Journal of Cognitive Psychology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/pecp21

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To cite this article: Marianna E. Kapsetaki, Ioana Elisabeta Militaru, Ines Sanguino, Matilde Boccanera, Neila Zaara, Andreea Zaman, Flavia Loreto, Paresh A. Malhotra & Charlotte Russell (2021): Type of encoded material and age modulate the relationship between episodic recall of visual perspective and autobiographical memory, Journal of Cognitive Psychology, DOI: 10.1080/20445911.2021.1922417

To link to this article: https://doi.org/10.1080/20445911.2021.1922417

Published online: 26 May 2021.

JOURNAL OF COGNITIVE PSYCHOLOGY
https://doi.org/10.1080/20445911.2021.1922417

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Type of encoded material and age modulate the relationship between episodic recall of visual perspective and autobiographical memory

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ABSTRACT

Episodic memory enables us to form a bank of autobiographical memories across our lifespan. The relationship between autobiographical memory and laboratory-measures of episodic memory is complicated and these processes might be differentially affected by ageing (e.g. Diamond et al., [2020]. Different patterns of recollection for matched real-world and laboratory-based episodes in younger and older adults. *Cognition*, 202, 104309.). Here, we examine whether the ability to recall one's own visual perspective relates to richness of autobiographical recall, and how this relationship is affected by age. Memory of perspective at encoding, was assessed in younger (18–35 years) and older adults (65–85 years). Participants, wearing head cameras, viewed arrays of objects. Later they were asked which images represented earlier scenes, and if the image was taken from their perspective (i.e. from their camera). Performance was compared with autobiographical memory. Accuracy in identifying their own perspective correlated with autobiographical scores. Age-group was a moderating factor in this relationship. Subsequently, new participants encoded photographs of objects and were later asked whether they recognised the images. Visual perspective was manipulated in these photographs. In this task there was no relationship between performance and autobiographical memory. In younger adults only 3-D encoding of scenes relates directly to autobiographical memory but ability to complete these two tasks appears to operate independently in the older group.

ARTICLE HISTORY
Received 30 June 2020
Accepted 19 April 2021

KEYWORDS
Visual perspective; episodic memory; autobiographical memory; ageing

Introduction

Autobiographical memory allows us to recall events from our lives, it relies on the episodic memory system. Indeed, episodic memory is fundamental to autobiographical memory as it enables recall of detailed events contextualised within space and time. Recall of autobiographical events is scaffolded by both general and personal semantic knowledge (Conway, 2009; Irish & Piguet, 2013; Renoult et al., 2012). To examine autobiographical memory, participants recall events from their lives (see Kopelman et al., 1989; Levine et al., 2002; Piolino et al., 2003). The episodic component of these memories is measured through the specificity of the event's context and the vividness of sensory description. Results from these paradigms identify a decline in episodic richness of autobiographical recall with increasing age (e.g, see Piolino et al., 2006; St Jacques & Levine, 2007). This decline in episodic detail in autobiographical events harmonises with work in experimentally controlled laboratory-based tests of episodic memory. For example, older adults show increased difficulty in discriminating between similar events as well as deficits in precise recollection of stimuli (e.g. Koen & Yonelinas, 2016; Pidgeon & Morcom, 2014; Yeung et al., 2013). Yet, it is unclear whether episodic memory laboratory tests and autobiographical memory interviews are assessing an identical underlying process. In much research, distinct neural networks are involved when comparing memory for real world events to laboratory encoding of more simple stimuli (Chen et al., 2017; McDermott et al., 2009

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Monge et al., 2018). For example, McDermott et al. (2009) performed a meta-analysis, including articles assessing laboratory-based memory tasks and those using an autobiographical measure in order to examine common areas of neural recruitment. They demonstrated very few areas of overlap between the two types of memory assessment (e.g. some small regions in posterior cingulate cortex). These discrepancies are important and raise the question of what is different and what is shared between episodic recall in autobiographical memory and episodic recall of laboratory—introduced stimuli.

One potential avenue of interest in investigating the differences between lab-based episodic memory performance and autobiographical recall is that episodic memory in the lab is frequently assessed with two-dimensional (2-D) images on a computer screen, whereas we form our autobiographical memories while moving in and interacting with the world in three-dimensional (3-D) space. There is evidence that these 2-D images are likely to be processed and experienced very differently to 3-D experience of the same objects. For example, an electroencephalography (EEG) study examining perception of 3-D objects compared to 2-D pictures of very similar items revealed stronger brain responses linked to motor plans for 3-D stimuli (Marini et al., 2019). Real-world-presented objects also preferentially capture attention compared to 2-D pictures or even 3-D representations of the same objects (Gomez et al., 2018). As might be expected, due to their greater attentional interest and superior activation of motor circuits, real world objects appear to be remembered better than 2-D photographs (Snow et al., 2014). In a very recent study, when retrieving details about scenes which had been encoded in a real-life 3D environment (compared to equivalent scenes that were encoded in a 2D environment), participants reported a greater subjective sense of recall and were more objectively accurate (Diamond et al., 2020). Pertinent to the current study, Diamond et al. (2020) demonstrated that older adults were less accurate overall but produced a similar level of subjective recollective experience as the younger group. Therefore, it is valuable to examine whether there are memory differences in experiencing real-life 3-D objects and similar objects in 2-D photographs and how this interacts with memory for the rich 3-D events that form our autobiographical memory across the lifespan. A key interest here is that, in addition to motor plan affordances and potential attentional effects, 3-D scenes are also experienced in a richer spatial context. That is, when we view a scene that is physically present in front of us, we form a spatial representation of this scene from our own perspective. Photographs can be taken from different viewing directions, but this 2-D stimulus does not replicate the full spatial context of the scene. It is worth noting that the size of space experienced in a real environment is often larger than that shown in a 2-D photograph. The size and richer spatial context are likely to affect the role of egocentric and allocentric frames of reference when participants encode the stimuli (see Iachini et al., 2014). Both egocentric and allocentric contexts are necessary for the visual representation of our own perspective and the 3-D environment might allow these to be integrated more effectively (e.g. Ekstrom & Isham, 2017).

Here, we aim to examine whether a key aspect shared between autobiographical memory and some episodic tasks relates to the recollection of one's own self-perspective at retrieval. The reason for this is that integral to episodic recall is a rich mental image of what the event looked like to us at the time of encoding. If we recall our most recent trip into work, we construct a visuospatial mental image of the scene as we perceived it at the time. Therefore, accurate recall of egocentric—first-person—perspective is likely to be critical to episodic recall. St Jacques and colleagues, over a number of studies, demonstrated in healthy individuals that shifting from the encoding perspective at retrieval reduces the overall accuracy of the memory and leads to reduction in reported subjective vividness of the memory (Marcotti & Jacques, 2018; St Jacques et al., 2018, 2017 for a review see St Jacques, 2019). Relevant to the maintenance of one's own perspective is that an essential part of episodic memory is the ability to self-reference our memories. This is known as "autonoetic consciousness" (Tulving, 2002) and refers to the awareness of one's self in our memory. That is, that this is a recall of an event we ourselves experienced in the past. It is reasonable to argue that self-referenced memories are subjectively more compelling if they are accessible from a first-person perspective. Events that we might later recall are experienced through the perspective of our own eyes. As a result of how we interact with the world, the collation of visual information and the associated visual contexts from these events is from the perspective of our own eyes. When we are able to mentally recreate this perspective at recollection, we are likely to feel that we are vividly recalling an event from our life and, in an episodic memory task, we might be more sure that we experienced that scene in the encoding phase. There are rare potential exceptions to the statement that memories are *always* encoded from the perspective of our own eyes. In dissociative identity disorder people experience the presence of two or more personality "alters". There are examples of one alter encoding events which remain inaccessible to the other alters; these might then be examples of third-person memories from the same body (Morton, 2018). In addition, some studies have experimentally manipulated the perspective at encoding so that experimental participants experienced events from an observer perspective (e.g. see Bergouignan et al., 2014; Iriye & St. Jacques, 2021). However, although the quality and frequency of first-person *recall* might vary across individuals and our lifespans, in most circumstances most individuals encode their experiences through their own eyes. Here we aim to examine whether there is a relationship between the ability to correctly recognise one's own encoded scene from our first-person perspective and episodically rich recall in autobiographical memory.

