Published in final edited form as:

Aging Clin Exp Res. 2010 August ; 22(4): 314–323. doi:10.3275/6704.

Promoting Transfer in Memory Training for Older Adults

Elena Cavallini¹, John Dunlosky², Sara Bottiroli¹, Christopher Hertzog³, and Tomaso Vecchi¹

¹University of Pavia, Italy

²Kent State University, Ohio

³Georgia Institute of Technology, Atlanta

Abstract

Background and aims—Many studies have focused on memory training in aging showing older adults can improve their performance. Unfortunately the benefits of training rarely generalize to other tasks that were not specifically trained. We investigated the benefits of instruction-based training in promoting transfer effects in older adults.

Methods—In Experiment 1, we evaluated transfer effects in a training group who practiced using standard mnemonics to learn paired associates and word lists, and this group was provided instructions about how the mnemonics could be used for two of the four transfer tasks (text learning, name-face learning, grocery list learning, place learning). In Experiment 2, we compared transfer effects for two different training groups: one practiced the strategies with the two trained tasks and did not receive instructions and one had the same practice but also received instructions on all the transfer tasks.

Results—Transfer in text learning occurred in both experiments. Such transfer is particularly interesting considering that text learning was the most dissimilar task in terms of both the nature of the materials and the underlying processes that support performance. Such transfer was reliably greater when training involved instructions about applicability than when it did not.

Conclusions—Instructions to use practiced strategies on new materials could be a useful technique in promoting transfer in older adults. It seems that the lack of transfer does not necessarily arise from older adults' inabilities but instead because they do not realize that trained strategies can (or should) be applied to new materials.

Keywords

memory intervention; aging; transfer; instruction

The benefits of strategy training for improving older adults' memory performance have been demonstrated both for healthy older adults [1] and for those with cognitive impairment [2, 3]. Although memory performance can be improved, even in old age, this plasticity tends to decrease over the adult life span [4]. Moreover, the benefits of training rarely generalize to other tasks that were not specifically trained—that is, *transfer* of training is often minimal. Thus, discovering techniques that increase the likelihood of transfer represents an important aim for training research. Our present goal was to investigate a technique to promote transfer.

As mentioned above, transfer of training is quite rare. Consider a typical finding by Stigsdotter Neely and Bäckman [5], who evaluated the efficacy of multifactorial training that was based on training two strategies—interactive imagery and method of loci—along with attention skills and relaxation techniques to reduce anxiety. During training, the strategies were practiced during encoding of concrete words, which was followed by free recall. The criterion tests involved free recall of concrete words (i.e., the trained task) and three transfer tasks—namely, free recall of abstract words, forward digit span, and the Benton visual retention test. Training gains occurred in the trained task, but no gains occurred in the transfer tasks. Thus, although Stigsdotter Neely and Bäckman's [5] goal was to assess maintenance of training gains, their method and findings provide an excellent illustration of the lack of transfer that is often found with memory training [5, 6–15].

Nevertheless, transfer has been reported in a handful of studies [16–21]. Consider Anschutz et al. [16], who trained older adults to use the method of loci to learn word lists for free recall. Free recall of a grocery shopping list was used as the transfer task. Performance improved for both materials. Note, however, that this generalization involved near transfer, because the materials used in the transfer task (free recall of a grocery list) were quite similar to the trained materials. In fact, successful generalization of memory training has often been limited to near transfer [20, 21]. Moreover, some of the documented success has involved training the method of loci [16, 21], but unfortunately, this method has also failed to yield reliable transfer [10, 11]. In summary, although some researchers have reported reliable transfer, it is apparent that reliable techniques need to be discovered that may produce consistently robust transfer effects. Consider two general explanations for the lack of transfer effects in previous research, which provide the context for the present experiments. One possibility is that without extensive practice with a mnemonic on particular materials, older adults will be largely unable to effectively apply the mnemonic to those materials. In this case, perhaps disuse or generalized cognitive decline undermines older adults' ability to effectively apply mnemonics without practice. By contrast, an alternative possibility is that older adults merely do not know that the learned mnemonic can (or should be) applied to learning non-practiced materials. Of course, both explanations may be partly correct, but the latter knowledge deficit accords better with results of near transfer, and as important, should be relatively easy to sidestep with appropriate instructions. For instance, Verhaeghen [22] recommends training that involves “broader skills rather than specific techniques, at the same time focusing on the applicability of these skills in different contexts” (p. 17). Similar recommendations come from the literature on transfer [23], such as that transfer can be facilitated by training people in metacognitive awareness [24]. Based on these recommendations, our approach focuses on broader applicability of trained strategies by building transfer into the skill training itself, and as a consequence, older adults may be more likely to understand that these skills should be applied to a variety of materials across many contexts.

In Experiment 1, older adults were trained to use two mnemonics (imagery and sentence generation) to learn lists of words and paired associates. Four transfer tasks were administered, with text learning representing an important case, because compared to the other transfer tasks (which involved learning associations or simple items) it involves different processes that support performance. Indeed, text learning requires participants to study organized material with a hierarchical structure. Most important, instruction-based training involved discussion about how the trained strategies could be used on materials that were not practiced. In Experiment 1, this instruction focused on text learning and name-face learning, but no practice using the mnemonics with these materials was provided. In Experiment 2, we explored the potential benefits of instruction-based training further by examining the degree to which instructions yielded transfer beyond receiving practice on multiple materials.

