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**REHAB SERIES**

# Cognitive rehabilitation in the elderly: Overview and future directions

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## Abstract

This study provides an overview of the papers emanating from the experimental trial that evaluated a new cognitive rehabilitation program in older adults who were experiencing normal cognitive decline. The main features of the design are summarized, along with evidence that the training produced long-lasting improvement in memory performance, goal management, and psychosocial status. The benefits were attributed to several factors, including the program's emphasis on techniques that promoted efficient strategic processing. Limitations of the program and directions for future research are discussed (*JINS*, 2007, *13*, 166–171.)

**Keywords:** Research design, Treatment outcome, Neuropsychology, Frontal lobe, Memory, Aging

## A RANDOMIZED TRIAL TO EVALUATE A NEW COGNITIVE REHABILITATION PROGRAM: OVERVIEW AND FUTURE DIRECTIONS

The papers in this special section report the outcome of a trial that evaluated a new cognitive rehabilitation program in a sample of older adults who were experiencing normal cognitive decline. The program, 12 weeks long and conducted in a small-group format, provided comprehensive training in three distinct but integrated modules—Memory, modified Goal Management (GMT), and Psychosocial Function as it relates to effective cognition. In following an

evidence-based approach, we attached priority to improving attention-related strategies that support encoding and retrieval processes for purposes of learning and remembering new information (Memory). Similarly, with respect to real-world challenges, participants were presented with strategic techniques for organizing complex tasks into manageable units that enabled efficient execution and, ultimately, greater success (modified Goal Management). The third module was devoted to the importance of a positive attitude and how psychological well-being can affect cognitive function in daily life (Psychosocial).

## Critical Features of the Research Design

To maximize our ability to draw reliable conclusions regarding the effects of our training protocol, special attention was paid to the following considerations in planning the

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research. *Experimental design*: There were two groups, each receiving the same treatment and control procedures, according to a multiple baseline, crossover design. The design allowed for between- and within-group comparisons to evaluate the effects of rehabilitation training. *Subject selection*: Participants in the trial were between 71 and 87 years of age and free of diagnosed neurological and psychiatric conditions that could affect cognitive function. All lived active, independent lives in the community. The assignment of these individuals to an Early (ETG) or Late (LTG) Training Group was completed in a blocked quasirandom format. That is, participants were randomly assigned to each group, while ensuring that the two groups did not differ in terms of age, education, sex, intelligence, and scores on the Mini-Mental State Examination (MMSE). *Test battery*: The assessment battery was comprehensive in relation to the domains addressed in the training, evaluating memory and related cognitive functions, practical task planning, and various psychosocial attributes. Of importance to our general approach, several of the measures allowed us to assess the impact of training on more strategic versus more automatic processes. Repeated testing, with tests administered at the start of the trial, at key stages during the trial, and several months after the trial to assess long-term benefits, enabled us to track the effects of training (for more details, see the Introductory paper by Stuss et al., 2007).

## Results Highlights

The ETG and LTG did not differ at baseline testing (Assessment A), but there were significant benefits of training in all functional domains, immediately following training and at long-term follow-up. At Assessment B, where training-related benefits were most reliable, significant findings were accompanied by acceptable effect sizes as measured by  $\eta^2$ . In the case of two groups, this effect size index is related to  $d$ , the effect size index for the  $t$  test as  $d = \sqrt{4\eta^2/(1 - \eta^2)}$  (Cohen, 1988, Sections 8.2.2 and 8.2.3). Thus, in the memory measures, the Logical Stories Test revealed substantial improvement, with large and medium effect sizes for immediate ( $\eta^2 = .18$ ) and delayed recall ( $\eta^2 = .10$ ). In the Hopkins Verbal Learning Test (HVLT), the benefits were more modest with medium effects in subjective organization ( $\eta^2 = .16$ ), category clustering ( $\eta^2 = .09$ ), and secondary memory ( $\eta^2 = .08$ ; Craik et al., 2007). In psychosocial testing, the most salient finding was the overall improvement in psychosocial status, particularly in the ETG, as reflected in our standardized global psychosocial measure, the G7 index (Winocur et al., 2007). The effect size for the G7 index, which summarizes performance on seven intercorrelated psychosocial variables, fell into the medium category ( $\eta^2 = .12$ ). Performance on the individual component tests that comprised the G7 index were more variable, indicating that the composite G7 index was a more reliable measure of improvement in psychosocial well-being (Winocur et al., 2007). Finally, performance on the simulated real-life tasks

(SRLTs) in modified GMT substantially improved following training. Effect sizes for the overall GMT score ( $\eta^2 = .24$ ) and its related measures of task strategy ( $\eta^2 = .30$ ) and checking ( $\eta^2 = .19$ ) were high. For the GMT engagement score, the effect size could be considered medium ( $\eta^2 = .12$ ; Levine et al., 2007).