Computational and neuroimaging evidence suggest that to create an accurate image of the world around us—from our own first-person perspective—we rely on parietal cortex (see Burgess, 2008; Burgess et al., 2001; Lambrey et al., 2012). Parietal cortex is fundamental within episodic recall, with its role increasingly appreciated (for reviews Rugg & King, 2018; Sestieri et al., 2017). For example, in episodic tests, patients with damage to this region produce fewer "Remember" responses in Remember/Know paradigms, are less susceptible to false alarms and, despite accurate memory performance, show disordered ratings of confidence in their performance (Berryhill et al., 2009; Drowos et al., 2010; Hower et al., 2014; Simons et al., 2010). In autobiographical paradigms, these patients can recall events from their lives, but the reports are vague, imprecise and lacking detail (Berryhill, 2012; Berryhill et al., 2007). These recollections are even associated with a lower subjective feeling of having experienced the event themselves (Davidson et al., 2008). We developed a paradigm to directly examine whether patients with lesions in parietal cortex have difficulty discriminating, at recognition, their own encoded perspective of a scene from an alternative perspective (Russell et al., 2019). In our study, patients with damage to lateral parietal cortex were impaired in recognising scenes from their own perspective despite being equivalently accurate to healthy controls in other assessments of episodic memory and in alternative spatial judgements on the scenes. An imaging study using this paradigm in healthy participants suggested that the angular gyrus in parietal cortex was the region principally involved in accurate judgements of self-perspective during recollection. These results synchronise with other recent studies. For example, Tibon et al. (2019) found that increased angular gyrus activity was directly linked to greater vividness of recognition at recall. Trelle et al. (2019), confirmed involvement of angular gyrus at retrieval in an episodic task – in both younger and older adults – when stimuli were correctly recollected.

The features of episodic and autobiographical memory in patients with parietal damage, plus the better delineation of the role of angular gyrus, suggests that these parts of the episodic network enable a rich, vivid mental image of a scene during the recollection process. Even healthy ageing impacts episodic and autobiographical memory disproportionately when compared, for example, to semantic memory. The changes that memory undergoes in older adults in laboratory tasks suggest deficits with the explicit recollective process, while leaving familiarity judgements comparable to younger adults (e.g. Koen & Yonelinas, 2016). Related to this, the Remember/Know question is used frequently as a proxy for the sense of "autonoetic consciousness" experienced during recall and there is evidence that healthy older adults (as well as the patients with parietal damage discussed above) report fewer "Remember" responses compared to "Know" responses than to younger adults (e.g. Piolino et al., 2006). This suggests a change to the subjective quality of the memory recall. In episodic tasks, healthy older subjects seem to have deficits in remembering specific episodic details, that is, details directly related to a unique event and specific to time and place (e.g. Diamond & Levine, 2020; Folville et al., 2020). Older adults also show impairments on tasks requiring the integration of the object (what), spatial (where) and temporal (when) contexts inherent to episodic memory (e.g. Kessels et al., 2007; Mazurek et al., 2015). Potentially associated with this loss of episodic contextual integration, in autobiographical interviews, episodic recall is frequently reported as lacking detail and specificity (e.g, Addis et al., 2011; Levine et al., 2002; Schacter et al., 2013). Also, and clearly relevant to visual perspective, there is an increase of autobiographical memories reported from an "observer" rather than "field" perspective (see, Piolino et al., 2006, 2009). Therefore, some key characteristics of episodic memory in older adults are suggestive of a less rich recollective process and we might suggest that a decline in the ability to recollect the first-person perspective at recall is part of this (see Russell et al., 2019).

Here, we will examine the relationship between self-perspective in an episodic task and autobiographical memory in both young adults and older adults. It is possible that both of these processes are impacted by ageing, only one of them or indeed that the relationship between them undergoes change across the lifespan.

In the first study, with a group of younger and a group of older adults, we will use the episodic memory task we developed before, alongside an autobiographical interview like the TEMPau developed by Piolino and colleagues (Test Episodique de Memoire du Passe autobiographique, Piolino et al., 2003, 2009). Our episodic memory task allows participants to experience well-controlled, 3D scenes created from everyday objects. While experiencing these scenes, they wear a head-camera and are told that we will test their memory for the scenes with images from this camera. In a later recognition test they are presented with photographic images of the scenes. The images can be the exact scene they saw – the same objects in the same position, taken from the same position they were sitting or they can be the same scene from the same perspective but with an object moved or, finally, the same scene, with the objects in the same position, but shown from a different perspective. We will examine whether accuracy in discriminating between identical scenes and those taken from a shifted perspective associates with episodic richness in the autobiographical task. Further, whether the age groups significantly vary in performance on either task and/or in the relationship between performance in the tasks.

In the second study, instead of using 3D scenes in the encoding task, we will use 2D photographs of the same objects in a similar arrangement. Changing the encoding stimuli in this way, but keeping the recognition task similar, will enable us to further probe the nature of episodic tasks that relate to episodic recollection in autobiographical memory. Given the discrepancies between laboratory based episodic paradigms and measures in which people recall events from their own lives, this is an important step (e.g. Chen et al., 2017; McDermott et al., 2009).

Experiment 1

Methods

Participants

Forty-four participants from two age-groups took part in this study. The younger group ($n = 19$; * females) were aged from 18–35 years of age and the older group ($n = 25$, * females) were aged from 65 to 85 years of age (please note that some participants' demographic details for this study are in locked filing cabinet in my office and due to Covid-19 we have not been permitted in the building – this building is locked down and no access currently possible, have written note to Editor on this issue). Participants were recruited from adverts placed on the university research recruitment bulletin, posters on campus and through advertising via the University of the Third Age, UK. The project received ethical approval from the local university ethics committee. All participants gave written informed consent to take part in the study and confirmed that they had no current diagnosis of neurological or psychiatric illness. They were reimbursed for their time and inconvenience.

