Simulating the Future, Remembering the Past:

Effects of Sensory and Emotional Focus on Vividness and Memory Across the Lifespan

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Abstract

Remembering the past and simulating the future rely on overlapping constructive processes. Moreover, simulating a future event can influence what is later remembered. However, there are key gaps in our knowledge of this process when it comes to healthy ageing: older adults often report simulations as being more vivid than younger adults despite producing fewer episodic details, and they are less susceptible to simulation-induced memory biases. The present study aimed to address these gaps by manipulating the type of information prioritised during future simulation and examining influences on subjective vividness and subsequent memory across younger and older adults.

Younger and older adults simulated future events while focusing on either sensory or emotional information, then read narratives describing the hypothetical outcomes of those events, before finally completing a recognition test for narrative details. Subjective vividness ratings were collected during simulation, and memory performance was assessed using discriminability (d') and response bias (C). Despite clear differences in the type of details generated across sensory and emotion-focused conditions, neither vividness ratings nor memory accuracy (d') varied as a function of focus condition. However, older adults demonstrated a more liberal response bias overall, and both age groups showed a more liberal bias following emotion-focused simulation.

These findings suggest that the subjective experience of vividness is relatively independent of the specific type of information emphasised during simulation, indicating that vividness may reflect broader evaluative judgements about the simulation rather than the amount or type of episodic details the simulation contained. The absence of focus effects on memory accuracy further indicates that altering simulation content alone may be insufficient to bias later remembering. Instead, the influence of future simulation on memory may depend

on whether the simulation meaningfully changes higher-level subjective states that persist into later encoding and retrieval.

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Introduction

The Nature and Importance of Memory

Memory is a cornerstone of human cognition. Without memory, even the most basic aspects of everyday life such as recognising faces, understanding language, navigating familiar spaces, or maintaining a coherent sense of personal identity, would not be possible (Baddeley et al., 2020; Squire & Dede, 2015). Memory enables us not only to recall what has already occurred, but to also draw upon those stored experiences to make predictions about the future and guide adaptive behaviour in novel or complex situations (Schacter & Addis, 2007; Tulving, 2002). By supporting both the recollection of past events and the mental simulation of potential future scenarios, memory underpins continuity of consciousness, facilitates learning and reasoning, and provides the foundation for goal-directed behaviour across the lifespan (Addis et al., 2008; Irish & Piguet, 2013; Schacter et al., 2017; Spreng & Schacter, 2017; Viard et al., 2013). In this way, memory is not merely a record of what has occurred, but a dynamic cognitive tool essential for navigating a constantly changing world.

This thesis contributes to our knowledge of memory and simulation, by examining the bidirectional relationship between past and future thinking, and how this relationship changes with age. I first review evidence that recollecting the past and simulating the future are linked processes. I then outline age-related changes in memory and simulation, with a focus on shifts from detailed to more generalised event content. Finally, I consider work showing that the type of information focused on when first simulating or experiencing an event can change what is later remembered. Thus, motivating the present study of how directing attention to different kinds of information during future simulation influences the way events are experienced and remembered.

Remembering and Simulating

Many of the adaptive functions of memory described above, rely on long-term, declarative memory, which refers to the memory for facts and events that can consciously be brought to mind (Cohen & Squire, 1980). The most prominent forms of declarative memory are semantic and episodic memory (Tulving, 1972, 1983). Semantic memory refers to the store of general knowledge about the world – facts, concepts, and language – independent of the context in which they were acquired (Binder & Desai, 2011; Suddendorf & Corballis, 2007). For example, knowing that the capital city of New Zealand is Wellington, or what the word "joy" means is part of our semantic memory. In contrast, episodic memory concerns personally experienced events situated in a specific time and place, and is uniquely associated with the ability to mentally re-experience the past (Tulving, 2002). For example, a close friend's wedding day, or your graduation day would be part of episodic memory. In particular, episodic recollection is characterised by autonoetic consciousness, or a self-reflective awareness that a remembered event happened to "me" in the past (Tulving, 1985, 2002). This self-referential aspect distinguishes episodic memory from semantic memory.

Although distinct, semantic and episodic memory systems are dynamically interdependent. Semantic knowledge provides a framework that allows us to make sense of specific experiences, fitting new events into existing schemas, mental structures built from prior knowledge (Irish & Piguet, 2013). Conversely, repeated retrieval of episodic memories helps to build and refine semantic knowledge, transforming specific experiences into generalised understandings over time (Renoult & Rugg, 2020). This bidirectional relationship supports cognitive flexibility: the semantic system offers stability, efficiency, and generalisation, while the episodic system provides specificity, novelty, and adaptability (Addis & Schacter, 2012; Binder & Desai, 2011). Together, they form a cohesive memory architecture that allows humans to balance detailed recollection with efficient knowledge-based reasoning.

While episodic memory is often thought of as a system for preserving past experiences, research shows that it is fundamentally constructive rather than a simple replay of events (Schacter et al., 2007). This constructive nature of memory means that rather than storing experiences as exact records, the episodic memory system reconstructs past events from the separate details comprising the events, such as the people, places, actions, and emotions involved. According to the Constructive Episodic Simulation Hypothesis, this constructive capacity supports not only remembering the past, but also means that details from separate memories can be flexibly recombined into novel configurations (Schacter & Addis, 2007). Flexible recombination of memory details enables the simulation of possible future events, a process known as episodic future thinking (Addis et al., 2007; Schacter & Addis, 2007; Schacter et al., 2012; Schacter et al., 2017). The ability to think about the future in this way is useful for anticipating future outcomes, planning complex goals, and making informed decisions (Benoit & Schacter, 2015; Schacter et al., 2017). A key premise of this theory is that both remembering and simulating events rely on overlapping cognitive and neural mechanisms that retrieve and combine episodic details.

Neuroimaging evidence supports this account by demonstrating the engagement of a common core network during both episodic recollection and future simulation. This network, first characterised in work on self-projection, includes the hippocampus, medial prefrontal cortex, posterior cingulate cortex, and lateral temporal and parietal region (Buckner & Carroll, 2007). Buckner and Carroll (2007) proposed that these regions support the capacity to project oneself across time by retrieving stored information and constructing internally generated scenarios. Within this network, the hippocampus plays a critical role in binding and recombining episodic details into coherent representations, while the medial prefrontal and posterior regions contribute to self-referential processing and the organisation of simulated events (Addis et al., 2009; Hassabis & Maguire, 2009). Consistent with this framework, people with hippocampal damage show parallel impairments in recalling past experiences and simulating future or fictitious events, highlighting the central role of the core network in episodic simulation (Hassabis et al., 2007).

The aforementioned Constructive Episodic Simulation Hypothesis claims that we draw on elements of memory to simulate the future. But interestingly, this relationship also works in reverse; that is, simulating a future event can influence how a later real experience is remembered (Devitt & Schacter, 2018; Devitt & Schacter, 2020). Studies involving younger adults have demonstrated that when people simulate a future event in a positive emotional way, information encountered during the later actual event is more likely to be remembered in a positive manner, consistent with the prior simulation (Devitt & Schacter, 2018). These findings suggest that future simulation not only draws on episodic memory, but may also influence how later experiences are encoded and remembered. Theoretically, this overlap between remembering and simulating is important because it suggests that episodic future thinking is not merely a by-product of memory, but an active process that can shape how experiences are encoded, interpreted, and later remembered. However, although this bidirectional relationship between memory and simulation has been established, less is known about the mechanisms through which future simulation influences subsequent memory, particularly across the lifespan.

Age-Related Changes in Episodic Memory and Simulation

A well-established finding in cognitive psychology is that episodic memory declines with age (Kensinger, 2009; Nyberg et al., 2012). Rather than a uniform loss of memory, ageing changes the type of information people remember. Older adults tend to recall fewer specific details about events, such as what happened, where it occurred, or when it took place, and instead rely more on the general meaning or “gist” of their experiences (Levine et al., 2002). These age-related reductions are particularly evident for sensory and contextual details, while more general, knowledge-based information is preserved or even increased

(Addis et al., 2008; Gaesser et al., 2011). Thus, memory becomes less precise but more schematic with age.

At a neural level, these changes in episodic memory are linked to age-related differences in brain function. Longitudinal evidence shows that the hippocampal volume declines with age (Raz et al., 2005), and reductions in hippocampal volume have been associated with poorer memory performance, particularly on tasks requiring episodic retrieval (Ezzati et al., 2016; Persson et al., 2006). At the same time, older adults show greater activity in prefrontal brain regions that support planning, monitoring, and evaluation during remembering. This pattern, known as the posterior-anterior shift in ageing, suggests that older adults rely more on control and reasoning processes when retrieving memories (Davis et al., 2008). Although this increased prefrontal involvement can help support overall performance (Cabeza, 2002; Reuter-Lorenz & Cappell, 2008), it does not fully compensate for reductions in fine-grained episodic detail.

