .09$, $p > .250$. However, in line with other UK-based studies on ageing, younger adults had significantly more years of formal education (*cf.* Kvavilashvili et al., 2009; Tanguay et al., 2022). Our participants were also screened with self-report measures for depression (PHQ-9; Kroenke et al., 2001) and anxiety (GAD-7; Spitzer et al., 2006). Although depression and anxiety levels were higher among younger individuals, group differences were not significant.

Materials and procedure

Word lists

We developed two sets of word-lists from cluster eight of the Toglia and Battig (1978) semantic word norms. We used concrete nouns as word-cues, because previous research has shown that direct retrieval is more common when people are cued with concrete words compared to abstract words (Harris & Berntsen, 2019; Uzer et al., 2012). All word-cues from the two word-lists along with their psycholinguistic characteristics can be found in Table A1 of the Appendix and at https://doi.org/10.17605/OSF.IO/X6WQ2.

The two word-lists did not differ in terms of familiarity, $F(1, 18) = .08$, $p = .779$, $\eta_p^2 < .01$, concreteness, $F(1, 18) = 1.78$, $p = .198$, $\eta_p^2 = .09$, imagery, $F(1, 18) = .59$, $p = .453$, $\eta_p^2 = .03$, and emotional valence, $F(1, 18) = 1.33$, $p = .264$, $\eta_p^2 = .07$ (Table A1, Appendix).

Procedure and measures

At the outset of the experimental task, participants were orally provided with an explanation of the nature of AMs (i.e., memories of personally experienced events) along with some representative examples (e.g., "*Your shopping trip last weekend*", "*A holiday in Paris*", or "*Your first day at school many years ago*") to clarify that AMs can vary in characteristics like recency or specificity. The specificity of AMs was additionally explained with relevant examples later in the procedure when participants rated their AMs on several dimensions, including specificity (see below).

Participants were given explanations of the word-cue task (i.e., think of an event from their past that would involve or be related to the word-cue) along with an AM example with the word-cue "table" (*"Sitting around a large table with family last Christmas"*). Importantly, and in contrast to standard instructions used in many studies of voluntary AMs, no restrictive instructions regarding the temporal distance (recent or distant past) or the event type (specific, general) were provided to participants. This was necessary to ensure that task instructions did not put a high cognitive load on participants' executive and working memory resources and to minimise the need for participants to recruit strategic search operations to retrieve a memory (see also Kvavilashvili et al., 2009).

Each participant was randomly assigned to start with word-list A or B of the experimental AM task. The presentation order of the 10 word-cues within each word-list was random. Each word-cue was presented in a printed format by the experimenter using A5-size cards. Participants were instructed to recall a past AM as quickly as possible in response to each word-cue presented. As soon as they retrieved a memory, participants had to say "*okay*", and then they responded to questions regarding retrieval characteristics and several qualitative characteristics of each memory recalled, before moving to the next trial. Each question along with the response options were read by the experimenter while at the same time they were also presented to the participants in a printed format on A5-size cards. Participants' responses were recorded verbatim.

Retrieval latencies. The experimenter recorded retrieval latencies (in msec) from the moment the word-cue was presented until the participant said "*okay*", with a stop-watch. If no memory was retrieved within 60 s, the next word-cue was presented.

Retrieval processes and effort. Participants then answered the question *"How did you recall the memory"* by choosing one of two response options: (a) "*It just popped into my mind by itself*" (suggesting a direct retrieval process), and (b) "*I had to actively search to find the memory*" (suggesting a generative retrieval). A third (c) "*I don't know*" option was also provided, but no participant selected that option. Participants also rated how easy or difficult was it to recall the memory on a bipolar 5-point scale (1 = *very easy* to 5 = *very difficult*), indicating the absence or presence of retrieval effort, respectively.

Qualitative characteristics of memories. Next, participants provided a brief description of the memory, which was recorded with a voice recorder and later transcribed verbatim. They also rated several qualitative characteristics of the AM retrieved, including (a) the vividness of the memory (1 = *very vague* to 5 = *very vivid*), (b) the emotional valence of the memory at the present moment (1 = *very unpleasant*, 3 = *neither pleasant not unpleasant*, 5 = *very pleasant*), (c) the emotional valence of the original event at the time it occurred (1 = *very unpleasant*, 3 = *neither pleasant not unpleasant*, 5 = *very pleasant*), (d) the temporal distance of the past event from the present time (1 = *within the last day*, 2 = *within the last week*, 3 = *within the last month*, 4 = *within the last year*, 5 = *between one and five years ago*, 6 = *between six and ten years ago*, 7 = *ten or more years ago*), and (e) how often they had thought or recalled the memory (i.e., rehearsal frequency; 1 = *never* to 5 = *many times*). In addition, participants indicated (f) the event specificity by classifying each recalled event into one of the following three categories that were provided to participants together with example events for each category: (1) a specific, one-off event (e.g., "*Visiting a zoo last month*"), (2) an extended event, occurring over a period of time (e.g., "*A trip to Paris*"), or (3) repeated events, occurring regularly (e.g., "*Walking the dog every morning*").

Results

Dataset preparation

In total, participants retrieved 1033 memories across the two word-cue lists. Specifically, young adults ($N = 26$) recalled 515 memories (99% out of the 520 trials) and older adults ($N = 27$) recalled 518 memories (96% out of the 540 trials). The contents of each memory were inspected prior to any analysis and were coded as episodic AMs or non-episodic AMs (Schlagman et al., 2006). The vast majority of memories ($N = 937$) referred to personally experienced events that varied in terms of specificity. These included specific, one-off events (e.g., "*Writing a letter with my daughter about her tooth for the tooth fairy*"), extended events (e.g., "*A week-long holiday with a rented boat on Norfolk broads with friends*"), and repeated events (e.g., "*Going punting in Cambridge*"). All these memories were classified as episodic AMs. Only 9% of memories ($N = 96$) were classified as autobiographical semantic knowledge, i.e., autobiographical facts in the form of generic statements with no contextual details (e.g., "*I have a mirror in my hallway*" or "*I like my coffee weak*"), and were excluded from analysis (see also Barzykowski & Niedźwieńska, 2016; Ford et al., 2014). Although the number of excluded memories was nominally higher in older ($N = 60$, i.e., 11% of responses; $M = 2.22$, $SD = 2.02$) compared to younger adults ($N = 36$, i.e., 7% of responses; $M = 1.38$, $SD = 1.2$), this group difference was not statistically significant $F(1, 51) = 3.32$, $p = .074$, $\eta_p^2 = .06$.

Aggregated datasets were prepared for all analyses procedures (Schlagman et al., 2009), whereby mean values for each variable (e.g., retrieval effort or vividness) were calculated for each participant. To ensure that participants provided accurate ratings of memory specificity, the specificity of 531 randomly selected AMs (i.e., 57% of the total number of AMs) was also rated by one of the researchers. The agreement between the objective (researcher's) and subjective (participants') specificity ratings was excellent ($\kappa = .82$, $SE = .02$, $p < .001$). Hence, for the specificity variable, we used the participants' ratings and calculated the mean proportions of specific memories for each participant.

