





## Improving specific autobiographical memory in older adults: impacts on mood, social problem solving, and functional limitations

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### ABSTRACT

Older adults have difficulty recalling specific autobiographical events. This over-general memory style is a vulnerability factor for depression. Two groups receiving interventions that have previously been successful at reducing over-general memory in depressed populations were compared to a control group. Participants were healthy older adults aged  $\geq 70$  years: memory specificity training (MEST;  $n = 22$ ), life review ( $n = 22$ ), and control group ( $n = 22$ ). There were significant improvements in autobiographical memory specificity in the MEST and life review groups at post-training, relative to the control group, suggesting that over-general memory can be reduced in older adults. Change in social problem solving ability and functional limitations were related to change in autobiographical memory specificity, supporting the suggested role of specific retrieval in generating solutions to social problems and maintaining independence. Qualitative analysis of participants' feedback revealed that life review may be more appropriate for older adults, possibly because it involves integrating specific memories into a positive narrative.

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## Introduction

Life expectancy at older ages has reached its highest ever level (Public Health England, 2016), but there has also been a rise in the number of years people live with ill health (Office for National Statistics, 2016). Therefore, factors that ensure quality of life such as maintaining mental health, enriching social engagement, and prolonging independence have become increasingly important within the field of cognitive aging. Each of these factors has been found to rely to some extent on ability to recall specific autobiographical memories. Specific autobiographical memories refer to the recollection of unique events from one's personal past that occurred at a particular time and place and lasted less than one day, e.g., "The first day I drove a car by myself I was so nervous!" However, there is an age-related deficit in ability to recall specific event memories (Beaman, Pushkar, Etezadi, Bye, & Conway, 2007; Holland, Ridout, Walford, & Geraghty, 2012;

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Ros, Latorre, & Serrano, 2010), which is accompanied by an increased tendency to recall general memories instead, e.g., “Having driving lessons when I was a teenager.” This is termed over-general memory. Recalling autobiographical memories involves a hierarchical process whereby general material is retrieved first, triggering a generative search for the most specific knowledge at the lowest level. Over-general memory is thought to occur when this search process is aborted early, at the intermediate level of the hierarchy, before a specific event memory can be generated (Conway & Pleydell-Pearce, 2000). The problem with over-general memory is that it is negatively associated with mental health (Latorre et al., 2013), social functioning (Beaman et al., 2007), and independence (Holland et al., 2016). Cognitive interventions have been shown to reduce over-general memory associated with depression, and improve mood (Raes, Williams, & Hermans, 2009). This study sets out to examine two different interventions for autobiographical specificity in older adults. First, the contribution of autobiographical memory to older adults’ well-being will be reviewed in order to provide justification for the intervention.

### *Social problem solving and functional independence*

Ability to recall autobiographical memories is central to social functioning. For example, autobiographical memory has important social uses (Bluck, 2003) such as sharing memories for the purpose of developing intimacy and maintaining rewarding relationships, which is vital as reduced social networks are implicated as a risk factor for cognitive decline (Bennett, Schneider, Tang, Arnold, & Wilson, 2006). Autobiographical memories of specific events are also useful for solving social problems since they are used as analogs for generating hypothetical solutions (Beaman et al., 2007; Goddard, Dritschel, & Burton, 1996; Williams et al., 1996). This is based on the constructive episodic simulation hypothesis which states that similar episodic processes underlie both retrieval of details from the past, and construction of imagined future events (Schacter & Addis, 2007, 2009). Social problem solving has particular relevance to older adults’ well-being because it may prevent the detrimental impact of negative social interactions (Newsom, Nishishiba, Morgan, & Rook, 2003). Using memories of past events to simulate future scenarios is also important to older adults’ functional independence as effective solutions may be simulated for other types of open-ended problems (Sheldon, McAndrews, & Moscovitch, 2011), for example, to generate possible outcomes for financial problems (Sheldon et al., 2015). Furthermore, increased autobiographical memory specificity has been found to significantly predict reduced functional limitations in older adults who move to an independent, but supported living environment (Holland et al., 2016). Functional limitations refer to the impact of health difficulties on independence in everyday life, such as on mobility, amount of social engagement, general alertness, or communication with others. Given that autobiographical memory specificity is an important factor in the preservation of social functioning and independence, it represents a potential target for preventative interventions with older adults.

### *Autobiographical memory and psychopathology*

Specific autobiographical memory is also critical to maintaining mental health. Over-general memory was first noted in suicidal patients by Williams and Broadbent (1986). It is now considered an enduring trait of depression (Williams et al., 2007) and has been linked to other mental health conditions, such as posttraumatic stress (Moore & Zoellner, 2007) and disordered eating (Dalgleish et al., 2003; Ridout, Matharu, Sanders, & Wallis, 2015). The relationship between over-general memory and depression is particularly relevant in the field of aging, since depression is potentially one of the risk factors for cognitive decline (Chung et al., 2015). There is a high prevalence of major depression in older adults (Djernes, 2006), primarily because older adults are likely to experience life stressors or significant changes (e.g., retirement, bereavement, disability leading to loss of independence, isolation, and loneliness) that could negatively affect their mental health. The impact of life stressors is important since over-general memory has been shown to predict depression in response to chronic daily stressors in healthy participants (Anderson, Goddard, & Powell, 2010).

While over-general memory is a vulnerability factor for psychopathology, high autobiographical memory specificity is considered a protective mechanism (Latorre et al., 2013; Ricarte et al., 2011). Vivid memories of past events have benefits for mental health because they provide rich information that can be used to support goal pursuit, regulate emotion, and contribute to an overarching narrative, or life story (Singer, Blagov, Berry, & Oost, 2013). Interventions have been shown to both improve autobiographical memory deficits that are associated with depression and to improve mood in young and older adults (Raes et al., 2009; Serrano, Latorre, Gatz, & Montanes, 2004). Therefore, interventions that reduce depressive symptoms by focusing on improving memory specificity are likely to be particularly helpful in enhancing older adults' cognitive functioning and mental health.

### *Executive function as an underlying mechanism*

In order to develop interventions to reduce over-general memory as a preventive strategy in healthy, nondepressed older adults, it is helpful to consider overlaps in the underlying mechanisms of depression-related and age-related over-general memory. The mechanisms underlying over-general memory in depression and trauma are summarized by the CaR-FA-X model which highlights three processes that disrupt the retrieval process (Williams, 2006): Capture and rumination on general negative material; functional avoidance of painful emotional material attached to specific negative events; and impaired executive function (X).

Executive function in particular is integral to the monitoring and control process required for retrieval of specific memories. For example, Dalgleish et al. (2007) found that impaired memory specificity in depression was related to poor executive control, which they argued resulted in a difficulty inhibiting general memories during retrieval. In line with the findings in depression (Dalgleish et al., 2007), impaired executive function has been shown to play a role in age-related deficits in memory specificity. For example, Ros et al. (2010) found that over-general memory in older adults was related to performance on executive tasks (reading span and sustained attention). They argued that poor inhibition of non-relevant information underpins errors in both

working memory and autobiographical memory tasks (AMTs) (Ros et al., 2010). In addition, Holland, Ridout, Walford, and Geraghty (2012) demonstrated that poor memory specificity in older adults was related to an age-related deficit in the updating element of executive function (assessed using the random number generation [RNG] task), which suggests that over-general memory may also occur due to a deficit in the ability to update the task requirements during the retrieval process. Given that impaired executive function is an underlying factor in both depression-related and age-related deficits in memory specificity, it would be expected that interventions designed to improve memory specificity in depressed patients might also be useful for improving specificity in nondepressed older adults. Two of the main interventions that have been used to reduce an over-general memory retrieval style in depressed patients will be examined.

### *Memory specificity training*

Memory specificity training (MEST; Raes et al., 2009) is a stand-alone intervention consisting of systematic practice in recalling specific autobiographical memories in response to positive, negative, and neutral cue words and sharing those memories within a group setting. The basis of the MEST program emphasizes prevention since over-general memory may underlie depression due to a number of mechanisms, as summarized by the CaR-FA-X model (Williams, 2006), and is associated with maintenance of depressive symptoms.

