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Impact of metacognition and motivation on the efficacy of strategic memory training in older adults: Analysis of specific, transfer and maintenance effects

Barbara Carretti *, Erika Borella, Michela Zavagnin, Rossana De Beni

Department of General Psychology, University of Padova, Via Venezia, 8, 35131 Padova, Italy

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ABSTRACT

The current study examines the contribution of a number of metacognitive and motivational variables in explaining specific, transfer and maintenance effects of a strategic memory training program, based on the use of mental imagery, in older adults. Participants were assessed before and after the training (immediately post-test, and at 3- and 6-month follow-up) on list recall (criterion) and working memory (transfer) tasks. At the pre-test, metacognition (use of strategies, belief about memory, control on memory) and motivational measures (cognitive engagement, self-efficacy) were also collected. The training produced a benefit in both the criterion and transfer tasks, which was maintained at follow-up. Some of the metacognitive and motivational measures, over and above the level of performance obtained at pre-test, predicted the gains in the objective memory measures. The findings confirmed the importance of considering the role of metacognitive attitudes of older adults in memory training activities.

1. Introduction

In parallel with research examining the cognitive processes affected by aging, other studies are seeking ways to slow the effect of aging on cognitive performance through cognitive training. In particular, a large body of studies has been concerned with examining the usefulness of interventions focused on episodic memory. The assumption made below is that there is a potential modifiability of cognitive functioning, even in late adulthood, usually termed plasticity (e.g., Hoyer and Verhaeghen, 2006), which when adequately stimulated can positively alter memory performance. Consistent with this premise, memory training research generally reveals an improvement in memory performance in older adults through training of mnemonic strategies (see for example the meta-analysis by Verheaghen et al., 1992). Despite encouraging results, studies documenting transfer (e.g., Stigsdotter Neely and Backman, 1993; Carretti et al., 2007) and maintenance effects are rare (e.g., Willis et al., 2006; Brehmer et al., 2008; Borella et al., in press). The beneficial effects of memory training are on the one hand usually related to trained ability, and on the other very limited in duration: older adults tend to stop using the learned strategies after the training (e.g., Verhaeghen and Marcoen, 1996). A possible explanation may lie in the difficulty of modifying metacognitive and motivational attitudes (Troyer, 2001). In fact, enhancing cognitive performance alone is not sufficient to alter older adults' reduced knowledge about a memory task's characteristics, lower confidence about their performance in situations that require memory (self-efficacy), or motivation toward a memory task. In fact, it is well established that older adults usually perceive their memory as functioning more poorly than when they were young, and often rate themselves as having less control over memory and lower memory functioning than younger adults (Hultsch et al., 1987; Zelinski et al., 1990; Lachman et al., 1995). Such beliefs can have important consequences for memory task performance, in both laboratory and everyday life. In this context, it is well documented that memory self-efficacy is a potential mediator and/or moderator variable in explaining memory success (Bandura, 1989; Cavanaugh and Green, 1990; Berry and West, 1993; Welch and West, 1995). Enhancing maintenance of training benefits may therefore also mean addressing the beliefs older adults hold about memory, and their attitudes toward it (Lachman et al., 1992). In most cases, resistance to changing beliefs results from lack of suitable approach to them: training activities quite commonly either do not consider implicit beliefs, or else offer interventions that fail to alter negative stereotypes on the effect of aging on cognitive performance (Floyd and Scogin, 1997). These latter authors quantified the effect of memory training on subjective memory measures, using a meta-analysis, and found the size of the effect to be much smaller (0.19) than that obtained in objective memory measures (0.70), as reported by Verheaghen et al. (1992). This finding led them to conclude that without appropriate

* Corresponding author. Tel.: +39 049 8276 948; fax: +39 049 8276 600.
E-mail address: barbara.carretti@unipd.it (B. Carretti).

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activities aimed at metacognitive and motivational change, older adults' implicit beliefs and self-efficacy are hard to modify, this in turn explaining the fragility of interventions in terms of maintenance and transfer effects.

