An Older Adult Advantage in Autobiographical Recall

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Author Note

Preregistrations for studies reported in this paper can be found here and here

The research was supported by the Nottingham Trent University Research Kickstarter initiative.

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Abstract

This pre-registered online study aimed to measure the effect of environmental support on age-differences in autobiographical memory alongside memory for images. Young and older adults reported autobiographical memories about which they regularly thought (high environmental support through practice) or that were experimentally cued to be mundane (low environmental support). The support manipulation was also applied to descriptions of images that were produced whilst images remained on screen (high support) or produced from memory (low support). In line with existing theory, support disproportionately benefitted older adults in the quantity of information produced. However, analysis of the autobiographical descriptions showed no age deficit in reporting episodic detail, in contrast to much of the existing literature. A second group of young and older adults also evaluated the descriptions produced, and older adults' descriptions were consistently rated as higher quality than young adults' descriptions across several dimensions such as vividness and clarity. An unplanned meta-analysis was conducted to assess if a publication bias existed in the literature favouring the reporting of age-deficits in producing episodic detail in autobiographical memory: there was no evidence for a bias and the modal result of age deficits was generally supported. A key distinction is that the current study was conducted online - evidence is presented to argue that older adults may perform better at autobiographical memory tasks outside the lab.

Keywords: Autobiographical Memory, Environmental Support, Episodic Detail, Meta-Analysis, Aging

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It is well established that memory deficits resulting from healthy aging vary according to the specific requirements of a given memory task (e.g., Zachs, Hasher & Li, 2000; Naveh-Benjamin, & Ohta, 2012). In the current article we focus on age deficits in autobiographical memory (ABM), where reports of past events and experiences are generated by participants. Such studies produce rich data that can distinguish between processes with differential susceptibility to age-related decline such as episodic versus semantic content (Piolino et al., 2010) and emotional versus neutral content (St. Jacques & Levine, 2007), with links to key cognitive aging theory such as the resource deficit account (Holland & Rabbitt, 1990) and the inhibitory deficit hypothesis of ageing (Hasher & Zacks, 1988; Piolino et al., 2010). Furthermore, age-related deficits in ABM could influence an individual's sense of identity. For example, Haj et al. (2015) argued that 'autobiographical memory is essentially memory of the self and provides the foundation for self-consciousness, self-knowledge, and self-images.' This suggests that studying ABM could also provide insight into applied aging issues such as understanding a shifting sense of identity in older adults and the improvement of wellbeing in late life.

Autobiographical memory has been hypothesised to involve processes particularly susceptible to age-related decline such as episodic memory and unsupported, effortful retrieval (Levine et al., 2002), which corresponds with a resource deficit account of aging (e.g., Craik, 1986). For example, during autobiographical recall, older adults have been shown to generate less detail and less specific information relative to young adults (for a review see Schacter, Gaesser, & Addis, 2013). Similarly, Piolino et al. (2002) and Frankenberg et al. (2022) showed a greater emphasis on semantic compared to episodic content in ABM with increasing age. Such age deficits in reporting of episodic memory detail have been associated to measures of age-related inhibitory and executive function deficits

(e.g., Piolino et al., 2010, see Wilson, & Gregory, 2018 for a review). Furthermore, supporting autobiographical recall by probing during interviews has been shown to attenuate age differences in the production of episodic detail (St. Jacques & Levine, 2007). These findings suggest age differences in ABM can be described in terms of a resource-deficit account of aging (c.f., Holland & Rabbitt, 1990).

In contrast, it has also been argued that age deficits in autobiographical recall have been associated to processes independent of age-related episodic memory decline, because similar age deficits have been found for image descriptions and for imagination (Gaesser et al. 2011; Madore et al., 2014). Madore argued that reducing the memory requirement taps into other effects linked to ABM such as descriptive ability and narrative style; underpinning this is the notion of an age-related shift in the value of information (Castel, 2007). Firstly, older adults may simply adopt a different approach to tasks in a positive sense via the growth of skills throughout adulthood (Labouvie-Vief, & Blanchard-Fields, 1982), resulting in a shift in communicative goals (Madore et al., 2014). Secondly, older adults may proactively adapt their approach to tasks to minimise the impact of age-related decline (Castel, 2007). In older adults we see a greater emphasis on gist-based processing, representing the general meaning of information rather than specific detail (e.g., Koutstaal, & Schacter, 1997), and similarly a greater reliance on familiarity over recollection in memory tasks (see, Yonelinas, 2002, for a review). These changes may impact upon ABM recollection and contribute to a reduction in older adults' tendency to report specific episodic content. It may therefore be the case that older adults do have a fundamentally intact ability to engage in successful ABM recall, but that age-related change results in a shift away from the production of specific episodic detail due to both narrative style as well as compensatory habits. To investigate this, we assessed (i) age differences in descriptive ability in the presence and absence of ABM recall (describing

an ABM vs. describing images), crossed with (ii) the presence and absence of environmental support (see below) to minimise the need for compensatory strategies.

As mentioned above, previous research has contrasted image descriptions with ABM but in those studies images remained on screen (e.g., Gaesser et al. 2011; Madore et al., 2014; Strikwerda-Brown et al. 2021). In the current study we additionally contrast describing an image that remains on screen (high support) compared to describing an image from memory (low support). This will test if adding a memory requirement within a single task type can alter age differences in descriptive ability. If age deficits in ability are similar for the high-support and low-support levels of this manipulation, it will challenge existing theory that argues that age differences are dependent on the resource requirement of a given task (e.g., Holland and Rabbitt, 1990; St. Jacques & Levine, 2007).

The current study also has a novel manipulation of support for the ABM condition. Previous research has manipulated ABM support through the provision of experimental instruction probing for details (e.g., Levine et al., 2002, St. Jacques & Levine, 2007). In the current study we operationalised support by probing for regularly thought about ABMs. This extends upon a variety of work showing that older adults can perform similarly to young adults for practiced tasks that make use of established knowledge and experience (see Umanath & Marsh, 2014, Badham et al., 2016, for reviews). In a review of ageing and ABM, Piefke and Fink (2005) argued that older adults may show successful autobiographical retrieval for practiced recall. For example, Piolino et al. (2006) showed that older adults' ABMs had many affective and perceptual details and they argued that these were related to self-defining memories which are, by definition, well-rehearsed. This is potentially further evidenced by the 'reminiscence bump' where older adults' ABMs are typically retrieved from early adulthood (e.g., Schroots, Van Dijkum & Assink, 2004) as such memories are likely to have been retrieved many times. However, Janssen, Rubin, and Jacques (2011) found that

events retrieved from the reminiscence bump showed no enhancement in participants' self-ratings of vividness and experience of reliving compared to other ABMs. Therefore, existing theory is mixed regarding the influence of practice and rehearsal on age differences in ABM and we aim to clarify the influence of these processes in the current study.

A final aspect of the current study is the use of a second group of young and older participants to evaluate the descriptions produced. This allowed us to objectively utilise a new set of measures that were equally applicable to episodic ABMs and to the general descriptions of visual scenes for which existing autobiographical evaluation measures are less valid. This evaluation was derived from the memory experiences questionnaire (Luchetti, & Sutin, 2016). It included assessment of a participants' ability to report specific details including vividness and sensory information. It also included assessment of positivity, which has previously been shown to be more prevalent in older adults' ABM descriptions (Singer, Rexhaj, & Baddeley, 2007) and may equally apply to image descriptions due to an age-related positivity bias (see, Reed, Chan, & Mikels, 2014, for a review). Finally, the overall quality of the descriptions were also assessed (see Table 6 for the full set of measures). The second group of participants comprised both age groups and this served to explore age differences in *evaluation* of descriptions. For example, there may be own-group effects such that older adults prefer other older adults' descriptions compared to young adults' descriptions and vice versa (c.f., Wiese, Komes, & Schweinberger, 2013). This will help determine potential cohort differences in preferences for reporting information in certain ways, which may be an additional factor driving age-differences in ABM reporting.

Method

Overview

A group of young and older adults completed a description generation task, this was followed by a separate group of young and older adults who completed a description evaluation task based on the initial participants' responses. The study was approved by Nottingham Trent University College of Business, Law and Social Sciences Research Ethics Committee following BPS ethical standards.

Description Generation Task

Design. Young and older adults produced two autobiographical descriptions conceived as high and low support respectively: (i) an ABM about which that they regularly think (i.e., support through practice/rehearsal) and (ii) an ABM cued by the experiment (e.g., a time when they waited in a queue). They also completed two non-autobiographical descriptions of images under high and low environmental support respectively: (iii) the content of an onscreen image (i.e., support via stimuli presence) and (iv) the content of a recently displayed onscreen image from memory.

Participants. 58 young and 57 older adults took part in the experiment. Young adults received course credit and were recruited from the university, older adults received a £5 shopping voucher and were recruited from the Nottingham Trent University ageing research volunteer panel which was previously populated via local advertisements.

Alongside demographic information, participants completed self-rated measures of eyesight, hearing and general health as well as how often they engaged in moderate or vigorous exercise. Linear and ordinal models showed no significant differences between groups for all of these measures, summarised in Table 1.