Raes et al. (2009) demonstrated that MEST is a successful method of improving autobiographical memory specificity and reducing depression in young depressed women. Later studies found similar beneficial effects of MEST compared to treatment as usual (Moradi et al., 2014; Neshat-Doost et al., 2014). Since depression-related and age-related deficits in autobiographical memory specificity have a shared underlying mechanism, namely impaired executive function, it is plausible that MEST would have similar positive effects on memory specificity and mood in a nondepressed, older adult sample. Although it is likely that improvements in executive function may be the mechanism underlying the observed increase in memory specificity following MEST, this has not yet been examined. Therefore, the current study will determine if MEST can improve memory specificity and mood in older adults and further establish if improvements in memory specificity following MEST are related to concomitant changes in executive function.

### *Life review*

Interventions which focus on aspects of life review and reminiscence have been suggested to help maintain continuity of self (Atchley, 1989; Parker, 1995, 1999) and reduce depressive symptoms in older adults (Serrano et al., 2004). Life review has broadly been defined as the structural evaluation of memories in order to form a positive, integrated view of one's past (Westerhof, Bohlmeijer, & Webster, 2010). According to Butler (1963), life review is a "...naturally occurring, universal mental process characterized by the progressive return to consciousness of past experience..." (p. 66). However, there is a lack of support for evidence-based interventions, due to the variety of definitions of life review, lack of consistency in the types of methods, and different outcomes that have been measured (see Bluck and Levine, 1998 for review). Bluck and Levine (1998) and

Westerhof and Bohlmeijer (2014) proposed that combining empirical evidence regarding the role of over-general memory in mental health with the original theoretical work on life review (Butler, 1963, 1974) would help to progress this field of research.

Serrano et al. (2004) put this approach into practice by examining the effects of a novel life review method. In contrast to the stand-alone MEST, their program was framed within the context of traditional life review, defined as an emotional appraisal of past events, but with a particular focus on improving autobiographical memory specificity. Serrano et al. (2004) examined this method in a sample of clinically depressed older adults. The life review was conducted in one-to-one sessions where patients were required to answer questions designed to prompt specific memories from different life periods (childhood, adolescence, adulthood, and a summary). In contrast to the MEST program, the life review program was designed to prompt only positive memories, and not negative memories. This focus on positive memories is an important component, since one of the aims of life review is to construct a positive life narrative. The authors reported that the life-review group exhibited improved autobiographical memory specificity, increased life satisfaction scores, and a reduction in depressive symptoms compared to a control group (who received social services as usual). Importantly, the change in autobiographical memory specificity predicted the improvement in mood (Serrano et al., 2004). The current study examined if life review would improve memory specificity in a nondepressed sample of older adults.

### Comparisons

While MEST and life review have fundamental similarities in that both aim to improve autobiographical memory specificity, there are some differences in their theoretical design which suggest that the mechanisms underlying their effectiveness are distinct. For example, the beneficial effects of life review may be attributed to the focus on integration of specific memories within the context of one's whole life, as opposed to on systematic recall of specific memories as isolated events in the stand-alone MEST program.

Another key difference is the focus on valence. Raes et al. (2009) argue that the cognitive-emotional processing of negative autobiographical memories during training is more in line with theories of reduced autobiographical memory specificity in depression, i.e., impaired executive function or functional avoidance results in generalization of and rumination on negative memories, resulting in reduced access to specific memories. Alternatively, there is a positivity effect in older adults' autobiographical memories (Mather & Carstensen, 2005). For example, older adults recall memories more positively than younger adults (Kennedy, Mather, & Carstensen, 2004). This is explained by the socio-emotional selectivity theory which states that as people age, they prioritize emotion regulation processes because the future is perceived as less open ended; therefore, they invest their resources in more emotionally gratifying goals. Therefore, life review presents the opportunity for older adults to reappraise events from their early life more positively, in light of this later bias, and this may be the mechanism that accounts for improvement in mood. In support of this, a later replication of Serrano et al.'s (2004) study found that the beneficial effect on life satisfaction was related to a reduction in access to specific negative memories, by training access to specific positive memories (Latorre et al., 2015).

MEST has not been previously tested with older adults, and life review is commonly advocated in older populations. Thus, the underlying mechanisms explaining the effectiveness of each method may be dependent upon the age of the sample. Comparing effects of MEST and life review in a sample of nondepressed older adults will help determine whether inclusion of negative cue words impacts on effectiveness and suitability with older adults.

The formats were also different as MEST was group based while life review was delivered one-to-one. There are possible benefits to both; for example, the one-to-one setting is more confidential allowing recall of personal memories, while the group setting is more sociable and has better cost–benefit implications. Life review in a group format has also been found to improve self-esteem and life satisfaction in older adults (Chiang, Lu, Chu, Chang, & Chou, 2008).

### *Aims and hypotheses*

The principal aim of the current study was to determine if nondepressed older adults would improve their autobiographical memory specificity, independence, social problem solving, and mood after completing the MEST or life review interventions, relative to a control group who completed a workbook of cognitively stimulating activities. Our secondary aim was to tease apart the differential features that make each intervention effective, including their effect on executive function. Finally, we aimed to investigate older adults' perceptions and experiences of the different methods through qualitative analysis of written feedback. The purpose of this was to inform us how the techniques could be made more acceptable to the individual, as this is likely to make the interventions more effective.

To these ends, a sample of older adults completed initial measures of mood, autobiographical memory specificity, social problem solving, executive function, and independence. Following baseline assessment, participants were randomly assigned to either an intervention (MEST or life review) or the control group (where participants completed a workbook). Participants completed the same measures again after 4 weeks of intervention (or control activity) and after 3 months.

We hypothesized that immediately following training participants in the intervention groups would exhibit improvements in autobiographical memory specificity and mood relative to the active control group.

Given that MEST has been shown to have long lasting effects on memory specificity (Moradi et al., 2014; Neshat Doost et al., 2014), we predicted that, at 3-month follow-up, participants in the MEST group would still exhibit superior memory specificity than controls. We also examined the long-term effects of life review (at 3-month follow-up) but had no formal hypothesis given that the long-term effects of life review on specificity have not been examined previously.

Previous studies have not measured social problem solving ability or functional limitations. We aimed to explore these key factors since they have previously been linked to autobiographical memory specificity (Beaman et al., 2007; Holland et al., 2016). We hypothesized that the intervention groups would exhibit improvements on mood, social problem solving, and functional limitations relative to controls following training and at 3-month follow-up.

In terms of expected differences between the two interventions, we hypothesized that life review may have a stronger effect on mood and that improved mood would be related to increased recall of specific positive events, rather than negative, due to the focus on positive appraisal. This is expected because the inclusion of specific negative recall in MEST is less relevant to this age group due to the positivity effect, which suggests that older adults are successful at emotion regulation of memories (Mather & Knight, 2005). We also hypothesized that executive function would improve in the MEST group and would be related to increase in specificity because MEST provides focused practice in the use of executive function to inhibit general memories and monitor the generative search process required to retrieve a specific memory. Since executive function is integral to the hierarchical search process, we hypothesized that both methods would be particularly helpful for people with lower executive function.

Examination of relationships between changes in key variables is expected to reveal that changes in mood, independence, and social problem solving would be related to changes in specificity.

## Method

### Participants

Sixty-six healthy participants aged 70+ took part in the study (MEST,  $n = 22$ ; life review,  $n = 22$ ; control,  $n = 22$ ). Demographic information is displayed in Table 1. All participants were recruited through the University's participation panel for volunteers interested in healthy aging research, older age-focused organizations around the local area, and local advertisement in the community via posters. Participants received £7.50 per session at the University toward their travel expenses. Home visits were offered as an alternative in order to include those who were not as mobile. Participants who were under the age of 70 or had a diagnosis of a significant memory problem (including stroke, dementia, or traumatic brain injury) were excluded from participation. Participants who scored below the recommended cutoff of 88 (Hsieh, Schubert, Hoon, Mioshi, & Hodges, 2013) on the Addenbrooke's Cognitive Examination-III (ACE-III; Noone, 2015) on a pre-training assessment were also excluded from further participation due to possible cognitive impairment. Ethical approval was obtained from the University Ethics Committee, #709, with written informed consent being obtained from all participants.

