
Report of the Cognitive Rehabilitation Task Force, Brain Injury – Interdisciplinary Special Interest Group, American Congress of Rehabilitation Medicine

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A modified version of the Task Force Report will be published in Archives of Physical Medicine and Rehabilitation

The initial review and recommendations of the Task Force is available as:


SUMMARY

The Brain Injury – Interdisciplinary Special Interest Group (BI-ISIG) of the American Congress of Rehabilitation Medicine has previously conducted an evidence-based review of the literature regarding cognitive rehabilitation for persons with traumatic brain injury (TBI) or stroke published through 1997, leading to specific recommendations for clinical practice.¹ These recommendations have recently been updated by the Cognitive Rehabilitation Task Force of the BI-ISIG, based on a methodical review of the literature from 1998 through 2002. The updated review was conducted through PUBMED and INFOTRIEVE literature searches using combinations of attention, awareness, cognition, communication, executive, language, memory, perception, problem solving, reasoning, rehabilitation, remediation, and training as search terms. In addition, reference lists from identified articles were reviewed and a bibliography of 312 published articles was compiled. One hundred and eighteen articles were selected for inclusion following the initial screening. Thirty-one additional studies were excluded following detailed review. The excluded articles comprised 14 studies without data, 6 papers representing duplicate publications or follow-up studies, 5 papers that were non-treatment studies or experimental manipulations, 4 reviews, and 2 single case studies of individuals with diagnoses other than TBI or stroke.

Based upon the initial review, articles were assigned to one of six categories reflecting the primary area of intervention: attention; visual perception and constructional abilities; language and communication; memory; executive functioning, problem solving and awareness; and comprehensive-holistic cognitive rehabilitation. Articles were reviewed by at least two committee members and abstracted according to specific criteria. For each of the remaining 87 studies, the level of evidence was determined using the same criteria as in our prior review.
Of the 87 studies evaluated, 17 were rated as Class I, 8 as Class II, and 62 as Class III. Evidence within each predefined area of intervention was synthesized and recommendations were derived from consideration of the relative strengths of the evidence. The resulting practice parameters reflected three types of recommendations: Practice Standards, Practice Guidelines, and Practice Options.

Based on the initial and updated reviews, the Task Force concludes that there is substantial evidence from Class I studies to support the clinical recommendations for cognitive-linguistic therapies for people with language deficits after left hemisphere stroke, and visuospatial rehabilitation for deficits associated with visual neglect after right hemisphere stroke. There is additional evidence to support the use of gestural or strategy training for apraxia after left hemisphere stroke. There is substantial evidence to support the clinical recommendations for strategy training for people with mild memory impairment after TBI, strategy training for attention deficits due to TBI during the post acute period of rehabilitation, and interventions for functional communication deficits after TBI, including pragmatic conversational skills. The overall analysis of 47 treatment comparisons, based on Class I studies included in the current and previous review, reveals that a differential benefit in favor of cognitive rehabilitation was evident in 37 of 47 (78.7%) comparisons, with no comparison demonstrating a benefit in favor of the alternative treatment condition. Future research should move beyond the simple question of whether or not cognitive rehabilitation is effective, and look more precisely at the therapy factors and patient characteristics that optimize the clinical outcomes of cognitive rehabilitation.

The Brain Injury – Interdisciplinary Special Interest Group (BI-ISIG) of the American Congress of Rehabilitation Medicine has previously conducted an evidence-based review of the literature regarding cognitive rehabilitation for persons with traumatic brain injury (TBI) or stroke, leading to specific recommendations for clinical practice.¹ In that paper, the committee defined cognition as the “process of knowing” through the selection and acquisition of information, the understanding of that information, and the application of knowledge in the appropriate situation. Cognitive rehabilitation was defined as a systematic, functionally oriented service of therapeutic activities intended to improve cognitive functioning through (1) reestablishing previously learned patterns of behavior; (2) establishing new patterns of cognitive activity through compensatory cognitive mechanisms for impaired neurological systems; (3) establishing new patterns of activity through external compensatory mechanisms or environmental support; and/or (4) enabling persons to adapt to their cognitive disability in order to improve their overall level of functioning and quality of life. Regardless of the specific approach to intervention, we recognized that cognitive rehabilitation should be directed at changes that improve persons’ functioning in areas of relevance to their everyday lives.

Based on the review and classification of studies published through 1997, the committee made several specific recommendations regarding the effectiveness of cognitive rehabilitation for individuals with traumatic brain injury (TBI) or stroke. We recognize that clinical guideline development is an ongoing process that should include an updated review of the literature within five years of the initial recommendations. This report represents the updated evidence-based review and recommendations based on the additional literature published during the five year
period from 1998 through 2002.

METHOD

The development of evidence-based recommendations for this review followed our prior methodology involving identification of the relevant literature, review, analysis and classification of the existing research, and development of recommendations based upon the strength of available evidence. Online literature searches using Pubmed and Infotrieve were conducted using combinations of attention, awareness, cognitive, communication, executive, language, memory, perception, problem solving, reasoning, rehabilitation, remediation, and training as search terms. Relevant articles were identified by members of the committee, all of whom are experienced in brain injury rehabilitation and have contributed to published literature in the area of brain injury rehabilitation. Reference lists from identified articles were searched to complete the initial list of references. We identified several papers published prior to 1998 that had not been identified for our prior review. We elected to include randomized controlled trials published prior to 1998 that had not been included in the prior review, but not other studies. Two such papers were identified and included in this review. This resulted in the identification of 312 published articles. The abstracts or complete papers were reviewed in order to eliminate papers according to the following exclusion criteria: (1) papers not addressing intervention, (2) theoretical articles or descriptions of treatment approaches, (3) review papers, (4) papers without adequate specification of interventions, (5) papers that did not include participants primarily with a diagnosis of TBI or stroke, (6) studies of pediatric subjects, (7) single case reports without empirical data, (8) non-peer reviewed articles and book chapters, (9) papers describing pharmacologic interventions, and (10) non-English language papers.

One hundred and eighteen articles were selected for inclusion following this screening.
process. Based upon the initial review, articles were assigned to one of six categories reflecting the primary area of intervention: attention; visual perception and constructional abilities; language and communication; memory; executive functioning, problem solving and awareness; and comprehensive-holistic cognitive rehabilitation. We did not classify studies as multi-modal interventions for this review.

All of these articles were reviewed by at least two committee members and abstracted according to specific criteria: subject characteristics, treatment characteristics, methods of monitoring and analyzing change, statistical analyses performed, evidence of treatment effectiveness, and nature of the comparison condition.

Thirty-one additional studies were excluded following detailed review. The excluded articles included 14 studies without data, 6 papers representing duplicate publications or follow-up studies, 5 papers that were non-treatment studies or experimental manipulations, 4 reviews, and 2 single case studies of individuals with diagnoses other than TBI or stroke.

For each of the remaining 87 studies, the level of evidence was determined based upon criteria used in our prior review. Well-designed, prospective, randomized controlled trials were considered Class I evidence; studies using a prospective design with "quasi-randomized" assignment to treatment conditions were designated as Class Ia studies. Given the inherent difficulty in blinding rehabilitation interventions, we did not consider this as criterion for Class I or Ia studies. Class II studies consisted of prospective, non-randomized cohort studies; retrospective, non-randomized case-control studies; or multiple-baseline studies that permitted a direct comparison of treatment conditions. Clinical series without concurrent controls, or single-subject designs with adequate quantification and analysis were considered Class III evidence. All classifications were based upon the agreement of at least two reviewers. Disagreement between
any two reviewers was resolved through a third review and, if necessary, joint discussion of the three reviewers and the committee chairperson. Classification of all studies was also reviewed by the entire committee to ensure consensus prior to the final classification. Of the 87 studies evaluated, 17 were rated as Class I, 8 as Class II, and 62 as Class III.

Following the classification of studies, the overall evidence within each predefined area of intervention was synthesized and recommendations were derived from consideration of the relative strengths of the evidence. The level of evidence required to determine Practice Standards, Practice Guidelines or Practice Options was slightly modified from our initial definitions to reflect the actual decision rules applied in our initial review (Table 1). All recommendations were reviewed by the entire committee to ensure consensus.
## Table 1. Definition of Levels of Recommendations

**Practice Standards:** Based on at least one, well-designed Class I study with an adequate sample, with support from Class II or Class III evidence, which directly addresses the effectiveness of the treatment in question, providing substantive evidence of effectiveness to support a recommendation that the treatment be specifically considered for people with acquired neurocognitive impairments and disability.

**Practice Guidelines:** Based on one or more Class I studies with methodological limitations, or well-designed Class II studies with adequate samples, that directly address the effectiveness of the treatment in question, providing evidence of probable effectiveness to support a recommendation that the treatment be specifically considered for people with acquired neurocognitive impairments and disability.

**Practice Options:** Based upon Class II or Class III studies that directly address the effectiveness of the treatment in question, providing evidence of possible effectiveness to support a recommendation that the treatment be specifically considered for people with acquired neurocognitive impairments and disability.
Remediation of Attention Deficits

We identified five studies that addressed the remediation of attention deficits after TBI. In our prior review, we noted that most of the reported interventions in this area relied on practice with exercises intended to address specific aspects of attention, with the intent of restoring basic attentional abilities. In contrast, the interventions described in the current review were more likely to incorporate the development of compensatory strategies for attention deficits. Our prior review also distinguished between studies evaluating the effectiveness of interventions conducted during the acute period of rehabilitation and those providing treatment during the post-acute period of rehabilitation. In contrast, all of the studies in the current review addressed the remediation of attention deficits during the chronic period of recovery from TBI.

The five studies in this area included two Class I prospective randomized studies comparing attention treatment with alternative treatment conditions, one Class II study that compared attention treatment with a no-treatment condition, and two Class III studies.

Sohlberg et al. used a crossover design to compare the effectiveness of “attention process training” (APT) with a “placebo” treatment condition of brain injury education and supportive listening for 14 patients with acquired brain injury (12 TBI, 1 anoxia, 1 cavernous hemangioma). All of the participants had evidence of injury on neuroimaging studies; nine of the participants had sustained a severe TBI, and 3 had a loss of consciousness of less than one hour. All of the participants were at least one year post injury (ranging from 1 to 22 years) and exhibited “significant” attention deficits on neuropsychological evaluation and subjective report by the participant and/or a significant other. The participants were randomly assigned to groups that were differentiated by the order in which they received the two treatment conditions. The APT consisted of 24 hours of treatment over 10 weeks with tasks selected for each participant on
the basis of his or her specific profile of attention deficits. The therapeutic support condition consisted of one hour per week for 10 weeks of brain injury education, supportive listening, and relaxation training. The effects of treatment were evaluated using standardized questionnaires, neuropsychological tests, and data from structured interviews.