In the light of these considerations, some authors have proposed training activities directly designed to improve metacognitive (metamemory) and emotive-motivational components of memory performance. In particular, most studies have focused on ways to enhance the sense of self-efficacy in cognitive activities. However, findings are mixed, some reporting increases in objective memory measures alone, but not in subjective beliefs (Scogin et al., 1985; Scogin and Bienas, 1988; Rebok and Balcerak, 1989; Rasmusson et al., 1999; Woolverton et al., 2001), others showing increases in both objective and subjective memory measures (Lachman et al., 1992; De Vreese et al., 1998; Troyer, 2001; Cavallini et al., 2003; Valentijn et al., 2006; West et al., 2008; Hastings and West, 2009). Further, the magnitude of the effects varies within studies. For example, Cavallini et al. (2003) found some improvement in everyday objective tasks associated with a reduction in number of complaints reported by the trained participants (young and older adults) in ecological context, maintained after two years (Bottiroli et al., 2008). However, no effects were found in level of memory self-efficacy. Troyer (2001) demonstrated that a six-session program, targeting metacognitive knowledge about memory (how memory works, the role of strategies) and age-related changes, gave an increase in both objective and subjective memory measures. In particular, in this study trained older adults not only increased performance on a list recall task, but also showed positive change in their knowledge about memory functioning, and reported using a wider repertoire of memory strategies. Valentijn et al. (2006) reported a reduction in the level of anxiety and stress toward memory functioning, as well as improvement in some memory measures after a collective training group, where participants received information on memory functioning, age-related changes, self-efficacy, in comparison with self-taught participants, who used a training manual. Reporting on an individual program, which included participant discussion, Hastings and West (2009) described an increase in self-efficacy and a higher locus of control, compared to a control group; furthermore, gains were maintained in time (after 1 month).

Positive results were also found by the multifactorial training program of West et al. (2008), centered on increasing self-efficacy; this produced significant improvements in the training group (compared to control) for memory self-efficacy, locus of control, and objective memory measures (name recall and story recall). Moreover, trained participants were using effective strategies more frequently than the control group. Of particular interest was the fact that objective memory performance at follow-up was predicted by self-efficacy supporting the idea that implicit beliefs should be considered a key aspect in training studies.

1.1. Goals of the study

The aim of the present study is to evaluate the contribution of various metacognitive and motivational variables to explaining the effects of strategic memory training in older adults, whether specific (change in performance on a list recall task), transfer (working memory task) or maintenance (after 3- and 6-month follow-ups). To analyze this issue we adopted the procedure proposed by Carretti et al. (2007), where the reliability of the training was already tested both in terms of specific and transfer effects. In addition we wanted to extend previous results examining the maintenance of training gains (after 3- and 6-month follow-ups).

To measure personal beliefs about memory and the effective use of memory strategies in ecological situations, the multifactorial memory questionnaire (MMQ) (Troyer and Rich, 2002) was used. This instrument assesses overall contentment or satisfaction with one's own memory ability (MMQ-Contentment = MMQC), perception of everyday memory ability (MMQ-Ability = MMQA), and use of everyday memory strategies and aids (MMQ-Strategy = MMQS). In addition, participants completed the Memory Self-efficacy Questionnaire, adapted from De Beni et al. (2003), assessing subjective self-efficacy in relation to memory tasks.

As mentioned, older adults usually show inappropriate beliefs about their own memory capacity and inadequate control of memory performance, as a result of limited knowledge and use of memory strategies.

Moreover, we included the 'need for cognition' questionnaire (Cacioppo et al., 1996), which assesses an individual's readiness to engage in and enjoy thinking, thus reflecting a stable (although not invariant) intrinsic motivation to effortful cognitive activity. In fact, social and intellectual engagement have recently been proposed as factors influencing age-related changes in older adults' cognition (e.g., Schaie, 2005) and the motivation for further development of intellectual capacity (Lachman, 2006). Lack of engagement is indeed considered a factor that can lead to disuse of various cognitive processes and skills (Schaie and Willis, 2002), therefore influencing the course of aging (Schooler et al., 1999; Schooler and Mulatu, 2001). Consistent with these results, Stine-Morrow et al. (2008) showed that a program intended to operationalize an engaged lifestyle (structured on a team-based competition in ill-defined problem-solving) produced positive change in a composite measure of fluid ability from pre-test to post-test. In addition, readiness to engage in intellectual activities was modestly related to the pre- to post-test improvement in cognitive measures. Similar results were obtained by Tranter and Koutstaal (2008), who demonstrated that adults aged 60–75 years improved their performance in reasoning tests (such as the Cattell test and the Block test taken from WAIS-R) after a training program where they were proposed novel, mentally stimulating (i.e., word logic puzzles and critique of unfamiliar music etc., mimicking an engaged life-style).

Through the need for cognition questionnaire we sought to examine the contribution of predispositional engagement in determining the benefits of the strategic training proposed. It could be postulated that the greater the interest in intellectual activities, the greater the effort likely in learning and using the taught strategies, even after the end of the training, with consequent improvement in memory performance post-training sessions.