**Table 1.** Participant demographics across group type.

		MEST ( $n = 22$ )	Life review ( $n = 22$ )	Control group ( $n = 22$ )	Statistic	$p$ Value
Age	Mean	74.77	74.14	76.41	$F = 0.95$	0.392
	SD	6.57	3.67	6.24		
No. of years in education	Mean	18.77	17.77	19.14	$F = 1.32$	0.274
	SD	2.62	3.1	2.9		
Gender (% within group type)	Female	63.6	77.3	59.1	$\chi^2 = 1.77$	0.41
	Male	36.4	22.7	40.9		
ACE-III at baseline	Mean	95.45	94.82	94.5	$F = 0.52$	0.596
	SD	2.56	2.81	3.94		

MEST: Memory Specificity Training; ACE-III: Addenbrooke's Cognitive Examination-III.



## Materials

### *Autobiographical memory specificity*

The standard AMT (Dalglish et al., 2007; Williams & Broadbent, 1986) was used as a measure of ability to recall specific autobiographical memories. Ten cue words were presented to participants and they were instructed to recall a memory of a specific event, lasting less than a day on only one particular occasion, in response to each cue. A different set of cue words was used at each time point (pre-training, post-training, and 3-month follow-up). Five of the words from each set were positive (e.g., delightful, bright, carefree, lively, and reassured) and five were negative (e.g., tense, sorry, mistake, fault, and clumsy), presented in an alternating order. A pilot study conducted with 12 undergraduate students found that the three sets of cue words did not differ in terms of proportion of specific memories recalled,  $F(2,20) = 0.49$ ,  $p = 0.62$ , thus, indicating that the words were matched in their potential to evoke a specific memory. Participants were told that the memory did not need to be an important event and could be something trivial, as long as it was one specific event. Examples of acceptable and unacceptable responses were given, and participants completed a practice trial on which they received feedback before beginning the task.

Participants' responses were recorded using a digital audio voice recorder to be coded later. Memories were coded as "specific" if they were events that lasted less than a day and that occurred on one particular occasion (e.g., "Walking down the aisle on the day I got married"). Memories that lasted longer than a day (e.g., "My holiday in Spain") or were of repeated events (e.g., "Days out in the city") were coded as "general." Participants were prompted (e.g., "Can you think of a memory in relation to that?" or "Was that on one particular occasion?") if the type of memory recalled was unclear, or if the response was not a memory (e.g., it was an opinion related to the cue), or if the information related to future events. The first ratable memory was scored as specific, general, or if no memory was given the response was scored as "omission." The response was also coded as "omission" if no response was given within 1 min. The proportion of specific memories retrieved out of all 10 cue words gave the total score. Separate scores for positive and negative specific recall were also calculated by taking the proportion of specific memories recalled out of all five of each cue valence. A random sample of 90 memories from the AMT (30 from the MEST group, 30 from life review group, and 30 from the control group) was rated by an independent rater who was blind to group type for the purpose of analyzing inter-rater reliability of the outcome measure. Inter-rater reliability for specific versus general was good,  $K = 0.82$  with a percentage agreement of 92.2%.

### *Social problem solving ability*

In the Means End Problem Solving Procedure (MEPS; Platt & Spivack, 1975), participants described aloud how they would solve a set of four hypothetical social problem scenarios, for example,

You love your partner very much, but you have many arguments. One day they leave you. You want things to be better. The story ends with everything being fine between you and your partner. You begin the story with your partner leaving you after an argument.



The other three scenarios referred to problems with one's boss, falling out with friends and moving to a new neighborhood. These scenarios were previously used with depressed and nondepressed students (Anderson, Goddard, & Powell, 2009; Goddard et al., 1996, 1997). The mean "number of relevant steps/means" taken to solve the problem and the mean "effectiveness" of the solution from 0 to 7 were rated (higher scores on each reflect higher social problem solving ability). A random sample of 72 problem solutions (24 from the MEST group, 24 from life review, and 24 from the controls) was rated by an independent rater who was blind to group type for the purpose of analyzing inter-rater reliability. The intra-class correlation coefficient was 0.85 for number of relevant means, and 0.72 for effectiveness ratings.

### *Self-rated depression*

The Hospital Anxiety & Depression Scale (HADS; Zigmond & Snaith, 1983) is a self-report measure that can detect presence and severity of mild degrees of anxiety and depression. It comprises seven questions relating to depression and seven questions relating to anxiety. In a large population study, Mykletun, Stordal, and Dahl (2001) reported Cronbach's alpha of 0.76 for depression and 0.8 for anxiety. The subscore for depression (0–21) was used in the current study. The cutoff scores are as follows: normal 0–7, mild 8–10, moderate 11–14, and severe 15–21 (Zigmond & Snaith, 1983).

### *Independence*

The instrumental and basic activities of daily living scales (IADL, ADL) (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Lawton & Brody, 1969) (IADL: 0–8 and ADL: 0–6) are tools used to assess ability to perform basic (e.g., washing oneself) and instrumental (e.g., managing one's finances) activities of daily living independently. The functional limitations profile (FLP; Pollard & Johnston, 2001) comprises of a number of sub-constructs (e.g., mobility, alertness, and communication) to give a total score (0–1150) as a measure of self-reported limitations that affect everyday functioning.

### *Cognitive function*

The ACE-III (0–100; Noone, 2015) was used to screen for cognitive impairment (i.e., <88 indicated possible impairment; Hsieh et al., 2013). The ACE-III is a cognitive assessment commonly used as part of the process of assessing for dementia. It comprises five domains measuring language, memory, attention, fluency, and visuospatial skills. The sum of each domain gives a total score out of 100 as a general measure of cognitive function.

### *Executive function*

The RNG task (Towse & Neil, 1998) was used as a measure of executive function. This task involved participants calling random numbers from 1 to 9 in time with a metronome set at 1 beat per second for 1 min. The redundancy (*R*) score measures how frequently each digit occurred and indicates updating ability (Miyake et al., 2000). It was selected since this aspect of executive function has previously been related to over-general memory (Holland et al., 2012). The RNG index of how frequently pairs or triplets of digits occurred was selected as a measure of inhibition. This skill has been demonstrated to deteriorate with increasing age (Holland et al., 2012) and has been related to over-general memory,

purportedly because inhibition ability is required to allow access to specific events by inhibiting distracting general memories (Dalgleish et al., 2007). Thus, reduced inhibition with increased age may also contribute to over-general memory production. Lower scores on each measure indicated a higher level of randomness, i.e., higher executive function ability.

All measures have previously been used with older adults. They were selected due to previous evidence of relationships with autobiographical memory, for their user acceptability, brevity, and lack of need for complex equipment.

### *Feedback questionnaire*

Participants in the life review and MEST group were also given an optional feedback questionnaire at the end of the post-training session to complete if they wished to comment on their experience of the intervention. This contained seven open-ended questions such as “Did you feel you benefitted in any way from taking part in the training program, and if so, how?” and was completed and returned anonymously.

### *Interventions*

#### *Memory Specificity Training (MEST)*

The aim of the MEST intervention was to improve the specificity of older adults’ retrieval of autobiographical memories by providing systematic practice in this task. Following Raes et al.’s (2009) method, the MEST program involved participants attending sessions in small groups of four to six participants. Following an introduction session, there were 1 h weekly sessions, over four consecutive weeks. In each session, participants were asked to recall memories of specific events in response to positive, negative, and neutral cue words. Participants were instructed to try to recall memories of events that lasted less than a day on one particular occasion. Participants were also given homework tasks to complete which provided a further 10 cue words each week so that participants could continue practicing retrieving memories. Included in the homework was also a “specific memory of the day” task in which participants were required to write down a specific memory every evening from each day of the week in between the group sessions. The total number of specific memories participants had the opportunity to practice recalling was approximately 71, plus 8 extra cue words if time permitted during the group sessions (i.e., 2 potential extra memories per week).