Experiment 1

Method

Participants—A total of 62 participants took part at Experiment 1 and they were assigned to groups. The strategy with instruction group consisted of 34 participants (sampled from the University of Third Age of Pavia) with a mean age of 67.94 years ($SEM = .84$) and the control group consisted of 28 participants (sampled from aggregation center in Pavia) with a mean age of 68.64 years ($SEM = 1.19$). Before the pre-training tests, participants filled out a general demographic questionnaire. The reported level of education was lower for the control group ($M = 7.32$, $SEM = .75$) than for the strategy with instruction group ($M = 10.65$, $SEM = .62$).

Measures—Six memory tasks were administered during both the pre-training and post-training test, so that 2 versions of each memory task were given, one per testing session.

Associative learning: Participants were presented with 40 paired associates. Pairs were taken from Paivio et al.'s [25] word norms and were not repeated in any of the tasks or the two testing sessions. Across pre-training and post-training tests we attempted to equate stimuli and responses as closely as possible on two relevant dimensions, such as imagery, concreteness and frequency of use. Across pre-training and post-training tests we attempted to equate stimuli and responses as closely as possible on key dimensions, such as imagery (pre-training: $M = 4.98$, $SD = 1.46$; post-training: $M = 4.90$, $SD = 1.56$) concreteness (pre-training: $M = 4.78$, $SD = 1.99$; post-training: $M = 4.74$, $SD = 2.06$) and frequency of use (pre-training: $M = 24.35$, $SD = 21.02$; post-training: $M = 25.24$, $SD = 20.87$). Each pair was printed in the middle of a 5×7 index card. The 40 cards were handed to participants, who were instructed to study the pairs for up to 20 minutes. After study, each stimulus was individually presented, and participants were asked to write the response that had been paired with each stimulus.

List learning: Participants were presented with 40 words. Words were taken from Paivio et al.'s [25] word norms and were not repeated in any of the tasks or the two testing sessions. Across pre-training and post-training tests, we equated the single words on key dimensions, such as imagery (pre-training: $M = 4.95$, $SD = 1.50$; post-training: $M = 4.83$, $SD = 1.76$) concreteness (pre-training: $M = 4.83$, $SD = 1.81$; post-training: $M = 4.55$, $SD = 2.18$) and frequency of use (pre-training: $M = 23.5$, $SD = 16.95$; post-training: $M = 23.27$, $SD = 17.74$). Each word was printed in the middle of a 5×7 index card. The 40 cards were handed to participants, who were instructed to study the words for up to 20 minutes. After study, participants were asked to write down as many words as they could remember (in any order) on an answer sheet.

Text learning: Participants were presented with a short story with 22 major ideas (e.g., It was a quiet Sunday at Tirano railway station./The locomotive, to which the carriages had already been coupled, was standing on the track./The engine driver and his assistants got down to make sure everything was all right./Some damage to the brakes...). They had up to 15 minutes to study the story, and then they were asked to write down as much as possible of it from memory.

Name-face learning: Participants were presented with 20 black and white photographs of faces (2.75×4) paired with the first and last name printed below it. The 20 name-face cards were handed to participants, who were instructed to study the pairs for up to 20 minutes. After study, each face was individually presented, and participants were asked to write down the name that had been previously paired with each face.

Grocery list learning: Participants were presented with a list composed of 20 grocery items (e.g., 2 slices of veal). Each item was printed in the middle of a 5×7 index card. The 20 cards were handed to participants, who were instructed to study the pairs for up to 15 minutes. In the recall phase, participants were asked to write down as many grocery items (in any order) as they could remember.

Place learning: Participants were presented a map of a city. The map included the location and name of ten target monuments across the most important streets of the city. They were given up to 15 minutes to study, and then they had to write the position and name of monuments on a blank map.

Procedure—The strategy with instruction group took part in two 2-hr testing sessions and in four 2-hr training sessions in the following order: pre-training test, training sessions and post-training test.

The control group took part in the two 2-hr testing sessions only. Pre-training and post-training consisted in performing a trial of the six memory tasks, one participant at a time. The order of the memory tasks was identical for all participants: associative learning, list learning, name-face learning, grocery list learning, text learning and place learning. Instructions for all tasks were printed on a sheet of paper, and the experimenter read them to participants. They were then given the appropriate cards (i.e., associative learning, etc.) to study. When participants were ready for recall (or when they reached the limit on study time), they were provided with an appropriate answer sheet.

Training Sessions—Memory training was conducted in a classroom (half of the participants at a time) by one of two female trainers. Groups met once a week for a month. Two memory mnemonics (sentence generation and interactive imagery) were trained. Sentence generation consisted in the creation of a semantic link among words by making up a sentence, whereas interactive imagery consisted in the mental creation of an active picture of the words interacting. Moreover, training comprised practice of the two memory mnemonics on gradually increasing number of items across the four sessions. In particular, during the first session, they were given practice lists comprised of 3, 10, 15 and 25 paired associates. During the second session, practice lists were comprised of 5, 10, 15 and 20 single words. In the third session, practice lists consist of 5, 10, 25 and 40 paired associates. Finally, in the fourth session, they were given practice lists of 5, 10, 25 and 40 single words.