2. Subjects and methods

2.1. Participants

The initial sample consisted of 100 participants (54 females and 46 males), who were volunteers, recruited by word of mouth; all of them were Italian native speakers, and lived in residential or community homes. Anyone meeting the "exclusion criteria" proposed by Crook et al. (1986) was excluded from the study. However, during the two follow-up sessions, 19 (9 females and 10 males) participants abandoned the study: this group did not differ in any of the demographic characteristics considered in the study. The analyses were thus run on the group of participants who participated in the full set of sessions (81, 45 females and 36 males, aged 64–76 years). Characteristics of the sample are summarized in Table 1.

2.2. Materials and procedure

2.2.1. Criterion task

List recall task (Carretti et al., 2007). Two lists of 15 words comparable for word length and imagery value were prepared. Participants listened to the (audio-taped) lists of words presented

Table 1
Participant characteristics.

Parameters	Mean ± S.D.
Age (years)	68.78 ± 3.44
Education	8.64 ± 4.32
Memory self-efficacy	15.42 ± 4.11
Need for cognition	54.83 ± 11.25
MMQC	66.90 ± 11.67
MMQA	45.99 ± 9.21
MMQS	46.23 ± 10.82

at a rate of 2 s per word. At the end of each list presentation, participants had to recall as many items on the list as possible. No order constraint was set. The total number of words correctly recalled was used for scoring; pre- and post-test word lists contained different words; for the first follow-up, the pre-test word list was used while in the second follow-up the post-test word list was used. The lists were counterbalanced across testing sessions. Cronbach's α was 0.87.

2.2.2. Transfer task

Categorization working memory span (CWMS, adapted from De Beni et al., 1998; see also Carretti et al., 2007). This task is similar to the classic working memory tasks, the only difference being that it involves processing of lists of words rather than sentences, limiting the role of semantic processing. The materials consisted of eight sets of words, each set comprising 18 lists of words, which are organized in series of word lists of different lengths (from 3 to 6). Each list contains five words of high-medium frequency. Furthermore, the lists contain zero, one, or two animal nouns, presented in any position, including last. An example list is: house, mother, dog, word, night.

Half (four) of the sets were used as a pre-test and first follow-up task, the other four as post-test and second follow-up. The two sets were counterbalanced across testing sessions. Participants heard the lists of words presented at a rate of 1 s per word and had to tap their hand on the table whenever they heard an animal word (processing phase). The interval between two lists of words was of 2 s (the presentation was thus paced by the experimenter). At the end of the series, participants had to recall the last word of each list in serial order (maintenance phase). The total number of correctly recalled words was taken as the measure of their working memory capacity; Cronbach's α was 0.98.

2.2.3. Metacognitive and motivational assessment

Need for cognition (Cacioppo et al., 1996). This questionnaire was used to measure the extent to which participants like to engage in and enjoy thinking. It contains 18 items; responders have to indicate the degree to which each item characterized them on a 5-point scale (from not at all, 1; to very much, 5). Score: from 18 to 90; higher score indicating greater need for cognition. Cronbach's α was 0.87.

Memory Self-efficacy Questionnaire (adapted from De Beni et al., 2003). The questionnaire consists of five items assessing participants' self-efficacy about memory. Respondents have to rate their memory ability on a 5-point scale (from scarce: 1 to very good: 5). Maximum score is 25, higher score indicating better perception of one's own memory ability. Cronbach's α was 0.90.

MMQ-Contentment (adapted from Troyer and Rich, 2002). This consists of 18 items addressing emotions (both positive and negative) and perceptions that participants may have about their current memory ability. Participants have to indicate their level of agreement with each sentence using a 5-point scale (from strongly disagree: 1 to strongly agree: 5). Score: from 18 to 90; higher score indicating greater satisfaction with own memory. Cronbach's α was 0.90.

MMQ-Ability (adapted from Troyer and Rich, 2002). This contains 20 items describing everyday memory situations; participants have to indicate the frequency with which each mistake occurred on a 5-point scale (from never, 1 to all the time, 5). Score: from 20 to 100; higher score indicating a variety of memory errors. Cronbach's α was 0.86.

MMQ-Strategies (adapted from Troyer and Rich, 2002). This consists of 19 items describing memory strategies and aids that can be used in everyday memory tasks. Participants have to indicate the frequency with which each strategy is used on a 5-point scale (from never: 1 to every time: 5). Score: from 19 to 95; higher score indicating greater use of strategies in everyday memory tasks. Cronbach's α was 0.87.