#### *Life review*

Following Serrano et al.’s (2004) protocol, the life review intervention consisted of 1 h weekly sessions, over four consecutive weeks. Following an introduction at the beginning of the first intervention session, participants were asked to practice retrieving specific autobiographical memories of events that lasted less than 1 day, on one particular occasion. Each session was conducted one-to-one with a researcher. The aim of the intervention was to improve autobiographical memory retrieval in older adults for specific life events, with a focus on positive memories, within a life review context. Participants were asked 14 questions in each session designed to prompt specific memories, e.g., “Can you tell me about something that your father/mother did one day when you were a child that brought you happiness?” (Serrano et al., 2004). The questions were related to a particular life period each week, i.e., childhood,

adolescence, adulthood, and finally a summary. In addition, we asked participants to complete a homework activity each week in which they were required to write down specific memories in response to similar written prompting questions. The total number of specific memories participants had the opportunity to practice recalling was approximately 77.

### *Control workbook*

The control group was asked to complete a workbook at home over the course of four consecutive weeks. They were also offered the opportunity to receive autobiographical memory training at the end of the study after they had completed the 3-month follow-up. The control workbook consisted of cognitively stimulating activities that were not directly related to autobiographical memory (i.e., crossword and Sudoku puzzles). The purpose of this was to ensure that those in the control group were also actively completing cognitively stimulating tasks, but without specifically influencing autobiographical memory retrieval.

### *Procedure*

Participants first completed pre-training assessments to provide baseline measures of cognitive function, autobiographical memory specificity, self-rated depression, social problem solving ability, and independence. Participants were then randomly allocated to either an intervention (MEST or life review) or control group using computer-generated random numbers produced via the "RAND" function in a Microsoft Excel spreadsheet. For example, to randomize a block of 10 participants at a ratio of 1:1, a table was inserted containing a column of participant numbers and a column of random numbers. The order of the participant numbers was then randomized using the "custom sort" and "sort by" RAND in ascending order functions. Once the participant numbers were in a random order, the first five were allocated to intervention and the second five to control.

After an introduction to the assigned activity type, the interventions and control activity took place over the following 4 weeks. Participants completed a post-training assessment session in the fifth week, and finally a follow-up 3 months after the post-training session. The MEST program was set up first, followed by the life review program which started 6 months later. Therefore, we were unable to allocate participants at a ratio 1:1:1. Instead, participants were allocated at a ratio 1:1 to MEST:control, and then 1:1 life review:control. This meant that intervention-type allocation depended on the time participants were recruited (i.e., those enrolled earlier: MEST or control, or those enrolled later: life review or control). Participants were unaware of this and there was no reason to suspect any differences across participants between recruitment stages. Nine participants from the control group withdrew from the study before reaching the post-training assessment stage. Therefore, the ratio of randomization of participants was adjusted to 2:1 at this later point in order to ensure balanced sample sizes in each group.

The final sample consisted of 66 participants; however, four participants withdrew from the study due to illness before completing the 3-month follow-up (one from the MEST and three from the control group). This meant that only pre-and post-training data for these four participants were included in the analysis; therefore, the sample size of the 3-month follow-up data ( $N = 62$ ) was slightly smaller (MEST = 21; life review = 22; controls = 19). One participant in the life review group could not attend the post-training assessment due to a family bereavement but did attend the 3-month follow-up,

therefore was retained in the study. However, this meant that sample size of the post-training data for the life review group was  $n = 21$ .

## Results

### *Participant characteristics*

There were no significant differences between groups in demographics (see Table 1), AMT scores, depression ratings, social problem solving, or measures of independence at pre-training (see Table 2),  $p > 0.05$ . There was, however, a significant difference in redundancy scores between groups at pre-training,  $F(2,63) = 3.47$ ,  $p = 0.037$ . A  $t$ -test revealed that redundancy scores of the MEST group were significantly higher compared to life review group,  $t(42) = -2.31$ ,  $p = 0.026$ , indicating higher updating ability in the life review group (see Table 2 for means and SDs). The mean AMT score of the current sample ( $M = 0.7$ ,  $SD = 0.19$ ) is comparable to the mean AMT score of a previous study ( $M = 0.69$ ,  $SD = 0.12$ ) with healthy older adults, which found that older adults retrieved significantly fewer specific memories than younger adults (Holland et al., 2012). This suggests that the older adults in the current sample have age-related reduced autobiographical memory specificity as expected. The mean RNG index ( $M = 0.27$ ,  $SD = 0.06$ ) and redundancy ( $R$ ) scores ( $M = 1.56$ ,  $SD = 1.16$ ) of the current sample are also comparable to the mean RNG index ( $M = 0.19$ ,  $SD = 0.10$ ) and  $R$  scores ( $M = 2.78$ ,  $SD = 1.93$ ) in Holland et al.'s (2012) sample.

### *Missing data*

One participant did not complete the FLP in the pre-training session, and one participant did not complete the ADL, IADL, or FLP at 3-month follow-up. All other data from these two participants were included.

### *Adherence to intervention*

All participants in the life review group attended every intervention session. Three participants in the MEST group missed one of the group sessions due to illness. The proportion of intervention sessions attended by the MEST group was therefore: mean = 0.97,  $SD = 0.07$ .

### *Effect of interventions at post-training on autobiographical memory specificity*

Mixed 3 (life review, MEST, and control)  $\times$  2 (pre- and post-training) ANOVAs were conducted with the AMT proportion of specific memories score (AMT-pS) as the dependent variable. Statistics are displayed in Table 2. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ( $p > 0.05$ ). These analyses revealed a significant group  $\times$  time interaction:  $F(2,62) = 3.3$ ,  $p = 0.043$ , partial eta squared ( $\eta_p^2$ ) = 0.096. One-way ANOVAs showed that although there was no significant difference between the groups at pre-training,  $p > 0.1$ , at post-training, there was a significant difference between groups,  $F(2,62) = 5.17$ ,  $p = 0.008$ . The proportion of specific

**Table 2.** Means and standard deviations of all relevant variables at pre-training, post-training, and 3-month follow-up.