Self-reported changes in attention and memory functioning (particularly improvements in working memory) were more common after APT than after therapeutic support, while more psychosocial changes were reported after therapeutic support than after APT. Improvement in cognitive functioning on neuropsychological measures intended to assess the attention-executive network (e.g., the Paced Auditory Serial Addition Test [PASAT]) was also greater following APT than following therapeutic support. The degree of subjective improvements in cognitive functioning also corresponded with greater improvement of objective cognitive functioning on the PASAT. There was no evidence of specific benefits of APT on measures of vigilance or covert orienting, suggesting that the improvements after APT were not caused by general cognitive stimulation. The two Class III studies 5, 6 in this area also supported the effectiveness of APT for patients with TBI, but suggest that some of the benefit may be due to practice effects.6

The second Class I study 3 described an intervention intended specifically to teach patients with TBI to compensate for slowed information processing and the resulting experience of “information overload” in daily tasks. Twenty-two participants with severe or very severe TBI were included in the study, all of whom had evidence of slowed information processing on neuropsychological tests of attention. Participants were, on average, about 9 months post-injury (with 16 subjects greater than 6 months post-injury and 6 subjects between 3 and 6 months post-injury). Participants were randomly assigned to receive either the experimental “Time Pressure
Management” (TPM) treatment (12 participants) or an alternative treatment condition (10 participants). The TPM required participants to repeat information from videotaped stories or instructions involving activities likely to be encountered in daily life. The intervention consisted of training to increase awareness of errors and deficits, self-instructional training and cognitive modeling of correct task performance, and reinforcement of strategy application and maintenance under more distracting and difficult conditions. The alternative treatment condition consisted of “concentration training” aimed at increasing participants’ ability to repeat the same videotaped information through the rote rehearsal of generic instructions (e.g., try to focus, do not get distracted). Both conditions consisted of about 7 hours of intervention. Participants receiving TPM showed significantly greater increase in the use of self-management strategies to manage time pressure (e.g., interrupting the tapes and reiterating essential information), as well as significantly more improvement on a summary index of attention and memory functioning, compared with the participants who received generic “concentration training.” Further analyses indicated that the differential benefits of the TPM treatment were apparent on more complex tasks, which allowed participants to adjust their approach to the task, but not on basic reaction time tasks in which such a strategy could not be applied.

The results from the two Class I studies discussed above are consistent with a strategy training model for attention deficits after TBI. One small Class II study evaluated the effectiveness of an intervention intended to improve “working attention” in four participants with mild TBI, compared with four untreated patients. The intervention emphasized the use of strategies to allocate attention resources and manage the rate of information during task performance. On average, participants were about 8 months post injury at the start of treatment and received between 11 and 27 hours of treatment; both the treated and untreated participants
received neuropsychological evaluations about 23 weeks apart. The treatment participants were significantly more likely to demonstrate clinically meaningful improvement on neuropsychological measures of attention and reduction of self-reported attentional difficulties in their daily functioning. Further analysis suggested that the principal effect of the intervention was on participants’ use of strategies to manage information, with no direct effect on processing speed.

**Clinical Recommendations.** In the current review, there is evidence from two Class I studies with 36 subjects to support the effectiveness of attention training for subjects with TBI during the post-acute period of rehabilitation. In considering this evidence, along with our previous recommendation based on two Class I studies with 57 subjects, the committee recommends that strategy training for attention deficits exhibited by individuals with TBI be considered as a Practice Standard during the post-acute period of rehabilitation. Consistent with our prior review, the results of studies in this area again suggest greater benefits of attention training on more complex tasks requiring the regulation of attention, rather than on basic aspects of attention such as reaction time or vigilance. These results are consistent with the increased emphasis on strategy training to compensate for attention deficits in functional situations.

**Recommendations for Future Research.** Future research should incorporate analyses of specific patient characteristics and impairment profiles in order to predict who might benefit from attention training. For example, APT did not appear to lead to improvement on measures of vigilance; however, there was a differential effect of treatment on patients exhibiting high and low vigilance levels. There is still limited direct evidence demonstrating the benefits of attention rehabilitation in participants’ everyday functioning. One of the current studies documented improvement on tasks intended to simulate the informational demands of daily
tasks, and two studies 2,4 demonstrated improvements in participants’ self-report of attentional difficulties in their daily functioning. Although naturalistic observations are being developed to evaluate attention, this appears limited to patients with severe impairments during the acute stage of recovery; such methods may be less relevant to more subtle, high-level impairments of attention. 7 There is a need to develop functional assessments and patient-centered outcome measures in this area (as well as other areas) of cognitive rehabilitation. 2

**Remediation of Visuospatial Deficits and Apraxia**

Within the area of rehabilitation of visual-perceptual and constructional deficits, there were 13 studies included in this review. The majority of these studies (9 of 13) involved the rehabilitation of inattention or unilateral visual neglect, and one involved the restitution of visual fields. Three of the “neglect” studies included further evaluation of the effectiveness of limb activation during scanning activities and one study examined effectiveness of scanning treatment on wheelchair performance in patients with unilateral neglect. In comparison to the initial review, there was a new area of focus with two systematic studies of the rehabilitation of apraxia.

Of the thirteen studies reviewed in this area there were five Class I 8-10 or Ia 11, 12 studies, three Class II studies 13-15 and five Class III studies. 16-20 Three of the Class I or Ia studies involved the rehabilitation of inattention in subjects with a history of stroke. The Class Ia study 12 implemented a prospective controlled trial to examine the effectiveness of neglect rehabilitation training in two randomly selected groups of subjects within four months of their initial right-hemisphere stroke, using a partial cross-over design. The intervention was the same as one previously reported using a (Class II) within-subjects design. 21 Immediately after the initial testing, 10 subjects received generalized cognitive stimulation and a matched group of 10 subjects received training for neglect. The group receiving generalized cognitive stimulation
received delayed neglect training at the completion of the initial eight-week training period. The neglect training involved five one-hour sessions per week and included visual-scanning training, reading and copying training, and verbal figure description. While the group who received training for neglect demonstrated improvement on standard neglect tests and a functional measure evaluating generalization, the comparison group did not demonstrate modification of performance on neglect tests until they had been exposed to the neglect training at the end of the initial cognitive stimulation period. The investigators noted the need for specific spatial scanning training and for training of adequate length (5 to 8 sessions of consecutive treatment) to assist generalization to untrained tasks in subjects with acute or chronic history of stroke.

Niemier compared 16 randomly selected subjects with stroke in a treatment condition involving systematic cueing of visual scanning, using an image of a lighthouse, with 15 control subjects who received conventional rehabilitation. All subjects were less than 2 months post-stroke when treatment began. Subjects received treatment in a day hospital setting (mean length of stay of 25 days). During this period, the experimental treatment subjects received cueing by the interdisciplinary group of therapists on the use of a lighthouse image to promote scanning to the right and left on functional activities. The lighthouse treatment group demonstrated significant improvement on a cancellation measure and a therapist-rated attention scale, whereas the control subjects did not show improvement.

Kasten and colleagues examined the effectiveness of computer-based training for treatment of partial blindness due to optic nerve damage (N=19) or post-lesional lesions due to acquired brain injury (N=19, TBI or stroke) to a matched control group. After initial diagnosis of residual function in or near the blind portion of the visual field, visual restitution training involving 150 hours of computerized visual stimulation treatment was provided. The treatment
group was compared to a pseudo-treatment group that was exposed to 150 hours of computer-based visual fixation treatment. The visual restitution training resulted in significant enlargement of the visual-field in 95% of the subjects. The subjects with optic nerve damage showed much greater visual field enlargement than subjects with post-chiasmal lesions, although both restitution groups improved significantly. Secondary outcome measures indicated that 72% of the subjects reported subjective improvement in their functional vision. This result was in contrast to a lack of change in visual-field and limited perceived improvement (17% of subjects) in the pseudo-treatment control group. Among subjects who were re-examined approximately two years later, those who received the restitution training showed stable visual field enlargements; the pseudo-treatment control group showed no improvement.

The remaining two Class I or Ia studies involved rehabilitation of apraxia. Apraxia, the inability to carry out learned and purposeful activities such as dressing, can result in self-care deficits and dependence on caregivers. Smania and colleagues examined the effectiveness of gestural training and object use in six subjects with left hemisphere stroke and limb apraxia to seven matched subjects receiving conventional aphasia therapy. The target treatment consisted of 35, 50-minute sessions of systematic behavioral training using a series of gesture-production exercises. Although receiving an equal amount of treatment, the control group did not show any significant change in performance, while the treatment group demonstrated improvement in both ideational and ideomotor apraxia measures following treatment. The researchers expressed the need to develop standardized rehabilitation training procedures for apraxia and to determine if training procedures generalized to activities of daily living (ADL).

Donkervoort and colleagues conducted a multi-site study of subjects with apraxia from left-hemisphere stroke. Subjects were randomized into two types of treatment groups; a
treatment group receiving “strategy” training integrated into occupational therapy (N=56) and a
treatment group who received conventional occupational therapy (N=57). Both groups were
followed for 5 months. During the first 8 weeks they received one of the two therapies during
their inpatient stay. Subjects received about 15 to 19 hours of treatment during the study
treatment period, with no difference in treatment time between the two treatment conditions.
The main principle of the strategy training program was the use of internal or external
compensations for the apraxic impairment during the performance of activities of daily living
(ADL).23 The emphasis of conventional treatment was on sensorimotor impairments. Blinded
outcome assessments were conducted by a research assistant. Based on standardized
observations of ADL, the strategy training was more effective in improving ADL function than
the conventional occupational therapy after an 8-week treatment period. At 5-month follow-up,
no differences between the two treatment groups were seen; this finding appeared to be due to
continued improvement in the subjects who had received (and in some cases were still receiving)
conventional treatment. The investigators suggested that patients in the usual treatment group
needed more therapy to obtain a level of improvement in ADL functioning corresponding to that
of patients who received strategy training.

One Class II15 and one Class III18 study replicated Class I demonstrations that visual
scanning is an effective treatment for visual neglect. Both studies also introduced technologies
that may make this scanning treatment more available. Whereas classic treatment of visual
neglect uses a large and cumbersome display to challenge attention in all areas of the visual field,
Webster and colleagues15 used a computer projection system to accomplish the same end and
Mazer18 and associates used the Useful Field of View test for training.
Additional Class II\textsuperscript{13} and Class III\textsuperscript{16,17,19,20} studies introduced forced activation of the affected limb in conjunction with visual scanning training as a treatment for visual and possibly sensory neglect. Results from McCarthy’s group\textsuperscript{17} suggest that limb activation may be effective even if done in imagination. Although the design of these studies precluded the assessment of the unique contribution of either scanning training or limb activation to the treatment effect, positive results from these reports encourage verification through more rigorously controlled (Class I) research.