3-D Episodic memory task

Encoding. Participants were presented with 22 novel 3-D scenes to remember. Presentation was split into 4 blocks (3 of which included 6 scenes and one with 4 scenes). Each scene consisted of two items taken from a possible 14 categories, each category contained 8 possible exemplars. Examples of categories included kitchen items, toy vehicles, models of musical instruments and fruits. For each scene, items were positioned in separate squares of a 2×2 grid, placed on a table in front of the participant (see Figure 1). The two items that made up each scene were placed onto the grid by the experimenter and left in position for 1 min. Participants were told that their memory for the scenes and how they appeared to them would be probed later. All participants were wearing a head camera. It was explained that a still would be taken from each scene to be used later in a memory test. They were told they would need to

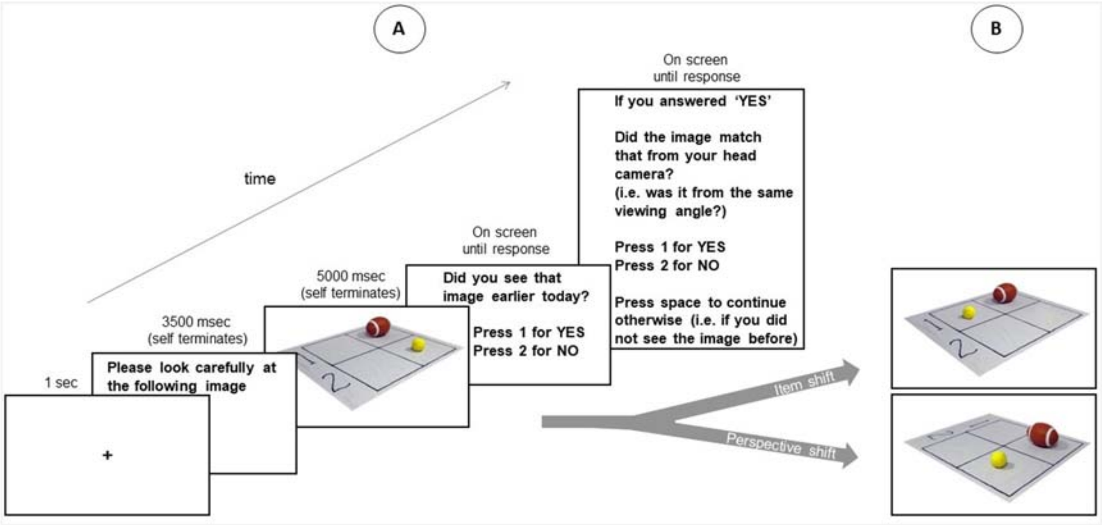

Figure 1. Schematic of events in the recognition test for Experiment 1. (A) Demonstrates what was on the screen and for how long the participants saw this information. Note that although these are photographs of the scenes in this part of the test, in the encoding session these items were placed onto this grid 'live' in front of the participants. The 'sport equipment' image seen here represents the 'Identical' condition. That is, this was exactly what was shown during encoding. (B) These images show the two possible non-identical lure trials. The top is the example of an 'Item Shift' trial and the bottom of the 'Perspective Shift' [To view this figure in color, please see the online version of this journal].

identify stills from their own session. In reality we pre-prepared stills of each scene – facilitating the later memory test and to ensure images were as clear as possible on the computer screen. No participant in either group questioned that the images were taken from their head camera or mentioned being suspicious during debrief.

For half of the scenes, participants sat to the left of the grid, for the other half to the right. Seating position was randomly allocated across trials with an equal distribution of both positions. Participants were asked to move seats for this manipulation. Viewing position, the items presented, and the order of presentation were counterbalanced across participants.

After each block, participants were cued with the category name of each scene and then asked to recall the items, their positions, and the viewing perspective they experienced that scene from (i.e. from the left or right). They were asked, for example, "when we showed you the 'kitchen items' scene can you tell us what items we showed to you, where they were on the grid and where you viewed this scene from?". This allowed us to check they had encoded the scene correctly and to give a reminder where appropriate.

Recognition task. During the recognition task 22 scenes were presented to participants on the computer. Eight of these scenes were identical to one of the scenes they had been presented with when wearing the head camera (i.e. the scene that they saw from the angle in which they had viewed it: identical condition); 8 were of the same scene but taken from the opposite viewing perspective (perspective shift condition); 6 were taken from the same viewing angle with the same items but one of the items was placed in a different position (item shift condition). The task was programmed using Psychopy software (Peirce, 2009).

The recognition task was verbally explained by the experimenter, who remained in the room throughout in case participants had any questions. When the task started images remained on screen while participants answered the first question, which was presented on the screen, "Did you see this exact scene earlier?". It was previously emphasised that the viewing angle of these pictures was not relevant for the first question. If participants responded "yes" then they were asked: "Was the scene taken from your viewpoint (i.e. is it the image from your head-camera)?". Participants had to make a forced choice "yes" or "no" answer to this question.

Autobiographical memory interview

The autobiographical memory interview was based on the TEMPau developed by Piolino et al. (2003, 2009). The task was modified in order to match the number of meaningful time periods across age groups. We probed three life periods: Childhood – up to the age of 12; the most recent five years excepting the current year; the current year. For each period participants were asked to provide three memories. At the start of the interview the interviewer outlined what they were going to be asked to do and made it clear that they should describe specific events that did not last more than a day and were not repeated. They were also asked to: " … describe as many details as possible about the event: the time, the place, with whom the event happened. Describe any thoughts and emotions you can remember from the event while it was happening". They were also encouraged to avoid information that was not directly relevant to the event. The experimenter transcribed the memories directly to a laptop computer in the session and then checked what had been written immediately after the interview, leaving the room for the participant to have a break.

To facilitate recall we gave cues of possible events, using identical, relatively generic, cues. For example, in the childhood period one probe was, "Give details about an event that occurred connected to your childhood home". Or, from the most recent year, "Could you recall details of a particular meal you shared with someone else – friend or family – in the last year? This could be a meal out or at your or their home". If the probe did not facilitate access to a memory for a participant, they were encouraged to select another event that they could recall. In practice this happened on very few occasions. When participants struggled to follow instructions to recall a discrete, non-repeated event they were probed with a set instruction, "Remember we want to hear about a specific event". If they gave a brief, cursory description of an event they were given the set probe, "Can you add any specific details?". When participants indicated that they had finished recalling a particular event they were asked two questions. First, they were asked how much they fully pictured the scene in their minds whilst recalling. They rated this experience on a scale from 0 – not at all, to 4 – very clear and vivid. Second, they were asked if they recalled the memory as if they were observing it or from the perspective of their own eyes. If they said that they felt that they had used both perspectives, they were asked to select the predominant perspective of recall.

To create an "episodic score" for each memory we followed the marking scheme outlined in Piolino et al., 2003, adapted from Kopelman et al.'s (1989) Autobiographical Interview. Each memory was awarded a score on the scale below:

Absence of any memory or very general information = 0
Recall of repeated or extended event with no context of space or time = 1
Recall of a repeated or extended event but with some spatial/temporal context = 2
Recall of a specific event with some spatial/temporal context but few details = 3
Recall of specific event with spatial/temporal context and rich sensory details = 4

Each memory was scored by two independent markers, one of whom had not been in that particular participant's interview. Scores were averaged to give the final score for that event – if both markers were within one mark on the scale above. If the scores from the two markers differed by more than one mark on the scale, a third independent marker reviewed the memory and their score was then averaged with whichever original marker it was within 1 grade of, giving the final score for that event. In all occasions the third marker was within one mark of one of the markers. The scores for the three events recalled in each time period were averaged for each participant for analysis. Studies deriving the TEMPau "episodic score" (e.g. Noulhiane et al., 2008; Piolino et al., 2003, 2006, 2007) commonly use two independent markers who then agree a consensus on the eventual score. We adopted a different strategy here. First, a number of markers scored the memories (five markers across this study) making discussions logistically challenging. We also felt these discussions might be susceptible to influence of one over the other marker and for some of the participants one of the markers would have been present in the interview. This strategy of averaging the score across both markers, with a third marker used in cases of larger disagreement, was adopted as being robust and fair. All autobiographical scripts were anonymised.

