Psychological Research
https://doi.org/10.1007/s00426-024-01938-9

RESEARCH

Retrieving autobiographical memories in autobiographical contexts: are age-related differences in narrated episodic specificity present outside of the laboratory?

Daniel A. Hernandez[1] · Christopher X. Griffith[2] · Austin M. Deffner[1] · Hanna Nkulu[1] · Mariam Hovhannisyan[1] · John M. Ruiz[1] · Jessica R. Andrews-Hanna[1,3,4] · Matthew D. Grilli[1,3,4]

Received: 13 September 2023 / Accepted: 1 February 2024

Abstract
The Autobiographical Interview, a method for evaluating detailed memory of real-world events, reliably detects differences in episodic specificity at retrieval between young and older adults in the laboratory. Whether this age-associated reduction in episodic specificity for autobiographical event retrieval is present outside of the laboratory remains poorly understood. We used a videoconference format to administer the Autobiographical Interview to cognitively unimpaired older adults ($N=49$, $M=69.5$, SD = 5.94) and young adults ($N=54$, $M=22.5$, SD = 4.19) who were in their homes at the time of retrieval. Relative to young adults, older adults showed reduced episodic specificity in their home environment, as reflected by fewer episodic or "internal" details (t (101) = 3.23, $p=0.009$) and more "external" details (i.e., semantic, language-based details) (t (101) = 3.60, $p=0.003$). These findings, along with detail subtype profiles in the narratives, bolster the ecological validity of the Autobiographical Interview and add promise to the use of virtual cognitive testing to improve the accessibility, participant diversity, scalability, and ecological validity of memory research.

Introduction

Decades of cognitive aging research have established that young and older adults differ in the way they narrate autobiographical events (Frankenberg et al., 2022; Grilli & Sheldon, 2022; Levine et al., 2002; Rubin & Schulkind, 1997; St. Jacques & Levine, 2007). One notable difference is in the specificity with which autobiographical events are orally retold, with younger adults tending to provide more event-specific detail relative to older adults, and older adults often providing more background (e.g., semantic), meaning-based information (Levine et al., 2002; Simpson et al., 2023; St. Jacques & Levine, 2007). This difference in "autobiographical episodic specificity" is thought to reflect typical age-related changes in brain structure and function, as well as normal cognitive and motivational shifts in older age (Adams et al., 1997; Addis et al., 2011; Ford et al., 2014; Grilli & Sheldon, 2022; Piolino et al., 2010). However, pronounced reductions in autobiographical episodic specificity are also associated with disease-related brain aging, including mild cognitive impairment and dementia from Alzheimer's disease (Addis et al., 2009; Andrews-Hanna et al., 2019; Irish et al., 2011; Murphy et al., 2008). Reduced autobiographical episodic specificity, therefore, is a cognitive feature associated with both typical and atypical older age, albeit likely for distinct reasons.

Autobiographical episodic specificity and its age-associated reduction are commonly experimentally assessed with the well-known Autobiographical Interview (Levine et al., 2002; Simpson et al., 2023). In the Autobiographical Interview, specific details are characterized as "internal" and include references to the episodic or unique features of the event. These are contrasted with "external" details, which capture knowledge that typically provides a background story, along with other language features (e.g., editorializing,

✉ Daniel A. Hernandez
danielh5@arizona.edu

Matthew D. Grilli
mdgrilli@arizona.edu

1 Psychology Department, The University of Arizona, Tucson, USA

2 Psychology Department, University of Colorado, Colorado Springs, USA

3 Cognitive Sciences, The University of Arizona, Tucson, USA

4 Neurology Department, The University of Arizona, Tucson, USA

Published online: 04 April 2024

repetitions of information). Although the Autobiographical Interview has undergone several experimental adaptions (e.g., different types of cueing, emotional content of memories, past or future in autobiographical orientation), a consistent finding across tasks is that older adults tend to provide less internal detail relative to young adults, whereas external detail is either statistically equivalent or elevated with older age, which is considered a classic profile of reduced autobiographical episodic specificity (Acevedo-Molina et al., 2020a, 2020b; Addis et al., 2010; Levine et al., 2002; Madore et al., 2014; Peters & Sheldon, 2020; Wank et al., 2021). A recent meta-analysis including 21 studies comparing young to healthy older adults found large, statistically significant effects for both an age-associated reduction in internal detail (Hedges' $g = 1.007$) and an inflation in external detail (Hedges' $g = -0.799$) (Simpson et al., 2023).

The Autobiographical Interview is traditionally conducted in the laboratory. This means that researchers, when drawing conclusions about the broader impact of reduced autobiographical episodic specificity among older adults, have largely assumed that the Autobiographical Interview translates from in the laboratory out into everyday life. A few recent studies, however, have assessed autobiographical memory retrieval in individuals who are at home or in another non-laboratory context, using computer and smartphone technology. This work has shown, for example, that individuals recruited through MTurk can report on their autobiographical memories in an unsupervised context, and they experience positive and negative memories similar to those in the laboratory (Gower et al., 2023a, 2023b). In addition, several studies have demonstrated that autobiographical memory training programs, developed in the laboratory and clinic, can be delivered virtually in a videoconference format (Jung et al., 2023; Martens et al., 2019a, 2019b; Martens et al., 2019a, 2019b). Beyond autobiographical memory, recent research has in fact shown that many cognitive tasks, despite the reduction in control and translation to a home environment, produce similar outcomes when administered by videoconference (Brearly et al., 2017; Marra et al., 2020).

Nonetheless, whether the age-associated difference in autobiographical episodic specificity is present when retrieval is assessed in the home environment remains unclear. However, if the Autobiographical Interview is a robust, ecologically valid task of reduced autobio

graphical episodic specificity, we might expect that an alteration of context from laboratory to home would have minimal impact on age-related outcomes. To this point, research has shown that some age-related differences in autobiographical memory persist when staged events outside of the laboratory are later retrieved in the laboratory, suggesting that autobiographical memories normally retrieved by young and older adults in the laboratory may not be not unusual in their relationship to memory organization and accuracy (Diamond & Levine, 2020; St. Jacques et al., 2015). However, there are theoretical reasons to suspect that retrieving autobiographical memories in the home environment might mitigate age-related differences in autobiographical episodic specificity. First, the shift from laboratory to home dramatically alters the familiarity and self-relevance of cues that are available at retrieval for older adults. This is important because older adults may not self-initiate memory strategies as effectively as young adults, and therefore, an environment that is rich in familiar external cues may disproportionately benefit older adults' autobiographical memory performance (Craik, 1983, 2022). In other words, age-related differences in episodic specificity may partly reflect that the laboratory is a depersonalized, cue-impoverished environment that places high demands on self-initiated internal strategies to recall autobiographical events in detail. The presence of personal, familiar cues of the home environment may reduce reliance on self-initiated internal strategies and ultimately close the gap in episodic specificity that divides older adults from young adults. Second, there is interest in the idea that the types of autobiographical memories that come to mind in a familiar environment might be starkly different from those generated in the more controlled, depersonalized context of the laboratory. That is, personal, familiar cues are thought to increase the accessibility of certain types of memories that are naturally more specific (e.g., involuntary memories) and less affected by normal cognitive aging (Berntsen, 1998; Schlagman et al., 2009). Relevant to translatability, a recent study, which used a smartphone application to unobtrusively record autobiographical memory sharing in daily conversations, found that advanced age among older adults was not significantly related to a disproportionate drop in event-specific detail, although older adults were not compared to young adults (Wank et al., 2020). Thus, there are theoretical and empirical reasons to wonder whether the home environment may attenuate the reduction in autobiographical episodic specificity associated with older age—an outcome that could potentially place a boundary on the ecological validity of the laboratory-based Autobiographical Interview approach as a measure of cognitive aging.