Class II and III evidence for the efficacy of training more complex visuospatial and constructional tasks was present in the previous review,\textsuperscript{1} but specific evaluation of such procedures was noticeably absent in this more recent review of the literature. Dirette, Hinojosa and Carnevale\textsuperscript{14} evaluated interventions for deficits in visual processing among 30 subjects with TBI (n = 28) or stroke (n = 2). This study was intended as a randomized trial that compared training in compensatory strategies (self-verbalization, chunking, pacing) with “remedial” computer activities focused on the improvement of underlying subcomponents of visual processing. However, the authors noted that 80\% of the participants in the study used compensatory strategies, whether or not they were instructed to do so. They also noted that the participants who used compensatory strategies performed better, with both groups showing some improvement, although there was no difference between the two treatment conditions.

**Clinical Recommendations.** Two Class I\textsuperscript{10} or Ia\textsuperscript{12} studies of 41 subjects with cerebral stroke provide further replication of the effectiveness of visual scanning in treating unilateral neglect, consistent with the six Class I studies involving 286 subjects from our prior review.\textsuperscript{1} Class I studies demonstrating the efficacy of visual scanning training for visual neglect in both this and the previous review provide strong support that this type of intervention should be a
Practice Standard. Class II and III studies introduce the possibility of electronic technologies for visual scanning training that make this type of treatment more available, and introduce the addition of limb activation as a treatment of visual and possibly sensory neglect. Inclusion of limb activation or electronic technologies for visual scanning training is recommended as a new Practice Option, pending confirmation of efficacy through more rigorous investigation.

Two Class I⁸ or Class Ia¹¹ studies of 126 subjects with left hemisphere stroke provide evidence that apraxia can be treated effectively, and may facilitate improvement in functional activities of daily living compared with conventional sensorimotor or aphasia therapies. Specific gestural or strategy training for apraxia after left hemisphere stroke is therefore recommended as a new Practice Standard.

A Class I study⁹ of 19 patients with TBI or stroke provided evidence that computer-based restitution training can actually reduce the extent of damaged visual fields due to post-chiasmal lesions, and produce subjective improvements in visual functioning. This study supports the findings from Class II and Class III studies that were reported in our prior review.¹ However, we also previously noted that the observed reductions in visual field defects were insufficient to explain the associated reduction in functional impairments, and that functional improvement was associated with increased compensation through improved scanning rather than change in the underlying visual field deficit. Given the limited and contradictory evidence, we recommend that interventions intended to reduce the extent of damaged visual fields should only be considered a Practice Option, pending replication by independent investigators.

Recommendations for future research. Class I studies verifying the usefulness of technologies that might increase the availability of visual scanning treatment, such as computer projection and the UFOV test introduced in Class II and II studies, should be conducted. Class II
and III studies demonstrating positive results for limb activation in conjunction with visual scanning treatment for neglect merit verification through Class I research. Such studies should use factorial designs to separate the unique effects of each type of intervention as well as to evaluate the specific effects of each type of intervention on visual vs. sensory neglect.

The evidence that visual restitution training may actually result in regeneration of the visual fields makes it increasingly difficult to dismiss this possibility, even though it runs counter to conventional neurologic wisdom. This method merits further independent and rigorous investigation in other centers. Studies in this area should attempt to differentiate between the contribution of visual restitution training intended to impact directly on visual field restrictions and the contribution of compensatory mechanisms (e.g., improved scanning) to improved functioning.

Prospective, controlled (Class I) studies of interventions to improve more complex visuospatial abilities required for functional activities (e.g., meal preparation, driving) are recommended. Such interventions were explored through Class II and III studies with positive results in the previous review, but further investigation of such interventions is noticeably absent in this update.

**Remediation of Language and Communication Deficits**

The remediation of neurogenic communication disorders is an active area of research, with 40 studies identified in the current review addressing a range of language-related impairment. There were 3 Class I prospective, randomized treatment studies, one Class Ia study, one Class II controlled study, and 35 Class III case studies or clinical case series. As in the previous group of articles reviewed, most of the research involved subjects with left hemisphere stroke (35 articles with a total of 253 stroke subjects). Three studies with primarily
persons with stroke also included subjects with TBI\textsuperscript{29–31} and there were four single-subject studies of people with TBI.\textsuperscript{33–36} There was one study with 6 subjects with TBI\textsuperscript{32} for a total of 16 subjects with TBI across eight research articles during this review period. The limited number of studies (eight) including people with TBI compared to stroke (35 studies) is very similar to the last review article.

Denes and colleagues\textsuperscript{24} conducted a Class I study to evaluate the effect of intensity of treatment for 17 subjects with global aphasia, who were an average of three months post onset. Subjects were randomly assigned to receive either three hours or five hours of treatment per week for 6 months. The language treatment involved restoring comprehension and efficient use of language in a conversational setting, using a functional stimulation approach to therapy. Both groups improved from pre- to post-treatment, with a greater number of subjects in the intensive treatment reaching significant improvement in all language modalities. Unfortunately, follow-up was not reported. The study concluded that speech therapy is effective for patients with global aphasia, and that treatment intensity plays a critical role. This concept was supported by three additional Class III articles reporting improved functional communication of subjects with chronic stroke\textsuperscript{37} and improved naming ability of subjects with stroke or TBI\textsuperscript{31,34} with increased intensity of treatment.

Elman and Bernstein-Ellis\textsuperscript{25} evaluated the effectiveness of group treatment in a Class I study with 24 subjects who had sustained a left hemisphere stroke. All participants were at least 6 months post injury, and stratified according to their initial aphasia severity. Subjects were randomly assigned to receive either group communication treatment or a deferred treatment condition. Participants in the group treatment condition received five hours of treatment weekly for four months. The group communication treatment focused on initiation of conversations and
ability to convey a message, understanding of the communication disorder, awareness of personal goals and progress, and confidence for communication in personally-relevant situations. In order to control for the effect of social contact, participants in the deferred treatment condition participated in three or more hours per week of social activities such as movement classes, church activities and support groups. Formal language testing was completed at baseline, two months, four months, and follow-up one month post-treatment. Participants who received the group communication treatment showed significant improvement on traditional linguistic and communicative outcome measures. Family reports substantiated improved functional communication for participants who received the group communication treatment, compared with the participants receiving social contact. The group analysis of differential treatment effects was supported by additional analyses of clinically significant improvement for individual participants, with 50% of group treatment participants and 18% of deferred treatment participants demonstrating gains. Benefits of treatment were maintained four to six weeks following treatment. The study concluded that group communication therapy, rather than mere social contact, was responsible for participants’ improved communication skills. The effectiveness of group treatment to improve communication skills in subjects with TBI was supported by a Class III study. 32

Constraint induced therapy (CIT) to improve language skills was evaluated in a Class I study of 17 subjects with chronic aphasia. 26 CIT was described as massed practice of verbal responses designed to constrain patients to the systematic practice of speech acts with which they had difficulty. All of the subjects had chronic aphasia due to a single left hemisphere stroke, and had participated in extensive conventional speech therapy and reached an apparent maximum in the recovery of language function. The subjects were randomly assigned to receive either
conventional aphasia treatment (10 subjects, mean 8.3 years post onset) or CIT (7 subjects mean 2 years post onset). Both groups received the same number of total treatment hours; subjects in the CIT condition received three to four hours per day for two weeks, while subjects in the conventional treatment condition received 30 to 35 hours of treatment over a four-week period. Outcomes were assessed on standard clinical tests, self-ratings, and blinded-observer ratings of the patients’ communication effectiveness in everyday life. The results demonstrated significant benefit of CIT compared with conventional treatment; the group receiving CIT showed substantial improvement, while those receiving conventional aphasia therapy did not show significant overall improvement. CIT resulted in significant improvement on 6 of 8 formal language measures compared with improvement on 1 of 8 measures after conventional therapy. The participants receiving CIT also reported a significant 30% increase in the amount of communication in everyday life after treatment, which was confirmed by ratings made by clinicians who were blind to participants’ treatment condition. The participants receiving conventional aphasia therapy did not improve on this measure. The reported improvement in communication function for participants with chronic aphasia in such a short treatment period is remarkable. Unfortunately, follow-up for maintenance of gains was not reported in this study of an innovative treatment for rehabilitation of functional language skills.

In an effort to evaluate a cost-effective and functional treatment program, Worrall and Yiu conducted a Class Ia study\(^{27}\) in which trained volunteers provided a 10 week functional communication home program for 14 people with chronic aphasia (12 months post injury), compared to non-language based recreational treatment and no treatment conditions, in a crossover design. Subjects were assigned to groups by matching severity of aphasia. Between-group comparisons revealed significant improvement from the functional communication
program compared with no treatment, but not compared with recreational activities. The treatment effect was maintained for the 12 subjects available for follow-up. The study concluded that the people with aphasia made modest changes in everyday communication skills from the functional communication treatment, and that this represented a cost-effective resource to provide extended services to people with aphasia in the community.

A Class II study with 17 subjects with left hemisphere stroke compared treatment approaches to improve performance on a functional communication task (ordering clothing from a catalogue in telephone and written versions). Subjects received either context-based or skill-based treatment (6 subjects in each condition), compared to 5 subjects in conventional treatment. Context-based treatment focused on the specific activity of catalog ordering, using role playing, compensatory strategies and problem solving on the functional task. Skill-based treatment included tasks of picture/word naming and comprehension of the targeted vocabulary to remediate or facilitate the needed language skills, not presented in a functional context. Those in conventional therapy were treated with both functional and skills practice determined by the clinician group, although treatment did not focus on the specific communication task of ordering from a catalog. Those subjects who received the context-based treatment improved the most on the catalog ordering tasks, along with improvements in oral naming. Those subjects in skill-based treatment showed broader, multimodality improvements with improved overall efficiency in language skills. There was no reported improvement for subjects in the conventional treatment on the catalog ordering task. This study is valuable in demonstrating the differential effects of the type of treatment.