The results will be presented in two main sections. The first section focuses on the parallel-forms reliability of the word-cue method. The second section focuses on the effects of retrieval type and age on the retrieval and memory characteristics.

Parallel-forms reliability

To evaluate the consistency of results across the two word-lists, we ran a series of correlations between the number of memories, the retrieval characteristics, and the memory characteristics in word-lists A and B. Table 2 presents the descriptive data on the total number of AMs retrieved, the number of directly and generatively retrieved AMs, and the retrieval and memory characteristics in each word-list, as well as the correlation coefficients between lists A and B.

To further determine the equivalence of the two word-lists, we ran 2 × 2 mixed ANOVAs on recall measures, with age group (between-subjects variable with two levels: young vs. older) and word-list (within-subjects variable with two levels: A vs. B) as independent variables. The analysis did not reveal any significant effect of word-list on the total number of AMs retrieved, $F(1, 51) = 2.97$, $p = .091$, $\eta_p^2 = .05$, the number of directly retrieved memories, $F(1, 51) = 1.10$, $p = .299$, $\eta_p^2 = .02$, the number of generatively retrieved memories, $F(1, 51) < 0.1$, $p = .961$, $\eta_p^2 < .01$, the reported retrieval effort, $F(1, 51) = 0.34$, $p = .564$, $\eta_p^2 < .01$, the average retrieval latencies, $F(1, 51) = 1.14$, $p = .290$, $\eta_p^2 = .02$, and the proportion of AMs rated as specific, $F(1, 51) < 0.43$, $p = .515$, $\eta_p^2 < .01$. Moreover, no significant word-list × age group interaction effect was obtained on the total number of AMs retrieved, $F(1, 51) = 1.03$, $p = .316$, $\eta_p^2 = .02$, the number of directly retrieved memories, $F(1, 51) = .57$, $p = .450$, $\eta_p^2 = .01$, the number of generatively retrieved memories, $F(1, 51) = 2.09$, $p = .155$, $\eta_p^2 = .04$, the retrieval effort, $F(1, 51) = 0.48$, $p = .493$, $\eta_p^2 < .01$, the average retrieval latencies, $F(1, 51) = 0.14$, $p = .709$, $\eta_p^2 < .01$, and the proportion of specific memories, $F(1, 51) = 0.16$, $p = .691$, $\eta_p^2 < .01$. Given the absence of word-list by age group interaction effects, age effects are presented in detail in the next section. The lack of significant differences coupled with the high positive correlations between word-lists A and B on all measures (Table 2) indicate high parallel-forms reliability of the word-cue method in consistently eliciting AMs across both younger and older adults.

Table 2. Descriptive data from lists A and B, along with correlational results.

Measure	Word List A	Word List B	Correlation (r)
Number of AMs			
Total number of AMs	8.70 (1.23)	8.98 (1.18)	.52*
Number of directly retrieved AMs	6.06 (1.89)	6.32 (1.81)	.50*
Number of generatively retrieved AMs	2.64 (1.83)	2.66 (1.80)	.50*
Retrieval characteristics			
Retrieval effort	1.69 (0.53)	1.72 (0.52)	.70*
Retrieval latencies (msec)	2764 (1295)	2632 (1129)	.72*
Memory characteristics			
Emotional valence (now)	4.09 (0.09)	3.80 (0.08)	.50*
Emotional valence (then)	4.00 (0.09)	3.59 (0.10)	.49*
Specificity (% specific)	79.50 (2.35)	77.69 (2.27)	.51*
Vividness	4.31 (0.08)	4.21 (0.08)	.64*
Temporal distance	4.96 (0.20)	5.16 (0.19)	.68*
Rehearsal frequency	2.23 (0.11)	2.40 (0.12)	.77*

Note. Data represent means (and standard errors); AMs = autobiographical memories; *$p \leq .001$.

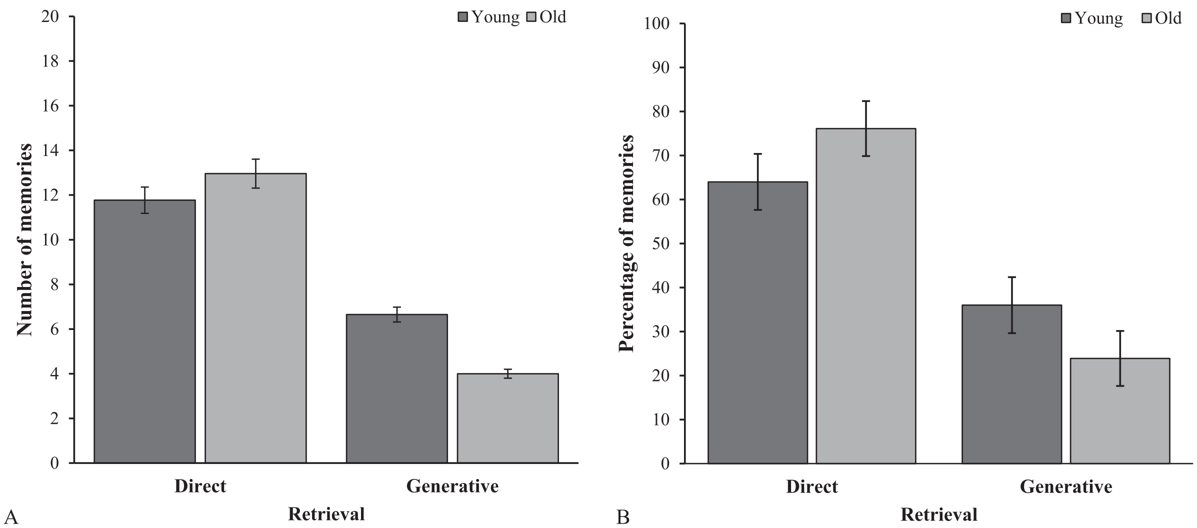
Effects of age and type of retrieval

Given the absence of word-list effects and word-list × age group interaction effects, data obtained from lists A and B were combined for all the subsequent analyses reported below.

Number of memories

We employed mixed factorial analysis of variance to examine the effects of age group (between-subjects variable with two levels: young vs. old) and retrieval type (within-subjects variable with two levels: direct vs. generative), and their possible interaction effects on the number of AMs recalled. There was a large main effect of retrieval type on the number of memories recalled, $F(1, 51) = 80.48$, $p < .001$, $\eta_p^2 = .61$, with substantially more AMs being retrieved directly ($M = 12.38$, $SD = 3.21$) than generatively ($M = 5.30$, $SD = 3.13$). A significant main effect of age group was also found, $F(1, 51) = 7.08$, $p = .010$, $\eta_p^2 = .12$, with older adults recalling fewer AMs ($M = 16.96$, $SD = 2.42$) than younger adults ($M = 18.42$, $SD = 1.42$). These main effects were qualified by a significant age group by retrieval type interaction effect, $F(1, 51) = 6.01$, $p = .018$, $\eta_p^2 = .11$. Analysis of simple main effects showed that the effect of age on the number of AMs recalled was significant for generatively retrieved memories, $F(1, 51) = 11.36$, $p = .001$, $\eta_p^2 = .18$, with older adults recalling fewer generatively retrieved AMs than younger adults (Figure 1, left panel). Importantly, and in stark contrast to generatively retrieved memories, age did not affect the number of directly retrieved AMs, $F(1, 51) = 1.87$, $p = .178$, $\eta_p^2 = .03$, although older adults had a slightly higher number of directly retrieved AMs than younger individuals (Figure 1, left panel).