2.3. Training procedure

Each participant attended six sessions that were completed within a 2-week time frame, with a fixed two-day break between sessions. The study was completed by two follow-up sessions after the training, at three and six months. Each session took about 30–60 min. Training activities were based on the strategic training program proposed by Carretti et al. (2007), with some variations.

Pre-test assessment. Differently from the study of Carretti et al. (2007) pre-test assessment was completed in two sessions (Sessions 1 and 2): in Session 1, participants were administered metacognitive and motivational questionnaires; in Session 2, they were given health and physical questionnaires, as well as the CWMS and list recall tasks.

Training sessions (Sessions 3–5). Training involved working with 12-word lists distributed across three sessions. Participants were instructed to create an image for each word, and also seek to make connection between the images obtained. In Session 3, participants were presented with two 10-word lists and two 15-word lists (Session 3); they controlled the word-presentation rate by raising their hand once the image had been created. The experimenter then read out the next word on the list. In Sessions 4 and 5, four 15-word lists were presented and the experimenter controlled the presentation rate. Using a stopwatch, the experimenter allowed approximately 4 s per word (after the word has been said) in Session 4, and 2 s in Session 5. The actual use of mental images was monitored by asking participants to orally rate the quality of the images at the end of each training list. This rating was requested after the recall phase.

Post-test and follow-up sessions. At the post-test (Session 6) and in the two follow-up Sessions (7 and 8), participants completed the CWMS and list recall tasks.

3. Results

3.1. Effects of the training program

Although the main focus of the current study was to highlight the role of metacognitive and motivational variables in predicting the increase due to a strategic memory training, specific effect on the criterion task as well as transfer effect on the CWMS working memory task were also investigated, with the caveat that the lack of a control group did not allow simple test–retest effects to be controlled for. To partially compensate this, the benefit from pre- to post-test performance, expressed as the difference between pre-and post-test relative to the pre-test (Carretti et al., 2007), was compared to that obtained in the study by Carretti et al. (2007), where the same training program was proposed without the inclusion of metacognitive and motivational measures. Finally, we examined maintenance effects at three and six

Table 2
Descriptive statistics by condition, mean ± S.D.

	Pre-test (N = 81)	Post-test (N = 81)	FU-3 months (N = 81)	FU-6 months (N = 81)
List recall	4.77 ± 1.54	6.70 ± 1.89	6.88 ± 1.83	7.16 ± 1.95
CWMS	45.00 ± 12.55	52.56 ± 10.32	53.98 ± 9.64	55.67 ± 8.77

months, comparing outcomes after training through performance on the pre- and post-tests.

A repeated measures ANOVA design was used to determine the effects of training with condition, that is (i) pre-test vs. post-test, (ii) pre-test vs. follow-up at three and six months, (iii) post-test vs. follow-up at three vs. six months, as within-subject variable. Descriptive statistics are presented in Table 2.

3.2. Immediate specific and transfer training effects: comparison between pre-test and post-test

List recall task. The main effect of condition was significant, $F(1, 80) = 96.34$, $p < 0.001$ $\eta_p^2 = 0.55$, with participants recalling more words on the post-test than the pre-test.

CWMS. The main effect of condition was significant, $F(1, 80) = 54.48$, $p < 0.001$, $\eta_p^2 = 0.41$, indicating that after the training participants recalled a larger number of words.

The rate of the increase due to training was comparable to that obtained in the study by Carretti et al. (2007): in the current study the index of benefit for the list recall task was 0.52 ± 0.59 while for the trained group of the study 0.30 ($p = 0.19$); the same was found in for the CWMS task: in the current study the index was 0.34 ± 1.58, and for the trained group of the study 0.29 ($p = 0.75$).

We also considered the indexes of effect size calculated using Cohen's formula (1988). The values for list recall performance indicated the effect was large: 1.11 (over 0.80) (Cohen, 1988); for CWMS the increase relative to pre-test was instead medium: 0.65 (between 0.50 and 0.80). As found for the index of benefit, the values obtained in the comparison between pre- to post-test mostly overlapped with those reported by Carretti et al. (2007): list recall task: 0.75; CWMS: 0.58.