To evaluate these potential outcomes, we used a videoconference format to administer a virtual Autobiographical Interview to young and cognitively normal older adults in their homes. We hypothesized that if age-related outcomes of the Autobiographical Interview are not contingent on retrieval occurring in the laboratory, older adults would provide fewer internal details and a lower proportion of internal details (i.e., internal:total details) relative to young adults in the home environment. However, if older adults disproportionately benefit from the availability of personal cues of the home environment, as we might predict from self-initiated (Craik, 2022) and memory context theories of cognitive aging (Schlagman et al., 2009), conducting the

Autobiographical Interview in the home environment may not detect age-related differences in autobiographical episodic specificity.

Materials and methods

Participants

One hundred and three participants were included in the present study, including 54 younger (age range = 18–34) and 49 older adults (age range = 61–83). The participants were recruited through online newspaper and newsletter advertisements, as well as social media and a campus email listserv. Participant demographics are reported in Table 1. As can be seen in Table 1, older adults had achieved significantly higher levels of education overall, $t\,(101) = 4.92$, $p < 0.001$. Young and older adults did not significantly differ in their ratio of women to men, $\chi^2 = 0.55$, $p = 0.46$, and they were similar in being predominately White non-Hispanic according to self-reported race and ethnicity. All participants were recruited, enrolled, and administered the following study procedures in compliance with the Institutional Review Board at the University of Arizona.

Table 1 Sample characteristics of young and older adults. Table 1 displays the demographic characteristics of young and older adults from the virtual Autobiographical Interview study.

Procedures

Neuropsychological testing. To be eligible for the present study, older adults were required to score within normal limits on a battery of neuropsychological tests. In line with our previous research (Acevedo-Molina et al., 2023; Grilli et al., 2018), older adults were comprehensively screened for abnormal age-related cognitive decline using a profile, actuarial approach (Bondi et al., 2014). Twenty-one participants completed neuropsychological testing in person before the COVID-19 pandemic began and were included in the study sample. The remaining participants completed neuropsychological testing on Zoom after the start of the COVID-19 pandemic. Domains tested were memory (California Verbal Learning Test Second Edition, Long Delay Free Recall; Rey Complex Fig. Test) (Delis et al., 2016; Meyers & Meyers, 1995), language (Boston Naming Test Total Score; Animal Fluency Total Correct) (Kaplan et al., 2001), and attention/executive functioning (21 participants completed Trail Making Test A&B in person (Reitan, 1955); the remaining participants completed the Digit Span Forward Total Score and Digit Span Backward Total Score from the Wechsler Adult Intelligence Scale IV (Wechsler, 2012), which was better suited for the virtual format). Consistent with prior research (Bondi et al., 2014), two scores more than one standard deviation below the age and education corrected mean in one domain or three scores across the three domains were used to screen out potential mild cognitive impairment.

Table 1 Participant characteristics

Demographics	Young adults ($N = 54$)	Older adults ($N = 49$)
Age M (SD)	22.5 (4.19)	69.5 (5.94)
Education	15.3 years	18.5 years
Female *N* (%)	43 (80%)	36 (73%)
Male *N* (%)	11 (20%)	13 (27%)
Race *N* (%)		
Black or African American	1 (2%)	2 (4%)
White	31 (57%)	47 (96%)
Asian	7 (13%)	0 (0%)
Native American	1 (2%)	0 (0%)
Other	14 (26%)	0 (0%)
Ethnicity *N* (%)		
Hispanic or Latinx	13 (24%)	0 (0%)
Non-Hispanic or Latinx	41 (76%)	49 (100%)

Virtual Autobiographical Interview. We administered the standard free recall and general probe portion of the Autobiographical Interview (Levine et al., 2002). In this task, participants were asked to recall five memories from their lifespan. The first memory recall task was from early childhood (before age 11). The second and third memory recall tasks were from adolescence (11–17 years) and early adulthood (18–35 years). The fourth memory recall task for the older adult group was from middle adulthood (35–55 years), whereas the younger adult group was asked about another early adulthood memory. The fifth memory recall task, regardless of the participant's age, was asked to recall a memory from within this past year. For each memory, participants were instructed to select an event that occurred in less than 24 h. The standard instructions for the initial recall portion of the Autobiographical Interview were used. Although we included a general probe (i.e., can you tell me more?), we did not administer the additional cueing portion that can follow initial recall (i.e., when specific aspects of events are cued for more detail) because of concerns about the overall length of the Autobiographical Interview in a virtual environment. The sessions were recorded with the permission from the participants.

The memory narratives were scored using the standard Autobiographical Interview scoring manual (Levine et al., 2002). That is, narratives were segmented into individual details, and each detail was scored as either internal to the event, meaning episodic (i.e., perceptual, time, place, event feature, and thought/emotion), or external to the event. External details include semantic knowledge, repetitions,

meta-comments, and descriptions of secondary events. Each narrative was scored by two raters who were trained in the Autobiographical Interview. Each rater achieved high interrater reliability for internal and external details (i.e., ICC > 0.90) with expert scorers on a standard memory dataset used for training. The two raters' scores were averaged for each participant, creating a more reliable estimate of their use of detail types.

