7. Cognitive-Communication Treatments Post Acquired Brain Injury

Penny Welch-West (M.CI.Sc. SLP), Connie Ferri (MSc. SLP),
Jo-Anne Aubut BA, Leanne Togher PhD,
Robert Teasell MD, FRCPC
Table of Contents

7.1 Introduction .................................................................................................................. 9

7.2 Communication Therapy Reviews ............................................................................. 13

7.3 Attention and Concentration ..................................................................................... 14
  • Challenges Post ABI ........................................................................................................ 14
  • Goals of Treatment .......................................................................................................... 15
  • Treatment strategies ......................................................................................................... 15
  • Materials and Devices ..................................................................................................... 15
  • Treatment of Communication and Attention Deficits .................................................. 15
    Drill and Practice ................................................................................................................ 15
    Mindfulness Based Mediation Techniques ........................................................................ 16
    Dual-Task Training ............................................................................................................ 16
    Cognitive Rehabilitation Strategies .................................................................................. 17
    Computer Assisted Technology for Attention ............................................................... 17
    Calendar to Improve Orientation ..................................................................................... 18

7.4 Verbal Memory and New Learning ............................................................................ 20
  • Goals of Treatment .......................................................................................................... 21
  • Treatment Strategies ....................................................................................................... 21
  • Materials and Devices ..................................................................................................... 21
  • Treatment for Verbal Memory and New Learning ....................................................... 21
    External Aids/Assistive Technology ............................................................................... 21
    Trial and Error Learning ................................................................................................. 21
    Cognitive Teletherapy ...................................................................................................... 22
    Google Calendar versus Standard Diary ......................................................................... 22
    Television Assisted Prompting versus Assistive Technology for Cognition .................. 23
    Compensatory Prospective Memory Training versus Self-Awareness Training .......... 23
    Personal Digital Devices (PDAs) .................................................................................... 24
    Diary to Improve Memory ............................................................................................... 24
    Neuropage Paging System ............................................................................................... 24
    Virtual Reality .................................................................................................................. 24
    Computer Assisted Memory Retraining .......................................................................... 25
    Memory Retraining Programs ......................................................................................... 25
    Cranial Electrotherapy ...................................................................................................... 26
    Computer Assisted Training ............................................................................................ 26
  • Internal Aids .................................................................................................................... 27
    Aids to Improve Verbal Memory and New Learning ...................................................... 27
7.5 Verbal Expression and Discourse .......................................................... 30
- Challenges Post ABI ............................................................................. 30
- Goals of Treatment .............................................................................. 30
- Treatment Strategies ........................................................................... 30
- Materials and Devices (related to articles reviewed and selected for inclusion based on evidence) ................................................................. 31
- Treatment of Verbal Expression and Discourse .................................. 31
  Yes/No Response .................................................................................. 32

7.6 Social Communication and Pragmatics .............................................. 33
- Challenges Post ABI ............................................................................. 33
- Goals of Treatment .............................................................................. 34
- Treatment Strategies ........................................................................... 34
- Materials and Devices ........................................................................ 34
- Treatments to Improve Social Communication and Pragmatics .......... 34
  Training Emotional Processing .............................................................. 34
  Remediation of Emotional Prosody ...................................................... 35
  Social Communication Skills Training ................................................ 35
  Group Treatment ................................................................................... 35

7.7 Reasoning, Problem Solving and Executive Function ....................... 37
- Challenges Post ABI ............................................................................. 37
- Treatment Strategies ........................................................................... 37
- Materials and Devices ........................................................................ 38

Treatment to Improve Reasoning, Problem Solving and Executive Functions ................................................................................................................. 38
  Enhancing Executive Function .............................................................. 38
  Group Therapy ....................................................................................... 39

Goal Management Training versus Motor Skills Training ..................... 40

7.8 Augmentative and Alternative Communication (AAC) .................... 41
- Difficulties Sustained Post ABI ............................................................ 42
7.9 Training Communication Partners ........................................44
- Difficulties Sustained Post ABI ........................................ 44
- Goals of Treatment ...................................................... 44
- Treatment Strategies .................................................... 44
- Treatments ..................................................................... 45
  Communication Partners .................................................. 45

7.10 Pharmaceutical Treatments ............................................ 46
- Therapies to Treat Cognitive-Communication Disorders post ABI. ............ 46
  Methylphenidate (Ritalin) .................................................. 46
  Donezepil ...................................................................... 47
  Bromocriptine .................................................................. 47
  Amantadine ..................................................................... 48
  Citicoline ........................................................................ 48

7.11 Conclusions ................................................................... 50

7.13 Table Appendices ......................................................... 53

7.12 References ..................................................................... 78
Table Directory

Table 7.1  Treatment to Improve Attention and Concentration Post ABI
Table 7.2  Treatments to Improve Verbal Memory and New Learning
Table 7.3  Treatments Used to Improve Verbal Expression and Discourse Post ABI
Table 7.4  Treatment to improve Social Communication and Pragmatics Post ABI
Table 7.5  Treatments Designed to Enhance Reasoning, Problem Solving Skills and Executive Function
Table 7.6  Training Communication Partners
Table 7.7  Pharmaceutical Therapies to Enhance Cognitive-Communication Skills
Key Points

Despite the success of APT training in improving cognitive functioning there is still evidence suggesting structured training programs are not effective in improving attention post ABI. More research needs to be conducted.

Dual task training assists individuals deal with dual-task situations rapidly and accurately.

Dual task training addressing speed of processing is effective.

Computer-based interventions that integrate learning, metacognitive and other validated strategies developed for the individual may be considered as an adjunct to clinician-guided treatment for the remediation of attention deficits after ABI.

Of note, despite the availability and demand for computer-assisted technology, to date it has only been found to enhance concentration and attention for those with a mild to moderate ABI. More research is needed investigating its effectiveness with those who sustain severe ABI.

In an isolated RCT regarding the presence of a calendar and temporal orientation, a positive effect was not found in improving an individual’s orientation to time and date.

The use of electronic calendars has been shown to be effective in improving memory post ABI.

Virtual reality programs are showing effectiveness in improving learning and working memory.

Cranial electrotherapy stimulation was not shown to be an effective treatment to enhance memory and recall abilities following brain injury.

Memory groups have been shown to improve everyday memory functioning and improve the use of memory strategies amongst those with a ABI.

Internal memory strategies appear to be an effective aid in improving recall performance.