Furthermore, during the thirds and fourth training sessions, trainers discussed how to apply the two memory mnemonics to other memory tasks. Precisely, at the end of the third memory training session, trainers invited participants in a discussion about the effectiveness and applicability of the mnemonics, such as “You learned to use these strategies on paired associates and lists of words. Do you think the strategies were useful? Do you think it is possible to use the strategies on other material such as associating names and faces? How do you think the strategies could be applied to the name-face learning?” At the end of the last memory training session, a similar discussion was again engaged using questions, such as “You learned to use these strategies on pairs associated and lists of words. Do you think the strategies were useful? Do you think it is possible to use the strategies on other material, such as the learning of a text? How do you think the strategies could be applied to text learning?” After these discussions, trainers provided correct information about the applicability of the strategies. As for the name-face learning, they explained how to grasp distinctive features both in the face and in the name of each photograph and to link them in a sentence or in an interactive imagery. A similar technique was described for text learning by choosing key words inside the text and connecting that using the two memory mnemonics. Participants did not practice using the mnemonics on either of these two memory tasks.

Data Analyses—Statistical analyses were undertaken using the Statistical Package for the Social Sciences, release 11.5.1 (SPSS Italian version). To evaluate group-related differences across testing phases, data were analyzed in a 2×2 mixed analysis of variance (ANOVA), with group (two levels: Strategy with instruction and Control groups) as a between-subjects factor, and phase (two levels: pre-training and post-training times) as a within-subject factor. Next, we examined group-related differences in study time across testing phases using a 2 (group) $\times$ 2 (phase) mixed ANOVA. In Experiment 1, given that groups differed with respect to level of education, education was included as a covariate in the ANOVAs. In Experiment 2, groups did not demonstrate differences in education, so it was not included as a covariate.

Results

Test Performance—For each task, we computed the mean correct performance for each participant on both the pre-training test and the post-training test. Means across participant's scores (along with standard errors of each mean) are presented in a table or figure, as noted below.

Practiced tasks: For associative learning (Table 1), a main effect occurred for group, $F(1, 59) = 5.43, p = .02, MSE = 0.04, \eta^2 = .08$, but not for phase, $F(1, 59) = 2.66, p = .11, MSE = 0.01$. Most important, a reliable Group $\times$ Phase interaction, $F(1, 59) = 6.77, p < .02, MSE = .01, \eta^2 = .10$, indicated that the strategy with instruction group improved more across testing phases than did the control group.

Regarding list learning (Table 1), the main effect occurred for group, $F(1, 59) = 13.03, p = .001, MSE = 0.04, \eta^2 = .18$, but not for phase, $F(1, 59) = 2.32, p = .13, MSE = 0.01$. Most important, the interaction was reliable, $F(1, 59) = 8.51, p < .01, MSE = 0.01, \eta^2 = .13$; the strategy with instruction group improved across testing phases, whereas the control group did not.

Transfer tasks: Four transfer tasks were administered, and two of them (text learning and name-face learning) received strategy instructions but were not practiced. We highlight results for text learning because (a) across both experiments, this task was always instructed (but not practiced) during training and (b) as compared to the other transfer tasks, text learning was the most dissimilar to the trained tasks in terms of both the nature of the materials and the underlying processes that support performance. Thus, text learning represents the greatest degree of transfer.

Regarding text learning (Figure 1), a main effect occurred for group, $F(1, 59) = 37.07, p < .001, MSE = 0.03, \eta^2 = .39$, but not for phase, $F(1, 59) = 1.98, p = .17, MSE = 0.01$. Most important, the interaction was also reliable $F(1, 59) = 5.78, p = .019, MSE = 0.01, \eta^2 = .09$. As evident from inspection of Figure 1, performance for the strategy with instruction group improved across testing phases, whereas performance for the control group did not.

A similar pattern of results was found for name-face learning (Table 1). An ANOVA revealed main effect for group, $F(1, 59) = 18.9, p < .001, MSE = 0.01, \eta^2 = .24$, but not for phase $F(1, 59) = 0.30, p = .60, MSE = 0.008$. The reliable interaction $F(1, 59) = 7.44, p < .01, MSE = 0.008, \eta^2 = .11$, indicated that performance for the strategy with instruction group improved across testing phases, whereas no improvement occurred for the control group.

For grocery-list learning (Table 1), all effects were reliable: group, $F(1, 59) = 19.2, p < .001, MSE = 0.01, \eta^2 = .25$, phase, $F(1, 59) = 4.58, p = .04, MSE = 0.01, \eta^2 = .07$, and the interaction, $F(1, 59) = 7.73, p < .01, MSE = 0.01, \eta^2 = .12$. The interaction indicated that

performance for the strategy with instruction group improved across testing phases, whereas performance for the control group did not.

By contrast, for place learning, a main effect occurred for group $F(1, 59) = 15.8, p < .001, MSE = 0.05, \eta^2 = .07$, but the main effect for phase and the interaction between group and phase were not reliable, $F_s < 1.0, MSE < 0.03$.

Study Times—Given that study was self-paced, differences in study times may be relevant to interpreting the effects described above. We computed the mean study time across participants' study times for each task, which are reported (along with standard errors of each mean) in a table or figure, as noted below.