Experimental procedure

The episodic memory task in which the scenes were experienced in "real-life" and the autobiographical interview were run in the same experimental session. Each participant came into the laboratory for this session, which lasted approximately 2 h. The encoding session was carried out first (lasting around 25 min), followed by a break, then the autobiographical interview (lasting around 45 min) and finally the recognition test from the head camera task (10 min). The rest of the session consisted of going through the information sheet, taking informed consent, breaks and debrief.

Results

3-D Episodic memory task. Given the nature of the questions asked, the data from this memory task were transformed into d′ values. The use of this index enables us to counteract the effect of response bias in the performance. That is, some participants might be particularly prone to report that "yes" the image is the same – given as they are very similar to those experienced earlier. This measure enables us to carefully judge the ability to discriminate own viewed scenes from those that are shifted in perspective. See Table 1 for means and SDs of Hit rate, False alarms and d′ values for the two questions of the task. Examination of the pattern of Hit Rates and False Alarms for the two questions reveals that the older group were very likely to incorrectly believe they had seen the scene previously. For the second question both the Hit Rates and False Alarms in the older group suggest they were very poor at discriminating whether it was from their head camera. This is despite the fact that they were allowed as long as they liked to respond and there was always an experimenter present in order to ask for clarification of task instructions.

Effect sizes are given with Cohen's d, labelled with its full name to distinguish from d′ values. Cohen's d can provide information about the magnitude of the effect. If Cohen's $d = 0.2–0.49$ the effect is small, if $d = 0.5–0.79$ the effect is medium, and if $d > 0.79$ the effect is judged as large (Cohen, 1988). A mixed effects ANOVA with within subject factor of question (d′ for Q1, d′ for Q2) and between subjects factor of group revealed a main effect of question ($F(1, 42) = 29.299$, $p < .001$, Cohen's $d = 0.8036$), a main effect of age group ($F(1, 42) = 29.786$, $p < .001$, Cohen's $d = 1.2256$), but no interaction between question and age group ($F(1, 42) = 1.045$, $p = 0.313$).

As our main interest was in the discrimination ability of the different age groups for the separate questions, independent samples t-tests were carried out on Question 1 "did you see this scene earlier?" and Question 2 "is this the exact scene from your head camera?". These tests revealed that younger adults were better at discriminating previously viewed scenes for both questions. Question 1 – $t(42) = 3.39$, $p < .001$, Cohen's $d = 1.035$; Question 2 – $t(42) = 5.89$, $p < .001$, Cohen's $d = 1.792$.

To compare discrimination performance for the task within the groups, paired samples t-tests revealed that for both groups discrimination was more difficult in Question 2 – "is this from your head camera?" than for Question 1 "did you see this scene earlier?". For the young group $t(18) = 4.63$, $p < .001$, Cohen's $d = 1.061$; older adults $t(24) = 4.06$, $p < .001$, Cohen's $d = 0.812$.

Analysis of the 3-D memory task suggests that this task is sensitive to changes in episodic memory in older adults. This harmonises with our previous work using a similar task with functional neuroimaging (Russell et al., 2019) in which older adults were particularly poor in Question 2 and this was in contrast to performance in other episodic memory measurements.

Table 1. 3D episodic task data (standard deviations in brackets) for Experiment 1.

Group	Question	Hit rate	False alarm	d′ value
Younger adults	1	.96 (.23)	.07 (.19)	3.75 (.91)
Older adults		.91 (.08)	.34 (.39)	2.20 (1.82)
Younger adults	2	.88 (.10)	.14 (.15)	2.71 (.94)
Older adults		.75 (.15)	.50 (.32)	.68 (1.26)

Autobiographical memory interview. As outlined above, every memory recalled by each participant received three evaluations. Two of these were self-evaluations: The rating of how much they mentally visualised the event, 1-4; whether the recall was from a field or an observer perspective. The third was the episodic score, derived as described in the section above. In order to analyse the data, these evaluations were averaged across the three memories recalled at each time period. In the case of the self-evaluations of mental imagery and the episodic scores a mean value was derived for each time period from the 3 memories recalled at each period. For the Field (represented as 1) versus Observer (represented as 0) judgements, the mode value from the three memories in each period was used to allocate a score of 0 or 1 for that time period. For example, if they rated two of the three memories as being from their own eyes (field) and one as being from an observer perspective it was scored 1; if they rated two as being from the observer perspective and one as an own eyes perspective it was scored as a 0.

In addition to analysis performed for each time period, a composite score across all time periods was also created for each participant. See Table 2 for the data and standard deviations.

Self-rated mental imagery of memory: Analysis of these scores was performed to examine age effects in the rating of the quality of the imagery involved during the recalled memory. A mixed effects ANOVA with within subject factor of time period of the self-rating (Time 1; Time 2; Time 3) and between subjects factor of group revealed a main effect of Time ($F(2, 84) = 20.48$, $p < .001$, Cohen's $d = 0.990$) but no main effect of age group ($F(1, 42) = 1.708$, $p = 0.198$, Cohen's $d = 0.246$) and no interaction with age group ($F(2, 84) = 1.10$, $p = .34$, Cohen's $d = 0.210$). Examination of this data in Table 2 suggests that both groups subjectively report more vivid recall as the memory becomes more recent.

Independent sample t-tests were performed for each time period and for the composite score across all periods to confirm that age group did not affect these self-ratings. These revealed that there were no significant differences in the self-rated quality of imagery experienced at any point (Time 1_childhood: $t(42)= - 1.36$, $p = 0.180$, Cohen's $d = 0.415$; Time 2_last 5 years: $t(42)= -1.67$, $p = 0.212$, Cohen's $d = 0.386$; Time 3_most recent year: $t(42) = .18$, $p = 0.857$, Cohen's $d = 0.055$; Composite; $t(42) = -1.55$, $p = 0.128$, Cohen's $d = 0.472$).

Field versus Observer perspective: See Figure 2 for this data. Chi-square analysis was performed to examine whether there were age group differences in the use of Field or Observer perspective across the time periods. This was not the case for any of the time periods used in the autobiographical interview (Time 1 = X^2 (1, $N = 44$) = .03, $p = .95$; Time 2 = X^2 (1, $N = 44$) = .72, $p = .39$; Time 3 = X^2 (1, $N = 44$) = .08, $p = .77$).

Table 2. Data from autobiographical interview in Experiment 1.

Group		Time 1	Time 2	Time 3
Younger adults	Self-Rate	2.66 (.78)	3.16 (.54)	3.60 (.48)
	Episodic Score	3.15 (.57)	3.14 (.51)	3.41 (.45)
Older adults	Self-Rate	2.97 (.74)	3.40 (.68)	3.57 (.53)
	Episodic Score	2.80 (.67)	2.73 (.62)	3.14 (.44)

Note: Standard deviations are shown in brackets.