A number of Class III studies looked at the types of cueing strategies to improve naming ability in subjects with anomic aphasia. Strategies included phonemic, orthographic, and
semantic cueing, with most treatment presented by a clinician and two studies using a computer
treatment program to improve word retrieval skills. Basso and colleagues\textsuperscript{38} found that
orthographic learning was more effective than reading or repetition cuing to improve naming,
with improvement maintained at follow-up. Other Class III studies found no difference in the
efficacy of orthographic cues and phonologic cues in naming ability\textsuperscript{47,48} and gains were made
and maintained with either cuing method. Phonologic cuing was effective in remediation of
anomia for subjects with post-stroke aphasia\textsuperscript{43,60} with some generalization to untrained words
and functional communication, maintained at follow-up in a case study.\textsuperscript{60} Semantic cueing was
shown to be effective for subjects with stroke\textsuperscript{43,62} and TBI.\textsuperscript{35} These studies, along with the
studies from the last review,\textsuperscript{1} support the efficacy of treating naming disorders in people with
chronic aphasia, but there is still no clear evidence that one method is more effective than the
others.

One Class III study\textsuperscript{44} used a computer program to facilitate word retrieval in 6 subjects
with moderate to severe naming impairments, compared to a clinician guiding each session. The
computer cuing program was effective in both the clinician-guided and partially-self-guided
conditions, suggesting that independent use of the computer can be an effective adjunct to
clinician-guided therapy. An additional Class III study\textsuperscript{56} demonstrated that oral naming
improved through unsupervised computer rehabilitation in the home.

Six Class III studies\textsuperscript{39-41,52,58,59} reported that people with severe expressive language
impairments following stroke can improve functional communication using writing as an
alternative strategy. Four Class III studies\textsuperscript{30,49,50,61} concluded that treatment was effective in
training comprehension and production of sentences, with the greatest improvement noted for
subjects with less severe Broca’s aphasia. An additional Class III study\textsuperscript{55} showed improved
syntactic complexity and communicative efficiency using a formal syntax stimulation treatment program in one subject following a stroke, compared to relaxation training. The authors also postulated that the psychological benefits of relaxation training can enhance the effects of treatment for aphasia, as the subject showed the most gains when the syntax stimulation treatment followed a relaxation session.

A Class III study by Wiseman-Hakes \cite{32} supported the effectiveness of group treatment to improve pragmatic communication skills for six subjects with TBI. The treatment addressed the subjects’ awareness of obstacles to effective communication, practice of effective communication, and generalization to natural contexts. The goal of the generalization phase was to apply the trained skills to tasks and settings in each individual’s particular community, incorporating practice with parents and peers and the selection of relevant activities and contexts. Significant within-subject improvements were seen for nonverbal communication, narrative organization and conversational skills. These treatment gains were maintained at 6 month follow-up.

**Clinical Recommendations.** The results from three Class I studies \cite{24-26} of language treatment with 58 subjects after left hemisphere stroke are consistent with the results from three Class I studies with 169 subjects from our prior review, \cite{1} providing additional support for the *Practice Standard* recommending cognitive linguistic therapies during acute and post acute rehabilitation for persons with language deficits secondary to left hemisphere stroke. There is evidence that group communication treatment can produce clinically meaningful improvements in language functioning, including improved functional communication, beyond the effects of social contact alone. \cite{25,32} There is support that functional communication treatment using volunteers, as well as recreational activities in a community setting, may contribute to modest
gains in everyday communication abilities for patients with chronic aphasia, representing a cost-effective adjunct to other therapies.  

Two Class I studies with 34 subjects and three Class III studies with 44 subjects support the concept that increased intensity of language treatment for subjects with aphasia results in improved communication skills. We recommend that treatment intensity be considered as a key factor in the rehabilitation of language skills after left hemisphere stroke, as a new Practice Guideline.

A number of Class III studies provide additional support for the established Practice Guideline that cognitive interventions for specific language impairments, such as reading comprehension and language formulation, are recommended after left hemisphere stroke or TBI. There is evidence to support the use of cuing techniques and semantic analysis to improve naming ability by people with aphasia and TBI, to improve writing skills in patients with chronic aphasia, and to improve sentence production in patients with agrammatic aphasia.

Two Class III studies demonstrated improvements in word retrieval and oral naming for subjects with chronic aphasia using computer-based tasks that were individualized for each subject and guided by a clinician. These results suggest that independent computer use may serve as an adjunct to clinician directed treatment of word retrieval. Based on these findings, the committee recommends, as a Practice Option, that computer-based interventions may be considered as an adjunct to treatment when there is therapist involvement; sole reliance on repeated exposure and practice on computer-based tasks without some involvement and intervention by a therapist is not recommended.
**Recommendations for future research.** Given the overall evidence to support the effectiveness of language interventions after left hemisphere stroke, additional research should be directed at specific parameters of treatment related to effectiveness. For example, several studies suggest that more intense treatment, including massed practice, produces significant benefits; this area merits further controlled investigation. Comparisons of different techniques for specific deficits (e.g., naming) should be pursued, especially in relation to different profiles of impairment or patient characteristics.

Over one-half of the studies in the current review reported follow-up data, with 22 of 23 studies reporting maintenance of a treatment effect. Future studies should evaluate the maintenance of treatment effects, as well as the relevance to overall outcome in functional communication skills.

Several studies from this and our prior review suggest that intervention provided in the home or community by trained volunteers can improve language functioning. We identified several additional studies that addressed training for volunteers or caretakers to support the conversation of partners with aphasia (but were excluded from formal review because they did not directly treat the people with aphasia). This may represent a valuable adjunct or alternative to traditional treatments, particularly for chronic aphasia that merits further controlled investigation.

Despite the promise of interventions to improve pragmatic communication in persons with TBI, and the committee’s strong recommendation in support of this form of intervention, there is still a compelling need for controlled studies in this area. We particularly recommend that studies in this area evaluate the contextual aspects of treatment that might contribute to effectiveness.
Remediation of Memory Deficits

Studies of the remediation of memory deficits have continued to address the use of compensatory strategies, as well as a growing interest in evaluating the application of assistive technology. We reviewed 13 studies in this area, which included 3 Class I\textsuperscript{68,69} or I\textsuperscript{a70} studies, 2 Class II studies,\textsuperscript{71,72} and 8 Class III studies.\textsuperscript{73-80}

Two of the Class I studies addressed the effectiveness of training strategies in memory rehabilitation. Kaschel and colleagues\textsuperscript{68} evaluated the use of a simple visual imagery technique for the rehabilitation of participants with mild memory impairment after acquired brain injury. The intervention consisted of a standardized imagery-acquisition procedure to promote imagery-generation, overlearning and automatization, and included an individually-tailored training period directed at the transfer of the strategy to everyday relevant materials. This visual imagery condition was compared with “pragmatic memory training” represented by the standard approach to memory treatment in 7 different rehabilitation centers. The pragmatic memory intervention varied across centers and patients, but included practical guidelines to improve memory, use of notebooks and calendars, and elements of attention training and planning procedures. Both the visual imagery and pragmatic conditions were preceded by three months of no-treatment baseline; this was followed by memory training for 30 sessions over 10 weeks, with follow-up assessment three months later. Twenty-four patients with brain damage documented on CT or MRI scan (primarily due to TBI or stroke) were randomly assigned to one of the two treatment conditions. All of the patients had initially been referred for memory rehabilitation, and memory problems were considered to be of primary importance, although patients with severe memory impairment on standardized evaluation were excluded. Patients with aphasia, neglect or hemianopsia, apraxia, agnosia, substance abuse, psychiatric illness, or severe
executive function deficits were excluded to ensure that participants were adequately motivated. Three patients failed to complete the treatment, resulting in 9 participants in the visual imagery condition and 12 participants in the pragmatic intervention condition. These participants were at least 6 months post-onset of their injury or illness, with the average time since onset being about 5 years.

The effects of treatment were assessed using neuropsychological measures of attention and memory, as well as patients’ and relatives’ ratings of everyday memory changes. One of the memorable aspects of this study was the generation of specific predictions regarding the expected effects for each treatment condition. For example, the visual imagery was predicted to produce domain-specific improvements for immediate and delayed recall of verbal material (e.g., story recall, remembering appointments), with no effect on more general memory or cognitive functioning. In contrast, it was predicted that pragmatic training might produce small, non-specific effects. Significant improvement was apparent for the imagery condition, and was restricted to the therapeutic interval and recall of verbal material, consistent with predictions. The improvements associated with visual imagery training were paralleled by positive changes in relatives’ ratings of patients’ memory functioning and were maintained at three month follow-up.

The Class I study by Ownsworth and McFarland investigated the remediation of “everyday memory impairment” using two approaches to training participants to use a diary to compensate for memory problems. Twenty participants recruited from a local brain-injury support group were randomly assigned to one of two treatment conditions. Fifteen of the participants had a TBI and all participants were in the chronic phase of recovery, an average of 15 years post-injury. Initial screening indicated reduced memory functioning, suggestive of mild memory impairment in most participants. There were 10 participants in each treatment condition.
In the “diary only” (DO) condition participants were taught a behavioral sequence of making a diary entry, checking the entry, and using the information as required. This form of intervention was compared with a “diary and self-instructional training” (DSIT) condition in which the participants were taught a self-management strategy to train them in the use of the diary to compensate for memory problems in appropriate everyday situations. Measurement of treatment effectiveness included a daily checklist of everyday memory performance and ratings of strategy helpfulness during the treatment period. Participants in both conditions reported greater use of strategies and reduced distress over memory problems during the intervention phase, compared with pre-treatment baseline. The DSIT intervention was associated with better maintenance of strategy use during the treatment period, and greater decline in memory problems. Participants in the DSIT condition also rated the strategies used to assist their memory as more helpful than the DO group. The results are consistent with a previous single-subject study and suggest that self-instructional training may facilitate the use of memory compensations to a greater extent than task-specific training methods. The results from this study also suggest that some forms of compensatory strategy training may be beneficial to patients who are many years post-injury. Both of the Class I studies from the current review are consistent with the conclusions from our prior review, indicating that compensatory memory strategy training is effective primarily for patients with relatively mild memory impairment. There is also indirect evidence from these two studies that patients’ motivation contributes to the use and effectiveness of memory compensations. In contrast, and not surprisingly, there is evidence from a Class III study that patients with poor awareness of their memory deficits are unlikely to benefit from attempts to train the use of memory compensations, such as a diary or journal.
One Class Ia study\textsuperscript{70} extended the results of a previous Class II study\textsuperscript{82} investigating the effectiveness of a portable pager (\textit{NeuroPage}) to improve independence in people with memory and planning problems in their daily functioning. This study used a randomized crossover design in which participants were allocated to receive 7 weeks of treatment (pager) or no treatment (waiting list) conditions following a two week baseline. Of the 209 patients recruited from a wide range of community referrals, 173 were enrolled and completed baseline assessments. Of these subjects, 94 participants initially received the pager intervention and 49 received no treatment (7 patients were not randomly assigned; there was no difference in conclusions of the study when these participants were excluded from the analyses); an additional 17 people withdrew prior to completing the planned intervention and 13 failed to complete the post-test assessment. Of the participants completing treatment, about 44\% had sustained a TBI, 25\% had suffered a stroke, and 31\% had other neurologic conditions. At the time of the study, participants were about 5 years since the onset of their injury or illness. The authors noted that many of the participants had been referred for the study by a therapist after other interventions had failed. During the intervention period, the use of the pager was adapted to address specific problems (e.g., taking medications, keeping appointments) that had been identified by patients or relatives as occurring on a typical day. During the intervention phase, significant improvements in the ability of participants to carry out everyday tasks with the use of the pager were apparent, compared with no-treatment and baseline conditions. Diagnosis was not related to effectiveness of the pager. The authors noted that the use of the external paging system seemed particularly useful for those people with some insight and a need to carry out some tasks independently. A more detailed, single-subject investigation of the paging system suggested that the pager appears
to be particularly beneficial for people who need to carry out certain tasks on a regular basis, and is facilitated by its ease of use and relevance to patients’ self-identified needs.78