Given that older adults recalled overall fewer AMs than younger adults, we also calculated the proportion of directly and generatively retrieved memories, out of the total number of recalled memories, and ran a similar 2 × 2 mixed ANOVA on the percentages of directly and generatively retrieved memories. We found a large main effect of retrieval type, $F(1, 51) = 81.56$, $p < .001$, $\eta_p^2 = .61$, with 70.17% of all AMs being directly retrieved whilst only 29.83% of the AMs were generatively retrieved. Importantly, we also found a significant age group by retrieval type interaction effect, $F(1, 51) = 7.44$, $p = .009$, $\eta_p^2 = .13$. Tests of simple main effects revealed a significant effect of age group on the percentage of generatively



Note. Error bars represent 95% confidence intervals.

Figure 1. Number (panel A) and percentage (panel B) of directly and generatively retrieved autobiographical memories in younger and older adults. Note. Error bars represent 95% confidence intervals.

recalled memories, $F(1, 51) = 7.44$, $p = .009$, $\eta_p^2 = .13$, with younger adults having a higher percentage of generatively retrieved memories than older adults (Figure 1, right panel). By contrast, the significant effect of age group on the percentage of directly recalled memories, $F(1, 51) = 7.44$, $p = .009$, $\eta_p^2 = .13$, was in the opposite direction, with older adults having a higher percentage of directly retrieved memories than younger adults (Figure 1, right panel).

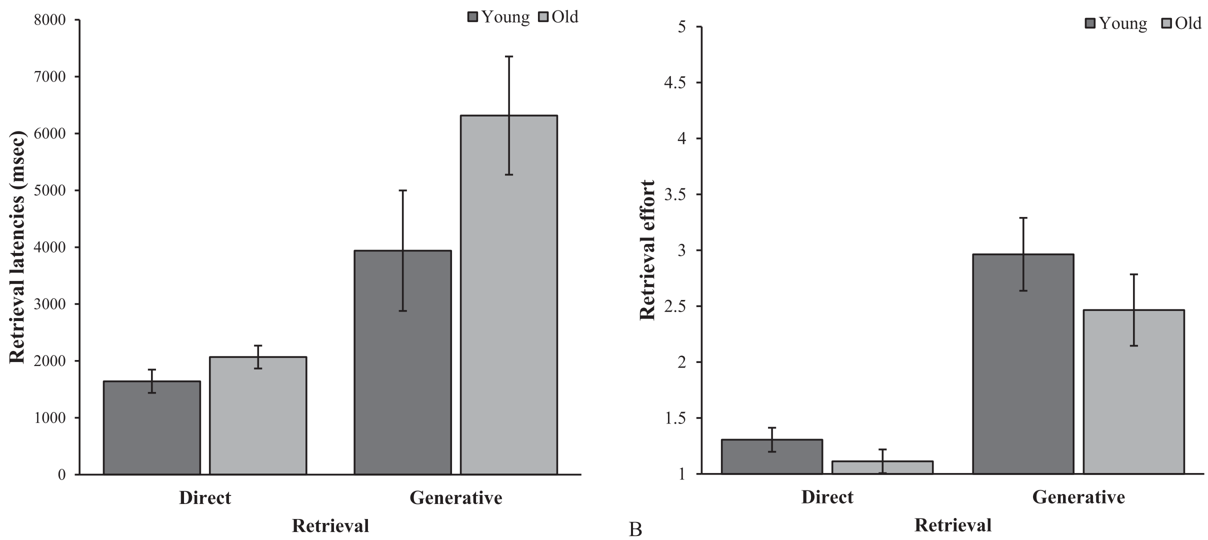
Retrieval characteristics

To examine retrieval characteristics, we ran a series of 2 (age group) × 2 (retrieval type) mixed ANOVAs on retrieval latencies and ratings of retrieval effort (for means see, Figure 2). Because two participants (one younger and one older) did not report any generatively retrieved memories, the analyses are based on 25 young and 26 older participants.

Retrieval latencies. There was a large main effect of retrieval type on retrieval latencies, $F(1, 49) = 77.41$, $p < .001$, $\eta_p^2 = .61$, with much shorter latencies obtained in directly retrieved AMs ($M = 1864$, $SD = 567$) compared to generatively retrieved AMs ($M = 5198$, $SD = 2964$). We also found a significant main effect of age, $F(1, 49) = 12.38$, $p < .001$, $\eta_p^2 = .20$, with longer retrieval latencies among older adults ($M = 4191$, $SD = 2007$) compared to younger adults ($M = 2790$, $SD = 1032$). However, these main effects were qualified by a significant age group by retrieval type interaction effect, $F(1, 49) = 6.89$, $p = .012$, $\eta_p^2 = .12$. Analysis of simple main effects showed that the effect of age group on retrieval latencies was significant across both directly, $F(1, 49) = 8.24$, $p = .006$, $\eta_p^2 = .14$, and generatively retrieved AMs, $F(1, 49) = 9.88$, $p = .003$, $\eta_p^2 = .17$, however, the effect of retrieval type on retrieval latencies was much stronger for older adults, $F(1, 49) = 66.55$, $p < .001$, $\eta_p^2 = .58$, than in young adults, $F(1, 49) = 18.69$, $p < .001$, $\eta_p^2 = .28$ (Figure 2, left panel).

Retrieval effort ratings. A similar analysis revealed a large main effect of retrieval type on retrieval effort, $F(1, 49) = 199.63$, $p < .001$, $\eta_p^2 = .80$, with much higher ratings of retrieval effort reported by participants for generatively retrieved AMs ($M = 2.71$, $SD = .84$) compared to directly retrieved AMs ($M = 1.21$, $SD = .28$). A significant main effect of age group was also revealed, $F(1, 49) = 6.89$, $p = .012$, $\eta_p^2 = .12$, with younger adults reporting overall a higher retrieval effort ($M = 1.93$, $SD = .47$) compared to older adults ($M = 1.48$, $SD = .41$). The age group by retrieval type interaction effect was not significant, $F(1, 49) = 2.05$, $p = .158$, $\eta_p^2 = .04$, suggesting that the effect of age on the reported retrieval effort was similar across directly and generatively retrieved AMs (Figure 2, right panel).

Correlations between indices of retrieval effort. Bivariate correlations were executed to examine the relation between the subjective (i.e., retrieval effort ratings) and objective (i.e., retrieval latencies) indices of retrieval effort in younger and older adults. Results revealed positive associations between the two measures of retrieval effort across both younger ($r = .56$, $p = .003$) and older ($r = .58$, $p = .002$) adults, indicating that longer latencies were associated with higher ratings of retrieval difficulty.[1] Furthermore, in both age groups, higher rates of directly retrieved AMs were negatively associated with both objective (i.e., retrieval latencies; young: $r = -.52$, $p = .006$; old: $r = -.58$, $p = .002$) and subjective (i.e., self-reported retrieval effort; young: $r = -.75$, $p < .001$; old: $r = -.79$, $p < .001$) measures of retrieval effort.