As a measure of crystallised intelligence, participants completed an online version of the multiple-choice part of the Mill Hill vocabulary test (Raven, Raven, & Court, 1988). Participants selected on screen one of six synonyms that matched a probe word. A Quasi-

Poisson regression showed that older adults outperformed young adults ($t = 9.57$, $p < 0.01$) as is typical for this task (Verhaeghen, 2003), indicating intact ability in the older group. As a measure of working memory, participants completed the forwards and backwards digit span task from the WAIS-IV (Drozdick et al. 2012) in an online format. Digits were presented sequentially at a rate of 1s per word and participants typed the digits from memory (either forwards or backwards) after the final digit was presented. The stopping rules from the WAIS-IV were automatically ascertained from responses (i.e., digit span was halted after two incorrect sequences were entered for a given amount of digits). Quasi-Poisson regression with highest digit span achieved as the outcome variable and age group and span type (forward / backward) as predictors showed no significant interaction between age group and span type ($t = 0.22$, $p = 0.82$), no significant difference between span types ($t = 0.45$, $p = 0.66$) but a significant difference between age groups ($t = 2.84$, $p < 0.01$), such that older adults (m = 10.5, se = 0.32) outperformed younger adults (m = 9.26, se = 0.3) regardless of span type.[1]

[1] Means represent WAIS scores where 10 corresponds to a span of approximately 6 or 7.

Table 1

Background Details for Participants in the Description Generation Task and the Description Evaluation Task

	Description Generation Task		Description Evaluation Task	
Variable	Young	Older	Young	Older
N (M/F) [a]	10/48	18/39	8/24	7/24
Age range	18-25	60-88	18-28	63-88
Mean age (SD)	20.0 (1.5)	70.8 (6.8)	20.7 (2.0)	73.1 (6.8)
Mean years of education (SD)	15.0 (2.0)	15.7 (4.4)	15.3 (1.6)	15.2 (3.5)
Self-rated eyesight [b]	4.1 (0.8)	4.0 (4.0)	4.3 (0.6)	3.8 (0.7)
Self-rated hearing [b]	4.0 (1.2)	3.7 (1.2)	4.3 (0.7)	4.0 (0.9)
Self-rated general health [b]	4.0 (0.7)	4.0 (0.7)	4.1 (0.7)	4.1 (0.7)
Self-rated exercise [c]	2.5 (1.0)	2.7 (0.9)	2.4 (0.9)	2.7 (0.9)

Notes: [a] Number of participants whose data were included in the analyses (males/females)
[b] Rated from 1-very poor to 5-very good.
[c] Rated how often they engaged in 'moderate or vigorous exercise for 20 minutes plus' (from 1-never/rarely to 4-5/7 times a week).
No significant differences were found between measures across age groups for both studies.

Materials. The study was conducted online using Qualtrics survey presentation software (Qualtrics, Provo, UT; www.qualtrics.com). For the two ABM conditions, Table 2 shows how memories were probed using instructions adapted from Sutin and Robins (2007) and Akhtar et al. (2017). The experimentally cued ABM randomly utilised one of nine cues which probed for memories that the participant would be likely to have experienced (e.g., 'Please describe an experience when you were in a clothes store.'). These cues also corresponded to the picture stimuli used in the image description conditions (e.g., a picture of the inside of a clothes store). After reading the instructions, the participant typed a description of their memory in a text box. Following this they were asked to report their age at the time

of the memory in a text box and they were allowed to respond ‘not sure’ and ‘approximately’. The participant was then asked to rate their experience of the memory using a randomised version of the short form of the memory experiences questionnaire (Luchetti, & Sutin, 2016) ‘designed to measure 10 phenomenological qualities of ABMs: Vividness, Coherence, Accessibility, Time Perspective, Sensory Details, Visual Perspective, Emotional Intensity, Sharing, Distancing and Valence’ (p. 602).

Table 2

Autobiographical Memory (ABM) Probes used in the Study (the bold text was included in the original presentation)

Regularly Thought about ABM	Experimentally cued ABM
Please use the textbox below to describe a memory about any kind of experience, but **it should be something you have thought about many times**. Please describe the memory in detail: what happened and when, whom you were with (if anyone), and how you felt or reacted. Please ensure the memory you bring to mind is of a specific, one-off experience that lasted minutes or hours. Please avoid recalling repeated events or events that lasted more than a few hours.	Please describe an experience when you were [in the countryside [a]]. Please describe the memory in detail: what happened and when, whom you were with (if anyone), and how you felt or reacted. Please ensure the memory you bring to mind is of a specific, one-off experience that lasted minutes or hours. Please avoid recalling repeated events or events that lasted more than a few hours.

Note: [a] Each participant experienced one of nine possible versions of this cue: ‘at the coast’, ‘at a coffee house’, ‘at a clothes store’, ‘in the countryside’, ‘at an art gallery’, ‘in a queue’, ‘at a park’, ‘at a swimming pool’ or ‘walking through a city’.

For the image description conditions, nine pictures were selected from a Pixabay (www.pixabay.com). Images were selected to be of everyday familiar scenes with no specific point of focus but with multiple objects that could warrant a description. Five of the images had people in them and four were unpopulated. The images corresponded to the nine possible experimentally cued ABMs indicated in the note to Table 2. Original images were all

landscape and were at least 960 pixels wide and 500 pixels high, images were all set to be displayed with a width of 800 pixels, maintaining the original aspect ratio.

For the high support condition, participants were asked to describe the image whilst it remained on screen by typing in a text box below the image. For the low support condition, the participant was informed that an image would be displayed for 15 seconds and that they would be asked to describe it on the following screen. On the next screen they were asked to describe the image from memory by typing in a text.

Counterbalancing. Each participant experienced (i) a regularly-thought-about autobiographical cue, (ii) an experimentally-defined autobiographical cue, (iii) an image description task where the image stayed on screen and (iv) an image description task where the image disappeared. The latter three conditions involved the same stimuli set: the image pool of nine images, each with matching descriptions that were used for the experimentally cued ABM. Participants were shown three different items across these three conditions (e.g., they would not be asked to describe a memory of being in a clothes store and to also describe an image of a clothes store). Three versions of the study were produced such that a given item was equally likely to appear in each of the three conditions. Under this constraint, individual images/autobiographical cues were randomly selected from three possible items for each condition.

Procedure. The task was completed online. As the task required typing of descriptions, participants were asked to confirm that they were using a real keyboard (i.e., not a touch screen) before being allowed to proceed, alongside providing ethical consent to participate. After completing the background measures indicated in the Participants section above, each of the four description-producing conditions was completed in a random order with one of the three counterbalancing conditions randomly selected.

Description Evaluation Task

Participants. 32 young and 31 older adults took part in the experiment. These were a separate group to those participating in the description generation task. They were recruited in the same way as the participants from the description generation task and a summary of their demographic information can be seen in Table 1 which shows no differences between groups for all measures.

Materials. The study was also conducted online using Qualtrics survey presentation software (Qualtrics, Provo, UT; www.qualtrics.com). All of the autobiographical descriptions generated by the first group of participants were anonymised with places and names altered. These were then placed into eight pools corresponding to the four experimental conditions (a regularly-thought-about ABM, an experimentally-defined ABM, an image description task where the image stayed on screen and an image description task where the image disappeared) which were crossed with the two age groups of generated data. If an initial participant did not complete all four of the conditions in the design, then that entire participant's data were excluded. This resulted in 51 young and 47 older adults' descriptions that were available to be evaluated.

The descriptions were evaluated using nine questions (see Appendix Table A1 for the full list of questions). These included questions adapted from the memory experiences questionnaire (Luchetti, & Sutin, 2016) when such questions were appropriate for the evaluation of other peoples' descriptions. This included questions on the vividness and valence of the description but not questions such as how accessible the memory was or how emotional the memory generator was at the time of the event. To assess potential own-group biases, participants were also asked to rate how similar the description was to something they might produce, and to rate overall how good the description was. Ratings for each question

were completed on a 100-point sliding scale with labels *strongly disagree* to *neither agree nor disagree* to *strongly agree*. The sliding scale was initiated in the central position.

Procedure. Participants completed a consent form and the demographic information. They then rated 16 descriptions, two from each of the eight pools described above. The order of the pools was randomly selected. Two distinct descriptions were randomly displayed from each pool.

Results

The results are divided in to two sections: The first section covers direct experimenter analyses of the generated responses. The second section covers analysis of participant-generated evaluations. All data were analysed using R version 4.0.3 (2020-10-10). For all models, categorical predictors were coded with sum contrasts and pairwise comparisons are presented with Tukey corrections. Lower order effects are included for completeness.

Section 1: Direct Experimenter Analyses of Description Generator Task

Word Count

Initially, as a fully objective measure, the number of words in the memory descriptions were analysed using a multilevel Poisson regression (see Table 3 for Model Summary). Generator age, environmental support and description cue condition were included as fixed effects with participant included as a random intercept term. Results showed a significant effect of the three-way interaction, visualised in Figure 1. Pairwise comparisons, detailed in Table 4, showed that older adults had significantly longer descriptions for all environmental support by description cue condition combinations, with the exception of low support for images.