Practiced tasks: For associative learning (Table 2), an ANOVA revealed that times were longer for the strategy with instruction group than for the control group, $F(1, 59) = 41.9, p < .001, MSE = 33.8, \eta^2 = .42$. The main effect for test phase and the interaction were not reliable, $F_s < 1.9, MSE = 12.1$. For list learning, a main effect also occurred for group, $F(1, 59) = 81.4, p < .001, MSE = 25.7, \eta^2 = .58$, but the main effect for test phase and the interaction were not reliable, $F_s < .50, MSE = 12.95$.

Transfer tasks: For text learning (Figure 2), study time was longer for the strategy with instruction group than for the control group, $F(1, 59) = 5.14, p = .27, MSE = 20.5, \eta^2 = .08$. The main effect for phase approached reliability, $F(1, 59) = 4.1, MSE = 10.5, p = .05$. Most important, the interaction was reliable, $F(1, 59) = 8.85, p < .01, MSE = 10.5, \eta^2 = .13$. Whereas times slightly increased across tests for the control group, they actually declined across tests for the strategy with instruction group.

Regarding name-face learning (Table 2), the ANOVA revealed a main effect for group, $F(1, 59) = 103.2, p < .001, MSE = 18.6, \eta^2 = .64$, whereas the main effect for test phase and the interaction were not reliable, $F_s < 1.0, MSE = 9.48$. For grocery list learning, study time was longer for the strategy with instruction group than for the control group, $F(1, 59) = 15.7, p < .001, MSE = 19.1, \eta^2 = .21$. The main effect for phase and the interaction were not reliable, $F_s < 1.0, MSE = 5.1$. For place learning, reliable differences occurred in study times between groups, $F(1, 59) = 15.3, p < .001, MSE = 7.29, \eta^2 = .21$. The main effect for test phase, $F(1, 59) = 5.91, p < .05, MSE = 3.32, \eta^2 = .09$, and the interaction were reliable, $F(1, 59) = 11.77, p < .005, MSE = 3.32, \eta^2 = .17$. Times slightly increased across tests for the control group, but they decreased across tests for the strategy with instruction group.

Discussion

Instructions about how to use the trained strategies (imagery and sentence generation) on unpracticed tasks promoted transfer. Most impressive, transfer was evident for text learning, which was relatively dissimilar to the practiced tasks of associative and list learning. Such transfer cannot be attributed to increased study time after practice, because the strategy with instruction group used reliably less study time after training than before training.

Experiment 2

Two difficulties arise, however, in concluding that instructions per se are responsible for the transfer effects. First, an alternative explanation for the benefits of instructions is that training participants to use strategies on two different tasks—paired associates and list learning—produced the transfer. In particular, training the strategies on more than one task may make participants realize that the strategies could be successfully used on a variety of tasks. To evaluate this possibility in Experiment 2, we compared transfer effects for two different training groups: one who practiced the strategies with the two trained tasks and did

not receive instructions (strategy training alone) and one who had the same practice but also received instructions (strategy with instructions group). If practice on two tasks alone promotes transfer, then both of these training groups should demonstrate equivalent levels of transfer on the text learning task.

This design also allows us to handle another potential difficulty that arose in Experiment 1. In particular, greater transfer on text learning was demonstrated by the strategy with instruction group than by the control group, which we attributed to the extra instructions and training that the instructed group received. Nevertheless, the instructed group also received a great deal of experience with the memory tasks, and this experience alone may have boosted their performance on the post-training tests. In Experiment 2, however, the strategy with instruction group and the strategy alone group receive the same amount of experience practicing the tasks. Thus, any greater training gains enjoyed by the instruction group over the strategy alone group cannot be attributed to differential experience with the tasks and instead could be attributed to the instructions about how to use the strategies on unpracticed tasks.

Method

Participants—A total of 80 participants (from the University of the Third Age of Pavia) between the ages of 57 and 81 years were randomly assigned to groups. The strategy training alone consisted of 27 participants with a mean age of 65.81 ($SEM = 1.01$); the strategy with instruction group consisted of 24 participants with a mean age of 63.54 ($SEM = .89$); and the control group consisted of 29 participants with a mean age of 66.03 ($SEM = .74$). The reported level of education was 12.30 ($SEM = .57$) for the strategy training alone, 12.71 ($SEM = .59$) for the strategy with instruction group and 13.97 ($SEM = .47$) for the control group.

Materials, Procedure, and Training Sessions—Both training groups took part in two 2-hr testing sessions and in four 2-hr training sessions in the following order: pre-training test, training sessions and post-training test, whereas the control group took part in the two testing sessions only. Materials in both testing phases were identical to those used in Experiment 1, but few modifications were introduced in the procedure. First, the strategy training alone did not receive any instructions about how to apply the newly learned mnemonics to other materials. The strategy with instruction group received the same strategy training, but in addition, they also discussed and were given instructions on how to apply the two memory mnemonics to other materials. In order to maximize the effects of instructions, these were applied to all four transfer tasks (as described in Experiment 1), with instructions for each material occurring individually at the end of the second (for the grocery list learning), third (for the name-face learning) and fourth (for the text learning and place learning) training sessions. More in detail, in order to discuss how mnemonics could be applied to other tasks, trainers addressed to participants the same questions used in Experiment 1, such as “You learned to use these strategies on paired associates and lists of words. Do you think the strategies were useful? Do you think it is possible to use the strategies on other material such as the learning of a grocery list? How do you think the strategies could be applied to the grocery list learning?” After these discussions, trainers provided correct information about the applicability of the strategies. In general, they explained to link together items for each material in a sentence or interactive imagery, as described in Experiment 1. Again, instructions were not associated with practice on the four memory tasks.