The results also provided support for the theoretical basis of the interventions. Consistent with our general hypothesis, improvements in each domain were accompanied by related improvements in strategic processing under executive control. Thus, in the Memory domain, training resulted not only in improved list (Hopkins Verbal Learning Test-Revised;  $\eta^2 = .08$ ) and paragraph (Logical Stories Test;  $\eta^2 = .18$ ) recall, but also in increased use of various organizational strategies (e.g., semantic clustering,  $\eta^2 = .09$ ; subjective organization,  $\eta^2 = .16$ ). As participants became more strategic in their approach to recalling information, their reliance on less strategic approaches decreased. In the modified Goal Management module, participants not only improved on task performance, but also in terms of monitoring behavior and the types of strategies followed in performing the tasks. As well, the improved psychosocial status following training, as reflected most clearly in the G7 index, was accompanied by corresponding improvements on the Ways of Coping and Dysexecutive Tests, both measures of strategic function in social contexts.

The beneficial effects did not appear to be limited to the specific assessment tests. This finding was indicated by the SRLT results which showed that the benefits of training generalized to practical situations. There were other indications of generalization. Although not formally reported in the papers in this series, participants were also administered two tests of verbal fluency that are commonly used in neuropsychological and neurological assessment (e.g., Duff Canning et al., 2004; Stuss et al., 1998; Troyer et al., 1998): semantic fluency, which requires the generation of words that are categorically related to target semantic categories, and letter fluency, which requires the generation of words that begin with targeted letters. Because language was not a direct target of the intervention, the fluency tests provided a measure of the generalizability of effects to this cognitive domain. Training resulted in a significant improvement in the use of efficient strategies in word selection and generation in the phonetic fluency task, with effect sizes ranging from medium to large ( $\eta^2 = .09$  to  $.25$ ).

Improved performance in the psychosocial domain is another indication of generalized benefits to other functional areas. In addition to formal assessment of various attributes of psychosocial function, a self-assessment questionnaire (SAQ) was administered at the end of the program. The SAQ measured participants' personal assessments of the effects of rehabilitation training on their memory and goal management abilities, as well as their sense of well-being. The SAQ results indicated that both groups believed they were leading more meaningful lives ( $\eta^2 = .18$ ), that their memories were better ( $\eta^2 = .35$ ), and that they were

better at setting and achieving practical goals ( $\eta^2 = .23$ ). These results must be interpreted cautiously because participants could not be blinded to treatment and because participants' responses to SAQ items may have been influenced by their expectations of desired responses. Nevertheless, the pattern of SAQ responses was remarkably consistent with the scores of the objective tests over the entire testing schedule.

An encouraging result was that training-related benefits in all functional domains were maintained over the long-term. In some cases (e.g., the Logical Stories Test and Hopkins Verbal Learning-Revised Test of memory), there was continued improvement in the ETG between the end of rehabilitation training and long-term follow-up testing. As a cautionary note, it is important to recognize the potential influence of practice effects, but nevertheless these results, combined with the continued use of learned strategies, suggests that the participants were continuing to benefit from rehabilitation training.

An unexpected finding was that, while both groups benefited from training in all domains, improvements were greater and more long-lasting in the ETG. It must be emphasized that the differences cannot be attributed to demographic, health, or functional differences between the groups. Nor are they likely due to the influence of different group leaders. While there were several group leaders over the course of the trial, each was involved with both Early and Late Training Groups and there was no indication of differential responses by the participants. While it is conceivable that an undetected sampling error contributed to differences in the composition of the two groups, we believe that the explanation for the different responses lies in the design of the trial and the groups' preparedness for the training programs. Although all participants were fully briefed as to the schedule, the LTG participants may have been psychologically unprepared for the 3-month delay between baseline testing and the beginning of training. In fact, several expressed frustration over the delay, and it is possible that this negative reaction adversely affected their performance. Clearly, it is important that all participants understand the schedule and procedures and, as suggested in the Psychosocial paper (Winocur et al., 2007), this may be accomplished best through a more determined effort in the one-on-one meetings at the beginning of the trial. It is worth noting that, while this development clearly was not part of our research plan, it is, nevertheless, informative. If our interpretation is correct, it underscores the importance of psychosocial factors to the rehabilitative process and, specifically, the need to ensure that participants bring a positive attitude and are highly motivated to participate in the training program. This may be especially true in a cross-over design with a delay in the treatment.