Table 3

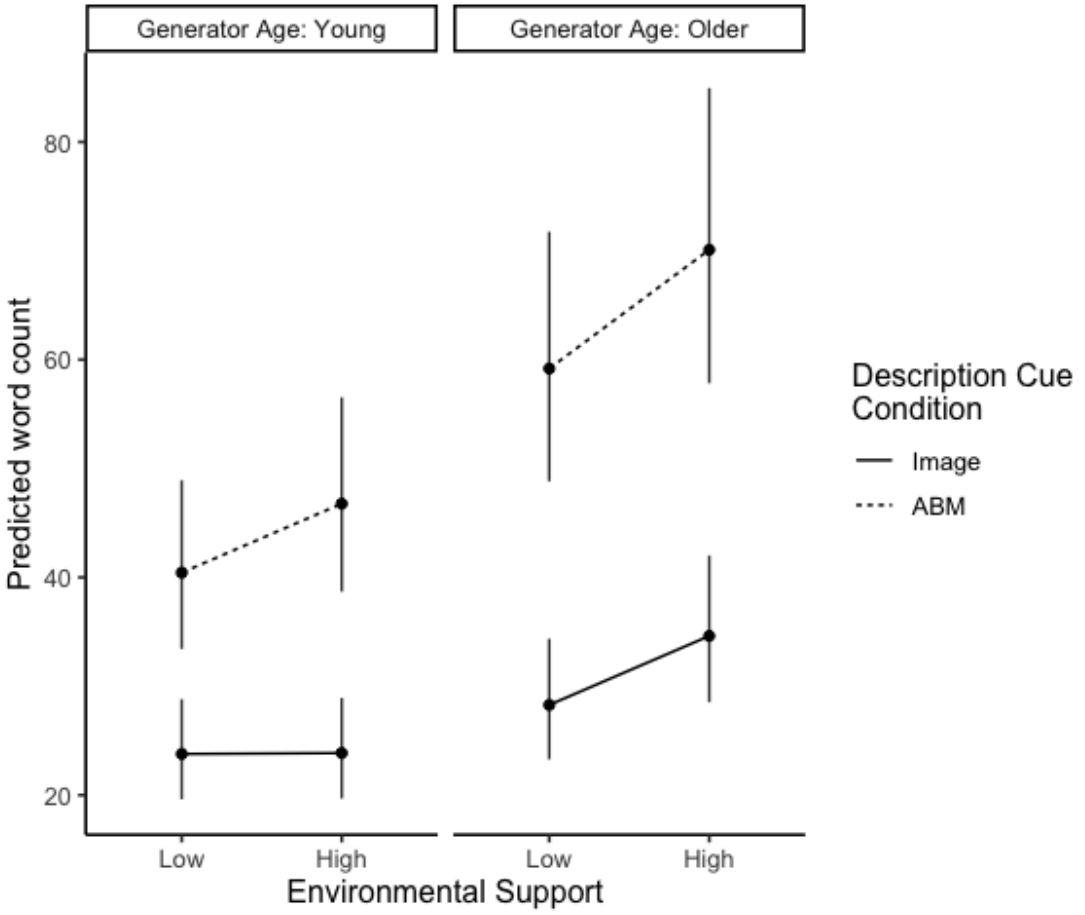
Results of the Model for Word Count

Predictors	*Incidence Rate Ratios*	*95% CI*	*p*
(Intercept)	38.01	33.26 – 43.45	**<0.001**
Generator Age	0.85	0.74 – 0.97	**0.015**
Environmental Support	0.94	0.92 – 0.95	**<0.001**
Description Cue Condition	0.72	0.71 – 0.73	**<0.001**
Generator Age * Environmental Support	1.03	1.01 – 1.04	**<0.001**
Generator Age * Description Cue Condition	1.03	1.02 – 1.05	**<0.001**
Environmental Support * Description Cue Condition	1.01	1.00 – 1.03	0.064
Generator Age * Environmental Support * Description Cue Condition	1.02	1.01 – 1.04	**0.003**
Random Effects			
σ^2	0.03		
$\tau_{00\ id}$	0.51		
ICC	0.95		
$N_{\ id}$	112		
Observations	405		
Marginal R^2 / Conditional R^2	0.207 / 0.962		

Note: estimates are exponentiated.

Figure 1

Generator Age by Environmental Support by Description Cue Condition Interaction for Predicted Number of Words



Error bars are ± 95% CI.

Results additionally revealed a significant two-way interaction of generator age and environmental support, such that older adults were more influenced by environmental support than were young adults. There was also a significant two-way interaction of generator age and description cue condition such that the greater word count for ABM cues compared to Image cues was more extreme for older adults. Finally, all main effects were significant: ABMs (m = 52.9, se = 3.6) had longer descriptions than images (m = 27.3, se = 1.9), high support (m = 40.6, se = 2.8) gave rise to longer descriptions than low support (m = 35.6, se =

2.4) and older adults (m = 44.9, se = 4.36) wrote longer descriptions than young adults (m = 32.2, se = 4.4).

Table 4

Pairwise Comparisons from the three-way Interaction on Word Count

Generator Age	Description cue condition	Env. Support	estimate	SE	z	p
Young - Older	Image	Low	-4.51	3.65	-1.23	0.22
Young - Older	Image	High	-10.76	4.14	-2.60	0.01
Young - Older	ABM	Low	-18.75	7.02	-2.67	0.01
Young - Older	ABM	High	-23.33	8.23	-2.83	0.00

Note estimates are exponentiated.

Episodic details

Autobiographical descriptions only were also evaluated for episodic details (internal details) compared to other details (external details) following Levine et al. (2002). One author completed these ratings and a second author coded 50% for agreement to be assessed. The intraclass correlation coefficient was calculated to assess agreement between the two raters. Results showed excellent agreement (Koo & Li, 2016), using the two-way random effects model and "single rater" unit for internal details (ICC = 0.94, $p < 0.001$) and external details (ICC = 0.92, $p < 0.001$). To create a final internal and external score, where available, the mean of both raters' scores was calculated.

Levine et al. (2002) propose calculating a ratio of internal-to-total details variable which reflects episodic details whilst controlling for length of output. However, ratio data, are unsuitable to be analysed in a linear modelling framework (Curran-Everett, 2013; Tu, Clerehugh & Gilthorpe, 2004), as such, we included a fixed effect of detail type (internal or external) into the model allowing us to examine the detail types together. Internal and external details were analysed using a multilevel linear regression with generator age, environmental support, detail type and their interaction included in the model as fixed effects. Additionally, age at which the memory was encoded, and memory word count were added as covariates. Participant was included as a random intercept. Results, detailed in Table 5 showed that across all description types, participants included significantly more internal (m = 6.09, se = 0.51) as compared to external details (m = 0.9, se = 0.51) and word count was also a significant predictor, which as might be expected, was found to have a positive impact on the number of details reported. All other variables had non-significant effects including the two- and three-way interaction terms (see Figure 2).

The finding that there was no significant difference in internal and external details between older adults relative to young adults was the opposite to the modal finding in the literature, so this was investigated further with some unplanned analyses. First, we calculated a Bayes factor for the generator age by detail type interaction predictor in the model. The Bayes factor for the generator age by detail type interaction was 0.037, as such data were 1/0.037 = 27.03 times more likely under the null as compared to the alternative hypothesis. In addition, given that our older sample also showed high scores in working memory relative to young adults, this suggested that we may have had a particularly able older sample. We computed a single internal and external score for each participant by averaging the scores for the mundane and regular ABM descriptions and correlated it with our working memory measures, utilising Bayes factors to evaluate the null hypotheses. There was evidence for the

absence of a correlation between working memory and internal and external scores for all correlations. Turning first to internal details, for backwards digit span (r_{median} = 0.11, BF = 0.45), data were 1/ 0.45 = 2.22 times more likely under the null compared to the alternative hypothesis; for forwards digit span (r_{median} = 0.02, BF = 0.23), data were 1/ 0.23 = 4.35 times more likely under the null compared to the alternative hypothesis. For external details, for backwards digit span (r_{median} = 0.11, BF = 0.45), data were 1/ 0.45 = 2.22 times more likely under the null compared to the alternative hypothesis; for forwards digit span (r_{median} = 0.02, BF = 0.22), data were 1/ 0.22 = 4.55 times more likely under the null compared to the alternative hypothesis (also when split by age groups for each measure, the null hypothesis was at least 2 times more likely). This indicated that the lack of difference in internal and external details in older adults relative to young adults was not driven by the working memory ability of the sample.