Modeling instructional techniques may be more effective than hand-over-hand moulding instructional techniques for aiding retention and recall of hand teaching.
Although the Lee Silverman Voice Treatment was found to improve the total number of words spoken per minute, overall the Traditional Dysarthria Therapy program was just as effective in improving the speech of those with non-progressive dysarthria.

Patients with severe head injuries may improve their ability to communicate “yes/no” responses with consistent training and environmental enrichments.

Training in social skills, social communication or pragmatics is effective in improving communication following brain injury.

Conversation group therapy appears to have a beneficial effect on pragmatic and quality of life concerns; however more research is required to explore these benefits.

Memory-retraining programs appear effective, particularly for functional recovery although performance on specific tests of memory may or may not change.

Although mnemonic strategies have been used to help improve memory post-ABI, retrieval practice appears to be the most effective.

Computer assisted training has not been found to be more effective in enhancing the memory skills of those who sustain a brain injury compared to therapist administered memory rehabilitation training.

Group cognitive initiatives appear to be successful in improving attention and executive control post ABI.

Goal management training is effective for treating some executive function deficits.

Despite the limited amount of research that has been done, augmentative communication intervention designed to assist with organization, access, and efficiency of AAC use, may be beneficial for individuals with severe ABI.

Training of communication partners including paid caregivers can improve the communication efficiency of people with severe ABI.

Methylphenidate has been found to improve working memory; however further study is needed to support its efficacy.

Donepezil helps to improve attention and short-term memory following brain injury.
Bromocriptine improves some executive cognitive functions such as dual-task performance and motivational deficits, however, it does not consistently improve memory. More research is needed before the benefits of using bromocriptine to enhance cognitive functioning are known.

Amantadine may not be an effective treatment to improve learning and memory deficits and executive function following.

Citicoline has not been found to enhance the functional and cognitive functioning in individuals who have sustained an ABI. The administration of the medication for this purpose appears to be under question.
7. Cognitive Communication Treatments Post ABI

7.1 Introduction
The primary purpose of this chapter is to review the evidence concerning cognitive-communication disorders and their treatments post moderate to severe ABI. Due to the vast number of changes in treatment approaches and concepts over the past 30 years, (e.g., the advancement of computerized software and hardware), a decision was made to focus on treatments and therapies developed over the past 20 years. We have therefore, included all RCTS and non-RCTS (prospective control and cohort studies) published between 1992 and 2012. All other inclusion criteria have remained the same (see Module 1- Introduction and Methodology for more details).

For this edition, we, once again, engaged in an expanded search of the literature using subject headings from the module and the following: social communication (discourse, pragmatics, social communication/social cognition, social perception, self-regulation and ABI, TBI or BI); verbal expression (word finding, word retrieval, naming, language formulation, verbal expression, sentence formulation and ABI, TBI or BI); auditory or listening comprehension (auditory and listening comprehension, receptive language, inference and figurative language); reading comprehension (visual processing, and oral reading and ABI, TBI and BI); written expression (discourse and formulation) and community and family communication; academic and academic supports and vocational communication and ABI, TBI and BI. This was an effort to capture all of the published materials available.

The term cognitive-communication disorder was adopted by the American Speech and Hearing Association (ASHA 1987) to distinguish the unique characteristics of communication post-ABI from those of aphasia following stroke. While there were inconsistencies in terminology throughout the 1980s and 1990s, the term cognitive-communication disorder is now widely used in the literature. Traditionally, descriptions of communication disorders in the ABI population fall into 4 main groups: apraxia, aphasia, dysarthria and cognitive-communication.

In an earlier study, Sarno and colleagues (1986) reviewed the charts of 125 individuals who had sustained a mild to severe ABI. They found 29.6% of individuals were diagnosed with aphasia (fluent aphasia, nonfluent aphasia, global aphasia), 34.4% were diagnosed with dysarthria and another 36% were diagnosed with subclinical aphasia. Further, individuals diagnosed with subclinical aphasia consistently outperformed those with classic aphasia on a variety of tasks, such as visual naming, sentence repetition, word fluency and the token test. Individuals diagnosed with dysarthria performed significantly better (p=0.03) than those with aphasia on all tasks. More recently, Duffy (2001) reviewed data obtained from the Mayo Clinic (1987-1990 and 1993-2001). Dysarthria was the most commonly diagnosed communication disorder, followed by other cognitive language disorders (including nonaphasic cognitive communication deficits that are associated with ABI). (see Figure 1)
The College of Audiologists and Speech-Language Pathologists of Ontario (CASLPO) (2002) provides the following definition of cognitive-communication disorders:

Cognitive-communication disorders are communication impairments resulting from underlying cognitive deficits due to neurological impairment. These are difficulties in communicative competence (listening, speaking, reading, writing, conversation, and social interaction) that result from underlying cognitive impairments (attention, memory, organization, information processing, problem solving and executive functions) (CASLPO, 2002).

Previous editions of this module separated cognition from communication impairments for ease of authorship across multiple sites; however, in this edition a decision was made to acknowledge the cognitive underpinnings on communication post ABI.

Communication deficits in brain-injured patients may include aphasialike symptoms such as naming errors and word-finding problems, impaired self-monitoring, and auditory recognition impairments. These constraints may also be coupled with other cognitive-communication impairments, such as attention and perception difficulties,
impaired memory, impulsivity, and severe impairment of the individual’s overall communicative proficiency within functional situations. These constraints can prevent the brain-injured individual from exhibiting even simple communication skills (Lennox and Brune 1993).

The study of language disorders following ABI has been challenging; conceivably more than any other area of communication disorders. Clinicians are required to deal with issues of language use or pragmatics to a greater extent than for other acquired neurological communication disorders. In some instances, the language disorders found among individuals with ABI are more than just a reflection of underlying cognitive deficits. At other times, precise language processing deficits occur in conjunction with cognitively associated communication disorders (Kennedy and Deruyter 1991).

Bloom and Lahey (1978) define language as, “knowledge of a code for representing ideas about the world through an conventional system of arbitrary signals for communication.” Language is comprised of some aspect of content or meaning, that is coded or represented in a linguistic manner for the purpose of use in a particular context (Bloom & Lahey, 1978).

Every aspect of language (content, form and use) includes cognitive processing. Impairment of any cognitive process may affect any and all components of language. It is the mutually dependent relationship between cognition and language that gives individuals the ability to generate, assimilate, retain, retrieve, organize, monitor, respond to and learn from the environment (Kennedy & Deruyter, 1991).