Data Analyses—Statistical analyses were undertaken using the Statistical Package for the Social Sciences, release 11.5.1 (SPSS Italian version). To evaluate group-related differences

in task performance, data were analyzed in a 3×2 mixed measures ANOVA, with group (three levels: Strategy training alone, Strategy with instruction and Control groups) as between-subjects factor, and phase (two levels: pre-training and post-training times) as a within-subject factor. Moreover, to investigate the interactions further, separate one-way ANOVAs were conducted on *gain* scores for each memory task, which were produced by subtracting the corresponding scores on the pre-training and post-training tests. For all follow-up comparisons, we performed a Tukey's test (which maintains a familywise error rate at .05). Finally, we examined group-related study time differences across testing phases using a 2 (group) $\times$ 2 (phase) mixed measures ANOVA. Interactions were investigated using paired samples two-tailed Student's *t* test.

Results

Test Performance

Practiced tasks: For associative learning (Table 3), the main effect for phase $F(1, 77) = 20.15, p < .001, MSE = .01, \eta^2 = .21$, and the Phase $\times$ Group interaction were reliable, $F(2, 77) = 7.20, p < .005, MSE = .01, \eta^2 = .16$. The one-way ANOVA revealed reliable differences on the gain scores, $F(2, 77) = 7.20, p < .005, MSE = .02, \eta^2 = .16$. Follow-up comparisons indicated that training gains were similar for both strategy with instruction group and strategy training alone, whereas no gains occurred for the control group. The main effect for group was not reliable $F(2, 77) = .87, p > .05, MSE = .08, \eta^2 = .02$.

A similar pattern of results was found for list learning. Effects were reliable for phase, $F(1, 77) = 39.47, p < .001, MSE = .01, \eta^2 = .34$, and for the Phase $\times$ Group interaction $F(2, 77) = 6.70, p < .001, MSE = .01, \eta^2 = .15$. Reliable differences occurred in the gain scores, $F(2, 77) = 6.70, p < .001, MSE = .03, \eta^2 = .15$, and follow-up comparisons revealed that both training groups demonstrated similar gains, whereas no gains occurred for the control group. The main effect for group was not reliable, $F(2, 77) = 1.66, p > .05, MSE = .07, \eta^2 = .04$. These findings replicate those of Experiment 1 by demonstrating reliable improvements in learning after strategy training.

Transfer tasks: As far as text learning (Figure 3), the main effect for phase, $F(1, 76) = 32.62, p < .001, MSE = .01, \eta^2 = .30$, and the interaction were reliable, $F(2, 76) = 10.38, p < .001, MSE = .01, \eta^2 = .22$. As evident from inspection of Figure 1, differential gains occurred across groups, $F(2, 76) = 10.38, p < .001, MSE = .01, \eta^2 = .22$. Follow-up comparisons revealed that training gains were greater for the strategy with instruction group in comparison to the strategy training alone group and the control group. Moreover, strategy training alone yielded greater training gains than did no training. The main effect for group was not reliable $F(2, 77) = 2.44, p > .05, MSE = .05, \eta^2 = .06$.

Analysis for name-face learning (Table 3) demonstrated a reliable main effect for phase, $F(1, 77) = 32.96, p < .001, MSE = .01, \eta^2 = .30$, whereas the main effect for group and the interaction were not reliable, $F_s < 2.1, MSE_s < .09, \eta^2 < .05$. No group improved across testing phases. For grocery list learning (Table 3), a reliable main effect occurred for phase, $F(1, 77) = 74.66, p < .001, MSE = .01, \eta^2 = .49$. The main effect for group and the interaction were not reliable, $F_s < 2.91, MSE_s < .06, \eta^2 < .07$. All groups improved across pre-training and post-training tests. For place learning (Table 3), analysis highlighted a reliable main effect for group, $F(2, 77) = 3.25, p < .005, MSE = .11, \eta^2 = .08$, and phase, $F(1, 77) = 17.91, p < .001, MSE = .03, \eta^2 = .19$. The interaction was not reliable, $F(2, 77) = .56, p > .05, MSE = .02, \eta^2 = .01$. All groups improved across pre-training and post-training tests.

Study Times

Practiced tasks: For the associative learning (Table 4), the main effect for group was not reliable, $F < 1.0$, $p > .05$, $MSE = 27.78$, $\eta^2 = .02$, and study times increased across tests, $F(1, 77) = 20.59$, $p < .001$, $MSE = 9.83$, $\eta^2 = .21$. The Phase X Group interaction was reliable, $F(2, 77) = 4.60$, $p < .05$, $MSE = 9.83$, $\eta^2 = .11$, indicating that both strategy training alone, $t(26) = 3.12$, $p < .005$, and strategy with instruction group, $t(23) = 3.76$, $p < .001$, increased their study times across tests, whereas the control group did not, $t(28) = 0.31$, $p > .05$.