In the course of analyzing the large data set that emerged, we looked for specific relationships between performance on cognitive and psychosocial tests. In particular, we anticipated a relationship between training-induced cognitive improvement and changes in the G7 index, but this turned

out not to be the case. In all likelihood, the variability of the G7 index between individuals and the individualized responses of the participants to the training program contributed to this negative outcome. With respect to the latter, it was noted that, at the group level, the ETG and LTG improved on several cognitive and psychosocial measures following training, but that the same individuals did not necessarily improve on the same sets of measures. Thus, it was not unusual to observe significant improvement on a particular cognitive test (e.g., HVLTL) that, in some individuals, appeared to be related to a corresponding improvement on a particular psychosocial test [e.g., Ways of Coping (WOC)] but on a different psychosocial test [e.g., Locus of Control (LOC)] in others. In such cases, the effects were not sufficiently consistent to yield statistically significant relationships.

### Comparisons With Other Approaches

The results of this trial add to a growing body of evidence that points to potential benefits of cognitive retraining programs designed for older adults (e.g., Scogin & Bienias, 1988; Stigsdotter Neely & Bäckman, 1993a, b; 1995; Willis & Nesselrode, 1990; Yesavage & Rose, 1983). The present study extends the previous work in several ways. For example, in contrast to early programs which often focused on specific functions (e.g., Yesavage & Rose, 1983) and a limited range of tests (e.g., Scogin & Bienias, 1988; Willis & Nesselrode, 1990), the present program was designed to be comprehensive to improve cognition function as broadly as possible. The rationale was that training in critical areas (e.g., use of mnemonic aids, strategic processing, psychosocial adjustment) could be integrated into an approach that would result in improvement in overall cognitive function.

A frequent criticism of cognitive retraining programs is that benefits do not extend to other tasks or outside the training environment (e.g., Rebok & Balcerak, 1989; Stigsdotter Neely & Bäckman, 1995). Even in cases where transfer effects have been reported (e.g., Anschutz et al., 1985; Yesavage & Rose, 1983), they were restricted to a small number of specific tasks. By comparison, in the present study, benefits were reflected in different measures of memory function, several aspects of goal management, strategic functioning, and various psychosocial attributes. Moreover, as indicated above, unpublished findings suggested that an enhanced ability to function strategically translated into improved fluency and linguistic ability.

Another important question relates to long-term benefits. Several previous studies included follow-up assessments at post-training intervals that ranged between 6 months and 7 years (Anschutz et al., 1985; Scogin & Bienias, 1988; Stigsdotter Neely & Bäckman, 1993a; 1995; Willis & Nesselrode, 1990). While some successes have been reported at the longer intervals, the results are mixed, with failures or modest successes variously attributed to lack of practice and/or discontinued use of memory aids (Scogin & Bienias, 1988), progressive loss of episodic memory function (Stigs-

dotter Neely & Bäckman, 1993a), lack of a supportive environment (Willis & Nesselroade, 1990), and the nature of the training program (Stigsdotter Neely & Bäckman, 1993a). Our approach emphasized the development of compensatory strategies. Although the impact of practice cannot be ruled out, the results suggest that participants appeared to build on the strategies that they acquired during training, resulting in continued improvement over the 6-month follow-up period.

Finally, we are aware of two other randomized control trials that evaluated cognitive training programs for the elderly. Both were large studies that yielded promising results. In the SIMA trial that involved 390 older adults, Oswald and colleagues (1996) examined the effects of a 9-month program in which participants received memory, competency, or psychomotor training. Assessment, which was conducted 1 year later, revealed that each type of training resulted in improvement, although the benefits were specific to the content areas of the training, with little generalization to other functional areas. By far the most ambitious randomized control trial of this nature was conducted by the ACTIVE Study Group (Ball et al., 2002), which involved 2832 older adults. This multicenter study compared three cognitive interventions (memory, reasoning ability, speed of processing), each consisting of 10 sessions over a 5–6 week period. Outcome measures, which included practical problem solving as well as standard experimental tests, made extensive use of composite measures to assess overall ability in the respective areas. Over a 2-year period, significant improvements followed each training program but, as in the SIMA study, participants performed better only in the cognitive domain in which they received training, with no evidence of generalization to real-world activities. The results of the two randomized trials, added to those of the present trial, are encouraging, but it remains to be determined whether the approach taken by the ACTIVE and SIMA groups, which focuses on specific cognitive functions, is likely to yield greater and longer-lasting benefits than the multidimensional approach taken in our program.