Several aspects of cognition that may affect language identified by the American Speech-Language-Hearing Association (ASLHA) subcommittee of Cognition and Language are:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>impaired attention, perception or memory</td>
</tr>
<tr>
<td>2)</td>
<td>inflexibility, impulsivity, or disorganized thinking or acting</td>
</tr>
<tr>
<td>3)</td>
<td>inefficient processing of information (rate, amount and complexity)</td>
</tr>
<tr>
<td>4)</td>
<td>difficulty processing abstract information</td>
</tr>
<tr>
<td>5)</td>
<td>difficulty learning new information, rules and procedures</td>
</tr>
<tr>
<td>6)</td>
<td>inefficient retrieval of old or stored information</td>
</tr>
<tr>
<td>7)</td>
<td>ineffective problem solving and judgment</td>
</tr>
<tr>
<td>8)</td>
<td>inappropriate or unconventional social behaviour</td>
</tr>
</tbody>
</table>
Due to the integral relationship between cognition and language, a “disruption in these processes may affect the language processes of phonology, syntax, semantics and pragmatics, and compromise the symptomatology after ABI, that is, the cognitive, language, and behavioral deficits” (Kennedy & Deruyter, 1991 p 129).

A significant amount of data on the number of ABIs that occur per year and survival rates may readily be found in the ABI literature. However, specific to the topic of communication, there is a real absence of data documenting how many of these individuals have communication impairments following their injury. Additionally, much of the literature focuses on the assessment of communication deficits rather than reporting treatment efficacy.

Many brain injury survivors, unlike individuals with developmental communication disorders, have a history of normal learning, language and speech. Typically, they are younger than stroke survivors, and have greater concerns regarding transitions back to school and work. The mechanism of injury is unique, and is related to a collection of cognitive-communication disorders. Therefore, it is important to regard acquired brain-injured individuals as a distinct group (Turkstra 1998).

Ylvisaker & Szekeres (1994) noted that communication impairments in ABI patients are generally described as nonaphasic in nature. This is a different type of communication impairment than that seen following stroke and this distinction is an important one. In ABI, communication challenges are often observed along with otherwise intact speech, fluency, comprehension and grammar (Ylvisaker & Szekeres, 1994). The communication style of those with an ABI has been described as “the language of confusion” (Halpern et al. 1973) as cited in (Ylvisaker & Szekeres, 1994).

Ylvisaker & Szekeres (1994) noted that prior to 1980, Speech-Language Pathologists (SLPs) working in the area of ABI were uncommon. While there has been a significant expansion in the outcome research and clinical services over the past 15 years it is apparent from this review that evidence-based research into therapeutic interventions is lagging.

There is a limited number of high quality RCTs within the literature dedicated to cognitive-communication impairments and the therapies performed to assist with the improvement of these deficits, especially impairments related to linguistic organization, reading comprehension, written expression and information processing. In a review conducted by Perdices et al. (2006) on brain injury, it was found that 39% of the studies conducted were single subject designs (SSD) and 22% were case series. In fact, only 21% were RCTs; this may be due to the challenges in conducting these research studies to answer questions of treatment efficacy (Vanderploeg et al., 2006). Difficulties conducting RCTs with those who have sustained an ABI include the complexity of the
disorder, the lack of homogeneity in this population, costs, specificity of treatment and the informed consent procedure (i.e. discomfort in potentially being randomized to an alternative treatment) (Struchen 2005; Wiseman-Hakes et al., 2010). Further, blinding participants to their treatment group, and team members who are responsible for providing the treatment is “nearly impossible” (Kennedy and Turkstra 2006).

An additional challenge to writing this module was the relatively large number of descriptive studies that delineate characteristic deficits in the ABI population relative to “normal” or uninjured participants. While this evidence is of interest, it was not within the scope of this current project and thus these papers have not been included in this module. Rather, this review focuses on published empirical treatment research studies involving the trial of one or more treatments. Inclusion criteria for studies in this module are: the study is a controlled treatment trial that includes a meaningful sample of individuals with ABI, and a robust methodological research design.

### 7.2 Communication Therapy Reviews

In reviewing the literature with regards to cognitive-communication interventions in acquired brain injury, Ylvisaker and Urbanczyk (1990) compared methods of cognitive retraining to more functional integrative methods set in real life activities. They described cognitive retraining approaches as “mental muscle building designed to improve aspects of cognition through repetition”. While they acknowledged that a number of studies had demonstrated statistically significant improvements on testing following a period of intensive cognitive retraining, they asserted that these improvements did not translate to functional improvements in daily communication (Ylvisaker & Urbanczyk, 1990, p. 222). Ylvisaker and Urbanczyk (1990) cautioned that efficacy of interventions must make a difference during everyday tasks, and generalize to everyday settings where the individual communicates on a daily basis.

Further, the authors indicate that there are several challenges to conducting treatment efficacy research in the field of cognitive-communication disorders. These include the following: significant heterogeneity within ABI, the confounding effects of spontaneous recovery, the need for highly individualized treatment, difficulties in generalizing from single-case illustrations, the need to measure improvement “in messy real world tasks” rather than on standardized psychometrically sound instruments and finally, the need for multifaceted, integrated rehabilitation which poses measurement problems.

Several authors have reviewed a variety of studies focusing on cognitive-communication therapies used to assist those post ABI (Kennedy et al., 2008; Coelho et al., 1996; MacDonald and Wiseman-Hakes 2010). In an earlier review conducted by Coelho et al. (1996), the concluding findings suggest that those who sustain an ABI benefit from the work of a Speech-Language Pathologist. Study authors found evidence to suggest that individuals undergoing therapy showed gains in receptive and expressive language,
speech production, reading, writing, and cognition. Further they noted that patients with more severe cognitive-communication deficits are more effectively remediated when treatment is directed toward the development of compensatory strategies such as the use of memory aids (e.g. appointment book, alarm watch, or a detailed daily schedule) (Coelho et al., 1996). Additionally, Coelho and colleagues (1996) reported that although interventions directed at particular cognitive deficits are important; clinicians must attend to broader issues of social skills retraining, timing of treatment during recovery, treatment location and its effectiveness (e.g. hospital, home, school, work). Study results from Mackay et al. (1992) suggest that intervention programs offered earlier post injury result in shorter rehabilitation stays. Further, for individuals with comparable disabilities, those who receive rehabilitation have better than average cost outcomes compared to those not receiving these services (Aronow 1987). For individuals with profound deficits following their ABI, treatment focusing on environmental modification or the arrangement of permanent support systems may be most effective (e.g. training family members/significant others to encourage patient/client during activities of daily living) (DePompei and Williams 1994; Story 1991). Although the findings of these studies were reported over twenty years ago, the same principles hold true today in discussions of cost effectiveness in therapy within both the hospital and outpatient settings.