These patterns suggest that age-related changes in episodic memory reflect a functional shift rather than a simple decline. With reduced access to detailed episodic information, remembering becomes less focused on precise event features and more guided by general meaning and prior knowledge. Greater engagement of prefrontal regions may help older adults structure and evaluate memories in a way that supports goal-directed behaviour (Cabeza, 2002; Reuter-Lorenz & Cappell, 2008). This shift may be partially adaptive, helping to maintain effective memory use in everyday contexts (Reuter-Lorenz & Park, 2014). From this perspective, compensatory prefrontal engagement does not restore detailed recollection, but instead reflects a trade-off, where memory becomes less precise but remains efficient and meaningful, shaping how past experiences are remembered in older adulthood.

Importantly, these age-related declines in episodic memory are mirrored in episodic future thinking (Addis et al., 2008). When asked to simulate future events, older adults generate fewer episodic details than younger adults and produce more semantic and off-topic information (Addis et al., 2008). Because constructing future events draws on the same episodic details and reconstruction processes as recalling the past, reductions in episodic specificity become evident not only in memory for past events, but also in the simulation of future events (Addis et al., 2008; Schacter & Addis, 2007). As a result, simulated future events become less specific and more general with age.

Practically, these memory changes have significant implications for everyday functioning. Older adults' increased reliance on gist and general meaning has been consistently linked to greater susceptibility to false memories (Devitt & Schacter, 2016; Koutstaal & Schacter, 1997; Schacter et al., 1997). As episodic memory representations become less detailed with age, memory judgements are more likely to be based on schematic similarity or overall emotional tone rather than on specific perceptual or contextual features (Koutstaal & Schacter, 1997; Schacter et al., 1997). This shift increases the likelihood that internally generated information such as inferences, expectations, or simulated details, will be misattributed to actual experience, particularly when false information aligns with the general meaning of an event (Devitt & Schacter, 2016; Norman & Schacter, 1997). At the same time, reduced episodic memory specificity promotes overgeneralisation of past experiences, whereby memories reflect what typically happens rather than what occurred in a specific instance (Addis et al., 2008; Levine et al., 2002). Such schematic representations blur distinctions between individual events and may limit the usefulness of memory for guiding future-oriented reasoning. Because memory plays a central role in evaluating risk and anticipating future outcomes, reliance on general affective impressions rather than detailed recollections can bias judgements about likelihood, consequences, and personal relevance of future events (De Brigard et al., 2016; Peters & Büchel, 2010). Together, these changes suggest that age-related shifts in memory quality alter not only what is remembered, but also how past experiences are used to inform decision-making and future planning, which are critical functions for managing finances, maintaining health routines, and navigating social relationships (Addis et al., 2010; Gaesser & Schacter, 2014; Madore et al., 2014; Schacter et al., 2017).

In this context, the bidirectional relationship between future simulation and memory is particularly relevant in ageing, where reductions in episodic detail could alter how simulated events influence later remembering. As such, experimental paradigms that directly manipulate future simulation provide a critical way to test how simulating the future influences subsequent memory.

In one such study, Devitt and Schacter (2020) examined the effects of emotional future simulation in younger and older adults. Their study comprised of two sessions, where participants first simulated future events in either a positive or negative way, and then read narratives about how those future events actually played out (hypothetically). Memory was assessed in the second session in a recognition test for specific target details from the narratives. Target details were either true details from the narrative, false details of opposing valence, or neutral distractors. Younger adults remembered the narratives more positively after positive simulation compared to negative and no simulation, suggesting that simulating future events can bias subsequent memory by influencing how details are encoded and evaluated. Importantly, this effect was reflected in response bias – the tendency to adopt a more liberal (more likely to say "yes, this occurred") or conservative (more likely to say "no, this did not occur") decision criterion when judging whether information was previously encountered. Younger adults were more likely to say that positive details had been present after positive simulation, indicating a shift toward a more liberal decision criterion for positive information. However, older adults were less affected by interference from simulated events. The authors proposed that reduced memory for the simulations over the delay between simulation and reading the narratives may have contributed to the diminished effect in older adults.

To test this, in a second experiment each narrative was presented immediately after its corresponding simulation. Under these conditions, older adults' memory for narratives more closely resembled that of younger adults, showing increased susceptibility to the effects of positive simulation. Nevertheless, the influence of future thinking on memory remained somewhat reduced in older adults, indicating additional mechanisms at play.

One possible explanation for this remaining reduction is that age-related decreases in episodic specificity limits how strongly simulated details are integrated with later experiences. Because older adults rely less on fine-grained perceptual and contextual information, simulated details may be encoded in a more general or schematic form that overlaps less with the specific features of the narrative, reducing the chance that simulated information will influence how the narrative is remembered.

Taken together, this work suggests that the effects of future simulation on memory may be shaped by the subjective qualities of the simulated representation. Considering such experiential factors provides a pathway for understanding age-related differences in simulation effects. One such quality that has received particular attention is vividness.

Vividness and Ageing

Vividness is a core quality of episodic remembering and future simulation, capturing how richly an event is experienced rather than how accurately it is recalled (D'Argembeau & Van der Linden, 2012). The sense of vividness refers to the degree to which a remembered or simulated event feels life-like, clear, and subjectively intense (Baddeley & Andrade, 2000; D'Angiulli & Reeves, 2007; Faul et al., 2025). Although vividness is often assumed to reflect the amount of sensory or perceptual detail retrieved, research indicates that it is a multidimensional construct that can be influenced by factors such as familiarity, emotional arousal, and personal significance (Benoit & Schacter, 2015; Kensinger et al., 2011).

Neuroimaging studies indicate that the experience of vividness engages a distributed network of brain regions that overlap substantially with the core episodic memory system. Higher vividness ratings are associated with increased activity in the hippocampus, precuneus, and posterior cingulate cortex, regions involved in re-experiencing or reconstructing event details (Addis et al., 2007; Gilmore et al., 2016). Vividness is also influenced by brain regions involved in emotion and self-reflection, such as the ventromedial prefrontal cortex and amygdala, which contribute emotional significance and personal meaning to events (D'Argembeau, 2013; Kensinger & Schacter, 2008). Together, these findings suggest that vividness emerges from an interaction between the reactivation of perceptual details from the original experience and higher-level evaluative processes that assess emotional meaning and self-relevance. The combination of these processes create the subjective feeling of "reliving" an experience.

Despite well-documented age-related declines in episodic detail, older adults do not typically report reduced vividness when remembering or simulating events. In contrast, subjective vividness ratings tend to remain stable, or even increase, with age (Addis et al., 2008; De Brigard et al., 2016; Folville et al., 2022). For instance, Addis et al. (2008) found that while older adults produced fewer episodic details when simulating future events, they rated these simulations as equally vivid as younger adults. Similarly, De Brigard et al. (2016) reported that older adults described simulated past and future events as equally vivid and emotionally rich as younger adults, even though their narratives contained less perceptual and contextual information. These findings are further confirmed by Folville et al. (2022) in their review paper. They reported that older adults often inflate the intensity of their vividness ratings relative to the actual precision and richness of retrieved details. Across multiple studies spanning laboratory tasks, autobiographical memory, and future simulations, older adults' trial-by-trial vividness ratings corresponded less closely to the amount of episodic detail retrieved compared with younger adults. In other words, older adults can experience memories or simulated events as subjectively vivid even when the actual perceptual and contextual content is diminished.

Taken together, these findings suggest that vividness does not simply reflect the quantity or precision of episodic details retrieved, particularly in older adulthood. Instead, vividness appears to function as an evaluative judgment shaped by how different types of information are weighted, with ageing associated with a shift away from fine-grained episodic detail toward broader emotional, semantic, and self-relevant cues. This reliance on more schematic, gist-based representations may allow older adults to maintain a rich and meaningful subjective experience of memory and simulation. However, the mechanisms underlying this dissociation between vividness and episodic detail remain unclear. Specifically, it is not yet well understood why vividness judgments remain stable or even inflated despite reductions in episodic specificity, highlighting a key gap in explaining how vividness is constructed and evaluated across the lifespan.

Socioemotional Selectivity Theory

Socioemotional Selectivity Theory (Carstensen, 1999; Carstensen et al., 1999, Carstensen, 2021) could provide a motivational account of why older adults may experience memories and simulation as subjectively rich and emotionally vivid, even when objective episodic detail is reduced. This theory proposes that perceptions of future time play a central role in shaping motivational priorities across the lifespan. When individuals perceive time as more expansive, as is typically the case in younger adulthood, they prioritise future-oriented goals such as knowledge acquisition, exploration, and novelty. In contrast, as perceived time becomes more limited with age, motivational priorities shift toward goals that maximise emotional meaning, wellbeing, and social connectedness (Carstensen, 1999). Importantly, Socioemotional Selectivity Theory does not argue that cognitive capacity declines cause these motivational changes. Rather, it emphasises that ageing is associated with a strategic reorientation of goals, whereby emotionally meaningful experiences become increasingly prioritised over tasks or information that are primarily useful for learning, problem solving, or achieving goals in the future (Carstensen et al., 1999). This shift has broad consequences for attention, information processing, and memory, influencing not only what information is attended to but also how experiences are encoded, evaluated, and later retrieved. From this perspective, age-related reductions in episodic detail do not necessarily imply a diminished subjective experience of memory. Instead, emotionally meaningful information may be preferentially attended to and weighted more heavily.