Statistical analyses

Consistent with laboratory-based research, we first examined whether there were significant age group differences in internal and external details gathered using the virtual Autobiographical Interview, using a two (group: young versus older) by two (detail type: internal versus external) mixed analysis of variance. We applied a square root transform to the detail data to improve data normality, and we used the Tukey correction on planned post hoc comparisons. To determine whether the magnitudes of effects in the virtual Autobiographical Interview were similar to the findings of a recent meta-analysis (Simpson et al., 2023), we calculated Cohen's d for age differences in the frequency of internal and external details, and we asked whether the 95% confidence interval for these effects spanned the Hedge's g reported in Simpson and colleagues (Simpson et al., 2023). As is common among laboratory-based research, we followed up with an independent samples t-test of episodic specificity proportional scores (i.e., internal:total), which accounts for any subtle group variability in overall detail generation. We next examined whether a drop in episodic specificity was similarly associated with older age when treated as a continuous variable among older adults. Finally, we examined the relative use of the internal and external detail subtypes. Here, we were interested in knowing whether, as is commonly found in the laboratory, event-related details would be the most common internal detail subtype and semantic details would be the most common external detail subtype, among both young and older adults. We were also interested in examining whether young and older adults significantly differed on select detail subtypes. To do so, we conducted separate two (group: young versus older) by four or five (detail subtype) analyses of variance on internal and external details, which again were done after the data were submitted to a square root transform. We used the Tukey correction on planned post hoc comparisons for the analysis of variance tests to follow.

Results

The mean internal and external details provided by each participant are depicted in Fig. 1. Our two (group: young versus older) by two (detail: internal versus external) mixed analysis of variance revealed a main effect of detail type such that, consistent with the task instructions, internal details were generated more than external details on the virtual Autobiographical Interview, $F\,(1, 101) = 25.2$, $p < 0.001$, partial $\eta^2 = 0.20$. Although there was not a significant main effect of group ($F\,(1, 101) = 0.14$, $p = 0.71$, partial $\eta^2 = 0.001$), there was a significant interaction between group and detail type ($F\,(1, 101) = 33.6$, $p < 0.001$, partial $\eta^2 = 0.25$). Planned post hoc t-tests with the Tukey correction showed that, relative to young adults, older adults generated fewer internal details ($t\,(101) = 3.23$, $p = 0.009$) and more external details on the virtual Autobiographical Interview ($t\,(101) = 3.60$, $p = 0.003$). The 95% confidence interval for the Cohen's d for the internal detail reduction ($d = 0.64$, 95% CI = 0.23–1.04) spanned the Hedge's g values reported in Simpson and colleagues' recent meta-analysis (Hedge's $g = 1.007$) (Simpson et al., 2023), as did the Cohen's d for the inflation in external details ($d = -0.71$, 95% CI = -0.30 to -1.12; Hedge's $g = -0.799$). We also found that whereas young adults generated more internal than external detail ($t\,(101) = 7.84$, $p < 0.001$), older adults did not significantly generate more internal than external detail ($t\,(101) = 0.54$, $p = 0.95$). Consistent with the apparent shift in internal and external detail use in older age, when we examined episodic specificity proportional scores (i.e., internal:total), there was a significant effect of group such that older adults had lower episodic specificity compared to young adults ($t\,(101) = 6.00$, $p < 0.001$, $d = 1.18$).

Figure 2 depicts the relationship between age and episodic specificity (i.e., internal:total) among the older adults (i.e., age 60+). Aligning with laboratory-based research, a bivariate Pearson correlation revealed a small-to-medium, significant linear relationship such that older age was associated with a decrease in episodic specificity in the virtual Autobiographical Interview, $r = -0.342$, $p = 0.016$. Given that the oldest older adult appeared to be an extreme case in the scatterplot, we reran the analyses as a Spearman correlation. This did not meaningfully change the results, rho = -0.293, $p = 0.041$.

Figure 3 shows the average number of internal detail subtypes (part A) and external detail subtypes (part B) used by young and older adults separately. For internal detail subtypes, a 2 (group: young versus older) by 5 (detail subtype) analysis of variance revealed a significant effect of detail subtype, $F(4, 404) = 566.44$, $p < 0.001$, partial $\eta^2 = 0.85$, and a significant interaction between detail subtype and age group, $F(4, 404) = 4.76$, $p < 0.001$, partial $\eta^2 = 0.05$, in addition to the previously reported main effect of group, $F(1, 101) = 11.2$, $p = 0.001$, partial $\eta^2 = 0.10$. Breaking down internal detail subtype use, as is commonly found in the laboratory-based version of the Autobiographical Interview, event details were by far the most common internal detail subtype, t's > 27.19, p's < 0.001. Thought/emotion and perceptual detail subtypes were more common than

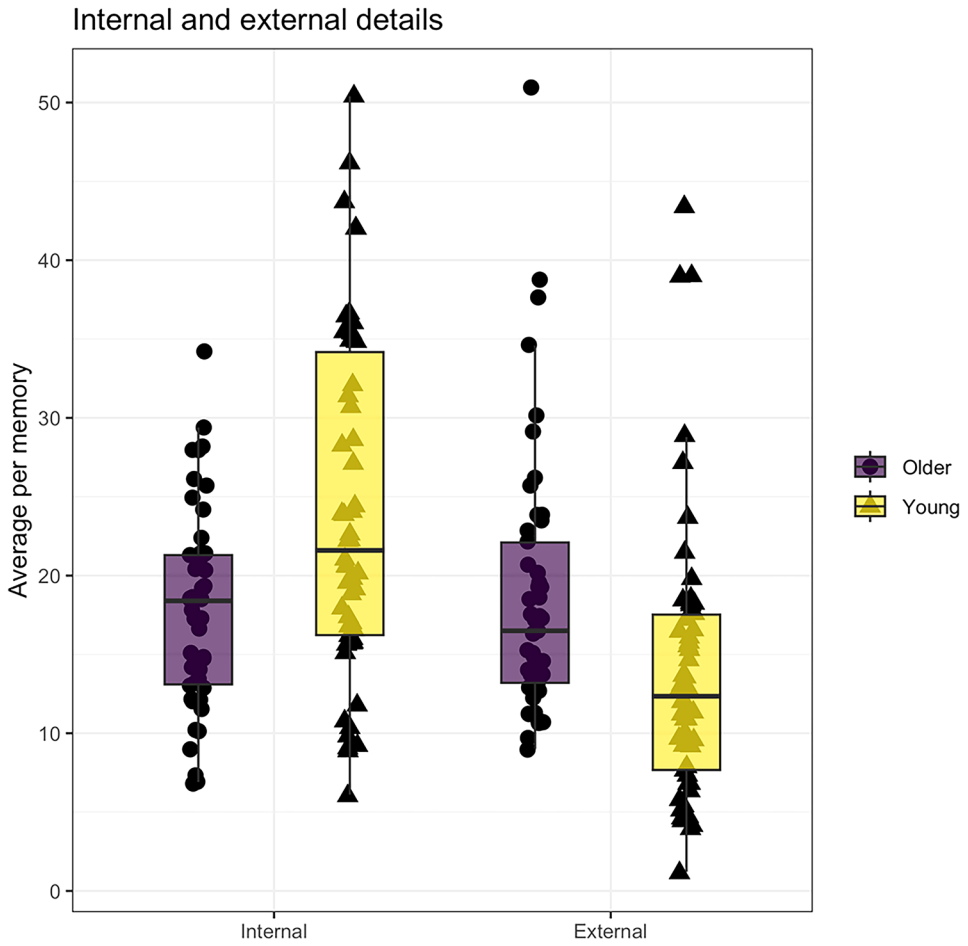

Fig. 1 Average internal and external details per memory in the virtual Autobiographical Interview. As shown here, on average older adults generated significantly fewer internal details and significantly more external details relative to young adults. Whereas young adults generated more internal than external detail, older adults did not. These results replicate what is commonly found with laboratory-based Autobiographical Interviews. Although we square root transformed the data for statistical analysis, we are depicting raw averages for illustrative purposes and for better comparison to prior work