Note. Error bars represent 95% confidence intervals.

Figure 2. Retrieval characteristics, including average retrieval latencies (panel A) and subjective retrieval effort (panel B), across directly and generatively retrieved autobiographical memories in younger and older adults.

Note. Error bars represent 95% confidence intervals.

Qualitative memory characteristics

We ran a series of mixed ANOVAs on all memory characteristics. Memory characteristics for directly and generatively retrieved memories in young and older adults are presented in Figure 3. As above, these analyses were based on 25 young and 26 older participants who reported both types of retrieval.

Emotional valence. Figure 3A shows the pleasantness ratings for the recalled memories (now) and the original events (then) as a function of retrieval type and age group. For the emotional valence of memories and original events, we ran a 2 (age group: young vs. older) by 2 (retrieval type: direct vs. generative) by 2 (time: now vs. then) mixed ANOVA with repeated measures on the last two variables. The effect of retrieval type was significant, $F(1, 49) = 9.91$, $p = .003$, $\eta_p^2 = .17$, with directly retrieved memories being overall more pleasant ($M = 3.94$, $SD = .51$) than generatively retrieved memories ($M = 3.78$, $SD = .77$). In addition, there was a significant main effect of time, $F(1, 49) = 4.35$, $p = .042$, $\eta_p^2 = .08$, with higher pleasantness ratings for memories (now) ($M = 3.96$, $SD = .57$) compared to the original events (then) ($M = 3.77$, $SD = .61$). Additionally, there was a significant main effect of age, $F(1, 49) = 8.26$, $p = .006$, $\eta_p^2 = .14$, with older adults rating overall their memories as more pleasant ($M = 4.08$, $SD = .67$) than younger adults ($M = 3.65$, $SD = .47$), regardless of time and retrieval type (no significant interaction effects were observed; Figure 3A).

Specificity. Figure 3B presents the percentage of specific memories recalled as a function of retrieval type and age group. A 2 (age group) by 2 (retrieval type) mixed ANOVA showed that there was no significant effect of retrieval type, $F(1, 49) = 2.75$, $p = .104$, $\eta_p^2 = .05$, age group, $F(1, 49) = .08$, $p = .776$, $\eta_p^2 < .01$, or age group by retrieval type interaction effect, $F(1, 49) = .08$, $p = .776$, $\eta_p^2 < .01$, on the percentage of specific AMs retrieved. Regardless of type of retrieval and age group, participants were far more likely to recall specific memories (78.48%) than non-specific memories (21.52%) (Figure 3B).

Vividness. Figure 3C presents the vividness ratings as a function of retrieval type and age group. Results from a similar mixed ANOVA yielded a large main effect of retrieval type on vividness, $F(1, 49) = 76.29$, $p < .001$, $\eta_p^2 = .61$, with higher vividness ratings for directly retrieved AMs ($M = 4.60$, $SD = .38$) compared to generatively retrieved AMs ($M = 3.94$, $SD = .77$). A significant main effect of age group was also revealed, $F(1, 49) = 29.19$, $p < .001$, $\eta_p^2 = .37$, with higher vividness ratings recorded by older ($M = 4.55$, $SD = .50$) than younger ($M = 3.96$, $SD = .41$) adults. In addition, there was a significant age group by retrieval type interaction effect, $F(1, 49) = 9.30$, $p = .004$, $\eta_p^2 = .16$. Analysis of simple main effects showed that the effect of age group on vividness was significant across both directly, $F(1, 49) = 20.89$, $p < .001$, $\eta_p^2 = .29$, and generatively retrieved AMs, $F(1, 49) = 24.11$, $p < .001$, $\eta_p^2 = .33$, however, the main effect of retrieval type was larger in younger adults $F(1, 49) = 68.10$, $p < .001$, $\eta_p^2 = .58$, than in older adults, $F(1, 49) = 16.48$, $p < .001$, $\eta_p^2 = .25$ (Figure 3C).

Temporal distance. Figure 3D presents the temporal distance of the recalled memories as a function of retrieval