Consistent with these motivational changes, a substantial body of evidence demonstrates age-related differences in emotional memory (for review see Reed et al., 2014). Older adults tend to show a positivity effect, characterised by preferential processing and remembering of positive relative to negative information (Charles et al., 2003; Mather & Carstensen, 2005). For example, Charles et al. (2003) found that older adults were more likely than younger adults to forget negative images, while memory for positive images was relatively preserved. This pattern suggests that older adults focus their attention and memory on emotionally meaningful information, rather than improving memory for all types of content.

Crucially, Socioemotional Selectivity Theory predicts that these motivational biases extend beyond memory for past events to include episodic simulation and future thinking. As simulating the future serves emotion-regulatory and goal setting functions (Gamble et al., 2021; Oettingen et al., 2001), older adults may construct future events in ways that emphasise emotional meaning over perceptual specificity. Supporting this view, research has shown that older adults include more emotionally meaningful content but fewer perceptual and contextual details when simulating future events (Addis et al., 2008; García-Bajos et al., 2017). From a Socioemotional Selectivity Theory perspective, this pattern reflects a goal-consistent prioritisation of emotionally salient aspects of an experience.

Thus, by shaping attentional priorities and how memories are evaluated, age-related motivational shifts can influence both the subjective experience of memory and the cues used to guide retrieval. Within this framework, cognitive processing in older adulthood may become more focused on emotionally meaningful information, influencing how memories are constructed, judged, and remembered. As a result, subjective experiences such as vividness may be disproportionately influenced by emotional meaning rather than by the amount of episodic detail retrieved. Therefore, if motivational goals bias attention toward emotionally meaningful information, then differences in memory may emerge from how attention is directed during event construction. Investigating the effects of manipulating attentional focus offers a way to test how such priorities can shape encoding and later remembering.

Manipulating Focus at Encoding and Retrieval

One approach to understanding how attentional priorities influence memory has been to examine how attention to different types of information during encoding affects later memory. For instance, Mitchell and Hill (2019) found that age-related declines in source memory – the ability to remember the origin of information (Johnson et al., 1993) – persist even when younger and older adults report similar subjective experiences at encoding. In their study, younger and older adults viewed images and were instructed to focus on specific features of each image, including visual characteristics (e.g., colour, brightness, sharpness), emotional qualities (e.g., the intensity of emotion evoked, positive or negative), and associative thoughts (e.g., the extent to which the image triggered personal thoughts or memories). Participants provided ratings for these features both while the image was visible (“See” trials) and later when they were asked to think about the image after a brief delay

(“Think” trials). Source memory was subsequently tested by asking participants to indicate whether each image had only been seen, seen and thought about, or was new.

Younger and older adults reported similar ratings across all features for both trial types, indicating that subjective experience at encoding was comparable between age groups. However, despite these comparable feature ratings, older adults showed reduced source memory accuracy, particularly in distinguishing whether an image had only been seen or had also been thought about. Because both age groups reported similar feature ratings yet differed in source accuracy, the findings suggest that age-related source memory errors are unlikely to be driven by differences in initial subjective experience, but instead reflect difficulties in later retrieval.

Recent work by Fenerci et al. (2025) further shows how age-related changes in memory accuracy may arise from differences in retrieval processes rather than encoding alone. In their experiment, younger and older adults watched an 8-minute film clip. After a short delay, participants completed an initial recall task under one of two retrieval goals. Those in the accuracy goal condition were instructed to describe the film as precisely and objectively as possible. Those in the social goal condition were asked to recount the film as if they were telling the story to friends, encouraging a more conversational and emotionally expressive style of recall. Memory for the film was tested after 24 hours using both recall and recognition tasks that separately assessed narrative accuracy (e.g., judging true versus altered statements about the film) and perceptual accuracy (e.g., identifying screenshots that had appeared in the film versus similar lures). In this second session, all participants were instructed to recall the film with an accuracy goal, regardless of their initial retrieval goal. When retrieval goals shifted across sessions (i.e., social goal in session 1 and accuracy goal in session 2), older adults who initially recalled the film under social goals showed less accurate recall of the film and poorer memory for perceptual details. These findings suggest that ageing is associated with reduced flexibility in retrieval, with memories being more strongly influenced by how the event was initially remembered.

Taken together, findings from Mitchell and Hill (2019) and Fenerci et al. (2025) indicate that age-related differences in memory reflect not only reductions in episodic detail, but also changes in how information is prioritised during remembering. Both the features attended to at encoding and the goals guiding retrieval can shape which aspects of an event are later recalled or recognised. These patterns highlight the importance of understanding how directing attention toward different kinds of information may influence later memory.

The Present Study

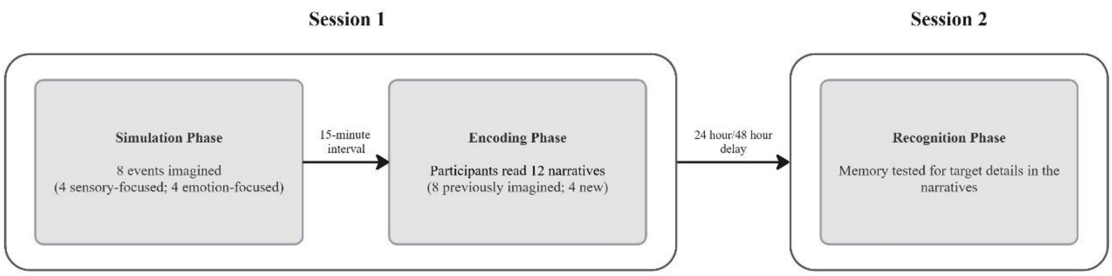
Existing evidence indicates that older adults produce fewer episodic details when remembering and simulating events, while still reporting simulations as equally vivid as those of younger adults (Addis et al., 2008; De Brigard et al., 2016; Folville et al., 2022). At the same time, experimental studies indicate that future simulation can bias later memory in younger adults, whereas older adults appear less affected by these simulation-induced memory effects (Devitt & Schacter, 2020). Yet, within this body of research, two key gaps remain. First, it is unclear why older adults report comparable or even higher vividness than younger adults despite producing less episodic detail. Second, it is not well understood why older adults appear relatively immune to the effects of future simulation on subsequent memory. Together, the existing findings and the remaining gaps suggest that age differences may not simply reflect reductions in detail, but changes in how different types of information are prioritised and used when constructing and evaluating simulated events.

From a Socioemotional Selectivity Theory perspective, older adults may prioritise emotionally meaningful information over sensory or perceptual details when constructing simulations. This shift in information prioritisation may help explain why simulations feel subjectively vivid despite containing fewer episodic details. At the same time, simulations with fewer episodic details may overlap less with later experiences, making it less likely that simulated details will influence how those events are remembered. In this way, age-related motivational changes may shape both the subjective experience of simulation and also the extent to which future simulation biases later memory.

The present study examines how focusing on different types of information during episodic future simulation, specifically sensory versus emotional detail, affects both subjective vividness ratings and subsequent memory accuracy in younger and older adults. This study uses a paradigm (see Figure 1) adapted from Devitt and Schacter (2020), in which participants first simulate future events and later read narratives describing the outcomes of those events, before finally retrieving those narratives. In the current study, we extend this approach by manipulating the type of detail participants focus on during future simulation (sensory vs. emotional) to examine how attentional focus shapes experience and later retrieval. When we refer to memory accuracy, we refer to the accuracy of participants' memory for the narratives they read, rather than the details of the simulated events themselves. This approach captures how memory works in everyday life, where simulating the future serves as a lens through which later events are understood and remembered.

Figure 1

Diagram of Study Paradigm



Thus, by examining how different types of attentional focus during future simulation can shape the subjective experience of vividness as well as subsequent memory performance, this study contributes to a more nuanced understanding of how ageing influences the qualitative nature of memory, rather than simply the amount of information remembered. The findings may help clarify the mechanisms underlying the dissociations between vividness and subsequent memory accuracy in late adulthood and offer theoretical insights into how motivational and cognitive systems jointly shape episodic future simulation across the lifespan.

Research Questions and Predictions

The research questions for this study were as follows:

1A: To what extent does focusing on different types of detail (sensory vs. emotional) during episodic future simulation affect vividness ratings?

1B: How do these effects change with healthy ageing?

2: Does focus condition (sensory vs. emotion) affect recall memory accuracy?

Research Question 1 is addressed in the simulation phase, whereas Research Question 2 is addressed in the recognition phase.

Consistent with the Socioemotional Selectivity Theory, it was predicted that older adults would report higher vividness ratings in the emotion-focused condition compared to the sensory-focused condition, reflecting their tendency to rely on emotional content to construct and evaluate their mental simulations. In contrast, given their flexibility in engaging different aspects of episodic simulation (Fenerci et al., 2025), it was predicted that younger adults would show comparable vividness ratings across both focus conditions, reflecting their ability to vividly simulate events regardless of whether the emphasis is on sensory or emotional detail.