3.3. Long-term effects of training: 3- and 6-month follow-ups

Pre-test vs. follow-ups (at 3 and 6 months). A significant main effect of condition was found for performance on list recall, $F(2, 160) = 104.05$, $p < 0.001$, $\eta_p^2 = 0.56$, with an increase of recalled words from pre-test to both follow-ups (3 months Mdiff. = 2.11, $p < 0.001$, and 6 months Mdiff. = 2.39, $p < 0.001$), which in turn were not significantly different within each other.

For the CWMS, there was a main effect of condition, $F(2, 160) = 92.91$, $p < 0.001$, $\eta_p^2 = 0.54$, with higher performance for the two follow-ups than at pre-test (3 months Mdiff. = 8.97, $p < 0.001$, and 6 months Mdiff. = 10.67, $p < 0.001$). Moreover, performance significantly increased from first to second follow-up (Mdiff. = 1.69, $p < 0.001$).

Post-test vs. follow-ups (at 3 and 6 months). The main effect of condition was significant for performance on the list recall task, $F(2, 160) = 3.34$, $p < 0.05$, $\eta_p^2 = 0.04$; at 6-month follow-up participants recalled a higher number of words than immediately after the training (Mdiff. = 0.46, $p < 0.05$). In addition, a main effect of condition was found for CWMS, $F(2, 160) = 16.98$, $p < 0.001$, $\eta_p^2 = 0.18$. At 6-month follow-up participants recalled a higher number of words than immediately after the training (Mdiff. = 3.11, $p < 0.001$), or at three months (Mdiff. = 1.69, $p < 0.05$); there were also significant differences between immediately after training and at three months (Mdiff. = 1.42, $p < 0.05$).

3.4. Predictors of improvement due to the training

Stepwise regression analyses were also carried out to provide an estimate of percentage variance in both (1) list recall and (2) CWMS task performance after training (post-test and two follow-ups), accounted for by performance on the pre-test, the metacognitive and motivational questionnaires, age and education.

For the list recall task, the analyses showed that performance on this task at pre-test ($\beta = 0.45$, $p < 0.001$) alone contributed to the explained variance at post-test ($R^2 = 0.21$, $p < 0.001$). However, at three months, a significant part of the variance was explained ($R^2 = 0.36$, $p < 0.05$) by pre-test performance on the list recall task ($\beta = 0.52$, $p < 0.001$) and the need for cognition score ($\beta = 0.21$, $p < 0.05$). After six months, 26% of the variance ($p < 0.05$) was explained by performance at pre-test on the list recall task ($\beta = 0.39$, $p < 0.001$) and the need for cognition score ($\beta = 0.25$, $p < 0.001$).

As regards the CWMS task, regression analyses showed that the variance ($R^2 = 0.49$, $p < 0.01$) in working memory performance after training was explained by performance on the pre-test ($\beta = 0.61$, $p < 0.001$) and the MMQS score ($\beta = 0.27$, $p < 0.001$). After three months a significant part of variance ($R^2 = 0.51$, $p < 0.001$) was uniquely explained by CWMS score in pre-test session ($\beta = 0.72$, $p < 0.001$). After six months, 49% ($p < 0.001$) of the variance was explained by CWMS performance on the pre-test ($\beta = 0.60$, $p < 0.001$) and age ($\beta = -0.19$, $p < 0.05$).

4. Discussion and conclusion

The study examined the contribution of various metacognitive and motivational variables to the strategic memory training gains in list recall and working memory measures. It is well demonstrated that, although an increase in objective memory measures is not associated with improvement in subjective memory measures (such as beliefs about memory and self-efficacy), objective memory performance depends to some extent on a person's implicit beliefs.

To examine the influence of metacognitive and motivational beliefs on benefit from training we enrolled a large group of older adults in a strategic training program (based on use of mental imagery strategies); we evaluated the relationship between initial subjective memory measures and increase in performance assessed immediately after the training and at two later times (at 3 and 6 months). In line with the results of Carretti et al. (2007), a study in which the efficacy of the strategic training used here had already been tested with older and younger adults, we found not only a specific training effect, but also a substantial transfer effect to working memory performance (CWMS task): participants improved performance from pre- to post-test, recalling a higher number of words in the CWMS task. Comparison of benefit indexes with those reported by Carretti et al. (2007) showed comparable rate of improvement for the list recall and working memory tasks. The results are also consistent with previous studies by other authors (Brehmer et al., 2008), showing that memory training based on strategy teaching improved performance on an episodic memory task (list recall).