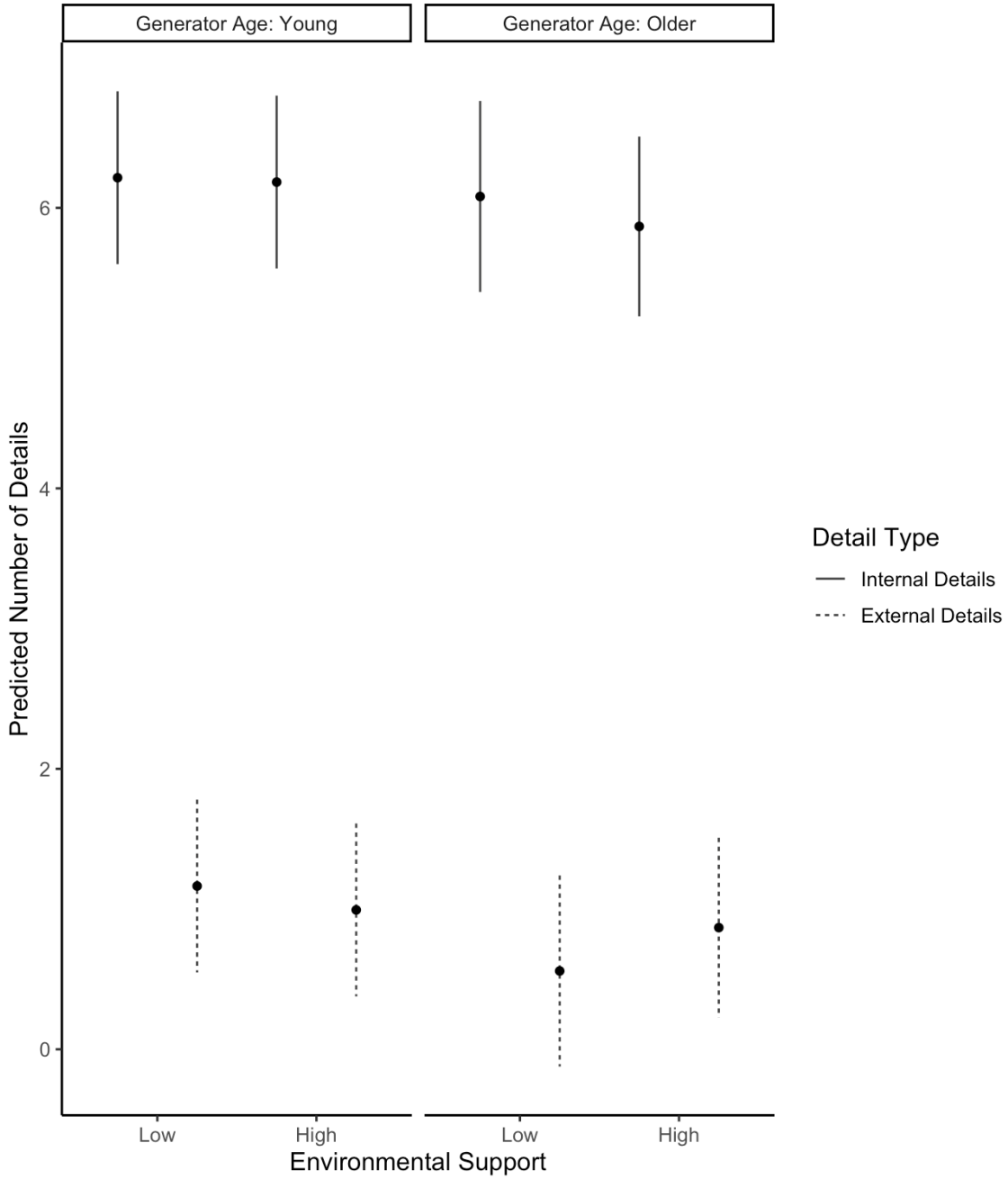
Table 5

Results of the Detail type model

Predictors	*Estimates*	*CI*	*p*
(Intercept)	3.61	3.02 – 4.21	**<0.001**
Generator Age [older]	0.11	-0.26 – 0.49	0.556
Environmental Support [high]	0.06	-0.24 – 0.36	0.688
Detail type [External]	-5.19	-5.61 – -4.77	**<0.001**
Age at Encoding	-0.00	-0.02 – 0.01	0.889
Word Count	0.04	0.03 – 0.04	**<0.001**
Generator Age * Environmental Support	-0.05	-0.34 – 0.25	0.764
Generator Age * Detail type	0.07	-0.35 – 0.49	0.742
Environmental Support * Detail type	-0.10	-0.52 – 0.32	0.654
Generator Age * Environmental Support * Detail type	0.17	-0.25 – 0.59	0.439
Observations	374		
R^2 / R^2 adjusted	0.716 / 0.709		

Figure 2

Generator Age by Environmental Support and Detail Type for Predicted Number of Details



Error bars are ± 95% CI.

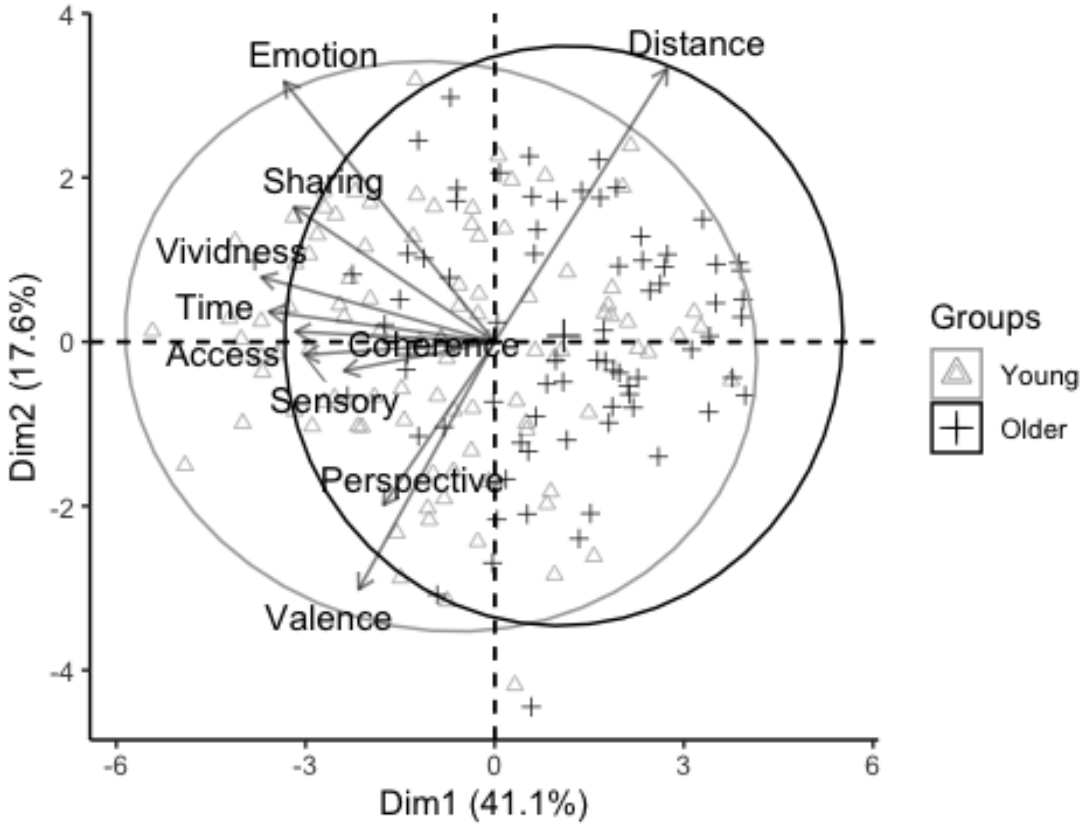
Memory Experiences Questionnaire

To explore the phenomenological properties of the memories by age group we entered all of the ten self-ratings from the Memory Experiences Questionnaire (MEQ) into a principal components analysis (PCA). PCA is a dimension reduction technique that works by transforming a large set of variables into a smaller set. Using PCA, correlations between multiple variables for multiple individuals can be plotted in a 2d plot; participants who are highly correlated cluster together and can be identified by existing groups in the data, here we used participant age group. PCA also determines which variables are most highly correlated with the clusters and hence, what variables the clusters may or may not be associated with.

The results of the first two dimensions of the PCA, which accounted for nearly 60% of variance, can be seen in Figure 3. Although there was overlap between the MEQ responses of older and young adults, young adults were more likely to score higher on all dimensions of the MEQ with the exception of distance, on which older adults were more likely to score higher. The distance construct represents the incongruence between the individual depicted in the memory and current conceptions of self so greater agreement with this dimension for older adults is not altogether surprising. The appendix Table A2 shows the correlations between all MEQ items.

Figure 3

Principle Components Analysis for the Memory Experiences Questionnaire



Section 2: Analysis of Description Evaluation Task

The second group of participants evaluated the initial participants' descriptions based on nine questions outlined below and in Appendix Table A1. Responses to each question were analysed with multilevel linear models. For all models, generator age, environmental support and description cue condition were included as fixed effects with participant and stimuli included as random intercept terms. Pairwise comparisons with Tukey corrections were used to explore significant interactions, results are summarized in Table 6 and Figures 4 and 5.

Table 6

*Analysis of Evaluator Participants' Ratings of Generator Participants' Descriptions**

	Main Effects** (levels)			Interaction effects**
Question	Generator Age Group (young, older)	Environmental Support (High, Low)	Description Cue Condition (ABM, Image)	
1: Something I might write	Older > Young (m = 47.6, se = 2.5; m = 39.4, se = 2.5)		ABM > Image (m = 45.9, se = 2.5; m = 41.2, se = 2.5)	Description Cue Condition x Environmental Support (Figure 4): No difference in question ratings for ABMs (m = 44.8, se = 2.7) or images (m = 44.5, se = 2.7) when environmental support was high (p = 0.89), but ABMs (m = 46.9, se = 2.7) were rated as being more similar to something participants would write than images (m = 37.8, se = 2.7) when support was low (p <0.001).
2: Easy to understand		High > Low (m = 70.3, se = 1.9; m = 66.7, se = 1.9)	ABM > Image (m = 70.2, se = 1.9; m = 66.9, se = 1.9)	Description Cue Condition x Environmental Support (Figure 4): No difference in ease of understanding for ABMs (m = 70.1, se = 2.2) or images (m = 70.5, se = 2.2) when environmental support was high (p = 0.84), but ABMs (m = 70.2, se = 2.2) were rated as being easier to understand than images (m = 63.2, se = 2.2) when support was low (p = 0.001).
3: Interesting to read	Older > Young (m = 55.1, se = 2.3; m = 45.5, se = 2.3)	High > Low (m = 53.9, se = 2.3; m = 46.7, se = 2.3)	ABM > Image (m = 57.1, se = 2.3; m = 43.5, se = 2.3)	Generator Age x Description Cue Condition (Figure 5): No difference in participants' agreement to the question for older (m = 46.2, se = 2.6) or young participants (m = 40.8, se = 2.6) when the description was of an image (p = 0.59), but older adults' descriptions (m = 64.0, se = 2.6) were rated as being more interesting to read than younger adults' descriptions (m = 50.2, se = 2.6) when they were of an ABM (p < 0.001).
4: Emotionally arousing	Older > Young (m = 43.2, se = 2.2; m = 35.8, se = 2.2)	High > Low	ABM > Image	Generator Age x Description Cue Condition (Figure 5): No difference in participants' agreement to the question for older (m = 29.9, se = 2.5) or younger participants (m = 28.4, se = 2.4) when the description was of an image (p = 0.51), but older adults' descriptions (m = 54.5, se = 2.5) were