For list learning (Table 4), study times increased across tests, $F(1, 77) = 27.2$, $p < .001$, $MSE = 10.83$, $\eta^2 = .26$, and the reliable interaction, $F(2, 77) = 7.68$, $p < .005$, $MSE = 10.83$, $\eta^2 = .17$, indicated that both strategy training alone, $t(26) = 4.32$, $p < .001$, and strategy with instruction group, $t(23) = 3.30$, $p < .005$, used more time across tests, whereas the control group did not, $t(29) = 0.13$, $p > .05$. The main effect for group was not reliable, $F < 1.0$, $MSE = 31.21$, $\eta^2 = .01$.

Transfer tasks: For text learning (Figure 4), the Group X Phase interaction was reliable, $F(2, 76) = 3.36$, $p = .01$, $MSE = 6.25$, $\eta^2 = .11$, indicating that the control group decreased study times across tests, $t(28) = 3.14$, $p < .005$, whereas neither the strategy training alone, $t(26) = .44$, $p > .05$, nor the strategy with instruction group, $t(23) = .00$, $p > .05$, did. The main effects for phase and for group were not reliable, $F_s < 1.0$, $MSEs < 16.22$, $\eta^2s < .04$.

For name-face association (Table 4), study times slightly increased across tests, $F(1, 75) = 5.94$, $p = .01$, $MSE = 11.40$, $\eta^2 = .07$. The main effect for group and interaction were not reliable, $F_s < 1.0$, $MSEs < 36.47$, $\eta^2 < .01$. For grocery list learning, study times increased across tests, $F(1, 77) = 5.65$, $p = .02$, $MSE = 5.77$, $\eta^2 = .07$. The main effect of group and the interaction were not reliable, $F_s < 1.0$, $MSEs < 17.31$, $\eta^2s < .02$. For place learning, the ANOVA revealed no reliable effects, $F_s < 1.0$, $MSEs < 11.29$, $\eta^2s < .03$.

Discussion

Three outcomes were notable in Experiment 2. First, as in previous research, mnemonic training boosted performance for the trained tasks. These effects were also paired with greater study times after training, presumably reflecting the extra time used to apply the trained mnemonics during study. Second, and most surprising, even with instructions about the broad applicability of the mnemonics, gains on several of the transfer tasks were not greater for the strategy with instructions group than for the other groups. As evident from inspection of Table 2, one difficulty here was that even performance for the control group improved across trials, suggesting the tasks were sensitive to prior practice during the pre-training session and hence would likely be less sensitive to demonstrating transfer effects. Third, and most important, as in Experiment 1, transfer of training was obtained for text learning, and this transfer was reliably greater for the strategy with instructions group than for the strategy training alone. This important transfer effect for the strategy with instruction group cannot be attributed to merely differential experience in practicing the trained tasks, because the strategy alone group received the same amount of training. Thus, it is apparent that mere instructions can promote transfer above-and-beyond any benefits obtained by training standard mnemonics alone.

General Discussion

Our most important finding is that instructions promoted transfer effects in text learning, which was particularly impressive given that text learning represents far transfer in the present experiment. For instance, as compared to the trained tasks (associative learning and list learning), which involve associating individual words, text learning involves multiple

processes, from decoding words and phrases within the text base itself to integrating larger units of meaning with prior knowledge to develop a situation model of the text [26]. Given the dissimilarities of the trained tasks and text learning, discovering which text processes were influenced most by the transfer instructions is an important issue for future research. Fortunately, one uninteresting explanation for these transfer effects can be ruled out by the present experiments. Namely, the transfer instructions may have merely increased how much time participants were willing to devote to learning, which in turn could boost text learning. In contrast to this possibility, participants receiving the instructions did not increase their study times from the pre-training to post-training tests.

Although strategy training alone did promote some transfer for text learning, Experiment 2 also demonstrated that the extra instructions about applying the strategies to other tasks were largely responsible for these transfer effects. By contrast, we did not find consistent transfer effects in the other non-practiced transfer tasks. We currently do not have a definitive explanation for such lack of transfer; however, data suggest that the tasks may have either been too difficult (name-face learning) or too easy (grocery-list learning and place learning) to be consistently sensitive to any subtle transfer effects. For instance, for the latter two tasks, performance gains were even shown by the control group (Experiment 1), suggesting that practice with the tasks alone could boost performance. Certainly, future research is required to fully understand when instructions about strategy applicability will promote robust transfer across a variety of tasks.

For text learning, one interesting question arises: Can we conclude that instructions per se produce *transfer*? On the one hand, transfer usually refers to cases in which a new strategy or behavior transfers to new conditions without any instructions about the possibility of transfer whatsoever [27]. In this case, the present findings would not adhere to strict definitions of transfer. On the other hand, however, the goal of memory training is to help older adults improve their learning across a wide variety of tasks, including those that were not practiced [1]. Thus, we would argue that “pure transfer” should not be considered the main goal of training research. Instead, we should seek new and straightforward techniques to promote better performance on untrained tasks.

Based on our current results, we advocate that transfer instructions should receive greater attention in training research as well in training itself. The innovation of this technique is that training benefits might be obtained without additional time spent on training, because raising older adults’ awareness that strategies can be widely applied can promote transfer. As important, such endeavors can have broader implications for the field: The transfer effects obtained for text learning from the use of straightforward instructions indicate that lack of transfer does not necessarily arise from older adults’ inabilities, but instead because they do not realize that trained strategies can (or should) be applied to new materials.