Five additional Class III studies75 – 77, 79, 80 investigated the application of some form of external compensation for memory impairments using assistive technology. One study77 adapted standard mobile phones to serve as a paging system, in order to prompt participants to complete everyday activities. The intervention was effective in increasing initiation of the relevant behaviors in all 5 participants with TBI. Three studies have demonstrated the efficacy of a portable voice organizer to recall therapy goals75 or to prospectively remember to perform relevant everyday tasks.76, 80 The use of electronic memory aids appears to be more likely in people who systematically use other types of reminders.79

Clinical Recommendations. Two Class I studies68, 69 with 41 participants demonstrated the effectiveness of memory strategies for subjects with mild memory impairments after TBI or stroke, including the reduction of everyday memory failures. These findings are consistent with the previous four Class I studies1 with 91 subjects and support the use of strategy training for subjects with mild memory impairment as a Practice Standard. These interventions may consist of internal strategies (e.g., visual imagery) as well as compensation through the use of notebooks or diaries. The benefits of specific intervention strategies may be evident on discrete aspects of memory performance, e.g., visual imagery to facilitate verbal recall, and superior to more general forms of memory remediation.68 There is evidence that the incorporation of self-management techniques enhances the use, maintenance and perceived helpfulness of a memory notebook.69 There is also evidence that interventions to promote the use of external memory aids can be beneficial for individuals with TBI who are many years post-injury.69
The use of externally directed assistive devices, such as pagers and voice organizers, appears to be beneficial for persons with moderate to severe memory impairments, including evidence from one Class Ia study that included persons for whom previous interventions had been ineffective. These interventions appear to be most relevant in relation to the facilitation of specific everyday tasks and activities that have been self-identified as relevant by the users. The use of external memory aids and assistive devices may require extensive training, or need to remain under the direction of someone other than the person with the memory impairment to be effective. As with our previous recommendation related to the use of interventions directed at the acquisition of specific skills, these interventions appear effective for increasing specific behaviors rather than improving memory functioning, per se. Based on the current evidence, in conjunction with the evidence from our previous review, training in the use of external compensations with direct application to functional activities (including assistive technology) is recommended for persons with moderate or severe memory impairment after TBI or stroke as a Practice Guideline.

Recommendations for future research. There is substantial evidence to support the effectiveness of memory strategy training for patients with mild memory impairments after TBI or stroke. There is a need to identify factors in addition to severity (e.g., co-morbid cognitive deficits, poor awareness, motivation) that influence the effectiveness of treatment. It is recommended that research on memory strategy training include an evaluation of treatment integrity, given the evidence that subjects may apply compensatory strategies without explicit instructions to do so. It is also recommended that studies assess the use and effectiveness of memory strategies, as well as external memory aids, in patients’ everyday functioning after
The effectiveness of various assistive technologies to compensate for severe memory impairment should be investigated through additional prospective, controlled studies.

**Remediation of Executive Functioning, Problem-Solving and Awareness**

The area of executive functioning, as noted in the previous review, includes a wide variety of integrative cognitive processes by which individuals monitor, manage, and regulate the orderly “execution” of goal-directed daily life activities. These integrative processes are superordinate in the accomplishment of daily life functions, with their successful implementation involving the orderly and purposeful interplay of a broad array of more basic cognitive skills. The current review included studies of problem-solving and emotional regulation, as well as several small studies that addressed the remediation of impaired awareness after TBI, stroke, or aneurysm. This area of investigation remains under-represented, especially in light of the putative importance of these types of problems in the rehabilitation and long-term recovery of individuals with acquired brain injury.

Nine studies were reviewed in the area of executive functioning, problem solving, and awareness, including one Class I study, one Class Ia study and seven Class III studies. The Class I study evaluated the effect of training goal-directed behavior on successful task completion. The problem-solving model of intervention, “Goal Management Training” (GMT), involved a sequential and recursive five-stage model consisting of orientation toward relevant goals, selection of goals, stating of subgoals, encoding and retention of goals and subgoals, and self-monitoring. In the self-monitoring stage, if the individual is not proceeding as planned, a re-orientation takes place and the process begins again. Thirty subjects with TBI were selected from 94 consecutive admissions to a major medical trauma center and randomly assigned to treatment and comparison conditions. Subjects were three to four years post-injury, with
severity of injury ranging from mild to severe. All participants were living independently and were classified as having either a good recovery (N=24) or moderate disability (N=6). An experimental group of 15 subjects was trained in a one-hour session in which the five stages of GMT were explained using a flow chart, verbal definitions, illustrative examples of breakdowns in goal management, and simulation of real-life activities to practice goal-management skills. Results of training with this group were compared to those of a group of 15 subjects who participated in one hour of motor skills training (MST), consisting of reading and tracing mirror-reversed text and designs. The effectiveness of training was evaluated with three paper-and-pencil tasks designed to correspond to everyday situations; each of these tasks was considered to require, for successful completion, the use of steps included in the training model. Results indicated that GMT was associated with improved performance on the paper-and-pencil tasks corresponding to everyday situations. The fact that the entire treatment in this trial was limited to a single hour of instruction limits the translation of these findings in terms of the clinical application and effectiveness of the intervention. In a clinical application of their GMT model to functional activities, the investigators treated a 35-year-old woman post-encephalitis, who exhibited deficits in everyday attention, memory, and execution of daily activities. The subject showed improvement in performance on two out of three paper-and-pencil tests, and a reduction in problem behaviors at post-training that was maintained at 1-month, 3-month, and 6-month follow-up periods.

One Class Ia study addressed the internalization of self-regulation strategies. Medd and Tate examined the effectiveness of a cognitive-behavioral program of anger management that involved self-awareness and self-instructional training. From 28 people recruited for the study from rehabilitation units, 16 participants with acquired brain injury were enrolled and completed
treatment, including 13 with TBI and one each with stroke, aneurysm and penetrating head injury. All participants exhibited post-trauma onset of problems with anger management identified by the referring clinicians, but no pre-injury psychiatric or emotional disturbance. Participants were grouped into pairs according to matched demographic variables, and then randomly assigned to the treatment condition or waiting-list control condition. The eight participants in the treatment condition received five to eight weekly, individual therapy sessions, using a stress-inoculation procedure modified to include information relevant to individuals with acquired brain injury. Modifications included training in the relationship between brain injury and subsequent anger management difficulties, anger trigger events, and the relation of intervening thoughts to anger responses. Efforts were made to increase participants’ awareness of anger via training to recognize their cognitive, physical, and emotional reactions. They were also given information and practice with various strategies to manage anger responses, including self-talk, cognitive challenging, assertiveness training, self-distraction, and time-out methods.

The eight participants in the no-treatment control group monitored their anger for 8 weeks. The effects of the treatment were evaluated with a state-trait anger scale, anger logs, and measures of self-esteem, anxiety, depression, and self-awareness. Results showed a significant decrease in the negative, outward expression of anger for the treatment group relative to controls, which was maintained at 2-month follow-up testing. While other measures of anger showed improvement, there were no other differences between treatment conditions. There was no change in participants’ self-reported awareness of problems with emotional control as a result of treatment.

Ownsworth, McFarland, and Young evaluated the effectiveness of a 16-week, group treatment program developed to enhance self-regulation skills and self-awareness, in a Class III study. Participants receiving the treatment consisted of 21 patients with acquired brain injury (16
with TBI). Sixteen patients had documented frontal lobe damage and all exhibited severe
cognitive impairments and poor self-awareness, an average of 8.6 years after injury. A majority
of participants had failed to respond to prior rehabilitation efforts. Participants met for weekly
90-minute sessions involving guided discussion, role-play, problem-solving, and development of
compensatory strategies around topics pertinent to brain injury. Outcome measures included
patient-centered interviews to assess participants’ self-awareness of deficits and self-regulation
skills. The self-regulation skills interview consisted of questions regarding the main cognitive or
emotional difficulty each participant had personally identified. Following treatment, participants
reported improved psychosocial functioning and greater knowledge of strategies, use of more
strategies, and increased effectiveness of strategies in their daily life in relation to self-identified
problem areas. Participants also exhibited improved ability to recognize their deficits as they
occur (emergent awareness), and to anticipate situations where they might experience difficulty
(anticipatory awareness) on the structured interviews.

Five additional Class III 90-94 studies specifically explored the effectiveness of training in
awareness following brain injury, typically incorporating behavioral interventions. In three of
the single-subject studies 90-92 the behavioral programs resulted in desired change in behaviors,
although increases in awareness did not occur without the addition of feedback and self-
monitoring techniques. In the remaining two Class III studies 93, 94 maladaptive behaviors
decreased as a result of the treatment, despite a lack of any change in awareness or
acknowledgement of problem behaviors.

Clinical Recommendations. One Class I study with 30 participants supports the effectiveness
of interventions for problem-solving deficits 86 although the direct application to clinical practice in
this study is constrained by the limited extent of the intervention. An additional Class III study 89
of 21 patients with acquired brain injury demonstrated improved strategy application and psychosocial functioning following treatment that incorporated training in problem-solving. These findings are consistent with the results of a Class Ia study with 37 participants from our prior review, \(^1\) and reinforce the *Practice Guideline* recommending the training of formal problem-solving strategies and their application to everyday situations and functional activities for people with TBI.