place and time details, t's > 6,40, p's < 0.001, and thought/emotion and perceptual details did not significantly differ from each other, $t = 1.98$, $p = 0.33$. Finally, place and time details did not significantly differ from each other, $t = 0.11$, $p = 1.00$. Given that there was a significant interaction between detail subtype and age group, we next examined whether this general pattern held in each group separately. It largely did, although a few differences emerged. For older adults, event details were by far the most common subtype, t's > 16.87, p's < 0.001, as it was for young adults, t's > 21.72, p's < 0.001. Similarly, thought/emotion details were more common than place and time details among older adults, t's > 6.96, p's < 0.001, and young adults, t's > 6.08, p's < 0.001. There was a group difference in perceptual details. Whereas young adults generated more perceptual than place and time details, t's > 6.63, p's < 0.001, older adults did not significantly generate more perceptual than place or time details, t's < 2.88, p's > 0.12. As was the case in the cohort as a whole, place and time details did not significantly differ in either young or older adults, t's < 0.47, p's = 1.00. One final group difference was in the relative use of thought/emotion and perceptual details. Whereas young adults did not significantly differ in the use of these two subtypes, $t = 0.82$, $p = 1.00$, older adults used more thought/emotion than perceptual details, $t = 3.38$, $p = 0.03$. When we compared young and older adults on internal detail subtypes, we found that young adults only generated more perceptual details, $t = 3.56$, $p = 0.02$, with the age groups not significantly differing on event details, $t = 2.92$, $p = 0.11$, place details, $t = 2.14$, $p = 0.50$, time details, $t = 1.82$, $p = 0.72$, or thought/emotion details, $t = 0.56$, $p = 1.00$.

For external details, a 2 (group: young versus older) by 4 (detail subtype) analysis of variance revealed a significant effect of detail subtype, $F(6, 606) = 93.1$, $p < 0.001$, partial $\eta^2 = 0.48$, and a significant interaction between detail subtype and age group, $F(4, 404) = 10.3$, $p < 0.001$, partial $\eta^2 = 0.09$, in addition to the previously reported main effect of group, $F(1, 101) = 20.0$, $p < 0.001$, partial $\eta^2 = 0.17$. Breaking down the external detail subtype use, as is commonly found in laboratory-based Autobiographical Interviews, semantic details were by far the most used external detail subtype, t's > 4.69, p's < 0.001, followed by metacognitive statements, which were significantly more common than external events and repetitions, t's > 7.17, p's < 0.001. External events were significantly more common than repetitions, $t = 3.23$, $p = 0.009$. Given the significant interaction between detail subtype and

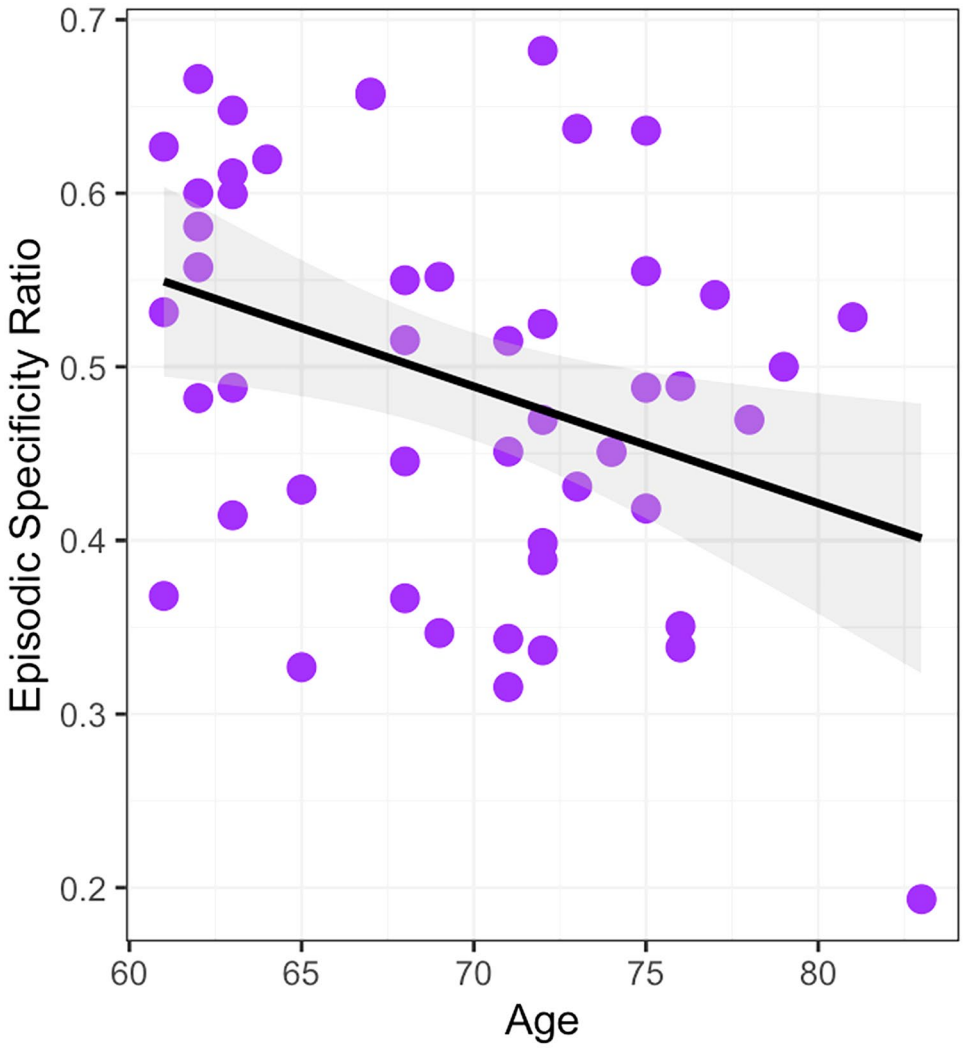

Fig. 2 Relationship between age and episodic specificity among older adults. As shown here, advanced age among cognitively normal older adults was significantly associated with a drop in episodic specificity, even after accounting for the extreme position of the oldest older adult, Pearson's $r = -0.342$, $p = 0.016$, Spearman's rho $= -0.293$, $p = 0.041$