Variable	Group difference at baseline				Post-training mean (SD)				3 (Time) × 2 (group) interaction				3 (Time) × 3 (group) interaction			
	MEST (n = 22)	Life review (n = 22)	Control (n = 22)		F value	p Value	MEST (n = 22)	Life review (n = 21)	Control (n = 22)	F value	p Value	MEST (n = 21)	Life review (n = 22)	Control (n = 19)	F value	p Value
AMT-pS	0.71 (0.22)	0.71 (0.16)	0.69 (0.18)	0.09	0.73 (0.27)	0.918	0.85 (0.14)	0.85 (0.15)	0.71 (0.2)	3.3	0.043*	0.78 (0.18)	0.76 (0.23)	0.73 (0.2)	1.71	0.153
AMT-positive-pS		0.69 (0.28)	0.7 (0.18)		0.73 (0.27)	0.13	0.881	0.82 (0.2)	0.8 (0.25)		2.49	0.091	0.76 (0.27)	0.73 (0.27)	0.71 (0.23)	2.06
AMT-negative-pS		0.7 (0.25)	0.73 (0.24)		0.65 (0.21)	0.67	0.518	0.89 (0.15)	0.9 (0.14)		0.82	0.445	0.8 (0.19)	0.79 (0.27)	0.76 (0.25)	0.48
MEPS No. of relevant means	3.58 (0.7)	3.95 (1.44)	3.23 (0.86)	2.6	0.083	0.083	3.63 (0.84)	4.05 (1.59)	3.01 (0.95)	1.22	0.302	3.58 (0.64)	3.83 (1.44)	2.89 (0.9)	0.76 (0.25)	0.547
Effectiveness (0-7)	3.76 (1.02)	4.01 (1)	3.47 (1.12)	1.47	0.237	0.237	3.88 (0.94)	3.95 (1.1)	3.17 (1.11)	3.64	0.032*	3.84 (0.88)	4.08 (1.02)	3.36 (1.17)	0.73 (0.2)	0.142
HADS depression (0-21)	5.95 (0.21)	3.18 (1.89)	2.86 (2.19)	2.64 (1.5)	0.47	0.629	3.5 (2.74)	2.86 (2.29)	2.86 (2.29)	3.23 (1.63)	0.61	0.548	3.14 (2.13)	2.55 (2.15)	2.68 (2.24)	0.25
ADL (0-6)	7.95 (0.21)	5.86 (0.35)	5.95 (0.21)	0.85	0.433	0.433	5.95 (0.21)	5.95 (0.22)	5.91 (0.29)	1.51	0.228	5.95 (0.22)	5.86 (0.36)	5.89 (0.32)	0.243	0.909
IADL (0-8)	294.5 (152.24)	7.95 (0.21)	7.95 (0.21)	0	1	7.95 (0.21)	8 (0)	7.95 (0.21)	7.95 (0.21)	1.05	0.356	7.95 (0.22)	8 (0)	8 (0)	0.534	0.734
FLP (0-1150)	0.27 (0.07)	209.41 (162.23)	209.41 (162.23)	312.05 (150.89)	2.72	0.074	301.55 (159.53)	182.1 (143.79)	182.1 (143.79)	326.23 (149.16)	0.54	0.586	323.48 (166.12)	244.38 (182.05)	323.84 (149.58)	0.5
RNG	2.02 (1.65)	0.25 (0.04)	0.28 (0.08)	1.72	0.187	0.187	0.27 (0.08)	0.24 (0.05)	0.26 (0.07)	0.45	0.643	0.25 (0.06)	0.27 (0.05)	0.29 (0.07)	0.212	0.212
R		1.14 (0.7)	1.52 (0.71)	3.47	0.037*	0.037*	2.26 (1.58)	1.44 (0.81)	1.62 (1.3)	0.07	0.929	2.38 (1.84)	1.62 (1.01)	1.53 (1.15)	0.882	0.882

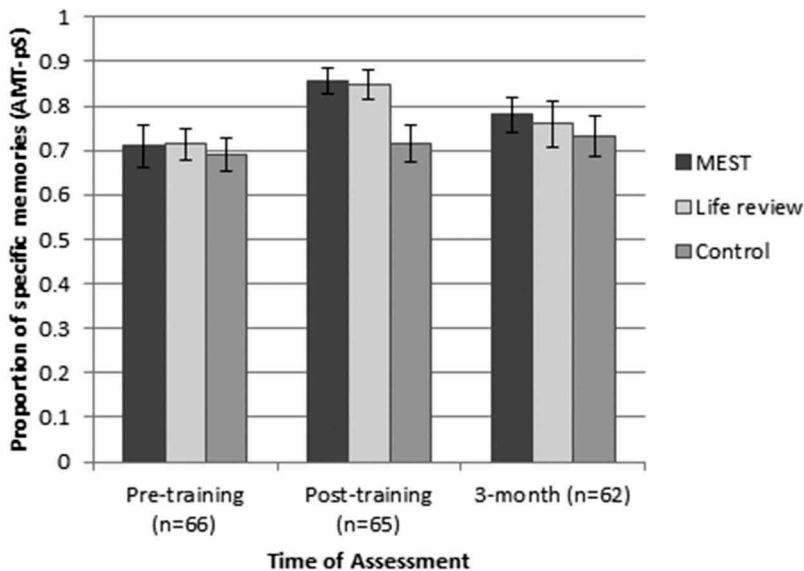
MEST: Memory Specificity Training; AMT-pS: Proportion of specific autobiographical memories recalled on the Autobiographical Memory Task; AMT-positive-pS: Proportion of specific memories recalled in response to positive cues; AMT-negative-pS: Proportion of specific memories recalled in response to negative cues; MEPS: Means End Problem Solving Procedure; HADS: Hospital Anxiety and Depression Scale; ADL: Activities of Daily Living index of independence; IADL: Instrumental Activities of Daily Living scale; FLP: Functional Limitations Profile total score; RNG: Random Generation Number Index; R: Redundancy score. \*Indicates p value significant to <0.05.

autobiographical memories recalled (AMT-pS) was significantly greater in the MEST  $t(42) = 2.76, p = 0.008$ , and life review groups,  $t(41) = 2.51, p = 0.016$ , compared to the controls. There was no difference between the MEST and life review groups at post-training,  $p > 0.1$ . Furthermore, planned pairwise comparisons showed that while AMT-pS did not differ across time in the control group ( $p > 0.1$ ), there was a significant increase across time on AMT-pS in the MEST,  $t(21) = -3.27, p = 0.004$  and life review groups,  $t(20) = -4.36, p < 0.001$  (see [Figure 1](#)).

Since depression has previously been related to autobiographical memory specificity, change in depression scores was also examined as a covariate to check whether a decrease in depression ratings accounted for the increase in autobiographical memory specificity. Change scores were calculated by taking the difference between scores at post-training and pre-training. The results remained significant,  $p < 0.05$ , thus, indicating that changes in autobiographical memory specificity could not be explained by changes in depression.

### *Long-term effects of interventions on autobiographical memory specificity*

In order to assess whether improvements in autobiographical memory specificity were maintained in the intervention groups relative to controls after a 3-month follow-up period, 3 (life review, MEST, and control)  $\times$  3 (pre-, post-, 3-month) ANOVA analyses were conducted with AMT-pS as the dependent variable. This revealed no significant interactions, indicating that autobiographical memory specificity did not remain significantly higher than controls in either of the intervention groups at 3-month follow-up (see [Figure 1](#)),  $p > 0.1$ .



**Figure 1.** Proportion of specific memories recalled at each time point in each group.

### Analysis of secondary outcome measures

Mixed 3 (life review, MEST, and control)  $\times$  2 (pre- and post-training) ANOVAs were conducted with each secondary measure as the dependent variable (see Table 2 for statistics). This allowed us to assess whether participants in each intervention group exhibited improvements in secondary measures of social problem solving (MEPS), depression ratings (HADS), independence (ADL; IADL; FLP), and executive function (RNG index; Redundancy score), relative to controls immediately following the training.

#### Social problem solving

There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ( $p > 0.1$ ). On the measure of MEPS effectiveness ratings, a significant 3 (life review, MEST, and control)  $\times$  2 (pre- and post-training) interaction was revealed:  $F(2,62) = 3.64$ ,  $p = 0.032$ ,  $\eta_p^2 = 0.11$ . One-way ANOVA showed that although there was no significant difference between the groups at pre-training,  $p > 0.05$ , at post-training, there was a significant difference between groups,  $F(2,62) = 3.62$ ,  $p = 0.033$ . MEPS effectiveness was significantly higher in the MEST,  $t(42) = 2.29$ ,  $p = 0.027$  and life review groups  $t(41) = 2.29$ ,  $p = 0.027$  compared to controls at post-training. However, pairwise comparisons showed that there were no significant effects of time on MEPS effectiveness in either the life review or MEST groups,  $p > 0.1$ , while it did significantly decrease from pre-training to post-training in the control group,  $t(21) = 2.37$ ,  $p = 0.028$ . There were no group type  $\times$  time interactions on the number of means generated on the MEPS task,  $p > 0.1$ .

In order to assess whether differences between groups were maintained after a 3-month follow-up period, 3 (life review, MEST, and control)  $\times$  3 (pre-, post-, 3-month) ANOVAs were conducted. There were no significant interactions on either the MEPS number of means or MEPS effectiveness, indicating that none of the above effects on social problem solving ability at post-training were maintained after a 3-month follow-up period,  $p > 0.1$ .

#### Depression

There were no significant group  $\times$  time interaction effects on HADS depression ratings, either at post-training or 3-month follow-up,  $p \geq 0.1$ . However, a floor effect was observed with 51.51% of the sample scoring below 2 out of 21 on the HADS depression rating scale at pre-training. None of the participants scored above the recommended cutoff for mild depression (8 out of 21; Zigmond & Snaith, 1983) at baseline.