Our previous review recommended that cognitive interventions that promote internalization of self-regulation strategies, through self-instruction and self-monitoring, be considered a *Practice Option* for the remediation of deficits in executive functioning. \(^1\) Two Class III studies \(^88, 89\) support this recommendation and one Class Ia study \(^87\) utilizing cognitive-behavioral techniques, including self-instructional training, suggests that these techniques may be used to promote more effective emotional self-regulation in patients with TBI. In addition, three Class I studies indicate that self-instructional training is an effective component of interventions for the remediation of deficits in attention, \(^3\) visual neglect, \(^10\) or memory. \(^69\) Recommendations in the area of executive functioning continue to be limited by the relatively small number of adequate studies.

The effectiveness of interventions directed at patients’ poor awareness of deficits has been addressed by the Class Ia study \(^87\) and six Class III studies. \(^89-93\) The group treatment study \(^89\) reported improvements in participants’ emergent and anticipatory awareness in relation to self-identified problem areas as a result of treatment. In addition, three Class III case studies specifically addressed the impact of techniques for improving awareness by promoting internal control of behavior, one via self-monitoring techniques \(^90\) and the others using observer feedback and self-evaluation. \(^91, 92\) Several studies suggest that behavioral improvement is not contingent
upon increased self-awareness.\textsuperscript{87, 93, 94} Given the small number of uncontrolled studies and inconsistency of methods and results in this area, there is insufficient evidence to make specific recommendations regarding interventions to improve self-awareness after TBI or stroke.

**Recommendations for future research.** Programmatic models of cognitive rehabilitation for training in executive functioning have demonstrated effectiveness, most notably in the area of problem-solving. It is recommended that future studies in this area incorporate treatment for problems of emotional control and psychosocial skills, particularly as these reflect components of problem-solving and self-regulation interventions.

The effectiveness of interventions attempting to promote the internalization of strategies needs to be addressed through prospective, controlled studies. This needs to be accompanied by the adequate definition and specification of components of executive functioning, and the evaluation of interventions directed at specific executive functioning components.\textsuperscript{89, 95}

Our previous review noted the potential use of external strategies for the rehabilitation of executive problems,\textsuperscript{96} and this approach still appears to have promise in the treatment of patients with marked difficulties in their planning and organization of everyday activities.\textsuperscript{70} Research in this area should attempt to evaluate factors (e.g., severity, poor awareness) that might determine whether, and which, patients might benefit from interventions directed at internal versus external compensation strategies.

Despite the importance that is commonly attributed to awareness as a mediator of rehabilitation outcomes, there continue to be few studies of interventions in this area. Patients’ awareness of deficits is germane to interventions in various areas of intervention, and attempts to increase awareness are often a component of comprehensive-holistic rehabilitation programs. It is recommended that the assessment of changes in patients’ awareness of deficits be incorporated
more routinely in studies of the effectiveness of cognitive rehabilitation. Research in this area would also benefit from greater specification of the severity and nature of awareness deficits, and relate patient characteristics and interventions to a conceptual model of awareness.  

Comprehensive-Holistic Cognitive Rehabilitation

We reviewed one Class I, 98 one Class II, 99 and five Class III studies 100-104 reflecting characteristics of comprehensive-holistic programs of cognitive rehabilitation. The research in this area typically evaluated integrated programs that offered a variety of treatment modalities and therapeutic disciplines. Most of the participants in these studies had sustained traumatic brain injuries.

The Class I study by Salazar and colleagues 98 evaluated the efficacy of cognitive rehabilitation for 120 people with moderate to severe TBI within a single, military medical referral center. Of 273 consecutively hospitalized patients, 120 patients met eligibility criteria and agreed to participate in the study. Patients participating in this study were an average of about 38 days post-injury. These patients were randomly assigned to receive either an intensive, standardized, multidisciplinary, in-hospital cognitive rehabilitation program 105 on a daily basis for 8 weeks (n = 67) or a limited home program 106 consisting of individual education and encouragement from a psychiatric nurse provided by a weekly 30 minute telephone call (n = 53). There was no difference between groups on either of the two primary outcome measures one year after treatment. Return to work was 90% for the cognitive rehabilitation group and 94% for the home group; fitness for military duty was 73% for the cognitive rehabilitation group and 66% for the home group. The authors noted these “extraordinarily high return-to-work rates” and suggested that participants’ high preinjury education and level of functioning, significant degree of spontaneous recovery, and ready availability of (military) employment after injury might have
limited the ability to detect any differential benefits from the cognitive rehabilitation program. The groups also did not differ on measures of neuropsychological or psychiatric functioning, although most patients showed cognitive improvement during the first year after treatment. A subgroup analysis of 75 participants with more severe injuries (those who were unconscious for more than one hour following TBI) showed a significant beneficial effect of the cognitive rehabilitation program. While this study does not provide strong support for comprehensive-holistic cognitive rehabilitation, the significant subject selection bias and restricted setting markedly limit the ability to generalize these findings to most areas of rehabilitation practice.

A principle contribution of the Class III studies that were reviewed is their relevance to understanding the impact of comprehensive-holistic cognitive rehabilitation on social participation and community integration after TBI. Malec\textsuperscript{100} reported the results of a comprehensive-integrated day program where cognitive and interpersonal therapies were applied for 96 people primarily with TBI or stroke. Significant improvements in social participation on the Mayo-Portland Adaptability Inventory (MPAI) were reported at 1 year follow up, despite no significant improvement on the ability scale of the MPAI. Among the patients who completed treatment, there was a 72% rate of independent living as well as a 39% report of community-based employment that was maintained at one year follow-up. Both Sander et al.\textsuperscript{101} and Seale et al.\textsuperscript{102} described the clinical outcomes of the same comprehensive day treatment program using the Community Integration Questionnaire (CIQ). Sander\textsuperscript{101} reported the results for 39 patients with TBI (half of whom had very severe injuries) who began treatment about 3 months post-injury. Significant improvements in functioning were noted on the Disability Rating Scale and the CIQ after an average of 4 months of treatment. Seale\textsuperscript{102} described the results for 71 patients with TBI who completed this program. Significant improvements on CIQ were again reported,
with greater improvement for patients less than 1 year post-injury compared with those patients who were 1 to 5 years post-injury. Analysis of clinically significant change scores on the CIQ was consistent with group analysis, with clinically significant improvement for 46% of patients; 59% of patients less than 1 year post-injury demonstrated clinically significant change compared with 36% of patients greater than 1 year post-injury. In another Class III study, Klonoff described the outcome of a “milieu-based” day program for 64 patients, most of whom had sustained a TBI (58%) or stroke (30%). About 90% of patients at discharge showed fair or good outcome based on staff ratings, with 62% engaged in gainful employment or full-time education.

There is evidence that the gains reported in community functioning following comprehensive-holistic treatment are stable over time. Sander indicated that gains in community functioning were maintained at 36 to 64 months post-injury, with no significant change from discharge to follow-up. Follow-up studies conducted for 112 patients with TBI and patients with other neurologic illness indicated that a majority of patients demonstrate consistent levels of productivity up to 11 years following treatment.

We reviewed one Class II and one Class III study that did not directly address the effectiveness of comprehensive treatment, but are relevant to the provision of individualized and group-based interventions within the context of comprehensive neuropsychological rehabilitation. Laatsch and Stress conducted a retrospective review of 37 patients who received at least two months of weekly, individualized cognitive rehabilitation therapy directed at improving self-awareness, developing compensation techniques to overcome basic cognitive limitations, and promoting the generalization of strategies in these individuals’ everyday functioning. Forty-six percent of the subjects had sustained a TBI (of whom 16% had a mild TBI and the remainder moderate or severe TBI), 27% had a stroke, and 27% had other neurologic
conditions. Subjects were, on average, about 2 years post-injury when they started treatment, although the range was from one month to 19 years. Twenty patients received therapy within 12 months of their illness, and 16 started therapies more than one year after illness. There was no attempt to analyze outcomes in relation to neurologic diagnoses. Thirty-four patients (89%) showed significant improvement on at least one neuropsychological measure following individualized cognitive rehabilitation, with 32% described as showing “overall improvement.” There was no difference between subjects starting treatment within the first year post-injury and those starting treatment one or more years post-injury. The results are limited by the absence of measures of psychosocial status, functional activity, or social participation.

Group treatment interventions are also integral components of comprehensive neuropsychological rehabilitation programs, with the interaction among participants being an essential means of addressing interpersonal communication, awareness, and social integration. The Class II study by Parente and Stapleton 99 evaluated the effectiveness of group-based cognitive skills training for 33 subjects with TBI, who were compared with 64 matched historical controls who had received similar services but did not receive the group treatment. The group treatment included training modules for a range of cognitive deficit areas, discussed the application of “thinking skills” to work or school settings, and trained academic and vocational skills; reciprocal client instruction was emphasized throughout all aspects of the training. Seventy-six percent of the subjects who participated in the group intervention resumed employment after treatment, compared with 58% of the comparison group. Several of the studies discussed earlier have indicated the effectiveness of group interventions for communication skills 25,32 and executive functioning. 89
Clinical Recommendations. The single Class I study of 120 subjects with TBI did not provide support for comprehensive cognitive rehabilitation compared with basic education and reassurance in the early stages of recovery from TBI, although patients with more severe injuries did show greater benefit with the more intense, structured treatment program. However, the ability to generalize from the results of this study is severely constrained by the restricted nature of the population, unique (military) setting, and limited course of treatment.

Four Class III studies with 265 subjects support the clinical effectiveness of comprehensive-holistic programs of cognitive rehabilitation for improving community integration, social participation and productivity after TBI or stroke. There is also evidence that gains in community functioning obtained from treatment are maintained for the period of several years following rehabilitation. Although patients who enter treatment less than one year after their injury show higher rates of community integration, there is also evidence indicating that patients receiving comprehensive-holistic cognitive rehabilitation one or more years post-injury demonstrate improvements in neuropsychological function and improved social participation. Overall, the results of the current review support our prior conclusion that treatment in post-acute programs of comprehensive-holistic cognitive rehabilitation are recommended as a Practice Guideline for people with moderate to severe TBI.