However, as can be seen in Figure 2 number of "own eyes" responses did increase as memory became more recent. Cochran's Q test of this binary categorical data revealed there to be significant effect of Time period on use of "Own Eyes" perspectives in the autobiographical interview (Cochran's Q test statistic = 11.70, $n = 44$, df = 2, $p = .003$, Cohen's $d = 0.783$).

This was led by a significant difference between own eyes perspective at Time 1 and the other two time periods (Time 1 compared to Time 2: Cochran's $Q = 5.40$, $p = .02$, Cohen's $d = 0.748$; Time 1 compared to Time 3: Cochran's $Q = 9.00$, $p = .003$, Cohen's $d = 1.014$), whereas there was no difference between Time 2 and Time 3 (Cochran's $Q = 1$, $p = .32$).

Episodic Score: Analysis of these scores was performed to examine for age effects in the "Episodic Score" allocated to participants' memories. A mixed effects ANOVA with within subject factor of memory time period of the episodic score (Time 1; Time 2; Time 3) and between subjects factor of group revealed a main effect of Time period ($F(2, 84) = 7.89$, $p < .001$, Cohen's $d = 0.531$), a main effect of age group $F(1, 42) = 7.054$, $p = 0.011$, Cohen's $d = 0.6057$), but no interaction between age group and time ($F(2, 84) = .27$, $p = .77$). Examination of Table 2 reveals that although the pattern of episodic scores awarded to the groups across the time periods appeared consistent, the scores are lower in the older group. In contrast to their self-ratings, the older adults' memories were recalled

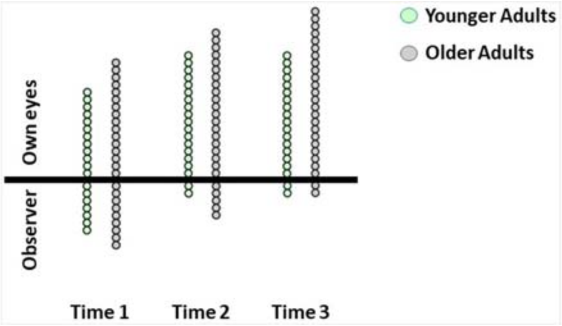

Figure 2. Individual participant responses in each time period and each age group in Experiment 1. Each circle represents one participant. Data were coded with the mode value; 'Own Eyes' if in all or most of the 3 memories within a time period a participant provided an 'Own-Eyes' response, whereas they were coded as 'Observer' if in all or most of the 3 memories within a time period the participant provided an 'Observer' response [To view this figure in color, please see the online version of this journal].

with fewer episodic details across most of the time periods and across the composite score from the task. Only at Time 1 – childhood – were the scores statistically equivalent ($t(42) = 1.83$, $p = .07$). At Time 2 (most recent 5 years) and Time 3 (current year) the younger adults' autobiographical memories contained significantly more episodic details ($t(42) = 2.34$, $p = .02$, Cohen's $d = 0.713$; $t(42) = 2.00$, $p = .05$, $d = 0.609$ respectively). Averaged scores across the whole task also revealed significantly better performance in the younger adults ($t(42) = 2.65$, $p = .01$, Cohen's $d = 0.807$).

Relationship between tasks. A specific aim of this investigation was to examine the relationship between the two tasks themselves and whether this was affected by age-group. Given the results above and for simplicity of comparison, we performed this analysis using the composite "Episodic score" for the autobiographical interview (collapsed across all time periods) and compared these with the d′ values for Question 1 and Question 2 of the episodic task, in which scenes were experienced in "real-life", with Pearson's correlation. Here we have also incorporated Bayes Factor into our analysis strategy (eg, Lee & Wagenmakers, 2014). This enables an assessment of the strength of the evidence for disproving the null hypothesis, which is of value here given the more complex analysis of a relationship between two tasks and how they interact with age-group. For Question 1 discrimination score (d′) and Episodic score of the autobiographical interview the relationship did not reach significance ($r = .29$, $n = 44$, $p = .06$, $BF_{10} = 1.119$, a value suggestive only of anecdotal evidence for the hypothesis of a correlation between these two). For Question 2 discrimination score (d′) and the Episodic score68 in the autobiographical memory interview there was a significant relationship ($r = .38$, $n = 44$, $p = .01$, $BF_{10} = 3.920$, this value is indicative of moderate evidence of a correlation between performance in this question and autobiographical episodic score). This suggests that our second question in particular – Is this the scene from your head camera? – might be related to the ability to recall episodic details in autobiographical memory.

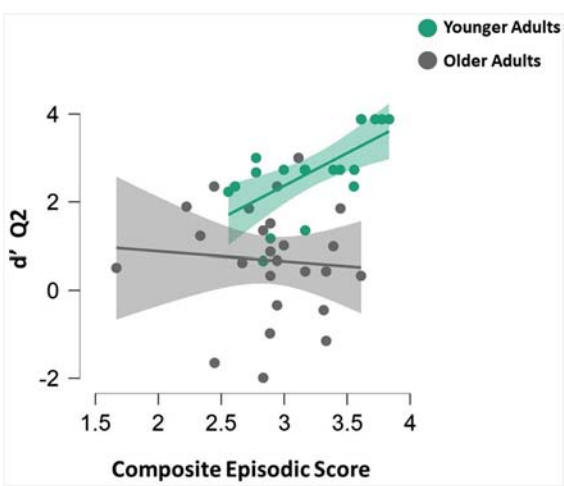

Figure 3. Scatterplot comparing Younger Adults' and Older Adults' composite episodic score in the autobiographical interview (*x* axis) with discrimination ability for own versus a shifted perspective - d′ discrimination for Question 2 in the 3-D task (*y* axis) in Experiment 1. The shaded areas around each regression line represent the 95% CIs [To view this figure in color, please see the online version of this journal].

To probe this relationship further and due to our particular interest in how age impacts upon these tasks, we performed analysis to formally examine the moderation effect of age on the relationship between our two tasks. To test this moderation, age was entered as a predictor of discrimination ratings (d′) for question 2 in the 3-D task, alongside mean-centred scores on the episodic score of the autobiographical memory task and the interaction between these two terms. Results indicated a significant difference between young and older adults on their d′ ratings, $B = -.88$, $SE = .18$, $t(40) = 4.92$, $p < .01$, $\beta = -.581$. There was no significant interaction between age-groups and the episodic score of the autobiographical task $B = -.64$, $SE = .4$, $t(40) = -1.62$, $p = .113$, $\beta = -.193$. Importantly, we found a significant moderating effect of age-group on the relationship between d′ and episodic score: $B = .92$, $SE = .4$, $t(40) = 2.32$, $p = .026$, $\beta = .256$, this indicates a medium effect size, $BF_{10} = 1.768$, indicative of small evidence of the effect.