7.3 Attention and Concentration

Challenges Post ABI

- Inability to maintain focus with and without distractions
- Inability to shift and divide attention appropriately (CASLPO 2002)

According to Park and Ingles (2001) attention is defined as the “voluntary control over more automatic brain systems to be able to select and manipulate sensory and stored information briefly or for long periods of time” (pg. 201). The speed at which information is processed or decisions are made; the ability to pay attention or stay focused on a task; the ability to complete more than one task at a time; and the ability to socialize, (due to attention issues); may impact the individual’s success in rehabilitation, returning to work or school and their ability to participate in other community activities.

In an earlier meta-analysis completed by Parks and Ingles, (2001), the authors suggested that attention deficits resulting from an ABI are treatable. Sohlberg et al. (2003) in a follow-up review, noted that attention training should be used in combination with self-reflective logs, anticipation/prediction activities, and feedback and strategy training for those who sustain mild-moderate attentional dysfunction.
Goals of Treatment
- To improve all aspects of attention including sustained, alternating, selective and divided attention.

Treatment strategies
1. Dual task training (performing two or more tasks simultaneously)
2. Drill and Practice
3. Computer Assisted Technology
4. Attention Process Training (APT)
5. Medication

Materials and Devices
1. Visual (Videotaped short stories -abstract and concrete);
2. Computerized tasks-simple memory tasks (visual stimulation of “language” characters, computer games, THINKable program, computerized calendar vs control diary)
3. Paper and pencil tasks
4. Auditory tasks
5. Electronic Aids
6. Medication

Treatment of Communication and Attention Deficits
Amos (2002) completed a RCT that evaluated remediating deficits of switching attention in patients with acquired brain injury. Twenty-four patients with ABI were randomly assigned to one of three groups and compared to eight normal controls. Results suggest perseverative error and random error are separate functions when switching attention, as suggested by a neural network model. The author notes that external inhibition significantly reduced perseverative error (applying an inappropriate rule continually), while an increase in perceptual salience decreased random error (continually failing to apply an appropriate rule) on the Wisconsin Card Sorting Test.

Drill and Practice:
Novack et al. (1996) found no differences between a group of 61 individuals with severe ABI who received focused stimulation compared to another group who received unstructured stimulation. Focused attention was divided into various levels, “with the lowest level involving focused and sustained attention, with more challenging tasks requiring selective attention; alternating attention and last divided attention” (Novack et al., 1996; p.55). Both groups showed improvement on the Digit Span and mental control subtests of the Wechsler Memory Scale-Revised (WMS-R). Test results also indicated that individuals performed better at the time of discharge than they did at the time of admission. Novack et al. (1996) suggested that the study results may have been affected by the individuals’ spontaneous recovery, leading to improved attentional skills.
Mindfulness Based Mediation Techniques

McMillan et al. (2002) evaluated the effectiveness of attentional control training (ACT) with a group of individuals who had sustained an ABI. The ACT program was designed to train individuals to sustain attention on a single repetitive stimulus for an extended period of time. In this study 145 individuals were randomly assigned to one of three groups: the ACT group, the physical exercise (PE) group and the control group. Those in the ACT group of received, over a 4 week period, 5 - 45 minute sessions using an ACT audiotape. Those in the PE group received the audio-tape training based on physical fitness training. The control group were not given any contact with the therapist. Study results found no significant differences on the measures of cognitive functioning or on anxiety or depression between the groups as a result of the ACT intervention. Overall study authors found no reason to recommend this training be offered to those who have attentional problems following a closed head injury (McMillan et al, 2002).

Dual-Task Training (performing two or more tasks at a time)

Post ABI impairments of attention are one of the most disabling consequences of severe injuries. Patients have been shown to have difficulty performing two or more tasks at the same time. Dual-task processing “requires strategic allocation of attention, task switching and synchronization” (Couillet et al., 2010 p 322). In this recent RCT, Couillet et al. (2010) randomly divided 12 participants into either a non-specific cognitive (control-A phase) group or an experimental rehabilitation (treatment-B phase) group. The control group (n=6) was asked to complete computerized or paper and pencil tasks focusing on divided attention or working memory, while the experimental group participated in a training program with specific dual task training. The objective of this phase was to train the participants to perform 2 tasks concurrently. Initially they trained to perform the task independently then simultaneously. Each treatment phase ran for 6 weeks at which time the groups reversed the order of treatment. Prior to completing the dual task, all were asked to complete the single tasks until they were able to do so without difficulty. To measure changes in divided attention, the divided attention subtest of the Test Battery for Attentional Performance (TAP) was used. At the 6th week assessment period the, BA group showed significant improvement (p<0.01) in reaction times and omissions compared to the AB group.

Fasotti et al. (2000) randomly assigned 22 severe ABI patients undergoing rehabilitation to either a Time Pressure Management (TPM) training group (n=12) or to a concentration group (n=10). Patients were pre-selected for inclusion in this study if they demonstrated slowed processing speed. TPM consists of a series of cognitive strategies to compensate for reduction in processing speed. There are 3 main stages: increased self-awareness of errors and deficits, acceptance and acquisition of TPM cognitive strategies (4 steps), and strategy application and maintenance in increasingly more demanding/distracting situations. The effects of the TPM training were evaluated on a waterbed task (WB-story task), and a Harvard Graphics (HG-computer task). The
concentration-training group consisted of 4 generic suggestions (e.g., focus, don’t get distracted). The following tests were administered to both groups: Rey’s Auditory Verbal Learning Test, the Rivermead Behavioural Memory Test, an Auditory Concentration Test, the Paced Auditory Serial Addition Task (PASAT) and Visual Choice Reaction Time Task. Groups were compared at three time points, pre-training, post-training and follow-up on task performance (information from a video recording). Results indicate the levels of managing performance in both tasks (WB and HG) showed a significant increase following training.

**Cognitive Rehabilitation Strategies**

In an earlier study Sohlberg et al. (2000) found that those who were assigned to the Attention Process Training group (APT) (n=7), showed improved performance on cognitive function and executive attention tasks compared to those in the brain education therapy group (n=7). Results of the Paced Auditory Serial Addition Task (PASAT) found those with higher PASAT scores were related to higher levels of vigilance. Improvement in PASAT scores was greater after APT than with brain education, suggesting participants benefited more from APT than from the brain education program. Similar results were also found when looking at the scores of the Controlled Oral Word Association Task (COWAT- a measure of frontal function). Those with higher vigilance scores had higher COWAT scores. Self-reports of those receiving only brain “education” indicated an improvement in psychosocial function.