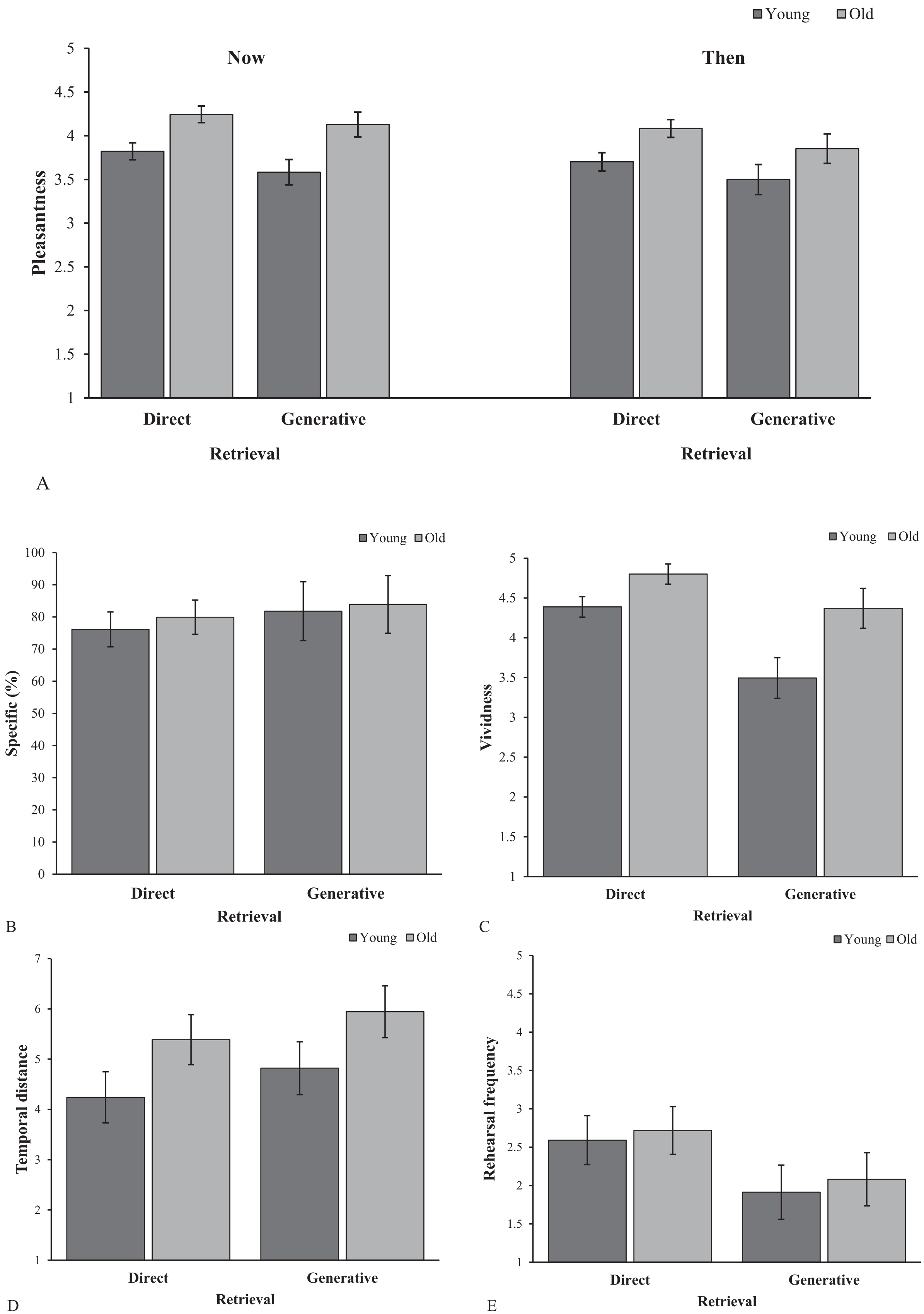


Figure 3. Memory characteristics, including emotional valence (panel A), specificity (panel B), vividness (panel C), temporal distance (panel D), and rehearsal frequency (panel E), across directly and generatively retrieved autobiographical memories in younger and older adults.

Note. Error bars represent 95% confidence intervals.

type and age group. A similar mixed ANOVA revealed a significant main effect of retrieval type, $F(1, 49) = 12.65$, $p < .001$, $\eta_p^2 = .21$, with directly retrieved memories being more recent ($M = 4.82$, $SD = 1.38$) compared to generatively retrieved memories ($M = 5.39$, $SD = 1.41$). Additionally, there was a main effect of age group on temporal distance, $F(1, 49) = 12.33$, $p < .001$, $\eta_p^2 = .20$, with younger adults recalling more recent memories ($M = 4.50$, $SD = .90$) compared to older adults ($M = 5.71$, $SD = 1.34$), regardless of retrieval type (there was no significant interaction effect, $F(1, 49) = .01$, $p = .937$, $\eta_p^2 < .01$; Figure 3D). A closer inspection of the temporal distribution of AMs (Figure 4) showed that 49% of younger adults' memories concerned events that had occurred within the last year, while only 17% of the memories they recalled concerned events that had happened more than 10 years ago. By contrast, 62% of all AMs recalled by older adults were of events that had occurred in the distant past and only 24% were memories of events that had happened within the last year. We also inspected the temporal distributions of older adults' directly and generatively retrieved AMs, which were found to be similar (Figure A1, Appendix), reflecting the absence of a significant interaction effect.

Rehearsal frequency. Figure 3E presents the rehearsal frequency of the recalled memories as a function of retrieval type and age. A similar mixed ANOVA yielded a large main effect of retrieval type, $F(1, 49) = 31.95$, $p < .001$, $\eta_p^2 = .40$, with directly retrieved memories having been more frequently rehearsed ($M = 2.66$, $SD = .79$) compared to generatively retrieved memories ($M = 2.00$, $SD = .88$). The main effect of age group was not significant, $F(1, 49) = .53$, $p = .472$, $\eta_p^2 = .01$, and there was no significant age group by retrieval type interaction effect, $F(1, 49) = .04$, $p = .853$, $\eta_p^2 < .01$ (Figure 3E).

Discussion

The main objectives of the present study were to compare the retrieval and phenomenological characteristics of directly and generatively retrieved AMs and to examine whether there were any dissociable age effects on AM depending on the type of retrieval involved. In addition, we assessed the parallel-forms reliability of two sets of word-cues in terms of number of memories recalled and their characteristics. To address these questions, we employed a word-cue paradigm whereby younger and older adults recalled AMs in response to two sets of 10 word-cues (20 trials in total). Participants reported whether each of their memories was retrieved directly or generatively and rated their subjective retrieval effort for each memory provided, while retrieval latencies were also recorded as an objective measure of retrieval effort. In addition, participants provided ratings for several qualitative characteristics concerning the phenomenology of each memory, including vividness, emotional valence, temporal distance, rehearsal frequency, and event specificity.

Several novel findings emerged from this study. First, we replicated and extended results from previous studies by showing that directly retrieved AMs are highly prevalent in word-cue paradigms not only in young adults but also in older individuals. Importantly, we found a marked dissociation between directly and generatively recalled memories as a function of age – while younger adults recalled a higher number of generatively retrieved AMs, there were no age effects on the number of directly retrieved AMs. Second, directly retrieved memories were rated significantly higher than generatively retrieved memories on several phenomenological characteristics in both age groups, indicating that older individuals evaluated the characteristics of directly and generatively retrieved AMs similarly to young individuals. However, in line with previous research on AM, older adults rated their memories as more vivid, emotionally positive, and temporally distant than younger adults, irrespective of the type of retrieval. Finally, results showed that the two word-lists had a good parallel-form reliability. These findings are discussed in more detail below with a focus on their theoretical and practical implications for research on cognitive ageing as well as research on AM in general.

Effects of age on direct and generative retrieval of autobiographical memories

In the present study, we found that direct retrieval of AMs in response to word-cues was highly prevalent across both younger and older adults, with around 70% of all AMs being directly retrieved. This replicates and extends previous findings involving young individuals (Barzykowski et al., 2019; Barzykowski & Staugaard, 2016; Harris et al., 2015; Harris & Berntsen, 2019; Jeunehomme & D'Argembeau, 2016; Mace et al., 2017; Mace, Staley, et al., 2021; Uzer, 2016; Uzer et al., 2012; Uzer & Brown, 2017) and confirms that direct retrieval is a very common occurrence in cueing paradigms not only in young but also in older adults. In line with these previous studies, we found that directly retrieved memories were recalled markedly faster than generatively retrieved memories and with substantially lower effort ratings. Importantly, we also found that the objective (i.e., retrieval latencies) and subjective indices of retrieval effort were closely associated. These convergent findings between objective and subjective measures of retrieval effort indicate that both young and older individuals were fairly accurate in intuitively discriminating whether their AMs were retrieved directly or generatively. This is further supported by the finding that none of the participants chose the "*I don't know*" option in response to the question how they retrieved their memory (*cf.* Uzer et al., 2012, Experiment 3).