To confirm a differential pattern of results between the age groups, analysis was first carried out on the different values of the correlation coefficients between the two groups in the relationship between Question 2 of the 3-D task and episodic scores in the autobiographical interview, these significantly differed ($z = 2.6037$, $p = 0.0092$), Pearson's correlations were then performed separately for the two age groups. This separation of data was revealing. The data of the younger adults showed a relationship between these measures ($r = .65$, $n = 19$, $p = .002$, $BF_{10} = 20.685$, a value indicative of strong evidence to accept this relationship) whereas, when analysed separately, the data from the older adults showed no evidence of a relationship between these tasks (r= - .08, $n = 25$, $p = .72$, $BF_{10} = 0.264$). See Figure 3 for a visual depiction of this data. For d′ values of Question 1 in the 3-D task there was no significant correlation with overall episodic score in the young group (r= .45, $n = 19$, $p = .052$, $BF_{10} = 1.640$) and again no correlation in the older group (r= .04, $n = 25$, $p = .85$, $BF_{10} = 0.252$).

Results from the first study demonstrate that our 3D episodic laboratory task, which specifically probes ability to discriminate between one's own eye's perspective and that from another angle, correlates with a measure of episodic richness in autobiographical memory. But this relationship is only shown for younger adults. When data are separated by age-group, we see that performance in the two tasks does not correlate in older adults. In fact, age group moderates the relationship between d′ discrimination in the second question of the 3-D memory task and the composite score of episodic richness in the autobiographical interview. To investigate this relationship, we carried out a second study in which we replaced the 3-D task with a task in which 2D photographs of similar scenes were encoded. This was to confirm whether the relationship we saw between the 3-D task and autobiographical memory in the first study was a result of the "real life" experience of the encoding session.

Experiment 2

Methods

Participants

Forty-six new participants took part in this study: 20 healthy young subjects (13 females) between 19 and 35 years old ($M = 25.4$, $SD = 5.38$) and 26 healthy older adults (12 females) aged between 65 and 82 years old ($M = 74.42$, $SD = 5.56$). Most of the young participants were recruited from posters on campus. Older adults in this study were recruited from a local gym and from advertisements placed in the university and local hospital sites. The project received ethical approval from the local university ethics committee. All participants gave written informed consent to take part in the study and confirmed that they had no current diagnosis of neurological or psychiatric illness. They were reimbursed for time and inconvenience.

Computer- displayed 2-D episodic memory task

Encoding. Images for this task consisted of 35 full-colour photographs of objects on a 2 × 2 black-and-white grid. The grid was identical to that used in Experiment 1. Objects were taken from the same categories as in Experiment 1 but only one object was used in each scene (see Figure 1a). Presentation of the scenes was programmed using Psychopy software (Peirce, 2009). Each scene was displayed for 6500 msecs, order of presentation of the images was randomised across participants. The 35 trials were split into 3 blocks, participants initiated the start of the next block themselves when ready. Instructions were given to all participants to remember the scenes presented to them, emphasising the need to focus on what the scenes looked like rather than just which objects were presented.

Recognition task. In the recognition task participants were presented with 35 images on the computer screen. Nineteen of these scenes were identical to those seen in the encoding session (identical condition); 8 images were presented in which the viewing perspective of the scene had changed by 90 degrees (perspective shift condition); 8 in which the position of the object had changed (item shift condition). Scenes were shown until participants made a response. In contrast to Experiment 1 only one object was shown in the photographs used in this study.

In order to counterbalance use of individual scenes across the testing conditions we pseudorandomised the condition for which an image was used in the recognition trials. Three versions of the recognition task were created in which the mappings of individual scenes were varied so that the same picture was presented in different recognition conditions for different participants. For example, an image like the rugby ball scene shown in Figure 1 was presented in the "identical" condition to some participants, in the "perspective shift" to others and in the "item shift" to the rest. Each version had the same number of identical images, perspective shift images and item shift images and the same objects as they saw in the encoding task. Participants were allocated to one of the three versions at the start of the task.

The presentation order of the scenes was randomised across participants. They were asked to make a forced choice decision to the question "Did you see this exact image earlier?"

And they had unlimited time to respond with a "yes" or "no" answer.

Autobiographical memory interview

This was administered and scored in the same way as described above in Experiment 1.

Experimental procedure

The computer- displayed 2-D episodic memory task and the autobiographical interview were run in the same experimental session. Each participant came into the laboratory for a session lasting approximately 90 min. The encoding session was carried out first (lasting around 8 min), followed by a break, then the autobiographical interview (lasting around 45 min) and finally the recognition test of the previously encoded photographs (10 min). The rest of the time consisted of going through the information sheet, taking informed consent, breaks and debrief.

Results

Computer- displayed 2-D episodic memory task.

In this task, participants were asked to judge "Did you see this exact image earlier?". Trials which were not original images could either be from a changed perspective (perspective shift - attempting to re-create features of the 3-D task) or contain a changed position of the item with the same perspective (item shift). To examine whether in this task we could see a similar effect of perspective in episodic memory with 2-D images we created two d′ scores for each participant. In one calculation the false alarms in the calculation were from the perspective shift trials and in the other the false alarms used in the calculation were from the item shift condition. This means that we could examine whether there were different discrimination abilities revealed across the two changed images. See Table 3 for these hit rates, false alarms and d′ values.

Table 3. Computer displayed 2D episodic task data (standard deviations in brackets) for Experiment 2.

Group	Condition	Hit rate	False alarm	d′ value
Younger adults	Perspective shift	.78 (.13)	.28 (.18)	1.50 (.77)
Older adults		.78 (.14)	.39 (.22)	1.19 (.79)
Younger adults	Item shift	.78 (.13)	.25 (.18)	1.57 (.66)
Older adults		.78 (.14)	.31 (.18)	1.43 (.76)

A mixed effects ANOVA with within subject factor of condition (d′ for perspective shift, d′ for item shift) and between subjects factor of group revealed no main effect of condition ($F(1, 44) = 1.690$, $p = 0.200$), no main effect of age group ($F(1, 44) = 1.439$, $p = 0.237$), and no interaction between condition and age group ($F(1, 44) = 0.494$, $p = 0.486$).

Independent means comparisons of d′ values revealed there to be no group differences in either comparison – neither for the perspective-shift condition ($t(44) = 1.34$, $p = .19$), nor the item-shift condition ($t(44) = .68$, $p = .50$). Paired means comparisons to examine performance within each age group for the perspective shift versus item shift condition revealed there to be also no significant difference in task performance between perspective and item shift lures in older adults ($t(25) = -1.46$, $p = .16$) or in younger adults ($t(19) = -.42$, $p = .68$).

In contrast to Experiment 1, the measure in Experiment 2 does not appear to be sensitive to age-related changes in episodic memory.

Autobiographical interview

Self-rated mental imagery of memory: See Table 4. As in the first study, analysis of these scores was used to examine for age effects in the rating of the quality of the imagery during recall. A mixed effects ANOVA with within subject factor of memory time period of the self-rating (Time 1; Time 2; Time 3) and between subjects factor of group revealed a main effect of Time ($F(2, 88) = 21.35$, $p < .001$, Cohen's $d = 1.009$), no main effect of age group ($F(1, 44) = 0.855$, $p = 0.360$) and no interaction with age group ($F(2, 88) = .03$, $p = .98$).

Independent sample t-tests were performed for each time period and for the composite score across all periods. These revealed that there were no significant differences between the groups in the self-rated quality of imagery experienced at any point (Time 1_childhood: $t(44)= -.59$, $p = 0.555$; Time 2_last 5 years: $t(44)= -.76$, $p = 0.452$; Time 3_most recent year: $t(44) = -.55$, $p = 0.588$;

Table 4. Data from autobiographical interview in Experiment 2.