If older adults generally experience less interference from simulated details, consistent with Devitt and Schacter (2020), then memory accuracy should be similar following emotion-focused and sensory-focused simulations. However, if emotionally meaningful information provides more diagnostically useful cues for remembering in older adulthood, then accuracy should be higher following emotion-focused simulations than sensory-focused simulations. For younger adults, if memory accuracy depends primarily on the availability of perceptual and source-specific cues, then accuracy should be higher following sensory-focused simulations than emotion-focused simulations; but if younger adults can flexibly utilise both emotional and sensory information to support accurate remembering, then accuracy may be similar across focus conditions.

Methods

Participants

This study was pre-registered prior to data collection, (https://aspredicted.org/see_one.php; see Appendix A). We recruited 27 younger adults aged 18 – 35 years (*M* = 19.5, *SD* = 1.86) and 25 older adults aged 65 + years (*M* = 71.1, *SD* = 5.03) through the University of Waikato's Introduction to Psychology Research Program and through postings around the Hamilton area and online on Facebook. Participants had no history of neurological or psychological disorder and had normal or corrected-to-normal vision and hearing. Older adults were screened for healthy cognition using the Mini Addenbrooke's Cognitive Examination (Hsieh et al., 2015). Participants gave informed consent in a manner approved by the University of Waikato Human Research Ethics Committee (approval number FS2021-21; see Appendix B), and were compensated with either course credits or $10 an hour for participation. Four participants were excluded: 2 for chance performance on the recognition test, and 2 for not completing the experiment. Therefore, data from 24 younger adults (*M* age = 19.0 years, *SD* = 1.16) and 24 older adults (*M* age = 70.9 years, *SD* = 4.98) were included in the analyses. A power analysis based on effect sizes from a similar study with younger adults (Devitt & Schacter, 2018) determined that a sample size of at least 24 was necessary to detect an effect of simulation on response bias. There were more females in both younger (n = 18) and older (n = 16) adult groups. On average, older adults had more years of education (*M* = 15.92 years, *SD* = 3.98) than younger adults (*M* = 13.83 years, *SD* = 1.20). All older adults scored 24 or above on the Mini Addenbrooke's Cognitive Examination.

Stimuli

Scenarios and short narratives for the simulation and encoding phases were adapted from Devitt and Schacter's (2020) experiment. There were a total of 12 scenarios for the simulation phase, with each scenario having a corresponding narrative for the encoding phase. Two versions of each narrative with differing target details were made to control for item effects. Participants were shown one of the two versions, counterbalanced across participants. During stimuli development, target details were classified into either emotion or sensory detail types by two raters. The overall agreement rate was 86.5%. Details that were disagreed upon were resolved through discussion and adapted accordingly. For example stimuli, see Appendix C.

Procedure

The study consisted of 2 sessions spaced 24 hours apart for older adults and 48 hours for younger adults, to equate memory performance. The first session involved the simulation and encoding phases. Session two involved the recognition phase. Participants were tested individually in a testing room. Stimuli were presented on a computer screen using E-prime, version 3 (Psychology Software Tools, Pittsburgh, PA).

In the simulation phase, participants simulated 8 of the 12 scenarios (random selection). Participants were instructed that future simulations should be plausible, not previously experienced, and to focus on one day within the next year. Each scenario was presented on screen with instructions to focus either on sensory information or emotion/thought information. Participants simulated 4 scenarios with a sensory focus, and 4 scenarios with emotion/thought focus (randomly assigned). The remaining 4 scenarios were withheld to form the no simulation condition. For each future simulation, participants were given 3 minutes to describe out loud the event in as much detail as they could, with the experimenter giving prompts as necessary. Participants were audio-recorded during this phase. At the end of the 3 minutes, a bell sounded to indicate the end. Immediately after each simulation, participants made ratings for the event they had just simulated using the number keys on the keyboard. Ratings were made on a Likert scale of 1 (low) to 7 (high) and included subjective ratings of vividness, the amount of sensory information the event contained, amount of emotion/thought information, type of emotion (1 being very negative, 4 being neutral, 7 being very positive), difficulty of simulation, and plausibility. Participants also indicated from what perspective they simulated the event, either through their own eyes or from an external view, by pressing either 1 or 2 on the keyboard, respectively. After simulating and making ratings for all 8 events, participants had a 15-minute break before moving on to the encoding phase.

In the encoding phase, participants were told to pretend it was a year later, and they were going to find out how their simulations actually played out. Short narratives for each scenario that the participant had simulated, as well as scenarios that the participant did not simulate (no simulation condition) were read. A total of 12 narratives, about a paragraph in length, were presented in random order. Narratives contained neutral information as well as both sensory and emotion/thought information. Participants were told there was no time limit and to read each narrative carefully at their own pace. After reading each narrative, participants made ratings for how interesting they found the story, the type of emotion, amount of sensory information, amount of emotion/thought information, and how well they could visualise the story on a 7-point Likert scale.

In session 2, participants completed a recognition test for target details in the narratives. 12 statements containing either sensory or emotion/thought target details were displayed for each narrative, one at a time. Participants were tasked with deciding whether they had read the statements in the narrative or whether it was different to what they had read. Participants were instructed to answer “yes” or “no” by pressing the 1 or 0 number keys on the keyboard (counterbalanced across participants). After all statements for each of the narratives were answered, participants made ratings for each narrative. Ratings included emotion of the story, amount of sensory information, and amount of emotion/thought information contained in the story on a 7-point Likert scale.

Statistical Analyses

All statistical analyses were conducted using SPSS (Version 30). To examine subjective vividness ratings from the simulation phase and memory performance from the recognition phase, a series of mixed design Analysis of Variances (ANOVA) were conducted. Consistent with prior work (Devitt & Schacter, 2020), response bias (C) was analysed in addition to discriminability (*d'*) to provide a more complete account of memory performance.

Discriminability was calculated using *d'*, by subtracting the standardized proportion of false alarms from that of hits (Macmillan & Creelman, 2005), with higher values indicating greater ability to discriminate between true and false details. Response bias was calculated using C, by multiplying the sum of the standardised hit and false alarm rates by -0.5 (Macmillan & Creelman, 2005). Higher C values indicate a more conservative response bias (i.e., more likely to say “false” regardless of memory status), whereas a lower C value indicates a liberal response bias (more likely to say "true”). To correct for response proportions of 0 or 1, we used 1/(2N) and 1-1/(2N), respectively.

The dependent variable for Research Question 1 was the participants’ subjective vividness ratings provided during the simulation phase. For Research Question 2, *d'* (discriminability) and C (response bias), served as dependent variables.

Audio recordings were transcribed and then analysed using LIWC-22 to provide an objective measure of the content of participants' event descriptions. LIWC-22 was used as a manipulation check to determine whether the attentional focus instructions changed the type of information participants expressed during episodic simulation. The program works by calculating the percentage of total words in a transcript that belong to specific word categories in its dictionary. In this way, LIWC-22 estimates how much emotional or sensory language was used. The Affect category was used to capture emotion-related language, while the Visual, Auditory, and Feeling categories were used to capture sensory-related language, as these categories most closely matched the focus of the emotion and sensory simulation conditions.

Deviations from Pre-registration

First, although the pre-registration specified a single ANOVA addressing subjective vividness, additional ANOVAs were conducted for *d'* (discriminability) and C (response bias) to provide a more complete analysis of memory performance. Including response bias was considered important for distinguishing differences in memory sensitivity from differences in decision strategy. Second, linguistic analysis of simulation transcripts using LIWC-22 was not included in the preregistration. The analysis was added as a manipulation check to objectively assess whether participants' descriptions differed in emotional versus sensory content across conditions. Finally, analyses on plausibility ratings were not preregistered and are therefore interpreted as exploratory.

Results

Manipulation Checks

To assess whether the attentional focus manipulation at the simulation phase was effective, we looked at participants' self-reported ratings of how much emotional and sensory information their simulations contained. Separate 2 × 2 mixed ANOVAs were conducted on sensory and emotion information ratings, with Condition (emotion-focused; sensory-focused) as a within subjects factor and Age Group (younger; older) as a between subjects factor. For sensory ratings, there was a significant main effect of Condition, $F(1, 46) = 39.50$, $p < .001$, $\eta p^2 = .46$, with participants reporting greater sensory detail in the sensory-focused condition than in the emotion-focused condition. For emotion ratings, a significant main effect of Condition was observed, $F(1, 46) = 39.39$, $p < .001$, $\eta p^2 = .46$, such that participants reported greater emotional detail in the emotion-focused condition than in the sensory-focused condition. The Condition × Age Group interactions were not significant for either sensory ratings, $F(1, 46) = 0.12$, $p = .730$, $\eta p^2 = .00$, or emotion ratings, $F(1, 46) = 0.46$, $p = .500$, $\eta p^2 = .01$ indicating that the manipulation was equally effective in younger and older adults.