group, we next examined whether the detail pattern held in each group separately. Both groups used semantic details more than any other external detail subtype, t's > 3.28, p's < 0.03. Young adults used metacognitive statements more than external events and repetitions, t's > 8.00, p's < 0.001. Older adults used metacognitive statements more than repetitions, $t = 10.65$, $p < 0.001$, but not external events, $t = 2.29$, $p = 0.31$. In fact, older adults used external events more than repetitions, $t = 6.34$, $p < 0.001$, whereas young adults did not, $t = 1.97$, $p = 0.51$. When comparing young and older adults, we found that older adults generated significantly more external events relative to young adults, $t = 6.19$, $p < 0.001$. However, the groups did not significantly differ on the other external detail subtypes, $t < 1.73$, $p > 0.67$.

Discussion

According to laboratory-based research, differences in autobiographical episodic specificity are defining features of typical cognitive aging and are significantly impacted by age-related neurodegenerative diseases (Andrews-Hanna et al., 2019; Levine et al., 2002; Simpson et al., 2023). Assessing episodic specificity in the laboratory provides insight into not only everyday memory, but also a host of cognitive functions that rely on memory retrieval, including future thinking, decision-making, and creativity (Madore et al., 2014; Schacter et al., 2007, 2017). The COVID-19 Pandemic limited the administration of

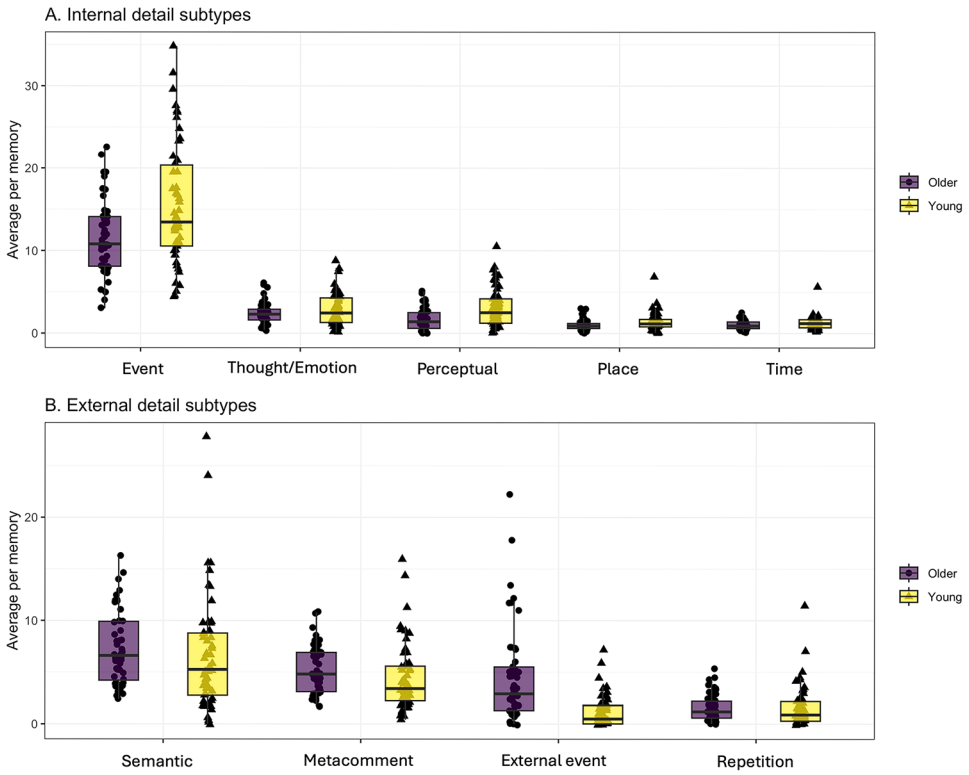

Fig. 3 Detail subtype use among young and older adults. As shown here, event and semantic details were the most commonly used in their respective categories, irrespective of age group. We also found that older adults showed a pronounced under-use of perceptual details and an overuse of external events, relative to young adults. Although we square root transformed the data for statistical analysis, we are depicting raw averages for illustrative purposes and for better comparison to prior work

in-person cognitive tests, such as the Autobiographical Interview, restricting this branch of research and clinical care. However, it provided an opportunity to evaluate age-related differences in autobiographical episodic specificity outside the laboratory and in a home environment, assessed by the virtual Autobiographical Interview.

In a relatively large study of autobiographical memory in young and cognitively unimpaired older adults, the present results replicated the typical, primary pattern of age-related differences found through laboratory administrations of the recall portion of the Autobiographical Interview (Simpson et al., 2023). Compared to young adults, cognitively normal older adults generated significantly fewer internal or episodic details and more external details. The magnitude of these age-associated differences in internal and external details on the virtual Autobiographical Interview was medium-to-large and broadly consistent with what is commonly found with laboratory-based Autobiographical Interviews (Simpson et al., 2023). Consistent with in-person research, we also found that, among the older adults, there was an age-related reduction in the proportion of details that were internal. These findings suggest that, despite the presence of personal, familiar cues of the home testing environment, there is a reliable shift in the type of details provided by older adults to the lifetime period cueing approach taken in the recall portion of the Autobiographical Interview.

Additional aspects of the data speak to the translatability of the Autobiographical Interview from the laboratory to the home environment. As repeatedly found in the laboratory, internal details were far more common than external details among the young adults in this virtual recall version of the Autobiographical Interview. Comparing the current results to the recall period of the initial Autobiographical Interview study (Levine et al., 2002), we see that, in the present study, the average number of internal details (mean = 23.9) and external details (mean = 13.7) generated by young adults was consistent with what is generally found in standard, laboratory-administered Autobiographical Interviews, indicating that how memories are described at home in a virtual Autobiographical Interview may be similar in episodic richness to memory retrieval in the laboratory among young adults. Regarding the older adults, the relative use of internal details (mean = 17.9) and external details (mean = 18.8) was also broadly aligned with what is commonly found in laboratory-based studies. Taken together, the results generally support the ecological validity of the Autobiographical Interview.