These positive findings can be interpreted by considering the teaching of imagery-based strategy as a way of improving the encoding of information through reliance on a deep, meaning-based, processing of word to be recalled. This better encoding is essential for supporting later retrieval, as classically proposed by Craik and Lockhart (1972). It appears particularly relevant in training studies as demonstrated by Bissig and Lustig (2007), who reported that time spent in encoding information is a more powerful predictor of success in a recognition task than individual differences in vocabulary and age.

In addition, our results reveal that this enhancement is enduring: comparison between performance on the post-test and at the two follow-ups showed good maintenance of the training gains in both criterion task (list recall) and transfer task (the working memory test). However, the maintenance effects should be considered with caution in view of the lack of a control group, this might have led to the overstressing of some results. Nevertheless, the primary goal of the study was to determine the role of metacognitive and motivational variables in predicting training benefits and their maintenance. Results of the regression analysis confirmed that these variables are relevant in explaining the changes due to the training, as reported earlier by other authors (West et al., 2008). For the list recall task, the increase in performance at 3-month follow-up was explained by the interest toward effortful cognitive activities (need for cognition) beyond the level of memory performance measured at pre-test. At the 6-month follow-up, the interest in cognitive activities (need for cognition) accounted for performance. Current findings suggest that the inherent tendency to seek and feel comfortable with complex activities is related to the ability to maintain the gains obtained after training; it can be postulated that participants who found interest or challenge in the activities proposed during the training program tried to continue using the strategies in their everyday activities. Unfortunately this must remain a hypothesis since we did not interview our participants on the self-reported use of strategies. Nevertheless, the speculation is in line with recent research showing that intellectual engagement is related to cognitive performance (Stine-Morrow et al., 2008). For example, Parisi et al. (2009) examined the contribution of predispositional and activity engagement to processing speed, working memory, fluid intelligence and reasoning measures in a large sample of adults, aged 55–93 years. Their results showed that predispositional engagement, in particular intellectual complexity factor (interest in challenging activities) derived from a range of questionnaires (need for cognition; mindfulness; and openness to experience) contributed independently to the explained variance in working memory, reasoning and fluid intelligence scores.

For working memory performance, the gains due to training were found to be predicted by the self-reported habit of using memory strategies (MMQS), beyond the baseline working memory performance. The transfer of training gains thus seemed to depend on the habit of using strategies, in other words a strategic approach to everyday situations. Participants who reported using a higher number of strategies were able to generalize what they learned in the context of an episodic memory task to a different memory task, i.e., the working memory task. In line with this possible explanation, McNamara and Scott (2001) demonstrated that 'more strategic' young participants displayed better working memory performance after the training than did their less strategic counterparts. The increment in working memory task performance can be interpreted by postulating that the training activities gave participants practice in going beyond mere rehearsal of information, to encoding and storing information using more appropriate strategies, in this case the long-term memory (LTM) imagery strategy. In other words, in line with the Ericsson and Kintsch (1995) concept of long-term working memory, the strategy training facilitated the use of the retrieval structure of LTM to improve both episodic memory and working memory performance. However, the 3- and 6-month follow-up performances were accounted by pre-test performance alone, and at the 6-month evaluation related negatively to age. It therefore appeared that participants with high working memory performance and used to employing memory strategies in everyday contexts were able to benefit more from the strategy instruction. However, maintenance depended only on initial level of working memory performance: older adults with higher efficacy in managing items to be recalled therefore consolidated the retrieval structures induced by the training.

In conclusion, our study confirms that memory training using imagery-based strategy can enhance the performance of older adults in a list recall task, this improvement being extendable to working memory performance, so replicating the results of Carretti et al. (2007). In addition, metacognitive and motivational factors were shown to play a role in explaining the amount of improvement due to training. In particular, the level of intellectual engagement seemed particularly relevant for predicting the rate of changes in episodic memory. These results give indirect support to the importance of promoting an active lifestyle for the further development and maintenance of efficient memory and cognitive processes in adulthood. To allow older adults to take full advantage of enrichment programs, training programs should therefore pay attention not only to participants' metacognitive attitudes but also the motivational aspects. Interestingly, transfer effects (i.e., the improvement on the working memory task), depended on other factors, and in fact at the immediate post-test a better performance was related to the individual use of strategies before the training. The current findings allow a profile to be built up of participants most likely to benefit from our training program—that is, they are interested in challenging cognitive activities, and tackle everyday activities in a strategic way. Future research on memory intervention programs for older adults should pay particular attention to these aspects: to ensure there is positive training effect on cognitive abilities, training programs for older adults need to enhance the participants' metacognitive and motivational attitudes.

Conflict of interest statement

None.

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