We also examined the amount and type of content produced during simulation by transcribing the audio recordings of event descriptions, then using LIWC-22 to quantify the amount of detail in four categories: Affect, Visual, Auditory, and Feeling. The Affect category was used to index emotion-related language, while the Visual, Auditory, and Feeling categories were used to index sensory-related language. Separate 2 × 2 mixed ANOVAs were conducted for each category with Condition (emotion-focused; sensory-focused) as a within subjects factor and Age Group (younger; older) as a between subjects factor. There was a significant main effect of Condition for Affect, $F(1, 46) = 24.98$, $p < .001$, $\eta p^2 = .35$, indicating that emotion-focused simulations contained a higher percentage of emotion-related words than sensory-related words. The main effect of Condition was also significant for Visual, $F(1, 46) = 33.41$, $p < .001$, $\eta p^2 = .42$; Auditory, $F(1, 46) = 36.86$, $p < .001$, $\eta p^2 = .45$; and Feeling, $F(1, 46) = 9.58$, $p = .003$, $\eta p^2 = .17$, indicating that sensory-focused simulations contained higher percentages of sensory-related words than emotion-focused simulations.

Table 1

Mean Manipulation Check Measures Across Simulation Conditions for Younger and Older Adults (Standard Deviations in Parentheses)

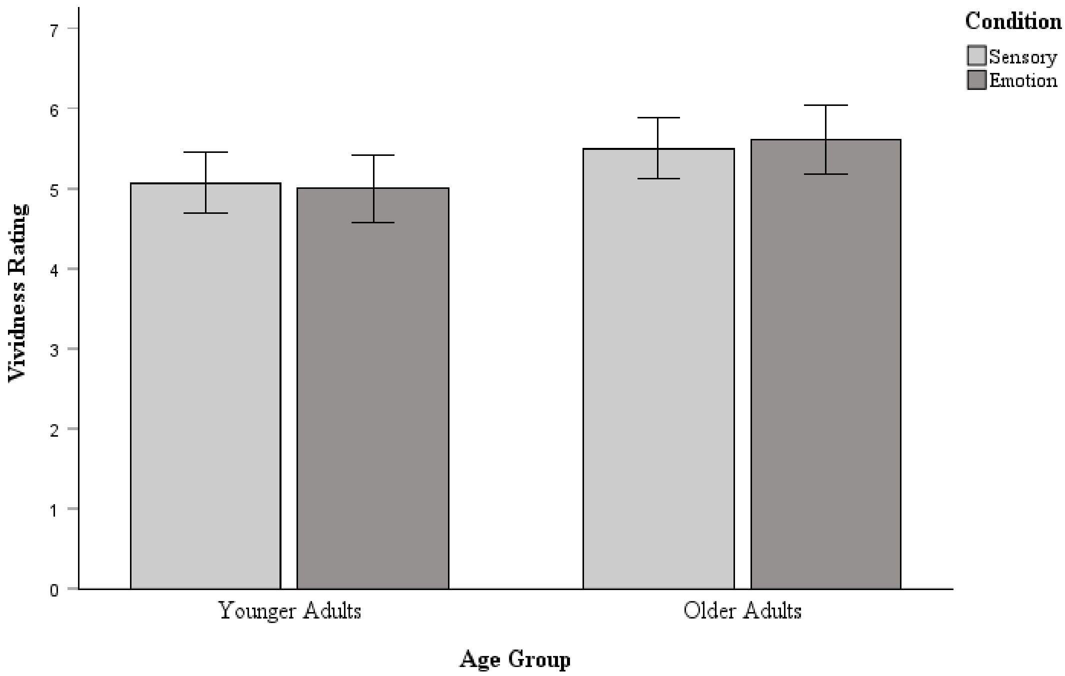
Self-Reported Rating Measure	Simulation Condition	Younger Adults	Older Adults
Sensory Information	Emotion	4.05 (1.14)	4.05 (1.33)
	Sensory	5.07 (0.75)	4.97 (1.04)
Emotion Information	Emotion	5.39 (0.78)	5.44 (0.91)
	Sensory	4.05 (1.14)	4.36 (1.33)
LIWC-22 Content (% of Words)			
Affect	Emotion	5.32 (1.45)	4.85 (1.05)
	Sensory	3.54 (1.07)	4.20 (1.38)
Visual	Emotion	0.91 (0.52)	1.00 (0.52)
	Sensory	1.59 (0.74)	1.43 (0.57)
Auditory	Emotion	0.31 (0.27)	0.08 (0.14)
	Sensory	1.09 (0.78)	0.50 (0.32)
Feeling	Emotion	1.49 (1.17)	0.69 (0.32)
	Sensory	2.02 (1.01)	0.87 (0.48)

Vividness Ratings

To address our first research question, vividness ratings were analysed to determine whether focus condition and age group influenced how vividly participants experienced their simulations (see Figure 2). A mixed 2 × 2 ANOVA was conducted to analyse subjective vividness ratings with Condition (sensory-focused; emotion-focused) as a within subjects factor and Age Group (younger; older) as a between subjects factor. There was no significant main effect of Condition, $F(1, 46) = .04$, $p = .844$, $\eta p^2 = .00$; overall vividness ratings were similar across both sensory-focused ($M = 5.28$, $SD = 0.95$) and emotion-focused conditions ($M = 5.30$, $SD = 1.07$). The main effect of Age Group was trending, $F(1, 46) = 3.99$, $p = .052$, $\eta p^2 = .08$, with older adults ($M = 5.56$, $SD = 1.03$) reporting higher vividness ratings than younger adults ($M = 5.03$, $SD = 0.92$). There was no Condition × Age Group interaction, $F(1, 46) = .65$, $p = .423$, $\eta p^2 = .01$.

Figure 2

Average Vividness Ratings of Younger and Older Adults Across Focus Conditions



Note. Error bars represent 95% CI.

Thus, results indicated that participants found their simulated events to be similarly vivid regardless of whether they focused on sensory or emotional aspects, and this pattern was consistent for both younger and older adults. This pattern was in line with predictions for younger adults, who were expected to show comparable vividness across both focus conditions, but did not support the prediction that older adults would report higher vividness in the emotion-focused condition. Consistent with prior research, older adults' simulated events were rated as more vivid than those of younger adults.

To gain a better understanding of findings related to Research Question 1, an exploratory ANOVA was conducted with participants' plausibility ratings. Results indicated that participants provided similar plausibility ratings for both the sensory-focused condition ($M = 4.64$, $SD = 1.22$) and the emotion-focused condition ($M = 4.84$, $SD = 1.06$) with no significant difference between the two conditions, $F(1, 46) = 1.42$, $p = .240$, $\eta p^2 = .03$.

Recognition Measures

To address our second research question, we examined whether simulation condition influenced memory accuracy using *d'* and response tendencies with C. Separate 2 × 3 × 2 ANOVAs were run to analyse discriminability (*d*') and response bias with (C) with Age Group (younger; older) as a between subjects factor and Condition (sensory-focused; emotion-focused; no simulation) and recognition Detail Type (sensory; emotion) as between subjects factors. The means and standard deviations for *d'* and C are displayed in Table 2.

Table 2

Mean Recognition Measures for Sensory and Emotion Details Across Simulation Conditions (Standard Deviations in Parentheses)

		Younger Adults		Older Adults	
Recognition Measure	Simulation Condition	Sensory Details	Emotion Details	Sensory Details	Emotion Details
d'	Sensory	1.33 (0.83)	1.45 (0.69)	1.41 (0.86)	1.01 (0.94)
	Emotion	1.19 (1.06)	1.28 (0.96)	1.44 (0.80)	1.28 (0.63)
	No simulation	1.17 (0.85)	1.21 (0.85)	1.43 (0.79)	1.27 (0.73)
C	Sensory	0.01 (0.34)	0.00 (0.41)	-0.27 (0.33)	-0.25 (0.36)
	Emotion	0.10 (0.44)	-0.08 (0.40)	-0.14 (0.34)	-0.30 (0.34)
	No simulation	0.06 (0.42)	-0.10 (0.45)	-0.13 (0.33)	-0.21 (0.44)