#### Independence

There was a significant main effect of time on total FLP scores,  $F(2,114) = 3.78$ ,  $p = 0.026$ ,  $\eta_p^2 = 0.062$ . A significant linear contrast was observed,  $F(1,57) = 4.16$ ,  $p = 0.046$ ,  $\eta_p^2 = 0.07$  indicating that FLP increased linearly (more limitations) across the three time points. There was no significant interaction between time and group type,  $p > 0.1$ . There were no group  $\times$  time interactions on any of the subscales of the FLP, or on the ADL or IADL,  $p > 0.05$ .

There was a ceiling effect on the ADL and IADL measures, with 92.42% scoring  $>5$  out of 6 on the ADL measure, and 95.45% scoring  $>7$  out of 8 on the IADL measure at pre-training.



### *Executive function*

There were no significant interaction effects on the RNG index or redundancy scores, either at post-training or 3-month follow-up  $p > 0.1$ .

### *Cue valence*

The effect of cue valence was examined using a 2 (positive and negative)  $\times$  2 (pre and post)  $\times$  3 (life review, MEST, and control) ANOVA. However, there were no interactions with cue valence,  $p > 0.05$ .

### *Relationship between initial executive function and change in AMT*

In order to test the hypothesis that both methods would be particularly helpful for people with lower executive function, the relationships between baseline executive function and change in AMS-pS (calculated by taking the difference between pre-training to post-training) were examined. Correlations between pre-training RNG index, pre-training  $R$  scores and change in AMT-pS were explored for each group separately. Change scores were also calculated separately for proportion of specific memories recalled in response to positive cues (AMT-positive-pS), and to negative cues (AMT-negative-pS). All variables reported were normally distributed as assessed by Shapiro–Wilk’s test,  $p > 0.05$ , except for redundancy ( $R$ ) and change in AMT-negative-pS in the MEST group, and  $R$  in the life review group; therefore, Spearman’s rho correlation coefficients were examined for these variables.

There were no correlations between pre-training RNG,  $R$ , and change in AMT-pS scores, in the MEST or control groups,  $p > 0.1$ . There was a significant positive correlation between pre-training RNG index in the life review group and change in AMT-positive-pS,  $r = 0.5$ ,  $p = 0.02$ . This suggests that in the life review group, lower executive function at baseline (i.e., higher RNG index) was related to greater change in recall of specific positive events. Further correlations were performed in order to check whether this finding could be explained by people with higher executive function being more likely to have higher memory specificity at baseline and, therefore, have less room for change/improvement. There were no significant correlations between pre-training RNG index and pre-training AMT-positive-pS,  $p > 0.1$ , suggesting that this was not the case. Percentage change scores (as opposed to absolute change above) for AMT-positive-pS were also calculated to examine change while taking into account baseline scores, and the correlation remained significant,  $r_s = 0.44$ ,  $p = 0.05$ .

### *Relationships between changes in variables*

Change scores were calculated for each measure by taking the difference between scores at 3-month follow-up and pre-training. Correlations between change in AMT-pS and change in the following: MEPS (number of means and effectiveness rating), HADS depression ratings, and FLP total scores were first analyzed in the whole sample ( $N = 66$ ). All pairs of variables reported here were normally distributed, as assessed by Shapiro–Wilk’s test,  $p > 0.05$ . The analyses revealed significant positive correlations between change in AMT-pS and change in MEPS number of means  $r = 0.38$ ,  $p = 0.003$ , and

between change in AMT-pS and change in MEPS effectiveness ratings,  $r = 0.25$ ,  $p = 0.046$ . A significant negative correlation was also observed between change in AMT-pS and change in FLP total score,  $r = -0.27$ ,  $p = 0.035$ . Therefore, improvement in recall of specific autobiographical memories overall was positively related to improvement in social problem solving ability and negatively to FLP score (i.e., reduction of functional limitations). There were no other significant correlations between change in AMT-pS and any of the other variables.

The above analysis was also conducted with each group separately (MEST,  $n = 21$ ; life review,  $n = 22$ ; control,  $n = 19$ ). All pairs of variables reported were normally distributed as assessed by Shapiro–Wilk’s test,  $p > 0.05$ , except for the “Change in MEPS no. means” variable in the life review group which violated the assumption of normality ( $p > 0.05$ ). Therefore, Spearman’s rho correlation coefficient is reported for the relationship between change in AMT-pS and change in MEPS number of means in the life review group only. The results revealed that change in AMT-pS was positively correlated with change in MEPS number of means in the MEST group,  $r = 0.53$ ,  $p = 0.014$ , and the life review group,  $r_s = 0.5$ ,  $p = 0.018$ , but not in the control group ( $p > 0.1$ ). Therefore, improvement in recall of specific autobiographical memories overall was positively related to improvement in social problem solving ability in both of the intervention groups separately. Correlations between change on AMT-pS and FLP total scores were not significant for any of the groups individually,  $p > 0.1$ . There were no other significant correlations between change in AMT-pS and any of the other variables in each group,  $p > 0.05$ .

### **Qualitative analysis of feedback questionnaires**

Thematic analysis (Braun & Clarke, 2006) was conducted on the responses participants gave on the feedback questionnaires that were returned in order to analyze and interpret the participants’ experiences of the intervention.

#### **Mest**

Feedback forms were returned anonymously by 17 participants out of the 22 participants who took part in the MEST intervention. Analysis resulted in three key themes:

#### **“Acceptability” (with 3 subthemes)**

*Onerous, but acceptable.* Participants reported that activities were onerous at times, but they also felt that this was justified as they recognized that any training intervention needs to be challenging in order to be effective.

*Relevance to everyday use of memory.* Three participants did not feel that this type of memory intervention was relevant or helpful to their experiences of everyday memory lapses. The focus on autobiographical memory lacked importance to them, and there was instead the suggestion that tips or strategies for dealing with perceived everyday difficulties, for example, maintaining or improving working memory, may have been more useful.

*Side effect of unpleasant memories.* The inclusion of negative cue words led to participants retrieving unpleasant memories. Sometimes they did not feel comfortable sharing these memories within a group. In some cases, this led participants to question the

reasoning behind the activities in which they were given negative cue words. For example:

It was just an opportunity to reminisce and not always pleasant memories. I personally do not like to dwell on the past.  
I try not to dwell on past negative experiences.

**“Feasibility”.** The task of recalling a specific memory in response to a cue word was considered by participants to be very difficult. The difficulty seemed to lie not just in moving past general memories in order to retrieve a particular event but also in terms of associating memories to the cue words, which were often perceived to be abstract. This also links to the subtheme 1b. “Relevance to everyday memory” as the recall tasks seemed repetitive and lacked relevance to participants because the cue words did not always have personal meaning to individuals. For example:

...finding events to some words which were vague, e.g., “content”, “disappoint”. I felt that a less abstract word might have helped me to remember a significant event.

### **“Outcome assessment” (with 2 subthemes)**

**Social benefit.** A number of participants enjoyed the social aspect of the MEST training in particular. They commented on the benefit of having the opportunity to meet new people and enjoyed the interaction element of the program. They also found it interesting to hear other people’s responses to the cue words and to share similar experiences.

**Mental stimulation.** One of the main positive outcomes of the program seemed to be that participants found it an interesting experience and that the challenging nature of the activities provided general mental stimulation, even if there were no specific improvements in memory.

### **Life review**

Feedback forms were returned anonymously by 14 participants out of the 22 participants who took part in the life review intervention. Analysis resulted in three key themes;

### **“Acceptability”**

The majority of participants found the activities to be a reasonable amount, with one even saying they didn’t feel that it was enough and they would have liked to receive more homework.

### **“Feasibility”**

A number of participants found it difficult to retrieve a memory of one particular event, rather than general memories. Although this was challenging, the main difficulty was then in recalling the details attached to that event, such as how they felt at the time. For example:

Pin pointing to specific events of less than one day in one’s past is remarkably difficult.  
...remembering how one felt at the time and what other sensations one had is much more difficult.