**Computer Assisted Technology for Attention**

Thomas-Stonell et al. (1994) studied 12 patients (6 treatment, 6 control) who participated in individualized, 8-week period of a computer-based program called
TEACHware for remediating cognitive-communication skills (i.e. attention, memory/word-retrieval, comprehension of abstract language, organization and reasoning/problem solving skills). The remediation modules of the TEACHware program were primarily in a game format with 3 levels of difficulty. In an effort to assist with generalization to real-life situations the subjects in the remediation group had a SLP, OT or teacher present and available to them at all times. Performance improved on both the screening module and standardized assessment measures within the remediation group.

In an early study, Gray et al. (1992) randomized a group of individuals with an ABI who reported having difficulty with concentration (which affected their reading and/or their ability to follow conversations) to either a treatment group or a control group. Stratification of severity was based on the Paced Auditory Serial Addition Task (PASAT). Those in the treatment groups were given fourteen 75 minute training sessions with these session lasting 3 to 9 weeks. The package consisted of 4 types of programmes: Reaction Time Training, Rapid Number Comparison, Digit Symbol Transfer, Alternating Stroop Program and Divided Attentional Tasks. The control group received approximately 12.7 hours of recreational computing delivered over 3-9 weeks. Controls were excluded from externally paced tasks, sort or masked displays. Participants were tested prior to treatment, immediately afterward and again 6 months later. Pretesting showed no differences between the groups. Initial post testing indicated scores on the Wechsler Adult Intelligence Scale-Revised (WAIS-R) picture completion and the PASAT Information Processing Rate (IPR) improved significantly for the treatment group (p=0.031; p=0.023 respectively). The in relation to their psychological well being, those in the treatment group, the IPR scores improved significantly during the intervention phase (p=0.004) and over the 6th month follow-up phase (p=0.001). For the control group, IPRs did not improve during training, but did improve 6 months later (p=0.034).

Ruff et al. (1994) evaluated the effect of computer-assisted rehabilitation using the THINKable computer program, a multi-media system that focuses on memory and attention retraining. All 15 participants were randomly assigned to one of two treatment groups: Group A received attention training first, followed by the memory training and Group B received training in the reverse order. Due to the small number recruited, the groups were analyzed as a pre-post comparison design. The THINKable system provides photo-like images using digitized real spec and is designed to accept touch screen responses or input using a mouse. Psychometric testing revealed modest but significant gains made for some memory and attention measures in each of the groups.

**Calendar to Improve Orientation**

In a randomized controlled trial, Watanabe et al. (1998) examined whether use of a calendar would enhance orientation following an acquired brain injury. Results
indicated that the presence of a calendar did not enhance performance on a temporal orientation test (date and time). It is difficult to judge the outcome of this study as no scores were reported for either the control or treatment group, and it is not clear whether post-traumatic amnesia, and/or severity of injury had an impact on performance.

The reader is encouraged to review the aforementioned studies within Table 7.1 at the end of this module for further details.

Conclusions

There is Level 2 evidence from a study conducted by Novack et al. (1996) suggesting specific structured training programs are not effective in improving attention post ABI.

Results from several studies indicate there is Level 2 evidence that dual task training has a positive effect on divided attention and is effective on speed of processing (Couillet et al., 2010; Fasotti et al., 2009)

There is Level 1b evidence suggesting Attention Process Training (APT) improves cognitive function (Sohlberg et al., 2000).

Based on the results of an earlier study conducted by Ruff et al. (1994), there is Level 2 evidence supporting the use of computer assisted technology to enhance concentration and attention post ABI.

Although TEACHware is no longer available, based on this one RCT, there is Level 2 evidence that this computer-based program designed to remediate cognitive-communication skills, improved cognitive and communication outcomes in individuals with ABI (Thomas-Stonell et al., 1994).

Based on the results of a study conducted by Watanabe et al. (1998), there is Level 2 evidence suggesting the use of a calendar did not improve patients’ orientation to time and date.

Despite the success of APT training in improving cognitive functioning there is still evidence suggesting structured training programs are not effective in improving attention post ABI. More research needs to be conducted.

Dual task training assists individuals to deal with dual-task situations rapidly and accurately.
**Dual task training on speed of processing is effective.**

*Computer-based interventions that integrate learning, metacognitive and other validated strategies developed for the individual may be considered as an adjunct to clinician-guided treatment for the remediation of attention deficits after ABI.*

*Of note, despite the availability and demand for computer-assisted technology, to date it has only been found to enhance concentration and attention for those with a mild to moderate ABI. More research is needed investigating its effectiveness with those who sustain severe ABI.*

*In an isolated RCT regarding the presence of a calendar and temporal orientation, a positive effect was not found in improving an individual’s orientation to time and date.*

### 7.4 Verbal Memory and New Learning

**Challenges Post ABI**

- Difficulties with processing information via: working, short term, episodic, procedural, prospective, semantic and long term memory (CASLPO 2002)
- Difficulties with either retention and/or retrieval of information that impacts overall communication competency

Verbal memory is divided into 3 stages: encoding (the taking in of new information), consolidation (storing memory for later use) and retrieval (extraction of the stored information). Wright & Schmitter-Edgecombe (2011) have suggested that individuals who sustain a traumatic brain injury have problems with encoding and the consolidation stages of memory. Over time the consolidating of information can improve; however, the encoding of information often remains problematic.

There are two types of memory aids: external and internal aids. External aids may be active high tech such as: computers, PDAs, and mobile phones and passive (no tech/low tech) including calendars, diaries, lists, timetables and dictaphones (McDonald et al., 2011; Sohlberg et al., 2007). As active aids become more readily available, there is a greater need to study their effectiveness in helping those with an ABI deal with prospective memory impairments.

Internal aids consist of strategies using word lists, word letter cuing or association. This module describes research evidence which investigated the use of active and passive external aids, and internal aids to enhance memory following brain injury.
Goals of Treatment
- To assist individuals who have sustained an ABI organize and take in new information, store it effectively for later use, and retrieve stored information easily.