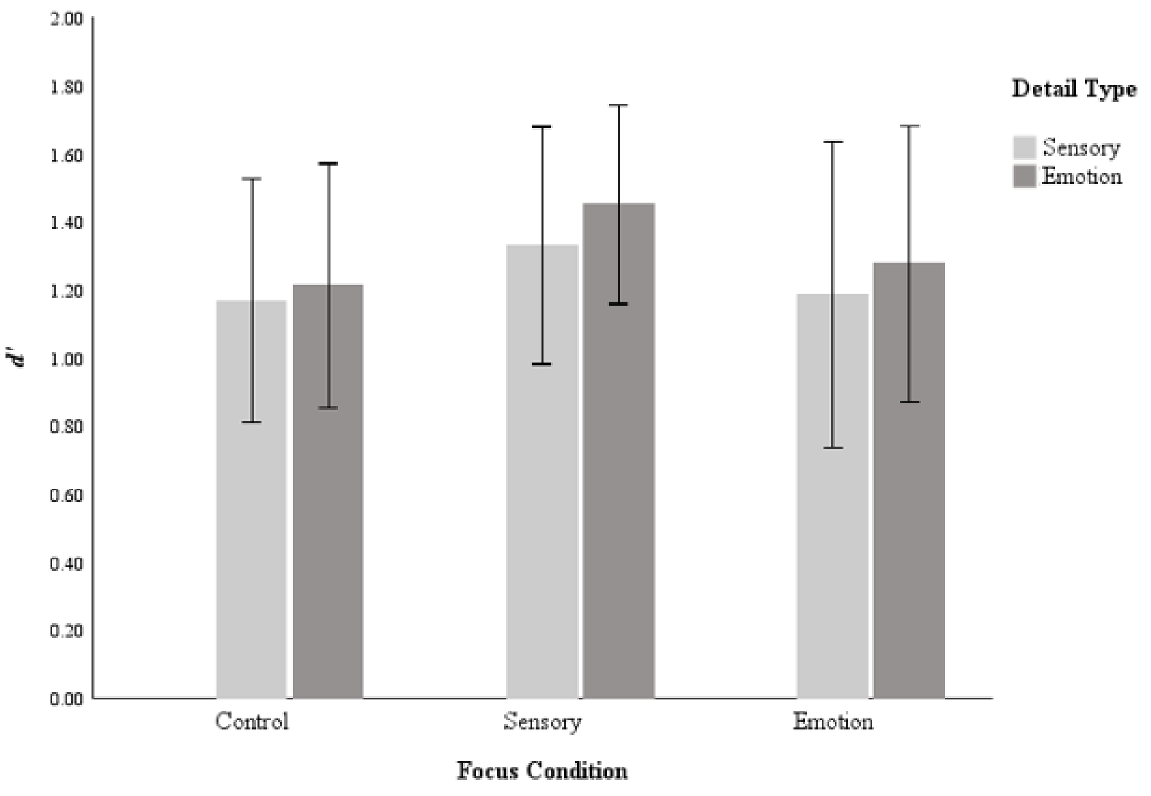
Discriminability (*d'*)

For *d'*, there was no main effect of Age Group, $F(1, 46) = .05$, $p = .820$, $\eta p^2 = .00$, Condition, $F(1, 46) = .96$, $p = .333$, $\eta p^2 = .02$, or Detail Type, $F(2, 92) = .02$, $p = .980$, $\eta p^2 = .00$. Younger and older adults showed similar discriminability overall (see Figures 3 and 4). The interaction between Condition and Age Group was trending, $F(1, 46) = 4.05$, $p = .050$, $\eta p^2 = .08$. There were no significant interactions between Detail Type and Age Group, $F(2, 92) = 1.52$, $p = .224$, $\eta p^2 = .03$, or Condition and Detail Type, $F(2, 92) = .06$, $p = .939$, $\eta p^2 = .00$. The three-way interaction was also not significant, $F(2, 92) = .07$, $p = .932$, $\eta p^2 = .00$.

Overall, the results indicated that younger and older adults were equally good at telling true details from false ones, and this ability did not change depending on simulation condition or on the type of detail being tested. These findings were broadly in line with predictions that memory accuracy would be similar across simulation conditions, particularly for older adults, but did not support the alternative prediction that emotion-focused simulation (for older adults) or sensory-focused simulation (for younger adults) would lead to higher accuracy. The trending interaction suggests an age-related difference in how simulation focus influences discriminability, however, given this result is trending, caution is advised in interpretation.

Figure 3

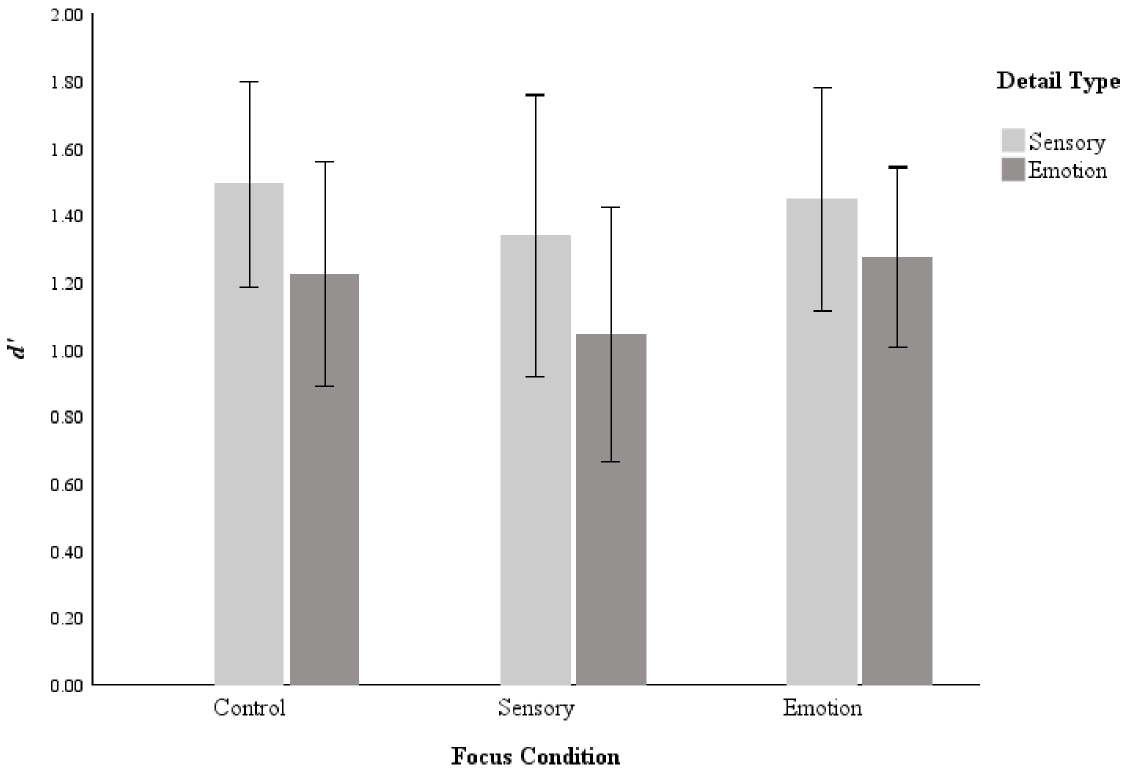
Mean d' of Younger Adults for Detail Types Across Simulation Conditions



Note. Error bars represent 95% CI.

Figure 4

Mean d' of Older Adults for Detail Types Across Simulation Conditions



Note. Error bars represent 95% CI.

Response Bias (C)

For response bias, there was a significant main effect of Age Group, $F(1, 46) = 8.86$, $p = .005$, $\eta p^2 = .16$, indicating that older adults ($M = -0.21$, $SD = 0.39$) adopted a more liberal response bias than younger adults ($M = 0.03$, $SD = 0.40$). A significant main effect of Condition was observed, $F(1, 46) = 5.42$, $p = .024$, $\eta p^2 = .11$, with participants showing a more liberal bias in the emotion-focused condition compared to the sensory-focused condition. The main effect of Detail Type was not significant, $F(2, 92) = 0.25$, $p = .780$, $\eta p^2 = .00$. There were no significant interaction effects between Condition × Detail Type, $F(2, 92) = 2.90$, $p = .060$, $\eta p^2 = .06$, or between Detail Type × Age Group, $F(2, 92) = 0.71$, $p = .496$, $\eta p^2 = .02$. The three-way interaction was not significant, $F(2, 92) = 0.08$, $p = .927$, $\eta p^2 = .00$. In sum, response tendencies varied as a function of simulation condition, where participants were more likely to judge details as having been present following emotion-focused simulation, whereas they responded more cautiously following sensory-focused simulation. This pattern did not differ across age-groups or detail types. Overall, however, older adults showed a more liberal bias than younger adults, reflecting a greater tendency to respond that details had been present.

Discussion

The present study investigated whether directing attention toward sensory information versus emotional information during episodic future simulation would influence the subjective experience of vividness and subsequent memory performance in younger and older adults. By adapting a future simulation paradigm and manipulating attentional focus during future simulation, the present study aimed to clarify how these factors jointly influence the subjective experience of vividness and subsequent memory performance across the adult lifespan.

Summary of Main Findings

Three key findings emerged. First, subjective vividness ratings did not differ as a function of focus condition or age group. Simulated events were experienced as similarly vivid whether participants focused on sensory or emotional information. Second, memory accuracy (d'), did not vary across simulation conditions, detail types, or age groups; however, there was a trending interaction between Condition and Age Group, suggesting that the influence of simulation focus on discriminability may have differed between younger and older adults. Third, response bias differed reliably with age, with older adults adopting a more liberal response bias overall than younger adults, and participants also showed a more liberal response bias following emotion-focused simulation across both age groups. Taken together, these findings suggest that manipulating the type of detail emphasised during episodic future simulation does not significantly influence the subjective vividness of simulated events nor subsequent memory accuracy, but that ageing is associated with systematic differences in decision criteria during recognition.