### *“Outcome assessment” (with two subthemes)*

**Life satisfaction.** The majority of participants found that recalling memories of positive events from their past was an enjoyable experience. The activities gave participants the opportunity to reminisce, bringing back happy memories that they hadn’t thought about for a long time. In many cases, this led to an overall feeling of gratefulness and satisfaction. For example:

I feel that focusing on so many memories which have been temporarily forgotten has helped me to appreciate that my life has been filled with happy experiences. Looking back has made me feel amazingly lucky and grateful for all the positive influences in my life. This gives me a feeling of peace and satisfaction.

In one case, even though unpleasant memories were also triggered during the program, they felt that they could look back on these from a positive perspective:

It has helped me to bring many happy memories to the forefront. Any unhappy memories I was able to cope with and realize how lucky I was to be able to overcome them and how much stronger it has made me. I hope it will help me and others for the future.

**Effect on recall style/perspective.** Similarly to those in the MEST group, participants commented on the beneficial mental stimulation the activities gave them. Further to this, they commented on how the activities had altered their perspective on memory, viewing memories in a different light and focusing more on positivity while looking back. For example:

I recalled incidents that at the time I didn’t think (of) as happy, but now, many years later, I have realized they were.

### **Summary of qualitative feedback**

Overall, there were some subtle differences between the experiences of the two groups. The main benefit of MEST seemed to be the social aspect of being part of a group, whereas the main benefit of life review was the focus on happy memories that were personally meaningful and uplifting. The extent of homework activities in the MEST group were perceived as onerous, but still acceptable and provided beneficial mental stimulation. The life review method had a greater perceived positive effect on mood but may be improved by including more homework activities to make it more challenging.

## **Discussion**

The first hypothesis that those receiving an intervention would exhibit improvements in autobiographical memory specificity relative to controls immediately following training was supported. This extends previous findings supporting the effectiveness of the MEST and life review programs in various populations (Latorre et al., 2015; Moradi et al., 2014; Neshat Doost et al., 2014; Raes et al., 2009; Serrano et al., 2004) to a healthy, independently living older adult population. Moreover, this improvement was not accounted for by change in depression. This has important implications for interventions aiming to preserve older adults’ well-being since increased autobiographical memory specificity is thought to be a protective mechanism for mental health (Latorre et al., 2013) and has

previously been related to better social problem solving (Beaman et al., 2007) and functional independence (Holland et al., 2016): factors vital to an active, healthy life in older age.

The second hypothesis that improvement in autobiographical memory specificity would be maintained after 3 months was unsupported. Participants were not asked to continue practicing the activities after the intervention period, meaning that they may not have integrated specific memory recall into their everyday lives, resulting in a shift back toward over-general memory. This is in line with findings from the qualitative analysis of the MEST training as participants felt that recalling past memories was not relevant or helpful in their everyday lives, possibly affecting their motivation to continue the practice. Future studies may consider booster sessions or redesigning the MEST activities in a real-life context. For example, asking participants to recall a specific memory in response to a hypothetical situation, such as “One morning you are feeling down and your self-esteem is low after you received a negative comment from a colleague at work. Recall a specific memory when you felt confident about something”, as opposed to asking participants to recall a specific memory in response to a simple cue word such as “confident.” It has been evidenced that the type of task instruction used can influence the over-generality effect in older adults. For example, Ford, Rubin, and Giovanello (2014) suggest that the verbal word cue tasks commonly used in autobiographical memory research magnify over-general memory in older adults because they involve reliance on executive function to maintain task instructions. When musical cues were used as a more emotional cue, executive function was not related to autobiographical memory specificity (Ford et al., 2014) which contrasts with findings of previous studies that used verbal cues (Addis, Wong, & Schacter, 2008; Piolino et al., 2010; Ros et al., 2010). Musical cues may also facilitate autobiographical retrieval by increasing arousal or reducing anxiety (Foster & Valentine, 2001). Furthermore, musical cues aid retrieval more so in older adults than in younger adults (Schulkind & Woldorf, 2005). This may be because older adults can relate memories to emotional cues. In support of this, the over-generality effect in older adults is reduced in response to emotional cues compared to neutral cues (Holland et al., 2012). Therefore, using cues that older adults can relate to emotionally may enhance long-term performance by reducing executive control demands and capitalizing on the emotional focus in later life.

The third hypothesis that intervention groups would exhibit improvements on secondary measures relative to controls was unsupported since no quantitative effects on depression or independence were observed. The floor effects in the measures of depression and ceiling effects in activities of daily living could account for this as there was little potential for improvement. Therefore, the hypothesis that there would be more improvement in mood in the life review group than in MEST was also unsupported. However, qualitative analysis indicated that life review had a beneficial impact on mood as participants reported a positive experience and feeling of life satisfaction, although this was not detected in the quantitative measures (i.e., HADS score). It is unlikely that this was due to demand characteristics since these benefits were only reported by participants in the life review group, and not by participants in the MEST group. A measure of life satisfaction may be beneficial for future studies to assess whether there was a significant quantitative effect to support the reported qualitative effect.

The hypotheses that change in mood would be related to increase in specific recall of positive events were unsupported as there was no change in mood and no effect of cue valence in the current study. The lack of effect of cue valence in the current study may be explained by the generally high executive function of the current sample since we screened out people with potential memory problems, potentially masking any effect.

We did find that in the life review group only, people with lower baseline executive function (i.e., higher RNG index indicating lower inhibition) also had higher change scores in recalling specific positive memories. Previous research has found that older adults use cognitive control processes to enhance positive memories and diminish negative memories (Mather & Knight, 2005). Therefore, these findings suggest those with lower inhibition and, thus, less ability to regulate emotional material, may benefit from practice in accessing positive events during life review while reducing the tendency to become stuck at the general level of retrieval. This supports our hypothesis that specificity training may be particularly helpful for people with lower executive function. The authors plan to further examine the effects of this life review intervention with older adults with mild cognitive impairment, a group who are likely to have lower executive functioning and lower memory specificity.

The hypothesis that executive function would improve in the MEST group and would be related to increase in autobiographical memory specificity was also unsupported since there was no change in executive function in any of the groups. Together with the lack of relationship between baseline executive function and change in AMT scores in the MEST group, this suggests that the effect of MEST on autobiographical memory specificity may be explained by simple practice effects, rather than by any impact on the executive processes involved in AM retrieval. The activities in the MEST training are very similar to the test used to measure autobiographical memory specificity (the AMT) in that it involved multiple cue word tasks. Thus, it is reasonable to conclude that the improvement observed was due to practice effects. It would be useful to include a parallel measure, such as the Sentence Completion for Events from the Past Tense (Raes, Hermans, Williams, & Eelen, 2007), to examine this further.

In support of the hypothesis that changes in variables would be related, overall change in autobiographical memory specificity was significantly related to overall change in social problem solving in the intervention groups. Thus, those who improved the most in recalling specific autobiographical memory recall also improved the most in social problem solving. This corresponds with the constructive episodic simulation hypothesis which states that the same episodic processes underlie both retrieval of the past and imagination of future events (Schacter & Addis, 2007). Therefore, remembered details of experienced events are flexibly recombined to create simulations of hypothetical scenarios, potentially providing alternative solutions to social problems. The ability to generate multiple alternative solutions is critical to social problem solving (D'Zurilla & Nezu, 1980). Social problem solving skills are important in later life for preventing the impact of negative social interactions and helping maintain valuable social relationships (Newsom, Nishishiba, Morgan, & Rook, 2003). Therefore, the implication that improving autobiographical memory retrieval may also have beneficial effects on generating solutions to social problems is important in this age group.