It is interesting to consider why the age-related shift in episodic specificity on the Autobiographical Interview persisted in a home environment, when there was reason to think that personal, familiar cues might eliminate age-related differences (Craik, 2022) and that autobiographical memory sharing in familiar contexts may differ (Schlagman et al., 2009; Wank et al., 2020). We recently suggested that the shift from episodic to semantic detail that characterizes normal cognitive aging may partly reflect a developmental and potentially adaptive shift in memory (Grilli & Sheldon,

2022). That is, older adults may prefer to describe memories in a more gist-like manner, capturing the basics of a particular event while drawing in more knowledge and meaning, reflecting a developmental shift in cognition and motivation, including a preference to make connections across events and describe them from another's perspective or in a more storytelling like way. From this viewpoint, we can speculate that the availability of familiar, personal cues may not have eliminated an age-related drop in episodic specificity, because older adults naturally prefer to describe memories in a manner that de-values idiosyncratic (i.e., episodic) features about a singular event, regardless of how available event-specific details might be. Another possible contributor is that the virtual Autobiographical Interview, despite being administered in the home environment, nonetheless used cued, voluntary memory retrieval, similar to the laboratory. It is possible that familiar environments with involuntary memory retrieval may eliminate age-related differences, which might need to be assessed in different ways from the Autobiographical Interview (Schlagman et al., 2009; Wank et al., 2020). As noted in the Methods, the present study did not include additional probing of specific, episodic features. Whether combining specific probing with the familiarity of the home environment helps older adults close the gap with young adults in episodic specificity remains an open question. Older adults also may show strong benefits of a home environment when autobiographical memories are retrieved under more naturalistic contexts, such as in conversation or when prompted in ways that go beyond lifetime period cueing. Finally, it is important to note that, although effect sizes were consistent with laboratory studies, the present study does not rule out that older adults disproportionately benefited from the home environment, given that we did not directly compare laboratory and home retrieval.

The present study also provides additional support and new insights into the type of results that can be obtained through a virtual Autobiographical Interview by analyzing detail subtypes. Regardless of age group, event and semantic details were by far the most common subtypes of internal and external detail categories, respectively. This is consistent with the detail profiles of laboratory-based Autobiographical Interviews. However, we also found additional detail subtype results that may have important implications for understanding how laboratory-based Autobiographical Interviews translate to home environments. First, relative to young adults, older adults appeared to have a pronounced difficulty generating perceptual details in the virtual Autobiographical Interview. Perceptual details were the only internal detail subtype that significantly differed between young and older adults, and the relative use of perceptual details in comparison to other internal details among older adults was less than their relative use among young adults. These results align with fMRI findings noting that older adults commonly experience activation differences in brain regions implicated in perceptual processing of episodic memories (Ankudowich et al., 2019; McIntosh et al., 1999) and may support the validity of virtual Autobiographical Interviews. Second, older adults appeared to have a pronounced tendency to reference external events. Here again, external events were the only external detail subtype for which young and older significantly differed, and the relative use among external subtypes was different between young and older adults. Although we did not have hypotheses surrounding detail subtype use, these results may reflect that in the home environment, older adults have a notable difficulty with perceptual details, and the presence of familiar cues may prompt retrieval of events that reflect related "asides" (Bluck et al., 2016). However, given that the present study did not directly compare home and laboratory environments, future research needs to clarify whether different detail profiles emerge across contexts.

Although we provide preliminary evidence of the translatability of the Autobiographical Interview from the laboratory to the home environment, future research is needed to address the limitations of the present study. First, a future study could collect both in-laboratory and virtual Autobiographical Interviews in the same set of participants. This will allow for a direct comparison of older age effects and may reveal differences that we cannot detect by comparing our findings to meta-analytic effect sizes (Simpson et al., 2023). It also would add insight into intra-individual reliability across contexts, which is valuable for knowing the degree to which the formats are interchangeable. Second, a future study could examine whether the added cognitive and technological demands of a virtual Autobiographical Interview impact reliability and validity in a clinical sample of older adults, such as older adults with mild cognitive impairment or dementia secondary to Alzheimer's disease. Third, future research could adopt recently developed scoring protocols to examine the influence of the home environment on more fine-grained distinctions in external details (Renoult et al., 2020; Strikwerda-Brown et al., 2019). For instance, perhaps the home environment boosts personal semantics.

In conclusion, the present study extends numerous laboratory-based experiments (Acevedo-Molina et al., 2020a, 2020b; Acevedo-Molina et al., 2020a, 2020b; Devitt et al., 2017; Levine et al., 2002; St. Jacques & Levine, 2007; Wank et al., 2021) by showing that cognitively normal older adults generated fewer internal and more external detail while narrating autobiographical events in their home environments during a videoconference version of the Autobiographical Interview. These findings add evidence that assessing autobiographical memory in the laboratory provides a window into how autobiographical memories are shared in daily contexts. Future research can investigate whether virtual assessment may be vital to developing accessible formats

of cognitive assessments that can reach diverse populations underrepresented in the psychological science literature (Andrews-Hanna & Grilli, 2021).

Author Contributions DAH curated the data, involved in formal analysis, visualized the data, and wrote the original draft; CXG curated the data, administrated the project, and wrote, reviewed, and edited the manuscript; AMD curated the data, administrated the project, and wrote, reviewed, and edited the manuscript; HN curated the data and wrote, reviewed, and edited the manuscript; MH curated the data and wrote, reviewed, and edited the manuscript; JMR supervised the data and wrote, reviewed, and edited the manuscript; JRAH acquired the funding, designed the methodology, acquired the resources, supervised the data, and wrote, reviewed, and edited the manuscript; MDG acquired the funding, designed the methodology, acquired the resources, supervised the data, visualized the data, and wrote, reviewed, and edited the manuscript.

Funding Research reported in this publication was supported by the National Institute on Aging of the National Institutes of Health under Award Number AG068098 and 1UF1AG046150-01. The first author (Daniel A. Hernandez) was supported by a Postbaccalaureate Research Education Program funded by the National Institute of General Medical Sciences under Award Number GM121228. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Declarations

Competing interests The authors declare no competing interests.

Conflict of interest We have no conflicts of interests regarding financial or personal gain.

Ethical approval This research was approved by the Institutional Review Board at the University of Arizona.

Open science and data transparency The data that support the findings of this study can be found here: https://osf.io/nxca9/?view_only=860d318ce90a4dab9902744fd9e899c8.