The integration of cognitive and interpersonal interventions is characteristic of comprehensive-holistic cognitive rehabilitation programs. There is also evidence from the current review that psychosocial interventions may facilitate the effectiveness of specific interventions directed at cognitive impairments after TBI or stroke. These findings are consistent with our prior recommendation that the integration of individualized cognitive and interpersonal therapies may be considered as a Practice Option.
**Recommendations for future research.** There is, most obviously, a need for additional well-designed, prospective studies to evaluate the effectiveness of comprehensive-holistic cognitive rehabilitation for people with acquired neurologic disability. There are particular challenges to conducting controlled clinical trials in this area, due to the complex and multifaceted nature of the intervention. The particular challenges include the definition and establishment of a homogenous study sample, identification and control of the (effective) ingredients of an intervention comprised of multiple components, establishment of a viable (and ethical) control condition, keeping subjects and/or therapists blind to the treatment conditions and avoiding cross-contamination of the treatments, conducting blind outcome assessments (particularly when these require clinical knowledge of the subjects), and the significant clinical and financial resources required to conduct these studies. Further research in this area might best be addressed through practical clinical trials that select clinically relevant, alternative interventions for comparison, represent a diverse population of study participants, and use a broad range of relevant health outcomes.\textsuperscript{109} The continued use of observational methods is also encouraged in this area, particularly to identify the types of patients who are most appropriate and likely to benefit from comprehensive-integrated cognitive rehabilitation.\textsuperscript{110}
Table 2.1  **Evidence-Based Recommendations for Cognitive Rehabilitation**

**PRACTICE STANDARDS**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Recommendations</th>
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<tbody>
<tr>
<td>Visuospatial rehabilitation</td>
<td>Recommended for persons with visuoperceptual deficits associated with visual neglect after right hemisphere stroke.</td>
</tr>
<tr>
<td>Cognitive-linguistic therapies</td>
<td>Recommended during acute and post-acute rehabilitation for persons with language deficits secondary to left hemisphere stroke.</td>
</tr>
<tr>
<td>Specific interventions for functional communication deficits, including pragmatic conversational skills</td>
<td>Recommended for persons with TBI.</td>
</tr>
<tr>
<td>Specific gestural or strategy training for apraxia</td>
<td>Recommended for persons with apraxia after left hemisphere stroke.</td>
</tr>
<tr>
<td>Memory strategy training</td>
<td>Recommended for persons with mild memory impairments from TBI, including the use of internalized strategies (e.g., visual imagery) and external memory compensations (e.g., notebooks).</td>
</tr>
<tr>
<td>Strategy training for attention deficits</td>
<td>Recommended during post-acute rehabilitation for persons with TBI. Insufficient evidence exists to distinguish the effects of specific attention training during acute recovery and rehabilitation from spontaneous recovery or from more general cognitive interventions.</td>
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</table>
## Evidence-Based Recommendations for Cognitive Rehabilitation

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<tbody>
<tr>
<td>Scanning training</td>
<td>Recommended as an important, even critical, element for persons with severe visuoperceptual impairment that includes visual neglect after right hemisphere stroke</td>
</tr>
<tr>
<td>Cognitive interventions for specific language impairments such as reading comprehension and language formulation</td>
<td>Recommended after left hemisphere stroke or TBI</td>
</tr>
<tr>
<td>Treatment intensity</td>
<td>Should be considered as a key factor in the rehabilitation of language skills after left hemisphere stroke</td>
</tr>
<tr>
<td>Use of external compensations with direct application to functional activities</td>
<td>Recommended for persons with severe memory impairment after TBI or stroke</td>
</tr>
<tr>
<td>Training in formal problem-solving strategies and their application to everyday situations and functional activities</td>
<td>Recommended during post-acute rehabilitation for persons with stroke or TBI</td>
</tr>
<tr>
<td>Comprehensive-holistic neuropsychological rehabilitation</td>
<td>Recommended during post-acute rehabilitation to reduce cognitive and functional disability for persons with moderate to severe TBI or stroke</td>
</tr>
<tr>
<td>Isolated microcomputer exercises to treat unilateral left neglect</td>
<td>Not recommended; does not appear effective</td>
</tr>
</tbody>
</table>
Table 2.3  **Evidence-Based Recommendations for Cognitive Rehabilitation**

<table>
<thead>
<tr>
<th>Practice Options</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention</strong></td>
<td><strong>Recommendations</strong></td>
</tr>
<tr>
<td>Systematic training of visuospatial and organizational skills</td>
<td>May be considered for persons with visual perceptual deficits, without visual neglect, after right hemisphere stroke as part of acute rehabilitation. Not recommended for persons with left hemisphere stroke or TBI who do not exhibit unilateral spatial inattention.</td>
</tr>
<tr>
<td>Inclusion of limb activation or electronic technologies for visual scanning training</td>
<td>May be included in treatment of visual neglect after right hemisphere stroke</td>
</tr>
<tr>
<td>Computer-based interventions intended to produce extension of damaged visual fields</td>
<td>May be considered for persons with TBI or stroke</td>
</tr>
<tr>
<td>Computer-based interventions as an adjunct to clinician-guided treatment</td>
<td>May be considered for cognitive and linguistic impairments</td>
</tr>
<tr>
<td>Sole reliance on repeated exposure and practice on computer-based tasks without some involvement and intervention by a therapist</td>
<td>NOT recommended.</td>
</tr>
<tr>
<td>Interventions that promote internalization of self-regulation strategies through self-instruction and self-monitoring</td>
<td>May be considered for persons with deficits in executive functioning after TBI, including impairments of emotional self-regulation</td>
</tr>
<tr>
<td>Integrated treatment of individualized cognitive and interpersonal therapies</td>
<td>May improve functioning within the context of a comprehensive neuropsychological rehabilitation program, and facilitate effectiveness of specific interventions.</td>
</tr>
</tbody>
</table>
CONCLUSIONS

The updated review of the literature regarding cognitive rehabilitation consisted of 17 Class I studies that included 291 patients with TBI and 247 patients with stroke, with 16 of the 17 studies providing evidence for the effectiveness of cognitive rehabilitation. Five Class I studies provide evidence for the effectiveness of remediation for visual inattention \(^9,^{10,12}\) or apraxia \(^8,^{11}\) in patients with stroke, and four studies support the effectiveness of interventions for communication deficits after stroke. \(^{24 – 27}\) One of these studies \(^{27}\) supported the use of volunteers to improve communication skills after chronic aphasia, compared with no treatment, but failed to demonstrate benefits compared with social recreation.

Among studies addressing the remediation of cognitive impairments following TBI, two Class I studies \(^2,^{3}\) support the training of compensatory strategies to improve attention during the post-acute period of rehabilitation. Two Class I studies support the use of memory strategy training, including the development of internalized strategies \(^{68}\) and use of a memory notebook or diary, \(^{69}\) for patients with mild memory deficits due to TBI. An additional Class I study \(^{70}\) indicated that an external cuing system may benefit patients with persistent, severe impairments of memory and planning due to TBI or stroke. A Class I study \(^{86}\) supports the use of interventions to improve problem-solving abilities. An additional Class Ia study \(^{87}\) suggests that intervention to improve emotional self-regulation may benefit individuals with TBI; this study contributes to the confluence of evidence supporting the use of interventions to promote the internalization of self-regulatory strategies after TBI. One Class I study \(^{98}\) failed to demonstrate the effectiveness of comprehensive-integrated cognitive rehabilitation after TBI compared with limited home-based treatment, although methodological concerns limit the generalization of these results.
Integrating the results from our previous and current reviews, the committee found evidence to support several of our initial recommendations, made several new recommendations, and modified several recommendations (Table 2). We continue to recommend visuospatial rehabilitation for people with visuoperceptual deficits associated with visual neglect after right hemisphere stroke as a *Practice Standard*, based on the combined results for 367 subjects from 8 Class I studies. Visual scanning training received support from additional Class II and Class III studies, and continues to be recommended as a critical element of this intervention (*Practice Guideline*). These studies also provided evidence that newer technologies (such as computer projection systems and the Useful Field of View) may be an effective methodology for training scanning. Several additional Class II and Class III studies introduced forced activation of the affected limb in conjunction with visual scanning training as a treatment for visual and possibly sensory neglect. Based on these new studies, the committee recommends that inclusion of limb activation or electronic technologies may be considered as a *Practice Option* for visual scanning training, pending more rigorous investigation.

We previously recommended that visuospatial interventions intended to increase visual fields directly, without the development of compensatory visual scanning, should *not* be considered an effective component of rehabilitation despite tentative Class II and III evidence. In the current review, one Class I study demonstrated reduction of damaged visual fields and subjective improvements in visual functioning from computer-based restitution training in 19 patients with post-chiasmal lesions due to TBI or stroke. Based on this new, although limited, evidence, the committee revised its recommendation to indicate that specific interventions intended to reduce the extent of damaged visual fields may be considered a *Practice Option*. This finding should be replicated by additional independent investigations.
The systematic training of visuospatial and organizational skills should be considered for people with visuoperceptual deficits without neglect after right hemisphere stroke during acute rehabilitation (Practice Option), based on our initial review.¹ There continues to be no evidence to support visuospatial interventions for people with left hemisphere stroke or TBI without visual neglect.

The rehabilitation of apraxia represents a new area of investigation since our initial review. Specific gestural or strategy training for apraxia after left hemisphere stroke is recommended as a new Practice Standard, based on two Class I studies of 126 subjects.

Cognitive-linguistic therapies for people with language deficits after left hemisphere stroke continues to be recommended as a Practice Standard, based on the combined results from 10 Class I studies of 386 subjects. Based on the results from two Class I studies with 34 subjects²⁴, ²⁶ and three Class III studies ³¹, ³⁴, ³⁷ with 44 subjects in the current review, the committee recommends that treatment intensity be considered as a key factor in the rehabilitation of language skills after left hemisphere stroke as a new Practice Guideline. We have previously recommended a Practice Guideline that interventions for specific cognitive-linguistic impairments (such as reading comprehension, language formulation and naming) are considered effective for people with left hemisphere stroke or TBI.¹ A number of Class III studies support the Practice Guideline that cognitive interventions for specific language impairments such as reading comprehension and language formulation are recommended after left hemisphere stroke or TBI.

Interventions for functional communication deficits after TBI, including pragmatic conversational skills, was previously recommended as a Practice Standard based on the results of a single Class I study of 16 subjects.¹ There is additional support for this recommendation in
the current review from a small Class III study of group pragmatic communication training. While the committee continues to support this area of intervention, additional investigations and validation of this area of intervention is needed. The contextual aspects of this intervention appear to require specific attention from clinicians and researchers.

Based on our prior review of multi-modal cognitive interventions, we had noted that the reliance on practice with computer-based tasks without extensive therapist involvement was not recommended. In the current review, two Class III studies demonstrated the potential value of independent computer use as an adjunct to clinician-based treatment for naming impairments. Based on these results, the committee modified its recommendation to indicate that practice on computer-based tasks, including independent computer use as an adjunct to clinician-directed treatment, may be considered as a Practice Option when there is some involvement and direction by a therapist.