Group		Time 1	Time 2	Time 3
Younger adults	Self-Rate	2.83 (.70)	3.30 (.68)	3.65 (.77)
	Episodic Score	2.78 (.54)	2.43 (.63)	2.51 (.62)
Older adults	Self-Rate	2.96 (.73)	3.44 (.63)	3.74 (.35)
	Episodic Score	2.44 (.68)	2.13 (.59)	2.57 (.47)

Note: Standard deviations are shown in brackets.

Composite: $t(44) = -.92$, $p = 0.360$). Overall, self-rated vividness increased across the time periods with the lowest rating for Time 1 and the highest for Time 3.

Field versus Observer perspective: See Figure 4, depicting this data. Chi-square analysis was performed to examine whether there were differences between the age-groups in the use of Field or Observer perspective across the interview. This was not the case for any of the time periods used in the autobiographical interview (Time $1 = X^2$ (1, $N = 46$) = .001, $p = .98$; Time $2 + X^2$ (1, $N = 46$) = .66, $p = .42$; Time $3 = X^2$ (1, $N = 46$) = .001, $p = .97$).

However, as can be seen in Figure 4, number of own eyes responses did generally increase as memory became more recent. Cochran's Q test analysis of this categorical data revealed there to be a significant effect of Time period on use of own eyes perspectives in the autobiographical interview: $n = 46$, df = 2, Cochran's $Q = 7.88$, $p = .019$, Cohen's $d = 0.226$.

This was led by a significant difference between own eyes perspectives at Time 1 compared to Time 3: $n = 46$, df = 1, Cochran's $Q = 5.40$, $p = .02$, Cohen's $d = 0.729$.

(Time 1 V Time 2 = n = 46, df = 1, Cochran's $Q = 3.27$, $p = .07$; Time 2 V Time $3 = n = 46$, df = 1, Cochran's Q = 1.0, $p = .32$).

Episodic Score: We examined how the "Episodic Score" allocated to participants' memories varied according to age group in this study. A mixed effects ANOVA with within subject factor of memory time period of the episodic score (Time 1; Time 2; Time 3) and between subjects factor of group revealed a main effect of Time period ($F(2, 88) = 7.75$, $p < .001$, Cohen's $d = 0.473$), no main effect of age group ($F(1, 44) = 1.772$, $p = 0.190$, Cohen's $d = 0.3136$), and no interaction between these two factors ($F(2, 88) = 2.93$, $p = .059$, Cohen's $d = 0.285$).

To follow procedure from Experiment 1 we further probed this data with independent sample t-tests. In contrast to Experiment 1, there were no significant differences in episodic scores in the autobiographical memory interviews at any time point. Time 1 – childhood – $t(44) = 1.79$, $p = .08$, $d = 0.532$; Time 2-most recent 5 years- $t(44) = 1.64$, $p = .11$; Time 3 -current year t(44) = -.33, $p = .74$; composite score $t(44) = 1.33$, $p = .19$.

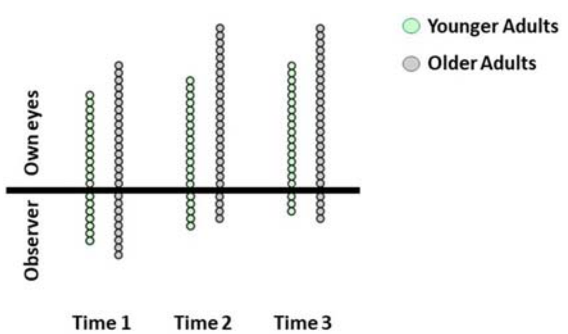

Figure 4. Individual participant responses in each time period and each age group in Experiment 2. Each circle represents one participant. Data were coded with the mode value; 'Own Eyes' if in all or most of the 3 memories within a time period a participant provided an 'Own-Eyes' response, whereas they were coded as 'Observer' if in all or most of the 3 memories within a time period the participant provided an 'Observer' response [To view this figure in color, please see the online version of this journal].

Relationship between tasks

As in Experiment 1, we were interested in examining whether performance in the 2-D task correlated with performance in the composite episodic score in the autobiographical interview. In contrast to the first study there was no overall interaction here between the autobiographical episodic score and the d' discrimination scores for either the perspective shift ($r = -.032$, $n = 46$, $p = .84$) or the item shift condition ($r = .056$, $n = 46$, $p = .712$).

For completeness, and as the relationship between tasks in Experiment 1 had been disparate between groups, we carried out this correlation analysis on the older and younger groups separately. This analysis demonstrated that performance in the 2D task and the episodic score of the autobiographical interview did not correlate in either age group. For the young group: $n = 20$, perspective shift d': $r = .17$, $p = .48$, item shift condition d': $r = .19$, $p = .39$; in the older group: $n = 26$, perspective shift d': $r = -.28$, $p = .16$, item shift condition d': $r = -.087$, $p = .67$.

General discussion

In our first study we used a novel episodic memory task in which participants experience 3D scenes from different viewing angles. Recognition memory of these scenes was later tested with images purportedly from the head camera they were wearing during encoding. The same participants completed an autobiographical memory interview, in which they recalled three memories from three different periods of their life. Older adults were significantly less accurate than younger adults in discriminating their own scenes from those taken from a different perspective. They also recalled less episodically rich autobiographical memories from all time periods and in the composite score across all periods. Our principal interest was in the relationship between these two tasks. Correlation analysis revealed a relationship between the ability to discriminate the different perspectives in episodic memory and in the episodic score obtained in the autobiographical interview. Further probing revealed this relationship was led by the younger adults – their key scores in the two tasks had a strong correlational relationship – whereas this correlation was not present for the older adults. Further moderation analysis confirmed that the relationship between the two tasks was moderated by age-group. This result suggests that a shared mechanism between some episodic tasks and autobiographical memory might be in the recollection from one's own eyes' viewpoint at test. Further, that this relationship changes across the lifespan. In a follow-up study with two different groups of participants we used the same autobiographical interview but changed the episodic task to involve photographs of the scenes. The correlation results were not replicated. This result is suggestive that this, more standard picture encoding, in an episodic memory task is not necessarily using the same mechanisms required in autobiographical recall.

What are the reasons underlying the correlation in performance between the two tasks in our first study? We believe this is due to the demands of our particular episodic task. The scenes consist of everyday objects placed on a real-life grid in front of the participants, who witness this placement while wearing a head camera. The effect of this type of encoding is to produce 3-D discrete events, which participants experience viewing from a real-world perspective. The presence of a head-camera cues them to encode what the scenes look like to them – i.e. to process them as a visuo-spatial image. They know they must later identify "their" scene. A useful strategy here is to create a mental image from their perspective in the recognition task with which to match the presented image on the screen. In our original study with this task we showed that the angular gyrus and nearby regions are critical for the ability to correctly recognise own viewed scenes (Russell et al., 2019). Evidence from other groups is delineating the role of these regions in autobiographical memory. For example, Bonnici et al. (2018) revealed that disrupting this region with continuous theta burst stimulation (cTBS) reduced the number of first-person recalled memories in an autobiographical interview. Here, we make explicit the link between our task and autobiographical memory.