### CAVEATS AND FUTURE DIRECTIONS

The experimental trial provided encouraging evidence as to the efficacy of our cognitive rehabilitation program, at least with respect to older adults. At the same time, we are aware of limitations to the protocol and the trial, and of the need to qualify our results. We learned important lessons that will help in improving the protocol and in conducting future trials. The following identifies areas of concern that will be addressed as we continue our research:

1. An obvious limitation of the present study, particularly in comparison to the ACTIVE and SIMA studies, was the relatively small sample size. No participants dropped out of the study for personal reasons over the course of rehabilitation training. However, due to unavoidable circumstances (see Stuss et al., 2007), it was not possible to test all participants in the long-term follow-up. This limitation raises questions of reliability of the long-term effects, where sample size may have affected power. However, effect sizes reflected that major findings were clinically important and, for the most part, met Cohen's medium to large effect size. It is also important to emphasize that the pattern of results across the functional domains, with respect to training-related benefits, were consistent and point to the same conclusions.
2. Notwithstanding our efforts to be comprehensive in terms of assessing functional outcome and the inclusion of simulated real-life tasks to assess practical task planning, the test battery for the modified GMT module did not directly measure participants' responses to cognitive challenges in their daily lives. Given available resources, this was not feasible in this trial but we recognize that the ultimate test of generalization is the extent to which our program changes the way people do things in *their* world. As we continue to refine the training program, the plan is to include such tests in future trials.
3. During the control period, the participants had minimal contact with their group leader and engaged in few controlled activities. This is a fairly standard procedure that is commonly followed in such studies, but it does have limitations. We decided to adopt this type of control because we believed that a control procedure that involved activities that were unrelated to cognitive training would have been detected by our relatively high functioning older adults. There was a related concern that subjecting these individuals to 12 weeks of "meaningless" activities might have an adverse effect on their daily lives. A principal disadvantage of following this approach is that it does not allow us to unequivocally rule out the possibility that the observed benefits were nonspecific effects related to the group experience. We consider this unlikely for several reasons that include the consistency of results across testing domains, the long-term benefits, and perhaps most importantly, the demonstration that benefits in specific outcome areas were related to parallel improvements in executive function and strategic processing. Nevertheless, in follow-up work, we are including alternative control procedures in which the group leader engages participants in challenging activities that are unrelated to the training program.
4. The experimental design allowed us to conclude that changes in the groups' performance were the direct result of rehabilitation, and not secondary to general participation. In most cases, we also found rehabilitation effects that were over and above those that could be attributed to repeated assessments. As expected, there were individual differences in participants' responses to training, and this variability extended to measures on which benefits were detected. Interestingly, the pattern of benefits varied from individual to individual. This finding may be related to the observation that individuals differed in

their use of strategies, some using a large variety and others a relatively small number. Our multidimensional approach was designed to allow the flexibility that we believed was needed to accommodate the considerable variability that characterizes a relatively healthy, functional elderly population with real and perceived concerns about cognitive decline. At the same time, there is clearly more work to be done in terms of understanding strategy selection in group participants and in directing individuals to the most efficient strategies for them.

5. The question arises as to the most effective order of module presentation. It made sense to present the Memory module before the modified GMT module, but the decision to place the Psychosocial module at the end was largely intuitive. It would be worthwhile to determine whether the benefits of psychosocial training are optimal when administered at the beginning or the end of the program.

A related issue arises as to whether the training-induced benefits are the result of the program as a whole, secondary to one of the modules, or due to some combination of the individual modules. Although the program was designed to be integrative, it is possible that not all the modules contributed equally to the end result. Moreover, cause and effect relationships generally were difficult to ascertain. For example, it was unclear if the improved psychosocial status that was observed after training contributed directly to enhanced cognitive performance, if the reverse is true, or if there was some dynamic interplay between psychosocial and cognitive processes. If it turns out that one or two of the modules are primarily responsible for the results, it would be worthwhile to consider revamping and perhaps even shortening the protocol.

6. The protocol was designed to be versatile and adaptable to individuals with stable cognitive impairment (e.g., stroke, traumatic brain injury), as well as individuals with conditions that produce progressive cognitive decline (e.g., Mild Cognitive Impairment—MCI). The present trial was conducted on older adults whose cognitive function, while in decline, can be considered normal for their age. To assess the versatility of the program, it may be necessary to modify the protocol for populations with different patterns of genuine cognitive impairment. A related question concerns how well our program would work in combination with other (pharmacological) therapies. It is becoming increasingly common to prescribe anti-cholinesterase, cognitive enhancing drugs for certain patients (e.g., MCI), and it is important to ask if there are potential value-added benefits to combining this form of therapy with our behavioral program.

## Summary

We have developed a 12-week program of cognitive rehabilitation that is modular, yet comprehensive in its overall

approach. While still in the developmental stages, a randomized trial, involving groups of older adults with normal age-related cognitive decline, has provided evidence that the program may be effective in several functional areas. We attribute the promising results to a variety of factors, including the emphasis on strategic processes in lab-based and practical cognitive training, and our inclusion of a psychosocial training component that takes into account evidence that cognitive loss is the combined effect of biological and nonbiological influences. Several questions that arose from this trial, such as the adaptability of the program to other cognitively impaired populations and the respective contributions of the individual modules to improved performance, will form the basis of follow-up studies.

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