Treatment Strategies
Computer assisted training
- Use of electronic calendars to organize upcoming activities
- Use of specific software to assist with memory and new learning deficits
- Individualized reminder systems
- Errorless Learning
- Visual imagery

Materials and Devices
- PDAs
- Computers, electronic calendars (e.g., Google calendars), diaries, Smart Phones, I-Pads, Tablets
- Pagers
- Television Assisted Prompting
- Calendars and diaries

Treatment for Verbal Memory and New Learning
With the current surge in electronic equipment and software, there are a variety of treatment options available. There are also several internal aids used to improve verbal memory, although these have not been studied as extensively as the external aids.

External Aids/Assistive Technology

Trial and Error Learning
In a recently published RCT, Powell et al. (2012) compared trial and error learning to systematic instruction. Twenty-nine individuals were randomized to either the systematic instruction group (n=15) or the trial and error group (n=14). Twelve 45 minute training sessions were given to each individual. Each session targeted selected skills on a PDA. The systematic instruction condition emphasized mastery while trial and error treatment (conventional) emphasized exploratory learning. Following treatment, five areas were evaluated: accuracy; maintenance accuracy; fluency; generalization, and social validity. At the initial post-treatment follow-up there were no significant differences between the groups; however, at the 30 day follow-up significant differences began to emerge. Those in the systematic instruction condition performed significantly better (p<0.05) than those in the conventional condition. As well, those in the systematic instruction group were found to be more fluent (or efficient) on task performance than those in the conventional instruction group (Powell et al., 2012).
Cognitive Teletherapy
In this study completed by Bourgeois et al. (2007), 38 subjects, along with one significant other for each subject, were assigned to either the spaced retrieval (SR) group or the didactic strategy instruction (SI) group. Subjects were asked to maintain a daily log where they would note all areas with which they were having difficulties. Treatment goals were developed based on areas of difficulty. Those in the SR group were given prompt questions and responses for each goal selected. Answers to the prompt questions were expected to be given in exactly the same way each time. Those in the SI group received time with a therapist to discuss memory strategies. All sessions were conducted by phone for both groups. Results indicate that the frequency of memory problems decreased in both groups over time. Significant improvement in goal mastery (p<0.05) was noted in the SR group but not in the SI group. Scores on the Cognitive Difficulties Questionnaire (CDS) indicate both groups were experiencing fewer difficulties following treatment. Post treatment, scores on the community integration questionnaire (CIQ), showed no significant differences between the two groups.

Google Calendar versus Standard Diary
McDonald et al. (2011) conducted an RCT cross over trial in which participants were randomly assigned to a Google calendar (see diagram 1) group or a standard diary group. Prior to randomization, participants were asked to identify routines they would like to complete within the next 15 weeks. Following this, individuals were randomized to either the Google calendar group (group A) or the standard diary group (group B). At the end of the 5 week baseline, phase group A began using the standard diary and group B began using the Google calendar. While both memory aids helped to improve prospective memory performance of all participants, Google calendar was more effective in improving prospective memory then the standard diary. Participants were able to achieve 82% of their targets using Google calendar but only 55% of targets were achieved using the standard diary.

Figure 3: Google Calendar: [http://www.google.com/calendar](http://www.google.com/calendar)
In a randomized cross over trial conducted by Bergquist et al. (2009), 14 individuals participated in two internet-based interventions. Each group received 30 sessions on either an active calendar acquisition intervention (experimental condition) or 30 sessions of a control diary intervention (control condition). In the calendar condition, participants logged into the Instant Message (IM) system and worked with the therapist to become proficient in using the calendar to compensate for memory problems they were experiencing. Those in the diary condition spent an equal amount of time on line interacting with the therapist and keeping a log of their day-to-day events. Those in the calendar groups showed significant improvement in functioning (p<0.02) compared to those in the diary group. Of note, family members also found participants had fewer memory problems on the Neurobehavioural Functioning Inventory following treatment.

**Television Assisted Prompting versus Assistive Technology for Cognition**

In a randomized crossover design Lemoncello and colleagues (2011) randomly assigned 23 individuals into one of two groups. Those assigned to group A, the Television Assisted Prompting (TAP) group, had the TAP system installed on their television where they received reminders of events to be completed. Those in group B, the Assistive Technology for Cognition (ATC) group, received reminders through more traditional methods (paper planner, cell phones or computers). Following the 10 week intervention Group A received reminders in the more traditional way and group B began receiving reminders through the TAP system. Cognitive impairments were measured using the Paced Auditory Serial Addition Test (PASAT – attention), the California Verbal Learning Test-2 (CVLT-2 – verbal memory and new learning), the Modified Six Elements subsets of the Behavioural Assessment of Dysexecutive Syndrome (BADS – prospective memory and time management), and the Everyday Memory Questionaire (EMQ – everyday memory). The TAP system was found to improve task completion. This finding adds to the growing body of literature supporting the use of assistive technology to improve prospective memory post ABI (Wilson et al., 2001; de Joode E. et al., 2010; Lemoncello et al., 2011). Of note, the TAP system is not yet commercially available (Lemoncello et al., 2011).

**Compensatory Prospective Memory Training versus Self-Awareness Training**

In another RCT, 45 individuals were randomly assigned into one of 4 treatment groups (Shum et al., 2011). The treatment groups consisted of 4 different intervention programs: self-awareness plus compensatory prospective memory training; self-awareness training plus active control; active control plus compensatory prospective memory training and active control only. Participants were assessed using the Cambridge Prospective Memory Test (CAMPROMPT). Post interventions scores were found to improve significantly for those in the compensatory training component group (p<0.017) indicating greater changes in strategies used to improve memory. Compensatory prospective memory training included use of a diary or organizational
devices, and group members were encouraged to use written reminders, appointments and note taking. Of note, when family relatives were asked to assess the individuals’ everyday functioning pre and post intervention, no significant changes were found between the 4 groups.

**Personal Digital Devices (PDAs)**
Dowds et al. (2011) recruited 36 adults to participate in a RCT using two different personal digital assistant devices (PDAs) or a paper-based schedule book to assist them in remembering to complete various pre-selected tasks. Tasks completion rates were higher under the Microsoft Operating System (MOS) and the Palm Operating System (POS) conditions compared to pen and paper tasks. Participants using the POS PDA had a significantly higher task completion rate than those using the MOS PDA.