However, the most intriguing finding of the present study concerns the dissociable effects of age on the number and the proportion of directly and generatively

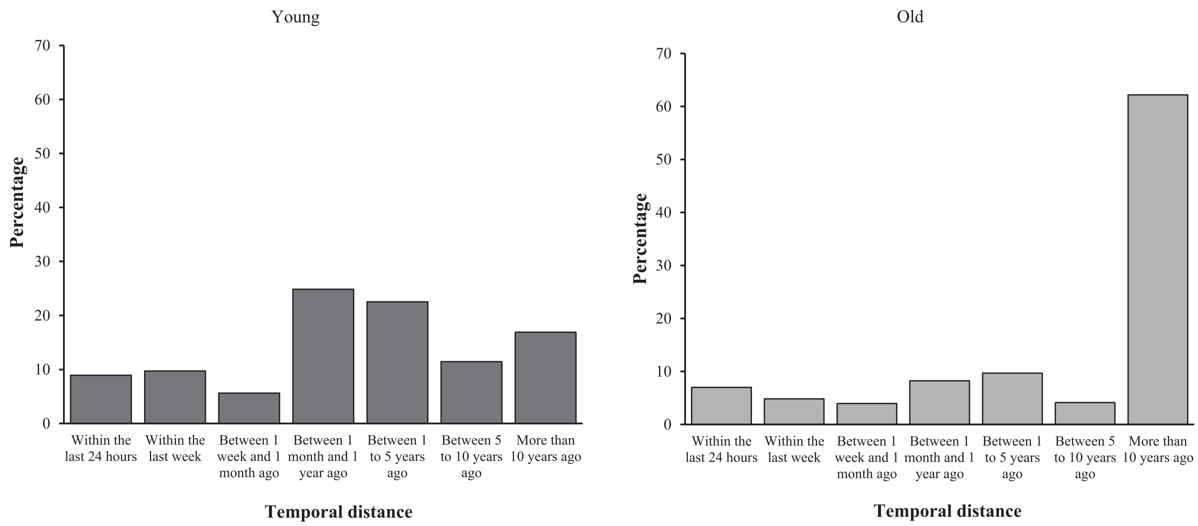


Figure 4. Distribution of the temporal distance from present time of autobiographical memories in younger and older adults.

recalled AMs. In line with typical research on ageing and AM that does not distinguish two modes of retrieval and assumes that AM recall involves, by default, effortful and top-down strategic retrieval, older adults recalled fewer AMs overall (e.g., Ford et al., 2014; Schlagman et al., 2009). However, a significant age by retrieval type interaction revealed that while older adults reported fewer generatively retrieved memories than younger adults, no age effects were observed on the number of directly retrieved memories. Given that older adults recalled fewer memories overall, we also examined the proportions of directly and generatively retrieved memories and found again a significant age by retrieval type interaction showing that while younger individuals still reported higher proportion of generatively recalled memories than older adults, older adults reported higher proportion of directly retrieved memories than younger adults.

These results partially contradict the findings of a recent study by Wank et al. (2021), which showed that older adults engaged in direct retrieval of AMs less often than younger adults. This discrepancy may be attributed to several important methodological differences between the studies. For example, Wank et al. (2021) (1) employed a retrieve-aloud paradigm and provided instructions restricting (2) the temporal distance of the recalled events (within the last 5 years) and (3) the specificity of the recalled events (only specific events had to be recalled). In addition, (4) direct versus generative retrieval was inferred by researchers from think-aloud protocols rather than from participants' explicit self-reports. In voluntary AM paradigms like the one employed in the present study, asking participants to retrieve a memory rather than share general mental content may involve some degree of monitoring (Barzykowski et al., 2019). Nonetheless, the retrieve-aloud paradigm with temporal and specificity restrictions would arguably require the recruitment of strategic search processes along with executive monitoring processes to a larger degree, which are by nature incompatible with direct and effortless retrieval processes, and would limit the available cognitive resources, particularly for older individuals. In fact, direct retrieval of memories is particularly prominent when people do not need to monitor their stream of awareness and are free to report only when something automatically pops in their mind rather than actively search strategically for a specific memory (Barzykowski et al., 2019). Incidentally, at the end of the retrieve-aloud task, Wank et al.'s (2021) participants indicated which word-cue (out of 20) elicited a memory that they chose not to report during the retrieve-aloud procedure. This could have happened, for example, when a memory that came to mind directly in response to a word-cue did not fit into the task requirements (i.e., recalling a specific event that happened longer than 5 years ago). When these trials were excluded from the analysis, the age difference in the proportion of directly retrieved memories became non-significant. This latter finding by Wank et al. (2021) provides some preliminary (albeit indirect) support for the idea that age effects in directly recalled memories may be attenuated or absent also in retrieve-aloud paradigms, as long as the temporal and specificity restrictions are minimal.

Consequently, the findings of the present study call for more systematic investigations of the prevalence of direct retrieval in older adults. Of particular importance is to compare the number and proportions of directly recalled memories with unrestricted retrieval instructions used in the present study versus typical instructions that ask participants to recall only specific memories (and from a certain time period) in response to word-cues. Based on the results of the present study, it is highly likely that contrasting age effects will emerge, with older adults reporting fewer directly recalled memories than young individuals with standard instructions, but this negative age effect will disappear when participants are free to report any AM that comes to mind.

Memory characteristics as a function of retrieval type and age

Although the number of studies on young adults comparing the prevalence of directly versus generatively recalled memories in word-cueing paradigms is growing, very few studies have compared their phenomenological characteristics (e.g., Barzykowski & Staugaard, 2016; Harris et al., 2015; Harris & Berntsen, 2019), and no previous study has examined this question in relation to ageing. Our results are broadly in line with previous findings and extend them to older adults by showing that in both age groups, directly retrieved AMs were more recent and more frequently rehearsed, as well as more vivid and emotionally positive compared to generatively retrieved AMs. In addition, even though participants were not instructed to recall specific memories, most memories referred to specific events rather than general events across both age groups (~78% of all recalled memories). In line with previous reports (e.g., Harris & Berntsen, 2019; Uzer & Brown, 2017, Experiment 2), generative retrieval also tended to produce numerically higher rates of specific memories than direct retrieval, although the difference was not significant.

In addition, we found main effects of age that broadly replicate the findings of previous research on AM and extend them to directly retrieved memories. More specifically, in line with previous reports of positivity effect in old age (Luchetti & Sutin, 2018; Mather & Carstensen, 2005; Rubin & Schulkind, 1997; Schlagman et al., 2006), older individuals rated their directly and generatively recalled memories as more pleasant compared to younger adults. Older adults also gave higher subjective vividness ratings of their memories than young individuals across both directly and generatively retrieved memories, although the difference was higher for generatively retrieved memories. This is in line with several previous studies that have reported higher vividness ratings among older individuals (Luchetti & Sutin, 2018; Rubin & Schulkind, 1997), and supports the notion that older adults develop a stronger reliance on the semantic and socio-emotional features of a memory over its perceptual details when they rate phenomenological characteristics like vividness (Johnson et al., 2015; Levine et al., 2002; Mather & Carstensen, 2005; for further discussion, see Folville et al., 2022).

Moreover, older adults' memories were temporally more distant than memories of young adults, which also accords with the literature on ageing and AM (e.g., Janssen et al., 2005; Rubin & Schulkind, 1997; Schlagman et al., 2009). In both age groups, inspecting the temporal distribution of AMs confirmed a clear recency effect, with a high proportion of memories referring to events that had occurred within the last year (Janssen et al., 2005), which was noticeably larger among young adults. However, the majority of memories recalled by older adults were of events that had happened more than 10 years ago. Such prevalence of distant memories in older adults may reflect a reminiscence bump effect (Rubin et al., 1986) – a robust finding in the AM literature that refers to the disproportionately high number of events recalled by older adults from their youth and early adulthood (Janssen et al., 2005; Rubin & Schulkind, 1997; Schlagman et al., 2009).