Functional limitations increased from pre-training to 3-month follow-up in the total sample. However, there was a significant negative relationship between overall change

in autobiographical memory specificity and overall change in functional limitations, showing that people who improved the least in autobiographical memory specificity (or did not improve or got worse) also had bigger increases in functional limitations, i.e., became more functionally impaired. Thus, those who improved the most in their autobiographical specificity showed more reduction in limitations (improvement in function). This supports the suggested role of ability to recall specific autobiographical memories in maintenance of independence in older adults. For example, in a study looking at the psychological benefits of supported living and retirement villages, Holland et al. (2016) found that increased autobiographical memory specificity predicted a reduction in functional limitations in the domain of communication in older adults who moved to an independent but supported living environment. The communication domain, measured using the FLP, indicates the extent to which one's health impacts on ability to communicate with others. This finding may be explained by the use of autobiographical memory to facilitate conversation when meeting new people, i.e., by sharing information about one's past and one's identity. These findings suggest that autobiographical memory may be useful for the rehabilitation of older adults with independent living concerns by reducing the negative impact of health on communication limitations.

The finding that there was little quantitative difference in effectiveness between the two intervention groups indicates that autobiographical retrieval practice, which was the main component of both programs, accounted for the improvement in autobiographical memory. We aimed to further compare the two interventions through qualitative analysis. This is one of the first studies to examine MEST training with older adults, and while it had similar quantitative effects to life review, it emerged from the qualitative feedback that MEST did not have a perceived effect on mood from the participants' point of view, while participants who did life review reported increased life satisfaction. There are some theoretical differences in design between MEST and life review which may account for this.

First, participants found it difficult to relate personal events to cue words which did not have any personal meaning to them, that is, the difficulty was not just in reaching a specific memory, but in relating memories to single words which were perceived as abstract or open to interpretation. Although participants in the life review group reported difficulty pinpointing specific events, they received a benefit from recalling meaningful, personal events from their life which had value to them. Thus, life review acknowledged the unique experiences of the individual, emphasizing the overall value of their life, while the recall tasks in the MEST training may have prompted random, less meaningful memories of isolated events, seeming to lack importance to participants. Interventions which frame autobiographical memory specificity practice in the context of a therapeutic program such as life review may be more suitable for older adults because it is in line with the natural life review process proposed by Butler (1963). In light of this, although over-general memory in older adults represents vulnerability to depression, perhaps this is not for the same reasons that it does in younger adults. In younger adults, it has been suggested that over-general memory mediates depression through increased rumination and experiential avoidance (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996; Raes et al., 2006), and programs such as MEST are based on this theory. However, in older adults, over-general memory may mediate depression by



impairing the natural reminiscence process, preventing integration of past specific memories into a positive narrative. Older adults tend to recall self-defining memories that have more integrative meaning than younger adults (Singer, Rexhaj, & Baddeley, 2007). "Meaning-making" and integrative reminiscences are important therapeutic tools for psychological well-being alongside specificity, rather than the simple recall and retelling of memories (Afonso, Bueno, Loureiro, & Pereira, 2011; Blagov & Singer, 2004; Singer et al., 2013; Thorne, McLean, & Lawrence, 2004; Wong & Watt, 1991). If impairment of integration due to reduced autobiographical memory specificity is the mechanism that accounts for the relationship between lower autobiographical memory specificity and reduced emotional health in older adults, this would help explain the different outcomes of the two interventions in this age group since life review included this element of integration. Future work may examine this by analyzing the integrative content of the memories retrieved during the life review sessions and by including a measure of life satisfaction.

Memory-based interventions for older adults such as traditional life review and reminiscence have previously been suggested to be enjoyable (Merriam, 1993) but lack empirical evidence as standard, structured interventions (Bluck & Levine, 1998). Findings from the current study suggest that a focus on the cognitive trait of autobiographical specificity incorporated into a traditional life review context offers a structured intervention that offers both a quantitative effect on autobiographical memory and is acceptable and engaging to participants.

Another key difference is that life review focused exclusively on positive memories, while the MEST program also incorporated negative memories. Qualitative analysis in the current study suggested the MEST group found the negative recall to be an unpleasant experience and did not understand the purpose of it. We suggest that the purpose of MEST to reduce a bias toward negative memories and prevent them becoming over-generalized in depressed populations is less comprehensible in a population of nondepressed older adults since they claimed not to dwell on negative experiences beforehand. Furthermore, when negative memories were spontaneously retrieved, participants in the life review group could cope with them or even view them from a positive perspective as they were within the context of one's whole life. This is in line with the suggestion that older adults may be more able to reflect positively and find greater meaning in their self-defining memories, providing opportunities for lesson-learning (Singer et al., 2007). In healthy older adults, there is evidence of a bias toward positive memories, named the "positivity effect" (Mather & Carstensen, 2005). Age may have an interactive effect so that recalling specific negative memories may not be helpful in this population, as older adults already seem to be successful at emotional regulation of memories. Therefore, life review appears to be more suitable for this population, although MEST could also be modified to focus on positive memories that are life relevant.

Lastly, the format of the two interventions was different: MEST was group based while life review was delivered one-to-one. Feedback from the MEST group referred to a social benefit. It has been suggested that the process of sharing autobiographical memories with others may be important to their functional use (Alea & Bluck, 2003). MEST gave the additional benefit of sharing memories with others from the same generation, rather than just with the researcher as they did in life review. This may have helped prompt

era-specific memories, such as those related to the war. In support of this, individuals tend to collaborate and co-construct memories with others (Edwards & Middleton, 1986; Gould & Dixon, 1993), and similarity in speaker–listener characteristics is suggested to support the memory sharing process (Alea & Bluck, 2003). However, some participants in the MEST group reported that they did not feel comfortable sharing some particularly personal memories within a group setting, whereas in life review, participants may have been more open to disclosing personal memories with the researcher in a more private setting.

### *Strengths and limitations*

Although our sample size was modest, it was larger than other studies which have found large effects on autobiographical memory specificity (Heeren, Van Broeck, & Philippot, 2009; Neshat Doost et al., 2014; Raes et al., 2009). It was also sufficient to detect effects according to a power analyses we conducted using our observed power of 0.606, our observed effect size of  $f = 0.33$ , with a type 1 error rate  $\alpha = 0.05$  for a within-between interaction design, which gave a total sample size of 14 participants.

Another limitation is that the different formats for the interventions and control group, i.e., group versus one-to-one versus workbook, introduce a potential confound as the level of contact with researchers and other participants was varied and the control group had the least contact. However, in the current study, the control group was actively completing a cognitively stimulating task while previous MEST studies have used no additional contact controls (Moradi et al., 2014; Neshat Doost et al., 2014). Future studies may address this issue further by including a better matched control group. Furthermore, Lamers, Bohlmeijer, Korte, and Westerhof (2014) found that life review in a self-help format had similar effects in reducing depression as in a group format (Korte, Bohlmeijer, Cappeliez, Smit, & Westerhof, 2012), implying that the benefits of life review are not just due to face-to-face contact with the researcher. The social interaction provided by group sessions has been found to have health-related benefits (Gleibs, Haslam, Haslam, & Jones, 2011). The authors are conducting a pilot study to address the potential confound of group benefits by examining the effectiveness of the MEST training in the form of a workbook, instead of in a group setting. This will allow us to explore the extent to which the benefits of MEST are simply due to being part of a group, or due to practicing the recall activities themselves.

Finally, the procedure for assigning participants to conditions may not be truly random since the life review intervention was started later. Participants were also allocated at a ratio of 2:1 nearer the end of the study. However, participants were unaware of this and there is no reason to suspect that participants who were recruited later in the process were any different than those recruited earlier. Furthermore, there were no differences between groups in terms of demographics, primary or secondary measures (with the exception of redundancy) at baseline. The higher redundancy score in the MEST group compared to life review at baseline (indicating lower updating ability) is unlikely to have resulted from the randomization procedure and did not affect any of the results since there were no significant effects relating to this measure.

## Conclusions

In summary, the findings suggest that both MEST and life review programs have potential as methods of autobiographical memory specificity training in older adults; however, the lack of longer term effects suggest adaptations may be beneficial. The qualitative feedback further suggested that life review may be a more acceptable method in this population. These findings are important since autobiographical memory training interventions may be especially useful for older populations who exhibit age-related reduced autobiographical memory specificity, while higher autobiographical memory specificity has been proposed as a protective mechanism for mental health. The finding of an association between autobiographical memory specificity and both social problem solving and functional limitations also has implications for older adults' well-being since these factors are both critical to healthy aging.

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