**Diary to Improve Memory**
Ownsworth and McFarland (1999) evaluated two different training approaches in the use of a diary to compensate for memory problems. They randomly assigned 20 ABI volunteers (15 TBI; 5 ABI) to either a Self-Instructional Training (SIT) approach or to a task-specific learning approach. The Diary-SIT approach trains compensation using higher cognitive skills of self-regulation and self-awareness. That is, participants where taught to question themselves with the following script: W-what are you going to do; S-select a strategy for the task; T-try out the strategy; C-Check out how the strategy is working (WSTC). It was suggested that this training approach provides direct, internal feedback, which can generalize to other situations involving memory. In contrast the Diary-Only approach taught subjects how to use the diary. Results indicated that those in the Diary-SIT group made consistently more diary entries, reported a reduction in everyday memory problems and made more positive ratings on treatment efficacy compared to the Diary-Only group.

**Neuropage Paging System**
Wilson et al. (2001) conducted a randomized controlled cross-over trial with 143 memory impaired patients. Of the 143 participants 93.7% had sustained an ABI. The objective for this study was to evaluate a paging system designed to improve independence in people with memory problems as well as to reduce deficits in executive function. Results demonstrated that the pager system significantly increased patients’ ability to carry out daily tasks, and successful task achievement was more efficient after the pager intervention was introduced.

**Virtual Reality**
In an RCT conducted by Grealy and colleagues (1999) the effects of exercise and virtual reality on individuals with ABI while still in rehabilitation was investigated. During this exercise program, patients were asked to use a stationary bicycle in conjunction with a non-immersive virtual reality program. Treatment was administered over a minimum of
4 weeks. The treatment group consisted of 13 patients currently in rehabilitation, while the control group was selected from a group of patients who had previously been in rehabilitation. Pre intervention scores and post intervention scores were compared for both groups. Results for those in the treatment group showed significant improvement on learning and memory tasks post intervention. Similarly, when compared to the controls, the experimental group fared significantly better on digit symbol as well as visual and verbal learning tasks.

**Computer Assisted Memory Retraining**

Self-practice, presentation of attractive stimuli, multi-sensory feedbacks and personalized training contents were the four different forms of computer-assisted cognitive re-training programmes that Tam and Man (2004) used to evaluate people with post-head injury amnesia. Participants were randomly assigned to one of four treatment groups (matched diagnostically and demographically): (1) self-paced group, which allowed individuals to move at their own pace in a non-threatening environment; (2) feedback group, which involved immediate provision of feedback in a non-judgmental fashion; (3) personalized group, whereby the computer presented training contents showed the participant’s actual living environment and routines; and (4) the visual presentation group, which was a provision of attractive and bright presentation designed to help individuals engage in the activity. Each group went through one of the four computer-assisted memory re-training strategies. Results revealed that the patients in the experimental group showed positive improvements on all of the four memory training methods as compared to the control group. However, there were no statistically significant differences among the four training methods. Nonetheless, this study showed that computer-assisted memory retraining yielded positive results for patients with post-head injury amnesia.

**Memory Retraining Programs**

Thick-Penny and Barker-Collo (2007) randomly assigned 14 individuals to either the treatment or control groups. Those in the treatment group (Memory Rehabilitation Group-MRG) participated in a memory rehabilitation program which consisted of 8 learning modules each 60 minutes long that ran twice a week for 4 weeks. During each session, materials were presented using a combination of didactic teaching and small group activities. Memory improvement and difficulties were evaluated. Overall, a reduction in memory impairment was noted at the end of the 4 weeks of intervention and again at the one month follow-up time period.

In a recent study by O’Neil-Pirozzi et al. (2010), individuals with ABI participated in twelve 90-minute sessions which were held twice a week. The intervention included memory education, and to improve memory function the study emphasized internal strategy acquisition. Primary emphasis was placed on semantic association followed by semantic elaboration/chaining and imagery. Results from the Hopkins Verbal Learning
Test indicated significant differences between the groups and those with a severe ABI performed more poorly than those with a moderate injury. Despite this finding, those with severe ABIs did perform better than those in the control group. In all, memory performance was seen to improve for all in the intervention group compared to the control group.

**Cranial Electrotherapy Stimulation**

Michaels et al. (1993) studied cranial electrotherapy stimulation and its effect on post-traumatic memory impairment in clinical care patients with closed head injury. Patients received CES or sham CES treatments for 40 minutes daily over a period of four weeks. The group receiving CES treatment did not improve in their memory performance, nor did their immediate or delayed recall improve. Further, with retesting, both the CES and the sham CES group showed a similarly significant trend with no group performing any better than the other. These results suggest that CES stimulation in brain-injured patients does not improve memory functioning.

**Computer Assisted Training**

In a RCT conducted by Dou et al. (2006) participants were randomized to one of two groups: the computer assisted memory training group (CAMG-treatment - group 1) or the therapist administered memory training group (TAMG-treatment - group 2) with each receiving one month memory training. Memory training was similar between the groups but they were delivered differently. The treatment groups received 20 training sessions with each running for 6 days per week and lasting approximately 45 minutes. The control group received no training. Sessions consisted of: training basic component memory skills in (1) the management of typical daily tasks utilizing/integrating the component memory skills, (2) customized programs and (3) skill consolidation as well as in the generalization of those skills in practice. Scores on the Neurobehavioural Cognitive Status Examination (NCSE) showed significant improvement in the TAMG and CAMG groups (p<0.015, p<0.02 respectively) compared to the control group. Results from the Rivermead Behavioural Memory Test (Cantonese version) showed the CAMG improved significantly compared to the control group (p<0.0001). Those in the TAMG showed no significant improvement.

**Conclusions**

*There is Level 2 evidence supporting the use of electronic calendars to assist in improving memory post-ABI (McDonald et al. 2011; Bergquist et al., 2009).*

*Results from a study conducted by Grealy et al. (1999) show there is Level 2 evidence suggesting virtual reality exercise programs have a positive impact on learning and working memory.*
There is Level 2 evidence suggesting memory group interventions can improve everyday memory functioning (Thickpenny-Davis & Barker-Collo, 2007).

There is Level 1b evidence, from one RCT, that cranial electrotherapy stimulation did not help to improve memory and recall following brain injury (Michaels et al., 1993).

Results from one RCT indicate there is Level 2 evidence suggesting general cognitive functioning does benefit from computer assisted cognitive retraining. Further study confirming these findings need to be conducted (Dou et al., 2006).

The use of electronic calendars has been shown to be effective in improving memory post ABI.

Virtual reality programs are effective in improving learning and working memory.

Cranial electrotherapy stimulation was not shown to be an effective treatment to enhance memory and recall abilities following brain injury.

Although computer assisted training has been found to benefit cognitive retraining following a brain injury, further study confirming these findings need to be conducted.