Acknowledgments

This research was partly supported by a grant from the National Institute on Aging, one of the National Institutes of Health (R37 AG13148) to Christopher Hertzog and John Dunlosky.

References

1. Verhaeghen P, Marcoen A, Goossens C. Improving memory performance in the aged through mnemonic training: a meta-analytic study. *Psychol Aging*. 1992; 7:242–251. [PubMed: 1535198]
2. Ghisla MK, Cossi S, Timpini A, Baroni F, Facchi E, Marengoni A. Predictors of successful rehabilitation in geriatric patients: subgroup analysis of patients with cognitive impairment. *Aging Clin Exp Res*. 2007; 19:417–23. [PubMed: 18007122]

3. Wenisch E, Cantegreil-Kallen I, De Rotrou J, Garrigue P, Moulin F, Batouche F, Richard A, De Sant'Anna M, Rigaud AS. Cognitive stimulation intervention for elders with mild cognitive impairment compared with normal aged subjects: preliminary results. *Aging Clin Exp Res.* 2007; 19:316–22. [PubMed: 17726363]
4. Singer T, Lindenberger U, Baltes PB. Plasticity of memory for new learning in very old age: A story of major loss? *Psychol Aging.* 2003; 18:306–317. [PubMed: 12825778]
5. Stigsdotter Neely A, Bäckman L. Maintenance of gains following multifactorial and unifactorial memory training in late adulthood. *Educ Gerontol.* 1993; 19:105–117.
6. Ball K, Berch DB, Helmers KF, et al. Effects of cognitive training interventions with older adults. A randomized controlled trial. *JAMA.* 2002; 288:2271–2281. [PubMed: 12425704]
7. Camp CJ, Foss JW, Stevens AB, Reichard CC, McKittrick LA, O'Hanlon AM. Memory training in normal and demented elderly populations: the E-I-E-I-O model. *Exp Aging Res.* 1993; 19:277–290. [PubMed: 8223827]
8. Derwinger A, Stigsdotter-Neely A, Persson M, Hill RD, Backman L. Remembering numbers. *Aging Neuropsychol Cogn.* 2003; 3:202–214.
9. Dunlosky J, Kubat-Silman A, Hertzog C. Training metacognitive skills improves older adults' associative learning. *Psychol Aging.* 2003; 18:340–345. [PubMed: 12825781]
10. Rebok GW, Balcerak LJ. Memory self-efficacy and performance differences in young and old adults: The effects of mnemonic training. *Dev Psychol.* 1989; 25:714–721.
11. Robertson-Tchabo EA, Hausman CP, Arenberg D. A classical mnemonic for older learners: A trip that works! *Educ Gerontol.* 1976; 1:215–226.
12. Scogin F, Bienes JL. A three-year follow-up of older adult participants in a memory-skills training program. *Psychol Aging.* 1988; 3:334–337. [PubMed: 3268276]
13. Scogin F, Storandt M, Lott L. Memory-skills training, memory complaints, and depression in older adults. *J Gerontol.* 1985; 40:562–568. [PubMed: 4031404]
14. Stigsdotter Neely A, Bäckman L. Multifactorial memory training with older adults: How to foster maintenance of improved performance. *Gerontol.* 1989; 35:260–267.
15. West, RL.; Tomer, A. Everyday memory problems of healthy older adults: Characteristics of a successful intervention. In: Gilmore, GC.; Whitehouse, PJ.; Wykle, ML., editors. *Memory, aging, and dementia: Theory, assessment and treatment.* New York: Springer; 1989. p. 74–98.
16. Anschutz L, Camp CJ, Markley RP, Kramer JJ. Maintenance and generalization of mnemonics for grocery shopping by older adults. *Experimental Aging Res.* 1985; 11:157–160.
17. Bottiroli S, Cavallini E, Vecchi T. Long-term effects of memory training in the elderly: A longitudinal study. *Arch Gerontol Geriatr.* 2008; 47:277–289. [PubMed: 17936376]
18. Cavallini E, Pagnin A, Vecchi T. The rehabilitation of memory in old age: Effects of mnemonics and metacognition in strategic training. *Clin Gerontol.* 2002; 26:125–141.
19. Cavallini E, Pagnin A, Vecchi T. Aging and everyday memory: the beneficial effect of memory training. *Arch Gerontol Geriatr.* 2003; 37:241–257. [PubMed: 14511850]
20. Stigsdotter Neely A, Bäckman L. Effects of multifactorial memory training in old age: generalizability across tasks and individuals. *J Gerontol Psychol Sci.* 1995; 50b:134–140.
21. Yesavage JA, Rose TL. Concentration and mnemonic training affective judgments improve name-face learning in the elderly. *J Gerontol.* 1983; 29:197–203. [PubMed: 6827036]
22. Verhaeghen, P. The interplay of growth and decline: Theoretical and empirical aspects of plasticity of intellectual and memory performance in normal old age. In: Hill, RD.; Bäckman, L.; Stigsdotter Neely, A., editors. *Cognitive Rehabilitation in Old Age.* New York: Oxford University Press; 2000. p. 3–22.
23. Barnett SM, Ceci SJ. When and where do we apply what we learn? A taxonomy for far transfer. *Psychol Bull.* 2002; 128:612–637.
24. Bransford, JD.; Brown, AL.; Cocking, RR. *How people learn: Brain, mind, experience, and school.* Washington DC: National Academy Press; 1999.
25. Paivio A, Yuille JC, Madigan S. Concreteness, imagery, and meaningfulness values for 925 nouns. *J Exp Psychol Monograph Supplement.* 1968; 76:1–25.
26. Kintsch, W. *Comprehension: A paradigm for cognition.* NY: Cambridge University; 1998.