Memory strategy training for people with mild memory impairment after TBI continues to be recommended as a Practice Standard, based on the combined results of 6 Class I studies with 118 subjects with TBI; this includes the use of internalized or patient-directed strategies in 95 subjects, and the use of a notebook or diary in 23 subjects. The use of external aids to support the acquisition of specific knowledge and performance of functional activities was previously recommended as a Practice Option for people with moderate to severe memory impairments after TBI. Based on the additional evidence from a Class I with 63 people with TBI and 36 people with stroke, and several Class III studies, that demonstrated the effective use of an external assistive device (such as a pager or voice organizer) as a means of compensating for moderate to severe memory impairments, the committee revised its recommendation to support the use of external aids to support functional activities as a Practice Guideline. Investigations of
additional forms of assistive technology, and principles to support the matching of persons and technologies, are still needed.

Based on the combined results of our reviews, there is now evidence from four Class I studies with 96 subjects (80 with TBI) to support the effectiveness of strategy training for attention deficits. Based on the increased evidence provided by the current review, the committee recommends that this form of intervention, directed at the regulation of more complex aspects of attention, be considered a Practice Standard for people with attention deficits due to TBI during the post acute period of rehabilitation.

Training in formal problem-solving strategies for people with TBI or stroke during the post-acute period of rehabilitation continues to be recommended as a Practice Guideline based on the combined results from two Class I studies with 67 subjects. Although there is additional Class I evidence to support this recommendation from the current review, the limited scope of treatment in this study limits its application in terms of the clinical effectiveness of the intervention, and also limits the strength of our recommendation. Our previous review recommended that cognitive interventions that promote internalization of self-regulation strategies through self-instruction and self-monitoring be considered a Practice Option for the remediation of deficits in executive functioning. Based on the findings from an additional Class I study of 16 subjects utilizing cognitive-behavioral techniques, including self-instructional training, there is evidence to support this area of intervention as a means of promoting more effective cognitive and emotional self-regulation in patients with TBI.

Based on our prior review, the use of comprehensive-holistic neuropsychological rehabilitation to reduce cognitive and functional disability for people with TBI was recommended as a Practice Guideline. The combined results of two Class I studies with 140
subjects provide equivocal evidence in this area of intervention, suggesting that patients show improvement but with limited evidence for differential benefit compared with alternative forms of intervention. These studies do suggest that comprehensive-holistic neuropsychological treatment may be more effective for people with moderate to severe TBI. The combined results from three controlled (Class II) studies of 138 subjects and four Class III studies of 270 subjects (most of whom sustained moderate to severe TBI) support the effectiveness of comprehensive-holistic neuropsychological rehabilitation, including long-term improvements in community integration and social participation. Based on the results of these various studies, we continue to recommend comprehensive-holistic rehabilitation as a Practice Guideline for people with moderate-severe TBI. Most of the studies reviewed in this area incorporated individualized cognitive and interpersonal interventions; these findings reinforce our previous recommendation that the integration of these components within the context of comprehensive-holistic neuropsychological rehabilitation may improve functioning and should be considered as a Practice Option.

The question of effectiveness of cognitive rehabilitation must really be answered in relation to the alternative treatments that are available, to both clinicians and people with TBI or stroke, hence, the emphasis on prospective, controlled trials as the preferred methodology. In order to examine this issue, we analyzed the results of the 46 Class I studies included in this and our prior review. For each study, we examined the nature of the alternative treatment or control conditions and classified them as representing no treatment, conventional rehabilitation, pseudo-treatment, a psychosocial intervention, or an alternative cognitive intervention. We relied upon the original authors’ description of the alternative condition to make these classifications, although on several occasions we were forced to rely on our judgment regarding the precise
Table 3. Differential treatment effects of cognitive rehabilitation (CR) compared with alternative treatment or control conditions based on all Class I studies.

<table>
<thead>
<tr>
<th>Nature of Treatment Comparison</th>
<th>Number of Comparisons</th>
<th>Number of Patients</th>
<th>Percent of comparisons showing differential benefit in favor of CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR vs. Other Cognitive or Psychosocial treatment</td>
<td>10</td>
<td>290</td>
<td>60.0 %</td>
</tr>
<tr>
<td>CR vs. Pseudo-treatment</td>
<td>15</td>
<td>582</td>
<td>66.7 %</td>
</tr>
<tr>
<td>CR vs. Conventional rehab.</td>
<td>14</td>
<td>587</td>
<td>92.9 %</td>
</tr>
<tr>
<td>CR vs. No treatment</td>
<td>8</td>
<td>342</td>
<td>100.0 %</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>1,801</td>
<td>78.7 %</td>
</tr>
</tbody>
</table>

Table 4. Differential treatment effects of cognitive rehabilitation compared with alternative treatment or control conditions based on Class I studies of persons with TBI.

<table>
<thead>
<tr>
<th>Nature of Treatment Comparison</th>
<th>Number of Comparisons</th>
<th>Number of Patients</th>
<th>Percent of comparisons showing differential benefit in favor of CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR vs. Other Cognitive or Psychosocial</td>
<td>7</td>
<td>145</td>
<td>71.4 %</td>
</tr>
<tr>
<td>CR vs. Pseudo-treatment</td>
<td>8</td>
<td>278</td>
<td>87.5 %</td>
</tr>
<tr>
<td>CR vs. Conventional rehab.</td>
<td>3</td>
<td>77</td>
<td>46.7 %</td>
</tr>
<tr>
<td>CR vs. No treatment</td>
<td>4</td>
<td>116</td>
<td>100.0 %</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>616</td>
<td>81.8 %</td>
</tr>
</tbody>
</table>
nature of the comparison. Only studies that reported direct statistical comparisons between treatment conditions were used in this analysis. For studies that compared the cognitive rehabilitation with more than one alternative condition, the treatment condition was compared separately with each of the alternative conditions. For the purpose of this analysis, we collapsed studies using psychosocial or “other cognitive” interventions as the alternative condition. This resulted in the comparison of 47 treatment conditions, representing 1,801 patients (Table 3).

It is clear that cognitive rehabilitation provides clinical benefits compared with not receiving any treatment. It also offers substantial benefit for people with TBI or stroke who exhibit cognitive impairments, relative to conventional rehabilitation. Cognitive rehabilitation produced greater improvement than pseudo-treatment, psychosocial treatment, or an alternative cognitive intervention in about two-thirds of the study comparisons. Overall, cognitive remediation resulted in a significant benefit compared with the alternative condition in about 79% of all treatment comparisons. In no case was there evidence that the alternative condition was superior to cognitive rehabilitation. Because many of the studies reviewed were concerned with remediation of neglect or language impairment after unilateral stroke, we conducted a similar comparison of treatments restricted to participants with TBI, based on 21 Class I studies providing 22 treatment comparisons. The results of this analysis are similar to the total sample, with about 82% of the treatment comparisons demonstrating a differential benefit of cognitive rehabilitation compared with the alternative condition (Table 4). There is one notable difference when looking at interventions only for people with TBI, in that the comparison of cognitive rehabilitation interventions with conventional rehabilitation methods showed less of a difference. This may be due to the relatively small number of studies in this category, as well as the fact that
the “conventional” rehabilitation for people with TBI incorporates interventions directed at cognitive impairments.

In many of the studies, overall, the alternative treatment condition appeared to address the participants’ cognitive deficits (at least superficially), which may have contributed to participants’ reporting subjective improvement, without necessarily showing improvement on objective measures of cognitive functioning. This interpretation appears consistent with the view that factors other than the specific intervention technique, such as therapeutic support and patient expectancies, make a contribution to the effectiveness of cognitive rehabilitation and should be considered in the design, implementation, and evaluation of interventions for cognitive deficits.

We previously noted that improvements in functioning after TBI and stroke might best be achieved through integrated treatment approaches that incorporate both cognitive and interpersonal therapies. The suggestion that non-specific factors contribute to the effects of cognitive rehabilitation is therefore not surprising, and does not necessarily diminish its clinical utility. None of the treatment comparisons indicated a differential benefit of the alternative treatment condition compared with cognitive rehabilitation, and evidence of a differential benefit of the alternative condition on specific outcome assessments was rare.

Although there is now substantial evidence supporting the effectiveness of cognitive rehabilitation for people with TBI and stroke, there continues to be some variability in the nature and design of interventions purported to address the same functional area. The need to provide greater specification of the theoretical basis, design and components of interventions has received increased attention as a prerequisite to investigating the effectiveness of rehabilitation. Increased efforts to standardize and replicate interventions across studies would strengthen the
evidence regarding cognitive rehabilitation, and enhance the translation of research into clinical practice. At the same time, we recognize the value of accommodating treatment approaches “to the complex and unique demands of patients’ lives.” 112, p. 216

Clinically, there is consensus that cognitive rehabilitation should not be focused exclusively on the remediation of impairments, but should reduce disability and help to restore social role functioning. However, this is not truly reflected in the published literature, with most studies addressing interventions directed at the level of cognitive impairments. In a similar vein, most studies evaluate the outcome of interventions at the impairment level rather than their effect on the performance of activities or changes in social participation. Even when interventions are directed at the remediation of impairments, this is presumably based on the (implicit or explicit) belief that this will ultimately result in more effective functioning in meaningful contexts. There is a persistent need to evaluate the effects of cognitive rehabilitation on relevant, functional outcomes.

Methodologically, there is controversy over the most appropriate design of intervention studies. Proponents of randomized controlled trials argue for the need for experimental rigor, while proponents of single-case studies advocate for the documentation of individualized interventions that reflect the particular needs and characteristics of the person being treated. Each of these designs has its merits. Randomized controlled trials are likely to be most useful when they examine the efficacy of strictly defined interactions in relation to outcome measures of limited scope, including the potential for unmasking the most efficacious treatment components. Well-designed observational studies should help to describe the clinical effectiveness of treatment, despite their methodological limitations, and may help to understand what treatments work for which patients in typical treatment situations. The use of single-
subject designs may be most appropriate for exploring innovative interventions, and the clinical application of cognitive rehabilitation in response to the varied, sometimes unique, needs of individuals.

Evidence-based practice is based on the integration of clinical expertise, consideration of patient values, and the best available evidence from clinically relevant research. There is now a substantial body of evidence indicating that patients with TBI or stroke benefit from cognitive rehabilitation. It is time to move beyond the simple question of whether or not cognitive rehabilitation is effective, and to look more precisely at the therapy factors and patient characteristics that optimize the clinical outcomes of cognitive rehabilitation.
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