Neurocognitive models postulate that older memories become hippocampal-independent, due to the structural reallocation of consolidated memories in the neocortex (Alvarez & Squire, 1994) and their semanticization over time (Winocur & Moscovitch, 2011), thus, they may be less affected by age-related hippocampal deterioration. Events from one's youth may also play a pivotal role in identity formation (Conway, 2005), and thus retaining them may be particularly important in preserving a coherent and continuous sense of self (Prebble et al., 2013). In the present study, we found no differences in the temporal distribution of older adults' directly and generatively retrieved AMs, however, future studies should further examine if a reminiscence bump is more likely to be observed in directly or generatively recalled memories.

Parallel-forms reliability of the word-cue method

We established the parallel-forms reliability of the word-cue method by showing that two sets of word-cues were comparable in terms of numbers of directly and generatively recalled memories, their retrieval latencies and several memory characteristics. Given that the majority of studies examining direct and generative AMs have used a list of common nouns originally reported by Uzer et al. (2012), having two parallel sets of word-cues is useful not only for increased generalisability of findings about the prevalence of directly recalled memories, but also for future studies with longitudinal and pretest-posttest designs. Both sets of words were selected from semantic norms (Toglia & Battig, 1978) and referred to objects high in ratings of familiarity, concreteness, and imagery and of neutral to positive valence. Our results provide further evidence of the effectiveness of such word-cues in eliciting AMs compared to more abstract cues such as emotion words (e.g., Uzer, 2016; Uzer et al., 2012; but see Harris et al., 2015) or words depicting super-ordinate categories (e.g., "fruit" or "toys"; Uzer, 2016), especially under conditions in which participants are free to recall any memory (specific or general) from any time period (Barzykowski & Staugaard, 2016).

Theoretical and practical implications

The results of the present study have several implications for theories of AM and cognitive ageing. A key assumption of the influential self-memory model of AM proposed by

Conway and Pleydell-Pearce (2000) is that the retrieval of memories is a slow and effortful process, in which memory is constructed from elements across a hierarchical autobiographical knowledge system (Conway, 2005; Conway et al., 2019). This understanding of AM recall as a predominantly strategic and top-down retrieval process is based almost entirely on findings obtained in word-cue experiments and is in stark contrast to research on involuntary AMs, which are recalled bottom-up in response to incidental cues (Berntsen, 1998; Mace, 2004; Mazzoni et al., 2014; Schlagman & Kvavilashvili, 2008). Interestingly, despite the absence of intention to recall a memory, the majority of involuntary memories that pop into mind in everyday life and in laboratory experiments refer to specific events that happened at a particular time and place (e.g., Berntsen, 1998; Schlagman & Kvavilashvili, 2008).

One of the key differences between investigations of involuntary and voluntary AMs is that typical instructions in word-cue experiments of voluntary AMs emphasise the importance of recalling specific memories (e.g., Rubin & Schulkind, 1997). Based on these instructions, if a participant recalls a memory of repeated event (e.g., daily walks in a park), they will have to initiate a new search process, which would prolong the retrieval latency and engage top-down strategic retrieval processes. Latencies will increase even further if participants are asked to recall specific memories from a certain time period (e.g., memories that happened in the last 5 years) (e.g., Wank et al., 2021). By contrast, in all laboratory and diary studies of involuntary AMs, participants are free to recall any AMs irrespective of their specificity or temporal distance.

What was remarkable in the present study is that even when using a word-cue paradigm for studying voluntary AMs, the majority of both directly and generatively recalled memories were still referring to specific events in both young and older participants (for similar results in young adults, see Barzykowski & Staugaard, 2016), presumably because we did not impose any restrictions on types of memories that participants had to recall (for similar results of an absence of a statistically significant age effect on recalling AMs of specific events in an unrestricted instructions condition, see Ford et al., 2014). It appears that asking participants to recall only specific memories does not allow researchers to observe how AM retrieval unfolds naturally in the word-cue paradigm.

Findings of the present study contradict the idea that voluntary recall of AMs is by default an effortful and strategic process. In fact, they show that the opposite might be the case, since, in the majority of trials, memories simply came to mind fairly fast and with minimal reported effort (cf. Barzykowski et al., 2021; Barzykowski & Staugaard, 2016). This finding emphasises the importance of cues in eliciting memories via automatic associative spreading activation processes (Conway, 2005; Mace et al., 2017; Mace, Petersen, et al., 2021) as well as using instructions that allow participants to recall any memories irrespective of their specificity and temporal distance from the present, and echoes findings from studies of involuntary AMs (Berntsen et al., 2017; Schlagman & Kvavilashvili, 2008). When such evidence is taken together, then a rather different theoretical understanding of AM retrieval could be developed, one that emphasises the prevalence of more automatic associative retrieval processes both in everyday life and in laboratory word-cue investigations.

This understanding of autobiographical recall as a more automatic and less effortful/strategic process also concurs with another important set of findings obtained in this study concerning the absence of age effects in the number of directly recalled memories. In fact, the proportions of directly recalled memories were higher in older adults when comparted to young individuals, indicating that negative age effects obtained in numerous previous studies of AM were probably due to standard instructions used by researchers to report only specific memories from certain time periods. There is now growing evidence from investigations examining age effects in tasks that rely on cue-driven or stimulus-dependent spontaneous retrieval processes, both in the laboratory and in naturalistic studies, that show the absence of negative age effects in various cognitive phenomena, such as involuntary AMs (Berntsen et al., 2017; Jakubowski et al., 2023), mind-wandering (Warden et al., 2019), prospective memory (Schnitzspahn et al., 2020), and flashbulb memories (Kvavilashvili et al., 2010), to name a few. These findings cast doubts on the pervasiveness of ageing-related cognitive decline in everyday life and support Craik's (1986) influential functional account of memory and ageing.

According to Craik's theory (see also Grady & Craik, 2000), large negative effects of age will be present in memory tasks that rely on self-initiated strategic retrieval processes in the absence of environmental support (e.g., free recall tasks), while effects of age should be attenuated or even absent in tasks that rely on associative automatic retrieval processes triggered by appropriate cues in the environment (e.g., priming, implicit memory tasks). At the time, when Craik's (1986) theory was proposed to account for age differences in various cognitive tasks, there was no research on tasks involving involuntary but conscious retrieval processes, but recent evidence on spontaneous cognitive phenomena clearly supports this theory and indicates that under the right conditions (i.e., when involuntary recall is not contaminated by strategic processes or other confounding variables), older individuals report memories and thoughts coming to mind as frequently or even more frequently than younger adults (Berntsen et al., 2017; Kvavilashvili et al., 2010; Schnitzspahn et al., 2020; Warden et al., 2019).

The absence of age effects in spontaneous cue-driven retrieval processes is also potentially important for research and clinical practice in pathological ageing, such as in mild cognitive impairment (MCI) or Alzheimer's disease (AD). A recent review of neuroimaging evidence on cue-driven spontaneous retrieval processes (Kvavilashvili et al., 2020) has shown that certain hubs of the default mode network, such as the posterior cingulate cortex and the inferior parietal lobe, are crucially involved in stimulus-dependent (i.e., cue-driven) spontaneous cognitive phenomena. Given that these brain regions are relatively well-preserved in healthy ageing, but are particularly compromised by beta amyloid accumulation in people with AD and MCI, the spontaneous retrieval deficit hypothesis was proposed, which postulates that individuals with MCI or AD will exhibit disproportionate disruptions in spontaneous retrieval processes (Kvavilashvili et al., 2020). Currently, only a small number of studies have demonstrated such impairments in AD and MCI (for a review, see Kvavilashvili et al., 2020), and the AM task that distinguishes directly and generatively recalled memories can afford an ideal means to examine disruptions in spontaneous retrieval processes in atypical ageing (e.g., Markostamou & Kvavilashvili, 2022).