Related to our argument are studies that demonstrate different neural regions or networks being involved in laboratory episodic tasks compared to "real-world" autobiographical recall (e.g. Chen et al., 2017; Monge et al., 2018). The tasks compared in these studies are often either more similar to our second study – e.g. asking participants to encode picture stimuli and comparing neural activation for that compared to autobiographical memory recall (e.g. Chen et al., 2017) or involve a less visual task such as word recall as the episodic condition (e.g. Monge et al., 2018). We suggest that when the episodic memory task involves encoding a 3D experience from different viewpoints, young healthy adults rely on the same recollective processes as when recalling an autobiographical memory. Also related here is the recent evidence linking the angular gyrus to vividness of recall in an episodic memory task (Tibon et al., 2019). In this study, during encoding, participants were explicitly asked to generate an association between two pictures (or a pair consisting of one picture and one sound) and were later tested on recall of the non-presented associate in a memory test. This task is different from that described here, but we would suggest that the generation of an associate between two images or an image or a sound is likely to involve creation of a visuo-spatial mental image. Further, for trials in this task for which recall was successful – and vivid – the visuo-spatial mental image would be re-experienced from the perspective it was created at retrieval.

It is interesting to note that in the studies described here participants encoded emotionally neutral scenes of everyday objects whereas in the autobiographical interview they are likely to have recalled events with emotional and/or self-referential content. Using neutral stimuli, which are easier to experimentally control, is a useful first step. However, further research would be useful to delineate the differential role of emotion across the tasks as emotional valence is known to enhance level of episodic detail in autobiographical memory (e.g. see, Kensinger & Ford, 2020).

It is also important to consider why the relationship might change with increasing age. Despite the reduction in performance (compared to the young group) in both tasks it would be possible for the same mechanism to be used at recall, albeit less successfully. This does not appear to be the case. The first potential reason might be that performance is more variable in this group, thereby making a correlation between tasks more difficult to find (e.g. MacDonald et al., 2012). Examination of Figure 3 does suggest more variability in the older group and this is likely to be part of the reason for this finding. In our original study, we also saw poorer performance in older adults in our perspective task but when we separated out accurate from inaccurate performance in our multi-voxel pattern analysis (MVPA) of neuroimaging data we could see the relationship between angular gyrus and *accurate* recognition of visual perspective at encoding. This suggests that older adults can complete this type of recollection but perhaps are less likely to do so. The current study did not explicitly collect data on strategies used by participants and so further studies should include those type of questions after the tasks have been completed. We would argue that the data do suggest older adults are not consistent in their ability to use these mechanisms that are effective in the younger groups, and that this leads to a weaker relationship between performance in these two measures. Relevant here is recent work by Horne et al. (2020) who demonstrate that older adults with equivalent memory performance in their episodic task achieve this performance in a *qualitatively different* way to the younger group. These differences are directly involved with a lack of recruitment of parietal regions in recollection by the older adults.

An aspect of autobiographical memory that we would expect to vary across the age-groups and did not were the participants'subjective judgements of their autobiographical memories, as it appears that the subjective experience of recall is integral to the role of angular gyrus (e.g. Bréchet et al., 2018; Yazar et al., 2014). Here, the subjective ratings of how vividly they pictured the scene in their mind in the autobiographical interview were not sensitive to age and did not mirror the episodic scores allocated to the memories by up to three independent experimenters. However, this dissociation between self-rated vividness and recall of episodic detail in older adults is seen in the literature. Recently Folville et al. (2020) examined this dissociation and linked it to reduced activity in precuneus of parietal cortex when retrieving memories in older adults when compared to young adults.

Results for the direct questioning of whether any mental image they had of the memory was from the first or observer perspective did not replicate the age-group results of previous studies (e.g. Piolino et al., 2006). We did see an increase- in both age-groups -of first person recall in recent memories, which harmonises with previous literature, but the older adults were no less likely to use first-person recall than the younger adults. Although it was important to include this question, during testing there were hints that this might be problematic. Participants often asked for so much clarification of this question that the experimenters felt they were prompting them with the answer and revealing too much about the aims of the study. It might be the case that this probing was not uniform across the age-groups and so future studies should record how many times and who requires clarification about these important questions. Also, the use of a continuous scale for field-observer perspective, as has been used in some studies (Berntsen & Rubin, 2006; Sekiguchi & Nonaka, 2014; Siedlecki, 2015; Verhaeghen et al., 2018), may provide a more precise measure of one's perspective.

Returning to the second study, the results suggest that the picture encoding task, despite involving a manipulation of encoded angle at recollection, did not relate to episodic recall in autobiographical memory. This harmonises with imaging results from picture encoding tasks when compared to autobiographical memory (e.g. Chen et al., 2017). Further study will enable additional clarification. Compared to the 3-D task, performance was very poor in both groups in discriminating the pictures they had encoded. This might suggest that the task was too challenging to identify differences between the age groups. Although participants were instructed to not only remember the object in the image but also " … what the whole image looks like to you", it is possible that participants presumed they would be able to recognise the pictures by remembering the objects within them for this task, whereas the objects were always the same and the only differences were in the angle of the photographs or the position of the objects. Future studies should clearly clarify this with participants so that they are not at or around floor performance. Results from the autobiographical interview did also not match with the first study. Episodic scores in the autobiographical interview were overall much lower. This might result from different interviewers involved in each study using the probes differently. The use of a more structured autobiographical interview would be a good extension of this work – for example the Autobiographical Interview, developed by Levine et al. (2002) – in order to reduce between interviewer variability. Nevertheless, the contrast between the correlations between the studies is revealing and sheds light on which aspects of an episodic memory task might be shared with episodic autobiographical recall.

In the work outlined in this paper, we were interested in whether the episodic elements of autobiographical memory relate to behavioural measures of self-perspective in a laboratory-based task of episodic memory. We have shown that this is the case when the episodic memory task involves experiencing 3-D stimuli but not when encoding photographs of similar scenes, and that this relationship changes with age. It appears to be the case that the ability of younger adults to remember the perspective from which they viewed a 3-D scene in the laboratory relates to the episodic richness of their autobiographical memory. Whereas remembering a photographed perspective in a 2-D image does not have this relationship with autobiographical memory. This suggests that one potential difference between some laboratory measures of episodic memory and those of autobiographical memory is in the personal spatial context that 3-D scenes allow (e.g. see Diamond et al., 2020; McDermott et al., 2009). Further, here there is evidence that older adults might not support episodic richness in their autobiographical memory with the ability to remember personal spatial perspective in 3-D scenes. This is interesting as previous work has identified both age-differences in the ability to perform this 3-D task, and identified parts of parietal cortex utilised in completing the judgments of whether a scene is taken from one's own visual perspective (Russell et al., 2019). Interestingly, other research has identified the subjective sense of recall and whether recall is from a field / own-eyes perspective as being associated with these same parts of parietal cortex (e.g. Yazar et al., 2014), whereas here similar self-rated judgments did not vary between our age-groups. Further research is needed to delineate the relationship between subjective and objective judgements of autobiographical and episodic memory in healthy ageing.

Acknowledgments

We would like to thank everyone who participated in our experiments. M.E.K. acknowledges support from the A. S. Onassis Public Benefit Foundation, A.G. Leventis Foundation, Sir Richard Stapley Educational Trust, and Hilda Martindale Educational Trust.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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