References

Acevedo-Molina, M. C., Matijevic, S., & Grilli, M. D. (2020a). Beyond episodic remembering: Elaborative retrieval of lifetime periods in young and older adults. *Memory, 28*(1), 83–93. https://doi.org/10.1080/09658211.2019.1686152

Acevedo-Molina, M. C., Novak, A. W., Gregoire, L. M., Mann, L. G., Andrews-Hanna, J. R., & Grilli, M. D. (2020b). Emotion matters: The influence of valence on episodic future thinking in young and older adults. *Consciousness and Cognition, 85*, 103023. https://doi.org/10.1016/j.concog.2020.103023

Acevedo-Molina, M. C., Thayer, S. C., Horn, K., Nkulu, H., Ryan, L., Andrews-Hanna, J. R., & Grilli, M. D. (2023). Past and future episodic detail retrieval is reduced among clinically normal older adults at higher genetic risk for late-onset Alzheimer's disease. *Neuropsychology, 37*(2), 194–203. https://doi.org/10.1037/neu0000866

Adams, C., Smith, M. C., Nyquist, L., & Perlmutter, M. (1997). Adult age-group differences in recall for the literal and interpretive meanings of narrative text. *The Journals of Gerontology Series b: Psychological Sciences and Social Sciences, 52B*(4), P187–P195. https://doi.org/10.1093/geronb/52B.4.P187

Addis, D. R., Musicaro, R., Pan, L., & Schacter, D. L. (2010). Episodic simulation of past and future events in older adults: Evidence from an experimental recombination task. *Psychology and Aging, 25*(2), 369–376. https://doi.org/10.1037/a0017280

Addis, D. R., Roberts, R. P., & Schacter, D. L. (2011). Age-related neural changes in autobiographical remembering and imagining. *Neuropsychologia, 49*(13), 3656–3669. https://doi.org/10.1016/j.neuropsychologia.2011.09.021

Addis, D. R., Sacchetti, D. C., Ally, B. A., Budson, A. E., & Schacter, D. L. (2009). Episodic simulation of future events is impaired in mild Alzheimer's disease. *Neuropsychologia, 47*(12), 2660–2671. https://doi.org/10.1016/j.neuropsychologia.2009.05.018

Amer, T., Wynn, J. S., & Hasher, L. (2022). Cluttered memory representations shape cognition in old age. *Trends in Cognitive Sciences, 26*(3), 255–267. https://doi.org/10.1016/j.tics.2021.12.002

Andrews-Hanna, J. R., Grilli, M. D., & Irish, M. (2019). A Review and Reappraisal of the Default Network in Normal Aging and Dementia. In J. R. Andrews-Hanna, M. D. Grilli, & M. Irish, Oxford Research Encyclopedia of Psychology. Oxford University Press. https://doi.org/10.1093/acrefore/9780190236557.013.384

Ankudowich, E., Pasvanis, S., & Rajah, M. N. (2019). Age-related differences in prefrontal hippocampal connectivity are associated with reduced spatial context memory. *Psychology and Aging, 34*(2), 251–261. https://doi.org/10.1037/pag0000310

Berntsen, D. (1998). Voluntary and involuntary access to autobiographical memory. *Memory, 6*(2), 113–141. https://doi.org/10.1080/741942071

Bluck, S., Alea, N., Baron-Lee, J. M., & Davis, D. K. (2016). Story asides as a useful construct in examining adults' story recall. *Psychology and Aging, 31*(1), 42–57. https://doi.org/10.1037/a0039990

Bondi, M. W., Edmonds, E. C., Jak, A. J., Clark, L. R., Delano-Wood, L., McDonald, C. R., Nation, D. A., Libon, D. J., Au, R., Galasko, D., & Salmon, D. P. (2014). Neuropsychological criteria for mild cognitive impairment improves diagnostic precision, biomarker associations, and progression rates. *Journal of Alzheimer's Disease, 42*(1), 275–289. https://doi.org/10.3233/JAD-140276

Brearly, T. W., Shura, R. D., Martindale, S. L., Lazowski, R. A., Luxton, D. D., Shenal, B. V., & Rowland, J. A. (2017). Neuropsychological test administration by videoconference: A systematic review and meta-analysis. *Neuropsychology Review, 27*(2), 174–186. https://doi.org/10.1007/s11065-017-9349-1

Craik, F. I. M. (1983). On the transfer of information from temporary to permanent memory. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences, 302*(1110), 341–359. https://doi.org/10.1098/rstb.1983.0059

Craik, F. I. M. (2022). Reducing age-related memory deficits: the roles of environmental support and self-initiated processing activities. *Experimental Aging Research, 48*(5), 401–427. https://doi.org/10.1080/0361073X.2022.2084660

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (2016). California verbal learning test—second edition. *American Psychological Association*. https://doi.org/10.1037/t15072-000

Devitt, A. L., Addis, D. R., & Schacter, D. L. (2017). Episodic and semantic content of memory and imagination: A multilevel analysis. *Memory & Cognition, 45*(7), 1078–1094. https://doi.org/10.3758/s13421-017-0716-1

Diamond, N. B., & Levine, B. (2020). Linking detail to temporal structure in naturalistic-event recall. *Psychological Science, 31*(12), 1557–1572. https://doi.org/10.1177/0956797620958651

Ford, J. H., Rubin, D. C., & Giovanello, K. S. (2014). Effects of task instruction on autobiographical memory specificity in young and older adults. *Memory, 22*(6), 722–736. https://doi.org/10.1080/09658211.2013.820325

Frankenberg, C., Knebel, M., Degen, C., Siebert, J. S., Wahl, H.-W., & Schröder, J. (2022). autobiographical memory in healthy aging: A decade-long longitudinal study. *Aging, Neuropsychology, and Cognition, 29*(1), 158–179. https://doi.org/10.1080/13825585.2020.1859082

Gower, T., Chiew, K. S., Rosenfield, D., & Bowen, H. J. (2023a). Positive biases and psychological functioning during the coronavirus disease 2019 pandemic. *Cognition and Emotion, 37*(6), 1123–1131. https://doi.org/10.1080/02699931.2023.2221022

Gower, T., Chiew, K. S., Rosenfield, D., & Bowen, H. J. (2023b). Positive biases and psychological functioning during the coronavirus disease 2019 pandemic. *Cognition and Emotion*. https://doi.org/10.1080/02699931.2023.2221022

Grilli, M. D., & Sheldon, S. (2022). Autobiographical event memory and aging: Older adults get the gist. *Trends in Cognitive Sciences, 26*(12), 1079–1089. https://doi.org/10.1016/j.tics.2022.09.007

Grilli, M. D., Wank, A. A., Bercel, J. J., & Ryan, L. (2018). Evidence for reduced autobiographical memory episodic specificity in cognitively normal middle-aged and older individuals at increased risk for Alzheimer's disease dementia. *Journal of the International Neuropsychological Society, 24*(10), 1073–1083. https://doi.org/10.1017/S1355617718000577

Irish, M., Hornberger, M., Lah, S., Miller, L., Pengas, G., Nestor, P. J., Hodges, J. R., & Piguet, O. (2011). Profiles of recent autobiographical memory retrieval in semantic dementia, behavioural-variant frontotemporal dementia, and Alzheimer's disease. *Neuropsychologia, 49*(9), 2694–2702. https://doi.org/10.1016/j.neuropsychologia.2011.05.017

Jacques, P. L., & Levine, B. (2007). Ageing and autobiographical memory for emotional and neutral events. *Memory, 15*(2), 129–144. https://doi.org/10.1080/09658210601119762

Jacques, P. L., Montgomery, D., & Schacter, D. L. (2015). Modifying memory for a museum tour in older adults: Reactivation-related updating that enhances and distorts memory is reduced in ageing. *Memory, 23*(6), 876–887. https://doi.org/10.1080/09658211.2014.933241

Jung, D., Choi, J., Park, S., & Choi, K. (2023). Improving older adults' autobiographical memory through video-conferencing intervention during COVID-19. *International Journal of Geriatric Psychiatry, 38*(8), e5973. https://doi.org/10.1002/gps.5973

Kaplan, E., Goodglass, H., & Weintraub, S. (2001). Boston naming test. 2001.