Limitations

One potential limitation of the study refers to validity of the self-report method and whether older participants were able to accurately discriminate directly and generatively recalled memories. While we acknowledge that mistakes could have been made on some occasions (see Harris & Berntsen, 2019), participants appeared to make decisions about the nature of retrieval fairly easily and never chose the *"I don't know"* response option. In addition, there was a strong negative correlation between the number of directly recalled memories and the objective measure of retrieval effort (i.e., retrieval latencies) in both young and old participants. Finally, when designing the study, we carefully examined possible wordings used in previous studies to refer to the direct and generative retrieval. Although direct retrieval is often denoted as *"The memory came to mind almost immediately"* (e.g., Uzer, 2016; Uzer & Brown, 2017), we decided to focus on the spontaneous process of retrieval rather than the length of time it took participants to recall the memory (i.e., *"The memory just popped into my mind by itself"*). This type of definition was better aligned with the response option of generative retrieval that was also defined in terms of retrieval process rather than retrieval latency (i.e., *"I had to actively search to find the memory"*).

Conclusions

This is the first study that investigated effects of age on the frequency and phenomenological characteristics of directly and generatively retrieved AMs in response to word-cues depicting highly familiar and concrete objects, while using non-standard instructions that allow the recall of any AM irrespective of its time frame or specificity. The results showed high prevalence of directly retrieved memories in both age groups and a clear dissociation of age patterns in the number and proportion of generatively and directly retrieved memories, with negative age effects in the former but not in the latter. This novel finding contributes to theories of cognitive ageing and provides new insights about the mechanisms of voluntary AM retrieval. It also highlights the need to assess the retrieval mode in AM research, especially when evaluating effects of typical and atypical ageing. Finally, the development of two parallel-form sets of word-cues will enable researchers to address different questions requiring longitudinal or within-subjects designs and help to evaluate potential changes among AD and MCI patients in the proportion of directly retrieved AMs over time.

Note

1. It is interesting to note that these positive associations were due to generatively recalled memories. Indeed, when correlations were computed separately for directly and generatively recalled memories, the positive associations between retrieval latencies and retrieval effort ratings were significant only for generatively recalled memories (young: $r = .42$, $p = .033$; old: $r = .51$, $p = .007$), but not for directly recalled memories (young: $r = .17$, $p = .407$; old: $r = .10$, $p = .644$).

Data availability statement

The data that support the findings of this study are openly available in Open Science Framework at https://doi.org/10.17605/OSF.IO/X6WQ2.

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Appendix

Table A1. Word-cues in word lists A and B and their psycholinguistic characteristics

	Psycholinguistic characteristics			
Word-cue	Concreteness	Imagery	Familiarity	Emotional valence
List A				
Beard	5.76	6.24	6.12	4.33
Biscuit	5.70	5.65	5.95	4.61
Boat	6.33	6.25	6.58	4.72
Camera	6.23	5.70	6.24	4.87
Coffee	6.43	5.79	6.39	4.73
Friend	4.40	5.63	6.50	6.16
Letter	5.31	5.46	6.48	5.05
Library	5.38	5.36	6.31	4.63
Mirror	5.91	6.34	6.57	4.54
Sunset	5.12	6.21	6.25	6.04
Total	$M = 5.66$ ($SD = 0.62$)	$M = 5.86$ ($SD = 0.36$)	$M = 6.34$ ($SD = 0.20$)	$M = 4.97$ ($SD = 0.63$)
List B				
Candle	5.61	5.88	6.18	4.94
Glasses	6.02	6.02	6.57	3.87
Hotel	5.88	6.00	6.47	4.62
Horse	6.31	6.05	6.17	4.94
Lemon	5.98	6.15	6.21	4.49
Magazine	5.91	5.65	6.15	5.19
Snow	6.14	5.87	6.59	5.32
Soup	6.11	5.98	6.50	4.41
Train	5.88	5.87	6.05	4.66
Wallet	5.80	6.11	6.09	4.48
Total	$M = 5.96$ ($SD = 0.15$)	$M = 5.96$ ($SD = 0.14$)	$M = 6.30$ ($SD = 0.20$)	$M = 4.69$ ($SD = 0.42$)

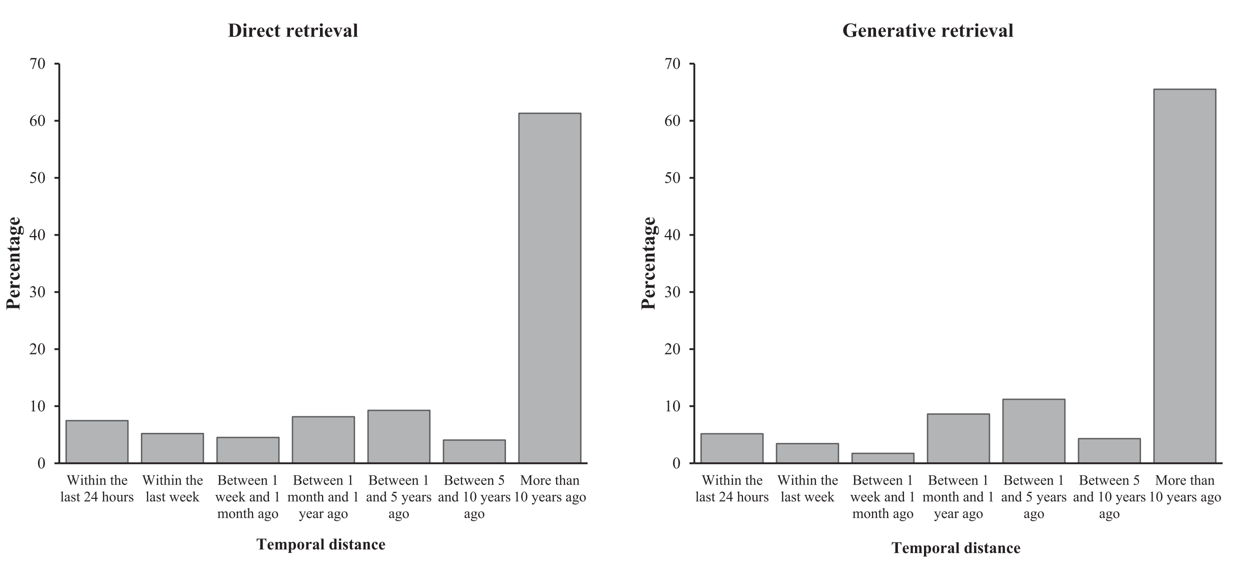

Figure A1. Distribution of the temporal distance from present time of directly and generatively retrieved memories in older adults