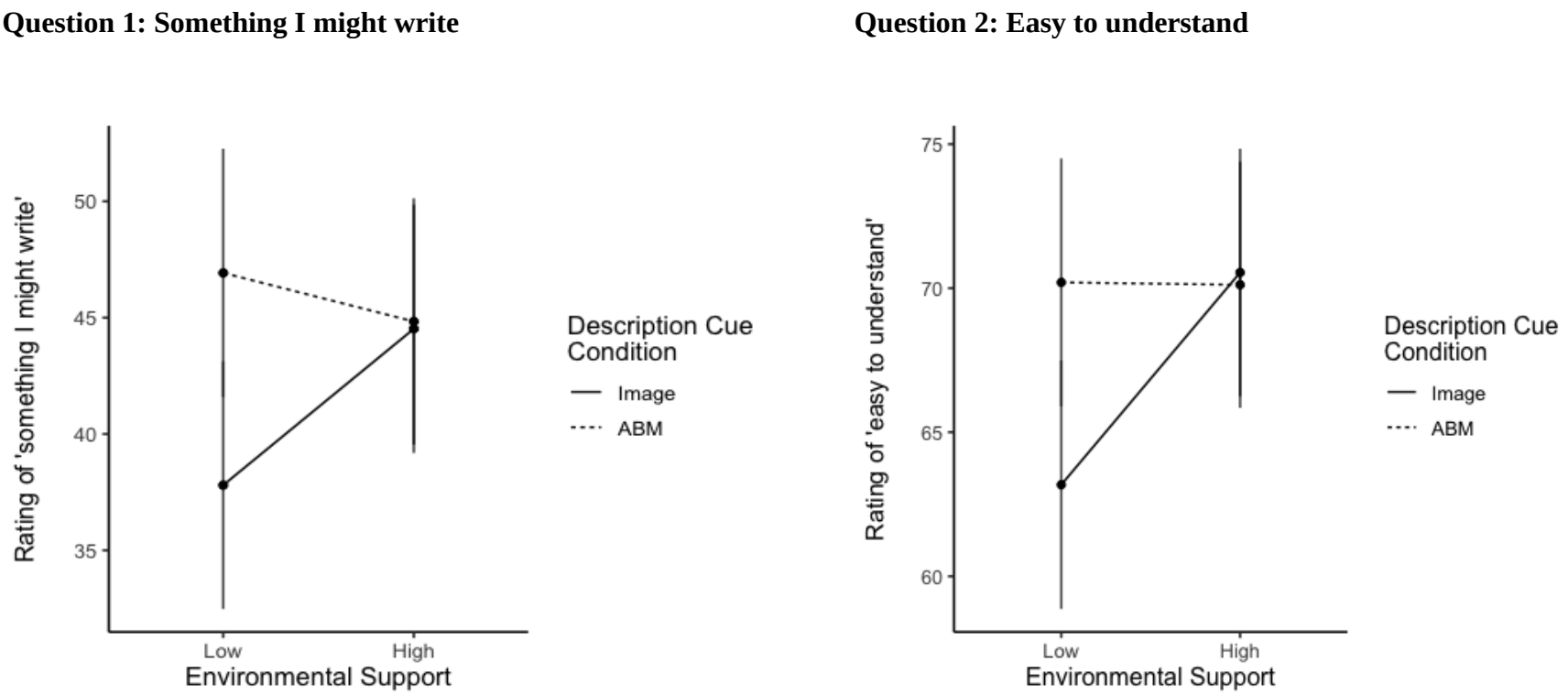
		(m = 44.1, se = 2.2; m = 33.9, se = 2.2)	(m = 48.9, se = 2.2; m = 29.1, se = 2.2).	rated as being more emotionally arousing than younger adults' descriptions (m = 43.2, se = 2.5) when they were of an ABM ($p < 0.001$).
5: Vividness	Older > Young (m = 56.1 se = 2.4; m = 50.6, se = 2.4)	High > Low (m = 56.0, se = 2.4; m = 50.6, se = 2.2)	ABM > Image (m = 57.9, se = 2.4; m = 48.7, se = 2.4)	
6: Clear order	Older > Young (m = 59.1 se = 2.1; m = 55.0, se = 2.1)	High > Low (m = 58.8, se = 2.1; m = 55.3, se = 2.1)	ABM > Image (m = 67.0, se = 2.1; m = 47.1, se = 2.1)	
7: Sensory information	Older > Young (m = 40.1 se = 2.5; m = 35.3, se = 2.5)	High > Low (m = 40.1 se = 2.5; m = 35.2, se = 2.5)	ABM > Image (m = 40.6, se = 2.5; m = 34.8, se = 2.5)	
8: Positive	Older > Young (m = 57.1 se = 1.9; m = 53.7, se = 1.9)			
9: Good description	Older > Young (m = 59.9 se = 2.3; m = 52.8, se = 2.3)	High > Low (m = 59.0 se = 2.3; m = 53.8, se = 2.7)	ABM > Image (m = 60.5, se = 2.3; m = 52.2, se = 2.3)	

* Higher ratings correspond to greater agreement with a given question.

** Significant results only are reported.

Figure 4

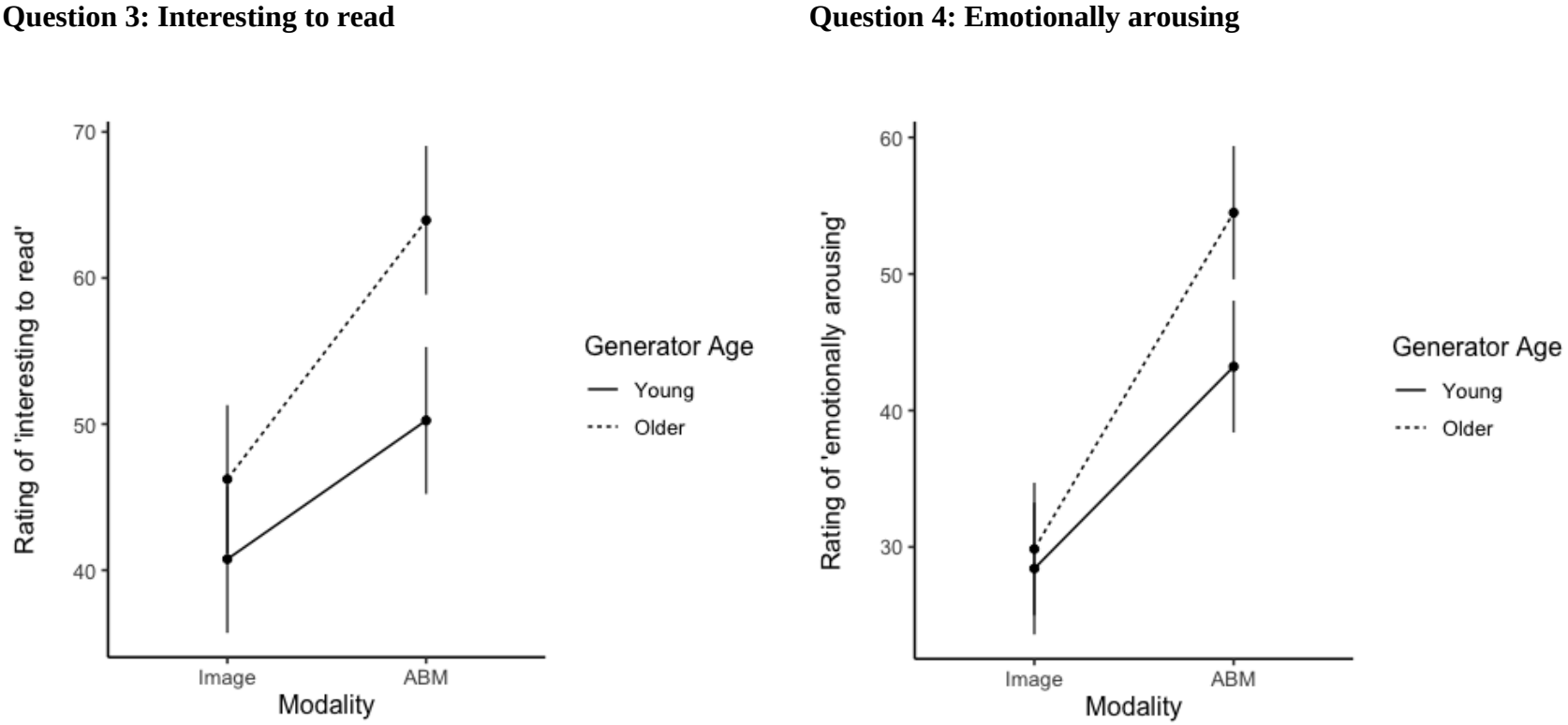
Interaction effects for Evaluator Responses to Question 1 and Question 2 depicting Generator Environmental Support against Generator Age Group



Error bars are ± 95% CI.