Future Simulation and Subjective Vividness

Research Question 1 asked to what extent would focusing on different types of detail (sensory vs. emotion) during episodic future simulation affect vividness ratings, and how would this effect differ with age. The present findings were in line with previous research showing that older adults tend to report simulations that are as vivid as those of younger adults (Addis et al., 2008; De Brigard et al., 2016; Folville et al., 2022). Importantly, both the self-report ratings and LIWC analyses showed clear condition-specific differences in the type of information generated, indicating that the focus manipulation successfully altered simulation content. This strengthens the interpretation of the findings, as the absence of condition effects on vividness cannot be attributed to a weak, or ineffective manipulation. Even though older adults generated more or less sensory or emotional detail depending on the condition, this variation in content did not translate into differences in how vivid the events felt. Their overall sense of vividness remained consistently high. This suggests that the phenomenological experience of vividness is not simply a reflection of the amount or type of detail included in a simulation. Instead, it may reflect a more global appraisal of the simulated event, incorporating factors such as coherence, plausibility, and personal relevance. Thus, attentional focus can influence the content of a simulation, but does not necessarily change the overall experience of how vivid that simulated event feels. This was true for both younger and older adults.

One potential explanation for this pattern is that vividness judgments rely on metacognitive heuristics, such as the ease of constructing a scenario, perceived plausibility, or confidence in one’s imagery ability, rather than the objective richness of details (Baddeley &

Andrade, 2000; D'Angiulli & Reeves, 2007). If both simulation conditions produced plausible, self-relevant scenarios, participants may have defaulted to similar vividness ratings regardless of the type of detail emphasised. The exploratory analysis of plausibility ratings further supported this interpretation, indicating that both simulation conditions were experienced as similarly plausible.

From the perspective of the Constructive Episodic Simulation Hypothesis, simulating future events involves flexibly assembling and recombining elements from past experiences, such as people, places, actions, and emotions, into coherent mental scenarios (Benoit & Schacter, 2015; Schacter & Addis, 2007). The subjective experience of vividness emerges not solely from the quantity or type of details included, but from the overall coherence, plausibility, and personal relevance of the simulated event (D'Argembeau & Van der Linden, 2012). Once a simulated event reaches a sufficient threshold of coherence and personal significance, additional emphasis on specific details, whether sensory or emotional, may have minimal impact on the global phenomenological experience. This account helps explain the present findings. The sense of "this event feels vivid" may depend more on the event's overall structure and relevance to the self than on the specific type of detail focused on, suggesting that subjective experience can remain stable even when attentional focus shifts. This interpretation aligns with prior work showing that older adults often report high vividness even when their simulations contain fewer perceptual or contextual details (Addis et al., 2008; Gaesser et al., 2011), and extends it by demonstrating that this pattern persists even when participants are explicitly instructed to focus on one type of information over another.

The absence of age differences further reinforces the idea that the subjective experience of vividness is preserved in healthy ageing. From a Socioemotional Selectivity Theory perspective, older adults' prioritisation of emotionally meaningful experiences may shape how they judge the vividness of simulated events. Specifically, they may give greater weight to the emotional significance of a simulation than to the amount of perceptual detail, so that even when sensory or emotional content is varied, their overall sense of vividness remains stable across conditions. Younger adults, in contrast, may consider a broader mix of cues, including both sensory and emotional information, but once a simulation is coherent and personally relevant, increasing emphasis on either type of detail does not meaningfully alter their vividness ratings either.

In relation to the gap identified in the literature, these findings suggest that the dissociation between reduced episodic detail and preserved vividness in older adulthood cannot be explained solely by the type of information generated during simulation. Instead, vividness appears to reflect higher-order evaluative and metacognitive appraisals that remain stable even when attentional focus and simulation content vary. Thus, the present findings provide further empirical support for the notion that subjective vividness becomes partially decoupled from objective detail with age.

Future Simulation and Memory Accuracy

Research Question 2 asked whether focus condition (sensory vs. emotion) would affect subsequent memory accuracy. Subjective vividness ratings were obtained during episodic future simulation, whereas memory accuracy (*d'*) was assessed for details from the narratives presented afterward. Thus, discriminability reflects memory for the narratives themselves, not memory for the simulated events. The purpose of the simulation manipulation was not to directly enhance memory for simulated content, but to establish an attentional and contextual orientation that could potentially influence how participants processed and encoded the narratives that followed. From this perspective, vividness ratings served as an index of participants' phenomenological engagement with the simulated event. Prior work suggests that episodic simulation can shape subsequent encoding by activating schemas, biasing attention, or altering the relative weighting of different types of information (Devitt & Schacter, 2018; Schacter et al., 2017; Szpunar et al., 2014). If directing attention toward emotional or sensory aspects during simulation had meaningfully altered participants' subjective experience, this could have carried forward into the narrative encoding phase, leading participants to preferentially attend to or encode corresponding types of detail.

However, neither vividness ratings nor plausibility ratings differed between condition or age group, suggesting participants entered the narrative encoding phase with comparable subjective contexts, regardless of simulation focus. Because the manipulation did not alter the overall phenomenological experience of the simulation, differences in how the subsequent narratives were encoded were likely reduced. Consistent with this account, memory accuracy for sensory and emotional details did not differ by simulation condition or age group overall, although a trending Condition × Age Group interaction suggests that simulation focus may not have affected younger and older adults in the same way. However, given that this effect was only trending, age-related differences in discriminability should be interpreted cautiously.

More broadly, the results point to an important boundary condition on the effects of episodic future simulation. Simulating a future event does not automatically bias subsequent memory performance. Rather, such effects may depend on whether the simulation meaningfully alters higher-level subjective states that persist into encoding. In the present study, the manipulation successfully changed the content of simulations toward sensory or emotional details, yet it did not alter how vivid or plausible the events were experienced overall. When simulations are experienced as equally vivid and plausible, even when they differ in content, memory for subsequently encountered information may remain relatively robust to differences in attentional focus during simulation. Therefore, the overall phenomenological quality of the simulation, rather than the specific type of detail emphasised, may be more likely to shape downstream encoding.

Importantly, these findings help address the gap identified in prior work on future simulation and memory which found that older adults are less influenced by future simulation during later remembering (Devitt & Schacter, 2020). The present results indicate that directing attention to sensory versus emotional information during future simulation may not, on its own, be enough to shape later memory. Thus, contrary to expectations, the type of detail prioritised during simulation may not be a primary mechanism through which simulation biases later memory, highlighting that other simulation characteristics may be more critical drivers of simulation-based memory biases.

Future Simulation and Response Bias

Although simulation focus did not affect discriminability (*d'*), clear age-related differences emerged in response bias (C), with older adults showing a more liberal decision criterion than younger adults. In practical terms, this means older adults were more willing to judge details as having been present, even when memory evidence was uncertain. Importantly, this pattern reflects a difference in decision strategy, not in memory ability. Signal detection approaches emphasise that memory performance involves both the strength of the memory signal and the criterion used to decide whether that signal is sufficient for acceptance (Dennis et al., 2007; Macmillan & Creelman, 2005). The present findings indicate that ageing influences this decision threshold, rather than the quality of the memory signal itself.

One mechanism that may help explain these differences is confidence calibration. Confidence reflects a person's subjective evaluation of how strong or reliable a memory feels, and it does not always correspond closely with objective accuracy (Koriat, 1997; Yonelinas, 2002). People can feel highly confident in incorrect memories or unsure about accurate ones. Research suggests that the link between confidence and accuracy becomes less tightly coupled in older adulthood (Sikora-Wachowicz et al., 2019; Zheng et al., 2019). In this context, a liberal response bias may arise when subjective feelings such as familiarity, plausibility, or emotional resonance are interpreted as sufficient evidence that an event detail was encountered before. Thus, older adults' greater tendency to respond "yes" to details as having been present may reflect reliance on these subjective cues, rather than weaker memory.

This interpretation aligns with work showing that older adults often rely more on heuristic signals, such as familiarity or general plausibility, particularly when recollection of specific contextual details is reduced (Hay & Jacoby, 1999). When these heuristic cues are experienced as strong, they may be taken as evidence that details were previously encountered, increasingly the likelihood of "true" responses. Younger adults, in contrast, may place greater weight on specific context or source information when making recognition decision, leading to a relatively more neutral response tendency.

In addition to age-related differences, focus condition also influenced response bias across both younger and older adults. Participants were more likely to respond to details as having been present following emotion-focused simulation than sensory-focused simulation, regardless of age group or detail type. One plausible interpretation is that emotion-focused simulation increased the subjective sense of familiarity or meaningfulness of subsequent narratives. Prior work suggests that episodic simulation can bias later encoding by activating related schemas and shaping attentional orientation (Schacter et al., 2017; Szpunar et al., 2014). If simulating an event in emotional terms made the later narratives feel more personally relevant, participants may have been more inclined to accept details as true.

Crucially, this shift in response bias occurred without any change in discriminability. This dissociation suggests that simulation focus influenced how participants evaluated memory evidence at retrieval rather than the quality of the memory itself. In other words, emotion-focused simulation did not help participants to better distinguish true from false details, but it did make them more willing to say that a detail had been present. Taken together, the present findings indicate that episodic future simulation may influence decision processes during recognition more than memory accuracy itself. Rather than strengthening the encoding of narrative details, directing attention toward emotional aspects of simulated events appears to shift the subjective criteria participants use when judging whether information was previously encountered. This highlights the importance of distinguishing between discriminability and response bias when interpreting the effects of episodic future simulation across the adult lifespan.