Levine, B., Svoboda, E., Hay, J. F., Winocur, G., & Moscovitch, M. (2002). Aging and autobiographical memory: Dissociating episodic from semantic retrieval. *Psychology and Aging, 17*(4), 677–689. https://doi.org/10.1037/0882-7974.17.4.677

Madore, K. P., Gaesser, B., & Schacter, D. L. (2014). Constructive episodic simulation: Dissociable effects of a specificity induction on remembering, imagining, and describing in young and older adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 40*(3), 609–622. https://doi.org/10.1037/a0034885

Marra, D. E., Hamlet, K. M., Bauer, R. M., & Bowers, D. (2020). Validity of teleneuropsychology for older adults in response to COVID-19: A systematic and critical review. *The Clinical Neuropsychologist, 34*(7–8), 1411–1452. https://doi.org/10.1080/13854046.2020.1769192

Martens, K., Barry, T. J., Takano, K., Onghena, P., & Raes, F. (2019a). Efficacy of online memory specificity training in adults with a history of depression, using a multiple baseline across participants design. *Internet Interventions, 18*, 100259. https://doi.org/10.1016/j.invent.2019.100259

Martens, K., Takano, K., Barry, T. J., Goedleven, J., Van den Meutter, L., & Raes, F. (2019b). Remediating reduced autobiographical memory in healthy older adults with computerized memory specificity training (c-MeST): An observational before-after study. *Journal of Medical Internet Research, 21*(5), e13333. https://doi.org/10.2196/13333

McIntosh, A. R., Sekuler, A. B., Penpeci, C., Rajah, M. N., Grady, C. L., Sekuler, R., & Bennett, P. J. (1999). Recruitment of unique neural systems to support visual memory in normal aging. *Current Biology: CB, 9*(21), 1275–1278. https://doi.org/10.1016/s0960-9822(99)80512-0

Meyers, J. E., & Meyers, K. R. (1995). Rey complex figure test under four different administration procedures. *The Clinical Neuropsychologist, 9*(1), 63–67. https://doi.org/10.1080/13854049508402059

Murphy, K. J., Troyer, A. K., Levine, B., & Moscovitch, M. (2008). Episodic, but not semantic, autobiographical memory is reduced in amnestic mild cognitive impairment. *Neuropsychologia, 46*(13), 3116–3123. https://doi.org/10.1016/j.neuropsychologia.2008.07.004

Peters, S., & Sheldon, S. (2020). Interindividual differences in cognitive functioning are associated with autobiographical memory retrieval specificity in older adults. *GeroPsych, 33*(1), 15–29. https://doi.org/10.1024/1662-9647/a000219

Piolino, P., Coste, C., Martinelli, P., Macé, A.-L., Quinette, P., Guillery-Girard, B., & Belleville, S. (2010). Reduced specificity of autobiographical memory and aging: Do the executive and feature binding functions of working memory have a role? *Neuropsychologia, 48*(2), 429–440. https://doi.org/10.1016/j.neuropsychologia.2009.09.035

Reitan, R. M. (1955). The relation of the trail making test to organic brain damage. *Journal of Consulting Psychology, 19*(5), 393–394. https://doi.org/10.1037/h0044509

Renoult, L., Armson, M. J., Diamond, N. B., Fan, C. L., Jeyakumar, N., Levesque, L., Oliva, L., McKinnon, M., Papadopoulos, A., Selarka, D., St Jacques, P. L., & Levine, B. (2020). Classification of general and personal semantic details in the Autobiographical Interview. *Neuropsychologia, 144*, 107501. https://doi.org/10.1016/j.neuropsychologia.2020.107501

Rubin, D. C., & Schulkind, M. D. (1997). Distribution of important and word-cued autobiographical memories in 20-, 35-, and 70-year-old adults. *Psychology and Aging, 12*(3), 524–535. https://doi.org/10.1037/0882-7974.12.3.524

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: The prospective brain. *Nature Reviews Neuroscience, 8*(9), 657–661. https://doi.org/10.1038/nrn2213

Schacter, D. L., Benoit, R. G., & Szpunar, K. K. (2017). Episodic future thinking: Mechanisms and functions. *Current Opinion in Behavioral Sciences, 17*, 41–50. https://doi.org/10.1016/j.cobeha.2017.06.002

Schlagman, S., Kliegel, M., Schulz, J., & Kvavilashvili, L. (2009). Differential effects of age on involuntary and voluntary autobiographical memory. *Psychology and Aging, 24*(2), 397–411. https://doi.org/10.1037/a0015785

Simpson, S., Eskandaripour, M., & Levine, B. (2023). Effects of healthy and neuropathological aging on autobiographical memory: A meta-analysis of studies using the autobiographical interview. *The Journals of Gerontology: Series B*. https://doi.org/10.1093/geronb/gbad077

Strikwerda-Brown, C., Mothakunnel, A., Hodges, J. R., Piguet, O., & Irish, M. (2019). External details revisited—A new taxonomy for coding "non-episodic" content during autobiographical memory retrieval. *Journal of Neuropsychology, 13*(3), 371–397. https://doi.org/10.1111/jnp.12160

Wank, A. A., Andrews-Hanna, J. R., & Grilli, M. D. (2021). Searching for the past: Exploring the dynamics of direct and generative autobiographical memory reconstruction among young and cognitively normal older adults. *Memory & Cognition, 49*(3), 422–437. https://doi.org/10.3758/s13421-020-01098-2

Wank, A. A., Mehl, M. R., Andrews-Hanna, J. R., Polsinelli, A. J., Moseley, S., Glisky, E. L., & Grilli, M. D. (2020). Eavesdropping on autobiographical memory: A naturalistic observation study of older adults' memory sharing in daily conversations. *Frontiers in Human Neuroscience, 14*, 238. https://doi.org/10.3389/fnhum.2020.00238

Wechsler, D. (2012). Wechsler adult intelligence scale—fourth edition. *American Psychological Association*. https://doi.org/10.1037/t15169-000