Figure 5

Interaction effects for Evaluator Responses to Question 3 and Question 4 depicting Generator Modality against Generator Age Group



Error bars are ± 95% CI.

Own Group Effects

Own group effects were analysed for ABMs only (i.e., excluding the image description conditions) for relevant questions, numbers 1, 3 and 9. Responses were analysed with multilevel linear models. Environmental support, generator age and evaluator age were included as fixed effects with participant and stimuli included as random intercept terms. Pairwise comparisons with Tukey corrections were used to explore significant interactions, results are summarized in Table 7 and Figure 6.

Summary of Section 2

For the analyses depicted in Table 6, where present, all main effects were consistent across questions. For all questions there were main effects favoring older adults' descriptions except for Question 2 *Easy to understand* (no age effect). Questions 3 and 4 (Figure 5) also showed age interactions such that the older adult advantage was present when writing descriptions of ABMs but not when writing descriptions of images. In general, these results support the generation of higher quality descriptions by older adults compared to young adults.

For the analyses of ABMs only, in the context of own group effects, all main effects were consistent across questions. For generator and environmental support, main effects were aligned with the previous analyses. Main effects of evaluator age indicated that older evaluators were more receptive to descriptions than young evaluators, possibly linked to an age-related positivity bias. There was some evidence of an own group bias with older evaluators preferring older generators descriptions, for low environmental support conditions. However, an effect opposite to the own group bias was also found in the high environmental support, young generator descriptions.

Table 7

*Own Group Bias Analysis of Evaluator Participants' Ratings of Generator Participants' Descriptions**

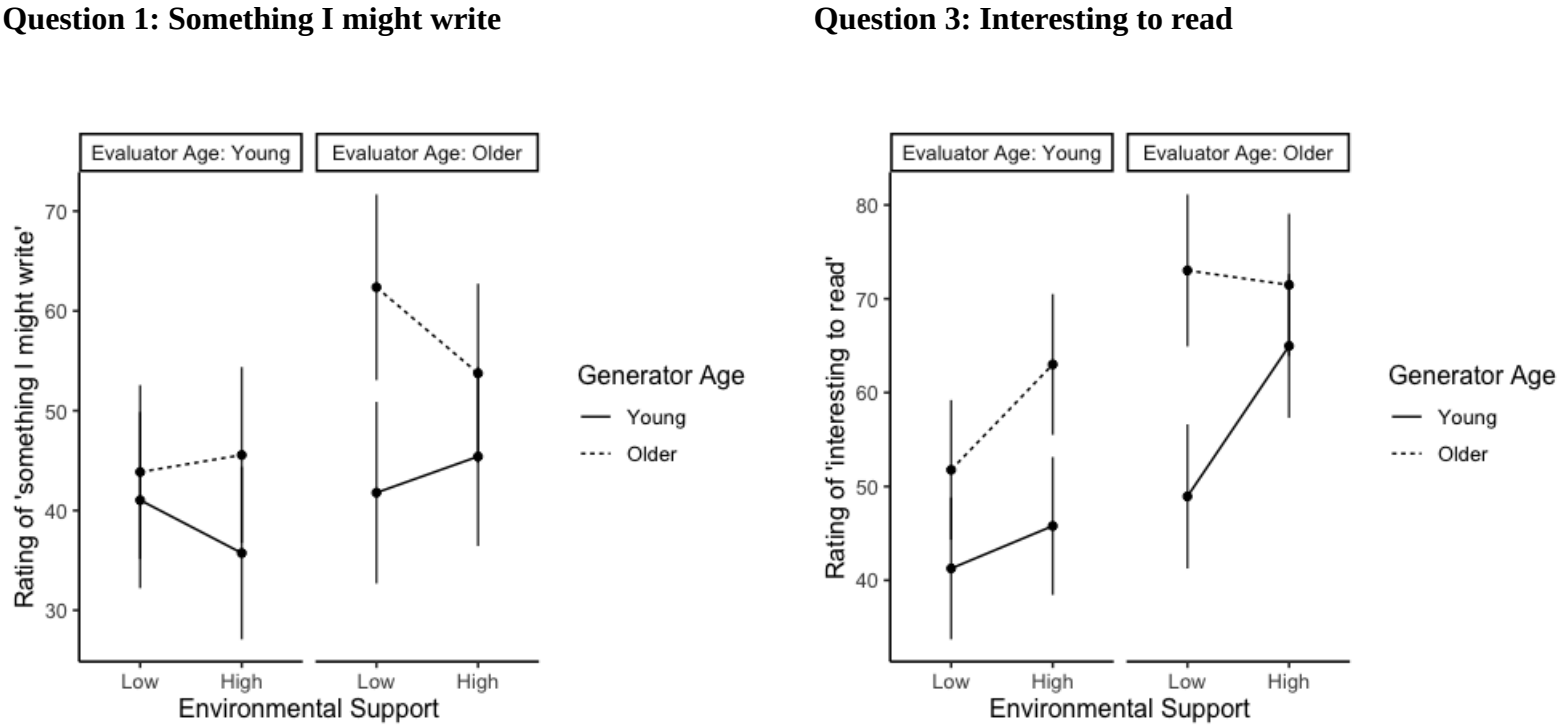
	Main Effects (levels)**			Interaction effects**
Question	Generator Age Group (young, older)	Evaluator Age Group (young, older)	Environmental Support (High, Low)	
1: Something I might write	Older > Young (m = 51.4, se = 2.87; m = 41, se = 2.85, $p < 0.001$).			Generator Age x Evaluator Age x Environmental Support (Figure 5, for pairwise comparisons see appendix Table A3). For the low environmental support condition and for older generators only, there was an own age bias such that older evaluators adults rated older generators descriptions as something they might write.
3: Interesting to read	Older > Young (m = 64.8, se = 2.5; m = 50.2, se = 2.47, $p < 0.001$)	Older > Young (m = 64.6, se = 2.83; 2.76, $p < 0.001$)	High > Low (m = 61.3, se = 2.46; m = 53.7, se = 2.49, $p < 0.001$)	Generator Age x Evaluator Age x Environmental Support (Figure 5, for pairwise comparisons see appendix Table A4). The same own age bias pattern as above was found as well as an effect opposite to the own age bias: For young generators, for high environmental support condition, older evaluators showed higher interest in reading those descriptions relative to young evaluators.
9: Good description	Older > Young (m = 60, se = 2.23; m = 53, se = 2.22, $p = 0.001$).	Older > Young (m = 60.2, se = 2.61; m = 52.8, se = 2.56, $p < 0.023$)	High > Low (m = 59.1, se = 2.21; m = 53.8, se = 2.23, $p = 0.002$)	

*Higher ratings correspond to greater agreement with a given question.

** Significant results only are reported.

Figure 6

Interaction effects for Evaluator responses to Question 1 and Question 3 depicting Evaluator Age, Generator Environmental Support and Generator Age



Error bars are ± 95% CI.

Section 3: Meta-Analysis of Age Differences in the Reporting of Episodic Detail in Autobiographical Memory