Alternative Explanations

Several alternative explanations warrant consideration. First, the simulation manipulation may have influenced dimensions of simulation not captured by the measures used in the present study. Sensory-focused and emotion-focused simulations may have differed in narrative coherence or sense of personal relevance, which were not directly assessed. Future studies could incorporate multidimensional phenomenological measures or qualitative analyses to capture these aspects more fully. Second, individual differences may have moderated the effects of simulation focus. Variability in imagery ability, emotional regulation, or motivation could have obscured condition effects at the group level. Assessing individual difference measures and examining their interaction with simulation focus would help clarify this possibility.

Limitations

Although participants in the emotion-focused simulation condition were instructed to focus on affective aspects of the simulated events, the emotional information generated during simulation was not constrained to a specific valence. Participants could simulate positive, negative, or mixed emotional content, and this variability was not systematically recorded. In addition, the emotion target details presented during encoding and tested at recognition were not categorised according to emotional valence. Thus, the emotional content of participants' simulations varied freely, and the emotion target details were treated as a single category regardless of valence. However, together they may have reduced sensitivity to emotion-specific effects, particularly in older adults. Prior work suggests that ageing is associated with selective prioritisation of positive over negative emotional information (Charles et al., 2003; Mather & Carstensen, 2005; Reed et al., 2014). Collapsing across positive and negative emotional content may therefore have obscured valence-dependent effects, potentially diluting differences between simulation conditions at the group level rather than indicating an absence of emotional influence on memory. This is notable given that the original studies by Devitt and Schacter (2018, 2020) found that influence of future simulation on later memory was explicitly valence-dependent, with memory biases emerging in a direction consistent with the emotional tone of the prior simulation.

Future Directions

Future research could extend this work in several important ways. Collecting confidence ratings alongside recognition responses would allow direct testing of confidence-based interpretations and provide insight into confidence–accuracy correspondence across age groups. Future studies could also independently manipulate simulation focus and classify target details by emotional valence. This approach would allow researchers to determine whether memory enhancements for emotional details are specifically driven by attending to affective information, or whether they instead reflect more general benefits of elaborative simulation that occur regardless of emotional focus. Lastly, manipulating the emotional intensity or personal relevance of simulated events may further help to clarify the conditions in which future simulation most strongly influences later memory.

Implications

Despite the absence of simulation focus effects on vividness and memory accuracy, the present findings have important theoretical and practical implications. They suggest that vividness is a resilient feature of episodic simulation that reflects evaluative and metacognitive processes rather than perceptual detail alone. The dissociation between subjective experience, memory sensitivity, and response bias underscores the importance of considering decision-level processes when interpreting age differences in memory. More broadly, the results highlight the value of separating memory strength from confidence and response strategy in studies of episodic simulation and ageing. Combined with evidence that older adults can experience simulations as vividly as younger adults (Addis et al., 2008; Folville et al., 2022), these findings suggest that phenomenological vividness does not necessarily translate to memory accuracy, emphasising the need to consider both encoding processes and retrieval decision strategies when explaining how episodic future simulation influences later memory.

Practically, the findings suggest that simulation-based tasks for older adults, such as cognitive training or memory interventions, may benefit from providing structured decision support or metacognitive cues to guide judgments. Given that directing attention to specific types of detail altered simulation content without changing vividness or memory accuracy, it is likely that the overall personal relevance and meaning of a simulation plays a larger role in shaping later memory than the particular features emphasised. As such, linking simulations to personally meaningful or goal-relevant outcomes may be more effective for shaping later memory than focusing on sensory or emotional details alone.

Conclusion

In conclusion, the present study examined how focusing on sensory versus emotional information during episodic future simulation influences vividness and memory in younger and older adults. The findings indicate that simulation focus does not substantially alter subjective vividness or memory sensitivity, but that ageing is associated with systematic differences in confidence-based response strategies. By integrating perspectives from episodic simulation, cognitive ageing, and metacognitive decision-making, this research advances understanding of how simulating the future relates to remembering the past across the adult lifespan.

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Appendix A

Pre-registration

ASPREDICTED

Wharton CREDIBILITY LAB UNIVERSITY of PENNSYLVANIA

MARS3 (#229470)

Author(s)
Joy Kim (University of Waikato) - jk300@students.waikato.ac.nz
Aleea Devitt (University of Waikato) - adevitt@waikato.ac.nz

Pre-registered on:
2025/05/20 19:49 (PT)

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
To what extent does focusing on different types of details (e.g., sensory or emotional) during episodic future simulation influence vividness ratings? Do these effects change with healthy aging?

3) Describe the key dependent variable(s) specifying how they will be measured.
The dependent variable is the vividness rating. Participants will provide ratings of vividness from a scale of 1-7 based on how vivid the event was in their mind after each episodic future simulation.

4) How many and which conditions will participants be assigned to?
Two conditions: sensory-focused and emotion-focused.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
A mixed designs (2 x 2) ANOVA will be conducted to examine the hypothesis. The ANOVA will test whether there is a main effect of condition (does imagination type change vividness rating), whether there is a main effect of age group (are vividness ratings generally different for YA and OA) and also test if there is an interaction (does the effect of condition depend on age group). Post hoc tests will be conducted if necessary.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
We will exclude participants for indicators of task non-compliance. Specifically:
1) If a participant provides descriptions of future events that are less than 1.5 minutes long for 3 or more events
2) If they read through 3 or more narratives at a rate of 20 seconds or less
3) If they achieve at or below chance on the recognition memory test.

Tasks in 2) and 3) are part of a larger study.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
25 participants will be recruited for each age group: 18-35 years and 65+ years.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
Nothing else to pre-register.

Appendix B

Ethics Approval

Te Wānanga o Ngā Kete | ***Division of Arts, Law, Psychology & Social Sciences***

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THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

Dr Aleea Devitt

School of Psychological and Social Sciences
Psychology Programme

13 March 2025

Dear Aleea

Re: **FS2021-21: Thinking backwards and forwards: Characteristics and consequences of age-related memory decline**

Thank you for submitting an amendment to the ALPSS Human Research Ethics Committee for your existing project. The ALPSS Human Research Ethics Committee is pleased to approve the following requested amendments:

Addition of two Masters students: Mia Wild & Joy Kim
Addition of two Honours students: Grace Hattingh & Hayley Harris

We wish you all the best with your research. Thank you for engaging with the process of Ethical Review.

Kind regards

Dr Amy Bird, Convenor
Division of Arts, Law, Psychology & Social Sciences Human Research Ethics Committee

Appendix C

Example Stimuli

The following are examples of a sensory-focused scenario and an emotion-focused scenario used in the simulation phase.

Sensory-focused:

You are moving into a new place.

Focus on SENSORY information.

Emotion-focused:

You have an appointment at the dentist.

Focus on EMOTION/THOUGHT information.

The following is an example of one of the 12 narratives participants read during the encoding phase. Both versions are shown, with target sensory and emotion details indicated in brackets.

Version 1

It was moving day, and you were loading your items into the truck you had rented. There was a light breeze, but it was sunny, making it the perfect day to move (SENSORY). There were lots of boxes to move still, and only a few of your friends had turned up to help. Once all the boxes had been loaded, you tried to move the washing machine, but it was too heavy (SENSORY). Luckily, your friend remembered their hand trolley, which made moving the appliance light work. You were pleased that you managed to fit everything into one load and didn't have to do a second trip (EMOTION). By lunchtime, everything had finally been transported to your new home. Alone in your new place, you stood in the lounge, and wondered what you should unpack first. You were not looking forward to having to organize yourself (EMOTION). First you tested a light switch, and you were impressed to see that the power was working already (EMOTION). You wandered about and poked through the stuff to unpack. You opened a box and discovered some fine dinner plates you had forgotten you owned. Unfortunately, the last tenants had left a small side table that you disliked (EMOTION). While moving the table you noticed the new paint on the walls (SENSORY). You started hanging up some of your jackets in the bedroom closet. Despite double checking your boxes, you appeared to be missing a few hangers (SENSORY). You realised how exhausted you were, so you decided to have a nap and finished unpacking a bit later.

Version 2

It was moving day, and you were loading your items onto the trailer you had rented. There was a gusty wind, and it was starting to drizzle outside, so it was not a good day to move (SENSORY). There were lots of boxes to move still, and you were grateful that so many friends had shown up to help. Once all the boxes had been loaded, you tried to move the washing machine, which was surprisingly lightweight (SENSORY). One of your friends helped you, but you accidentally bumped the appliance into the front door, which left a small dent. You were a bit annoyed that you couldn't fit all of your stuff into one load and had to do a second trip (EMOTION). By lunchtime, everything had finally been transported to your new home. Alone in your new place, you stood in the kitchen, and wondered what you should unpack first. You were pleased to have the opportunity to organize yourself (EMOTION). First you tested a light switch, and you were disappointed that the power wasn't on yet (EMOTION). You wandered about and poked through the stuff to unpack. You opened a box and discovered some dinner dishes had been broken. The last tenants had left a small side table that you quite liked (EMOTION). While moving the table you noticed the wallpaper was peeling (SENSORY). You started wiping down the shelves in the bedroom closet. You saw that the old tenants had left some hangers on the clothes rack, which you used

(SENSORY). You realised how exhausted you were, so you decided to have a nap and finished unpacking a bit later.