27. Detterman, DK. The case for the prosecution: Transfer as an epiphenomenon. In: Detterman, DK.; Sternberg, RJ., editors. Transfer on trial: Intelligence, cognition, and instruction. Norwood, NJ, Ablex: 1993. p. 1-24.

Figure 1. Proportion of correct recall for the text learning task. Bars represent the standard error of the means. Instructions about how trained strategies could be used on an untrained task (in this case, text learning) promoted transfer of training benefits for that task.

Figure 2. Mean study times (minutes) on the text learning task. Bars represent the standard error of the means. Transfer effects on text learning cannot be accounted for by increased time on task during the post-training tests.

Figure 3. Proportion of correct recall for the text learning task. Bars represent the standard error of the means. Instructions about how trained strategies could be used on an untrained task (in this case, text learning) promoted transfer of training benefits for that task.

Figure 4. Mean study times (minutes) on the text learning task. Bars represent the standard error of the means. Transfer effects on text learning cannot be accounted for by increased time on task during the post-training tests.

Proportion of correct performance on practiced tasks (associative and list learning) and transfer tasks in Experiment 1. Standard errors of the mean (SEM) are presented in parentheses.

Table 1

Group	Associative learning		List learning		Name-face learning		Grocery list learning		Place learning	
	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)
Control group										
Pre-training test	.10	(.02)	.24	(.02)	.02	(.01)	.40	(.04)	.25	(.03)
Post-training test	.12	(.02)	.25	(.03)	.02	(.01)	.43	(.03)	.28	(.03)
Strategy with instruction group										
Pre-training test	.18	(.03)	.35	(.03)	.08	(.02)	.61	(.03)	.39	(.04)
Post-training test	.28	(.03)	.46	(.03)	.20	(.03)	.74	(.03)	.43	(.04)

Mean study times (minutes) on practiced tasks (associative and list learning) and transfer tasks in Experiment 1. Standard errors of the mean (SEM) are presented in parentheses.

Table 2

Group	Associative learning		List learning		Name-face learning		Grocery list learning		Place learning	
	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)
Control group										
Pre-training test	8.10	(1.03)	6.40	(.91)	5.70	(.66)	5.30	(.52)	3.70	(.31)
Post-training test	9.40	(1.04)	6.60	(.88)	5.70	(.70)	5.10	(4.2)	4.00	(.37)
Strategy with instruction group										
Pre-training test	16.00	(.82)	14.80	(.79)	14.60	(.64)	8.70	(.65)	6.70	(.50)
Post-training test	16.90	(.55)	15.90	(.56)	14.10	(.65)	8.70	(.68)	5.10	(.39)

Proportion of correct performance on practiced tasks (associative and list learning) and transfer tasks in Experiment 2. Standard errors of the mean (SEM) are presented in parentheses.

Table 3

Group	Associative learning		List learning		Name-face learning		Grocery list learning		Place learning	
	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)
Control group										
Pre-training test	.37	(.04)	.54	(.03)	.21	(.04)	.69	(.04)	.56	(.04)
Post-training test	.37	(.04)	.57	(.04)	.26	(.04)	.80	(.03)	.65	(.04)
Strategy training alone										
Pre-training test	.28	(.04)	.40	(.04)	.09	(.03)	.58	(.04)	.37	(.05)
Post-training test	.37	(.04)	.58	(.04)	.21	(.04)	.76	(.03)	.53	(.06)
Strategy with instruction group										
Pre-training test	.32	(.04)	.51	(.04)	.21	(.04)	.72	(.04)	.52	(.05)
Post-training test	.47	(.04)	.64	(.04)	.30	(.05)	.85	(.03)	.62	(.06)

Mean study times (minutes) on practiced tasks (associative and list learning) and transfer tasks in Experiment 2. Standard errors of the mean (SEM) are presented in parentheses.

Table 4

Group	Associative learning		List learning		Name-face learning		Grocery list learning		Place learning	
	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)	M	(SEM)
Control group										
Pre-training test	15.00	(.81)	14.40	(.87)	12.10	(1.05)	7.80	(.67)	5.80	(.53)
Post-training test	15.20	(.87)	14.50	(.91)	12.90	(.97)	8.10	(.60)	4.60	(.41)
Strategy training alone										
Pre-training test	14.50	(1.03)	12.00	(1.10)	11.00	(.92)	7.00	(.72)	4.70	(.63)
Post-training test	17.80	(.59)	16.80	(.69)	12.70	(.83)	8.40	(.66)	4.70	(.51)
Strategy with instruction group										
Pre-training test	14.50	(.95)	13.80	(.96)	12.00	(.87)	7.20	(.68)	5.50	(.70)
Post-training test	17.70	(.64)	17.00	(.62)	13.60	(.96)	8.20	(.54)	5.30	(.47)