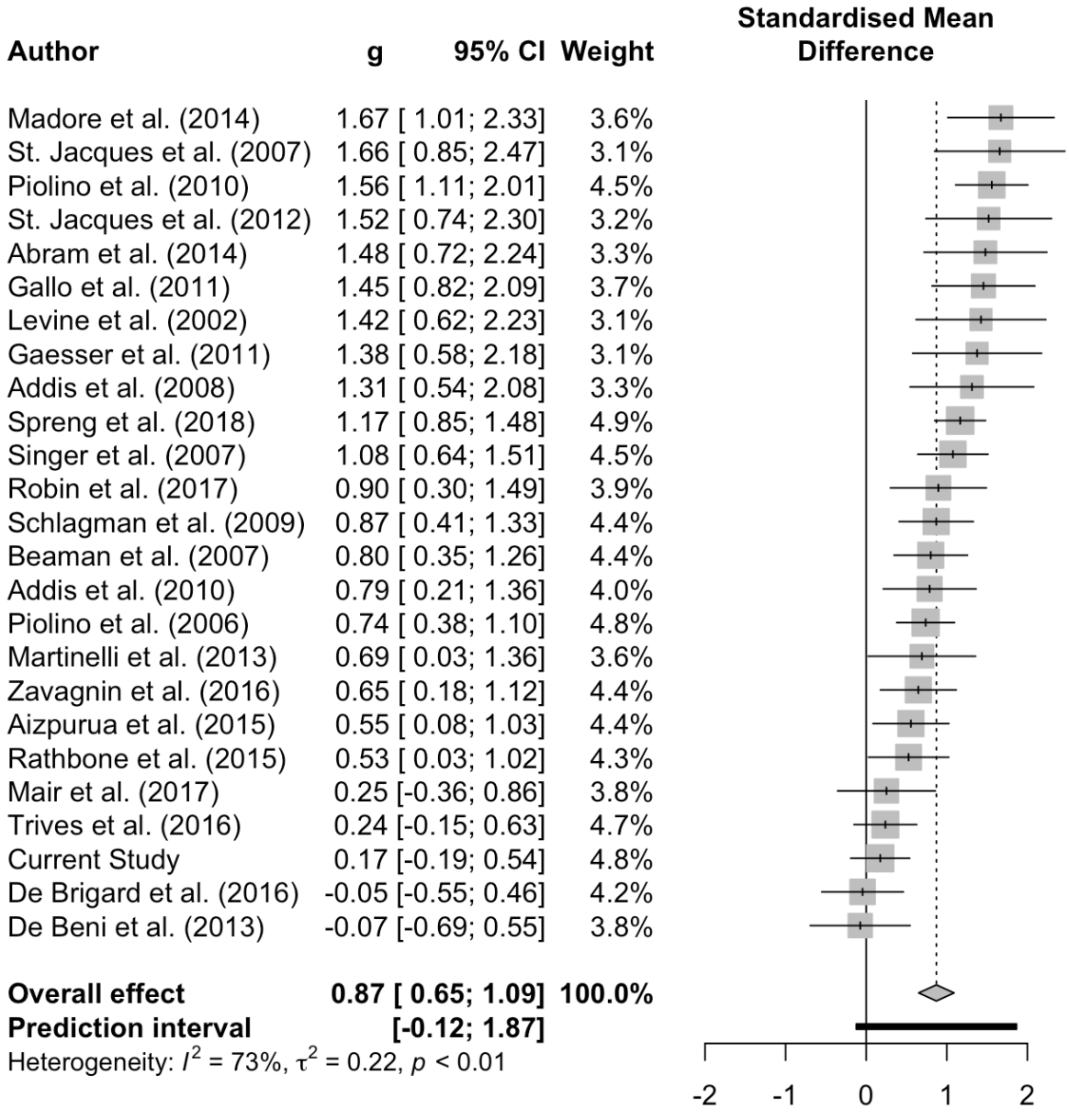
As our data largely showed an older adult advantage in producing richer and more detailed descriptions, and we did not replicate literature showing an age deficit in reporting specific episodic details, we conducted a small meta-analysis to assess the possibility of a publication bias for papers that show age deficits in reporting episodic detail. Taking the leading paper that showed this effect (Levine et al 2002, 740 citations in April 2021), we ordered the citing articles by their own citation counts and then, where relevant ABM studies were conducted, evaluated the effect size for the age deficit in reporting episodic detail. Titles were read for any information alluding to ABM or ageing, then abstracts and where relevant the articles themselves. Effect sizes were calculated as Hedge's *g* for the age difference in the amount of episodic detail reported in ABMs (for young versus older adults). Some studies reported only the ratio of episodic to total detail and those measures were used instead, for the current study we used the episodic/internal detail score. Effect sizes were calculated mainly from means and SDs (n = 17) of which three were measured from figures and some (n = 6) were converted from the F statistic. The top 24 cited articles were used which accounted for about half of the 740 papers that cited Levine et al. (2002) and our own data was also included, see Figure 7. These articles are marked with an asterisk in the references section.

The data were analysed using a random effects meta-analysis using the Sidik-Jonkman estimator (Sidik & Jonkman, 2007). Further, the Hartung-Knapp-Sidik-Jonkman method of estimating variance of the pooled effect was used since it has shown to produce more robust estimates when the number of studies is small and substantial heterogeneity is suspected (IntHout, Ioannidis & Borm, 2014). The model estimated the pooled standardised effect to be $g = 0.87$ (95% CI: 0.65-1.09), which was significantly different from zero ($t = 8.17$, $p < 0.001$), however there was substantial between study heterogeneity in the effect (I^2

= 73%, 95% CI: 59.8% - 81.8%) possibly due to differences in measurement, study design etc, which means that it is unlikely that these studies are drawn from the same population. As such the pooled effect should be interpreted with caution and the 95% prediction interval (-.12 – 1.87) provides a more reliable estimate of the true effect size. This broad prediction interval stretches below zero, meaning that future studies may range from finding a small negative effect to a strong positive effect.

Figure 7

Random Effects Meta-Analysis of 26 studies which Estimated the Difference in Episodic Detail between Young and Older Adults

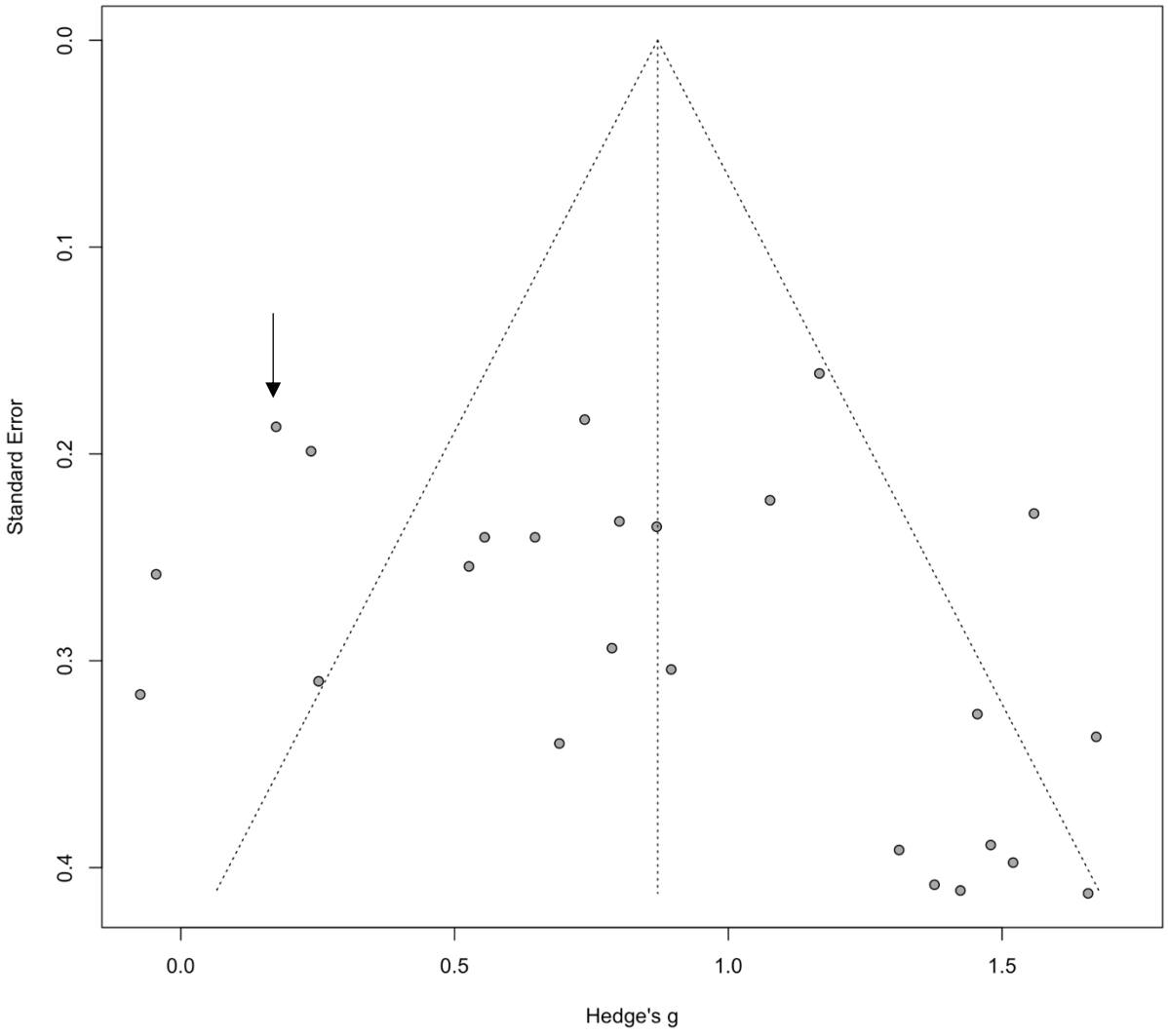


Finally, to assess possible publication bias we generated a funnel plot. Where there is no or little publication bias, we would expect to see all the studies lie symmetrically around

the estimate of pooled effect size (indicated by the vertical dotted line) and to narrow as the standard error decreases. Whilst there appears to be symmetry for larger studies (those with smaller standard errors) asymmetry appears to be driven by small studies with large effects, with corresponding small studies with small effects missing from the plot. However, Egger's test of plot symmetry revealed little evidence of plot asymmetry (intercept = 2.23, 95% CI: -0.46 - 4.92, $t = 1.63$, $p = 0.12$. Although due to substantial between study heterogeneity, caution should be used when interpreting the funnel plot (Figure 8).

Figure 8

Funnel Plot of Age Differences in Reporting Episodic Detail from Literature Analysed



Note: X axis shows effect size for the age difference in reporting specific/episodic detail (positive values favour young adults). Y axis is the standard error of the estimate. Dashed line shows the pooled estimate (.87). The arrow shows the effect from the current study.

Discussion

The current study investigated age differences in the reporting of ABM and in describing images. Manipulation of environmental support was encouraged through comparisons of regularly thought about ABM (high support) to experimentally probed ABM (low support), and by requiring participants to describe an image on screen (high support), or to describe an image from memory after it was removed from the screen (low support). In line with existing aging theory (Craik, 1986), a simple measure of word count showed that environmental support disproportionately benefitted older adults relative to young adults in evoking longer descriptions and this pattern occurred even more with autobiographical descriptions compared to image descriptions. Other subjective measures of description quality evaluated by a second group of participants generally favored high environmental support conditions but largely to the same extent in both age groups. Crucially, in contrast to much literature, older adults' descriptions were consistently reported as more favorable than young adults' descriptions on rating scales across multiple measures by the second group of rating participants. These included relatability ('Something I might write'), interesting to read, emotionally arousing, vivid with more sensory detail, more organized, and generally good ('This was a good description').

Alongside the overall improvement in quality of descriptions provided by older adults relative to young adults, we also found no age disadvantage in the reporting of episodic detail with a Bayes factor providing 'strong' (Lee & Wagenmakers, 2013) evidence favoring no difference between young and older adults. This finding is in contrast to the majority of literature on age differences in ABM, going against our pre-registered prediction of an age-related deficit in reporting episodic detail. It was initially suspected that we may have had a high performing older-adult sample, given that the older adults also scored higher than young adults on background measures of working memory. However, when we assessed the relation

of working memory to episodic richness there was evidence in favor of the null hypothesis, indicating no relation between working memory ability and autobiographical reporting. Furthermore, a meta-analysis has shown that a small proportion of studies (~10%) do show an older adult advantage in working memory and the authors of that paper additionally found "no age differences on backward digit span when measured by the WAIS" (Bopp, & Verhaeghen, 2005, p 226). This then led us towards evaluating a publication bias in the literature favoring results aligned with a leading early study showing age deficits in episodic richness (Levine et al. 2002). Across 24 studies the consensus was significantly in favor of an age deficit in reporting episodic detail in ABM, and a funnel plot showed publications varying reasonably equally about the mean indicating no publication bias. The heterogeneity of the data suggested future studies may still find results in either direction, but the most probable outcome would be aligned with existing literature. Therefore, the current study appears to be an outlier in the field which will be discussed further.

The most notable difference between the current study and the literature is that it was conducted online (also note that data were also collected pre-COVID-19), whereas all of the studies in the meta-analysis were conducted in the laboratory. It has been argued that 'taking cognition out of the wild and into the lab is specifically hurtful to older adults', not so much younger adults', performance' (Verhaeghen, Martin, Sędek, 2012, p. 9). This effect has been used to explain an older adult advantage in prospective memory tasks outside the laboratory (e.g., Aberle et al. 2010; Schnitzspahn et al. 2011; Henry et al. 2004). Theory relevant to prospective memory literature – age differences in intrinsic motivation to complete studies, and age differences in the impact of high control of the environment - may therefore equally apply to autobiographical recall.

Alongside the current data there is evidence for autobiographical recall to be more favorable to older adults outside the laboratory. In internet studies of ABM, increased age has

been shown to correspond to higher subjective reports of reliving and vividness (Janssen, Rubin, and Jacques; 2011) as well as vividness, coherence, and sensory detail (Siedlecki, Hicks, Kornhauser, 2015). Online research by Gardner, Mainetti, and Ascoli (2015) also showed older adults reported more autobiographical details than did young adults. Although, Janssen et al. (2015) found increasing age resulted in less retention of autobiographical recall via a consistency measure. Additionally, in an ABM study based on submitting online diaries, Dijkstra1 and Janssen (2016) found no main effects of age in measures of cued recall and recognition for later tests of memory content. This later study is consistent with a diary condition in Schlagman et al. (2009) whereby, for memories produced spontaneously and reported in diaries outside of the laboratory, there was no age deficit in the reporting of specific episodic detail. Notably, this effect in Schlagman et al. (2009) interacted with a lab-based autobiographical retrieval condition showing the established age deficit in reporting episodic detail, therefore evidencing a potential influence of the lab environment.

Another feature of our online study was the written format for recording ABM as opposed to the interview method used in most papers in this field. Theory is mixed regarding the impact of a written format and if it is particularly influential for one age group over another. Outside the ageing literature, Putnam, and Roediger (2013) found mixed effects favoring both written and spoken retrieval modalities across multiple experiments and argued that the response mode is irrelevant in determining recall performance. However, Kellogg (2007) argued that writing comes with its own cognitive demands (orthographic access, limited speed and reduced practice) compared to speaking and demonstrated poorer recall for written compared to spoken retrieval. The opposite was found by Grabowski (2007), who argued that writing is more effective for the demonstration of underlying knowledge because it affords greater dissociation from the present context than speaking, which is more typically targeted at a given listener. This raises another distinction between the current study and

previous research, as the online form may have influenced the perceived recipient of the ABMs compared to lab-based studies that are typically run by young assistants. Nonetheless, in our data, older generators' descriptions were generally valued more highly than young generators' descriptions regardless of the age group of the description evaluators (see Figure 6). Therefore, our data suggest minimal (or ineffectual) targeting of response generation towards particular age groups. Ageing research in this field is more limited but still mixed. For example, Frieske and Park (1999) found similar memory performance across age for encoding written and spoken material, whilst Hasher and Zacks (1988) found that encoding written material aided memory relative to spoken material, especially for older adults.

One question that remains is that if young and older adults produced similar amounts of specific details in their descriptions, why did our extra measures (based on judgements from a second group of participants, see Table 6) yield consistent older adult advantages in descriptive ability? Research has shown that older adults' narratives have been rated as higher quality than young adults' narratives (e.g., Pratt, & Robins, 1991) and this can occur despite age differences in detail production and off-target responding (see Baron, & Bluck, 2009, for a review). Baron and Bluck argued that off-target responding in the form of elaborating or supplying contextual detail improves narrative description by providing information relevant to interpretation. In the current study, for the measures 'interesting to read' and 'emotionally arousing' there was an interaction such that the older adult advantage was present for ABM descriptions but not for image descriptions. Our older adults may have felt more inclined to elaborate for ABMs (e.g., 'I had not lost any of my skill in sailing!', 'family holidays were always the first week in June') than for image descriptions. Additionally, narrative quality has been linked to vocabulary ability (Pratt, & Robins, 1991) which was higher for older adults in our sample and may have improved the descriptions. These insights highlight the value in developing new rating systems for evaluating ABM.

Finally, memory content data generally reflected the literature. We found an age-related positivity bias (Reed, Chan, & Mikels, 2014) with older adults' descriptions being rated as more positive than young adults' descriptions similarly for both image descriptions and ABMs. Participants' self-evaluation of their own memories through the MEQ (Luchetti, & Sutin, 2016) were largely also comparable across age, apart from the distance measure, which would be expected due to greater age affording opportunities for greater dissociation between the current and recalled self. This finding is also congruent with literature showing a reminiscence bump whereby personal events occurring between the ages of 10-30 are recalled more frequently than events from other time periods (e.g., Janssen, Rubin, & Jacques, 2011).

Summary

Given the literature above and our current data, it seems plausible that age deficits in ABM reporting may differ substantially inside and outside of the laboratory. We argue that future studies should be cautious about the extent to which lab based autobiographical work compares to everyday behavior in older adults. Nonetheless, ABM research has potential to test key theories of cognitive ageing regardless of its administration location, due to the richness of data produced and the many ways in which performance can be assessed. The current meta-analysis showed relatively consistent age-related deficits in reporting episodic autobiographical detail across the literature. The current study also extends the link between autobiographical recall and environmental support theories of ageing; showing that support through regular rehearsal can disproportionately benefit the amount of content produced by older adults relative to young adults.

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Appendix

Table A1

Questions used during the description evaluation task

Question
This description is like something I might write
This description is easy to understand
This description is interesting to read
This description is emotionally arousing
This description is vivid
This description has a clear order of events
This description involves a lot of sensory information (sounds, smells, tastes etc)
This description is positive
This description is a good description

Table A2

MEQ Correlation matrix

	Vividness	Coherence	Access	Time	Sensory	Perspective	Emotion	Sharing	Distance
Vividness									
Coherence	0.62***								
Access	0.64***	0.55***							
Time	0.72***	0.37***	0.42***						
Sensory	0.70***	0.54***	0.59***	0.62***					
Perspective	0.24**	0.32***	0.26***	0.21**	0.32***				
Emotion	0.59***	0.37***	0.42***	0.48***	0.50***	0.01			
Sharing	0.43***	0.23**	0.42***	0.40***	0.34***	0.12	0.47***		
Distance	-0.30***	-0.40***	-0.35***	-0.35***	-0.43***	-0.36***	0.03	-0.13	
Valence	0.18*	0.20**	0.20**	0.25***	0.30***	0.21**	0.00	0.17*	-0.32***

Note: $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A3

Pairwise Comparisons from the three-way Interaction on 'Something I might Write'

Evaluator Age	Generator Age	Env. Support	estimate	SE	df	t	p
Young - Older	Young	Low	-0.74	6.27	144.81	-0.12	0.91
Young - Older	Older	Low	-18.52	6.32	149.04	-2.93	0.00
Young - Older	Young	High	-9.68	6.19	141.84	-1.56	0.12
Young - Older	Older	High	-8.19	6.23	142.82	-1.31	0.19

Table A4

Pairwise Comparisons from the three-way Interaction on 'Interesting to read'

Evaluator Age	Generator Age	Env. Support	estimate	SE	df	t	p
Young – Older	Young	Low	-7.68	5.04	235.73	-1.52	0.13
Young – Older	Older	Low	-21.26	5.18	254.08	-4.10	0.00
Young – Older	Young	High	-19.18	5.02	240.69	-3.82	0.00
Young – Older	Older	High	-8.47	5.00	230.57	-1.70	0.09