Internal Aids

Aids to Improve Verbal Memory and New Learning
In a recent study, Potvin et al. (2011) assigned 30 moderate to severe ABI patients to either an experimental group (n=10) or a control group (n=20). Both groups were matched based on age and education. All participants were initially assessed using the Test Ecologique de Memoire Prospective (TEMP). Those in the experimental group participated in ten prospective memory training sessions. Each session lasted 90 minutes. The prospective memory (PM) program was divided into 5 phases: understanding PM functioning; training to visualize simple images; learning visual imagery techniques; applying visual imagery in PM; and applying visual imagery in everyday situation. The scores on the TEMP, following treatment, improved for those in the experimental group. Study authors also noted that those in the experimental group reported fewer symptoms of depression than the control group.

Twum and Parente (1994) randomly assigned 60 ABI patients into one of 4 groups (one control and three mnemonic strategy groups) counterbalanced. The research demonstrated improved performance for subjects who were taught a strategy (either
verbal labelling or visual imagery) while learning paired-associations. Treatment groups showed greater efficiency in learning and greater delayed recall information.

**Errorless Learning and Impact on Memory**
Tailby and Haslam (2003) also examined how learning can improve or limit later recall of information. Twenty-four ABI subjects were matched on basis of age, gender, pre-morbid and current intellectual status divided into 3 groups based on performance of verbal memory (mild, moderate & severe). Each group (n=8) was assigned to one of 3 learning conditions: errorless learning, self-generated; errorless learning, experimenter generated; and errorful learning. Results showed that regardless of severity level, subjects recalled more information in the errorless learning conditions (with self-generated superior to experimenter generated) than in the errorful learning condition.

**Using Visual Imagery to Enhance Recall of Names and Faces**
By using various visual imagery techniques to aid learning and recall, researchers have demonstrated that increasing the saliency of features encoded, results in an increase in the amount recalled. Milders et al. (1998) examined performance on a name learning task by increasing the meaningfulness of people’s names with various strategies (e.g. when learning a new name-face association try to think of an occupation or object with the same name or a famous person with a similar name etc). When subjects (13 severe ABI vs. 13 matched controls) were tested on 3 different memory tasks, results indicated a significant difference following training, more so for the control group than the ABI group. Also, learning procedures were more effective on one task (where subjects were required to learn the name-occupation-and town) compared to the other two tasks (famous-faces or name learning).

Glisky and Delaney (1996) evaluated implicit memory (priming using a stem completion task) and the use of vanishing cues when learning semantic information in a small number of ABI patients (n=8 & 4) who were still experiencing post traumatic amnesia (PTA) and a matched control group. Findings revealed that learning and recall of information (once PTA has resolved) had occurred, albeit at reduced levels compared to controls.

**Modeling versus Hand over Hand for Learning and Recall**
In a study investigating the effects of two instructional techniques (modeling and moulding) 16 participants were instructed to learn a sequence of 7 hand movements in the correct order (Zlotowitz et al. 2010). In the moulding condition, participants were taught the hand movements using a hand over hand technique. The modeling condition had participants model the hand movements as presented by the experimenter. Participants were tested on recall 5 minutes after their sequence recall and 30 minutes later. Results indicated there was no difference between the techniques after the short
delay recall; however, after the longer delay, recall was significantly better after the modeling condition compared to the moulding condition (Zlotowitz et al., 2010).

**Memory Training**
Berg et al. (1991) randomly assigned 38 individuals to one of three groups (strategy rehabilitation, pseudorehabilitation (drill and practice and no treatment). In the strategy group, individuals were taught general cognitive principles of memory functioning and aids (i.e., internal and external strategies were taught and practiced). Participants in this group participated in daily homework exercises 3x/week for 6 weeks. Here severely brain injured patients showed improved on objective measures of memory (15 Words Test, Face-Names Learning Test, and Shopping List) at 4 months following training in a strategy-use group compared to a pseudo-treatment and a no treatment control group. The pseudorehabilitation group individuals were given memory tasks and games that they were asked to practice and do as homework. More efficient ways of dealing with any assigned task was not provided to group members. Those in the no treatment group were not given any task to complete and no training was provided to them. All participants were tested at the same time. Reaction times for the no treatment group was slower than the other two groups and remained so for the duration of the study. Those in the strategy training group showed significant improvement on all memory performance measures.

In a follow up study, Milders and colleagues (1995) retested 31 of the original 38 individuals on the same memory tests. All memory tests were re-administered to all participants. Although the mean scores of the memory tests show no significant differences between the post-training and long –term testing for the groups as a whole, results from the pseudorehabilitation group indicated a significant improvement (p<0.5).

_The reader is encouraged to review the aforementioned studies within Table 7.2 at the end of this module for further details._

**Conclusions**

_There is Level 2 evidence that internal memory strategies appear to be an effective aid in improving recall performance (Berg et al., 1991; Milders et al., 1995)_

_Potvin et al. (2011) found Level 2 evidence to support the use of visual imagery techniques to improve prospective memory._

_There is Level 1b evidence, based on a study by Zlotowitz et al. (2010), suggesting that modeling techniques (patient mirroring target) are more effective then hand-over-hand moulding techniques._
Memory groups have been shown to improve everyday memory functioning and improve the use of memory strategies amongst those with ABI.

Internal strategies appear to be an effective aid in improving recall performance.

Modeling instructional techniques may be more effective than hand-over-hand moulding instructional techniques for aiding retention and recall of hand teaching action sequences particularly for delayed recall requests.

7.5 Verbal Expression and Discourse

Challenges Post ABI
- Difficulties include participating in a conversation (retrieving or finding the right word to express oneself), or talking at length about any given topic, formulating sentences, and naming objects or people (MacDonald and Wiseman-Hakes 2010).

Clinicians would be well acquainted with the presentation of word finding difficulties in the ABI population. Despite the variety and availability of treatment materials and strategies aimed at addressing anomia, there is unfortunately a real paucity of studies with strong evidence that meet the inclusion criteria for the ERABI project.

Due to impairments in cognitive abilities following an ABI or TBI, difficulties in producing proficient discourse is commonplace. Previous treatments have focused on improving narrative and structured conversations post injury (Kilov et al. 2009). Established treatments often focus on the individual’s ability to communicate with a clinician or researcher but not in the presence of a friend or family member (Jorgensen and Togher 2009). Whether an individual communicates with a friend, a family member or community member rather than a trained clinician post brain injury, has had an effect on the language choices made by both partners (Jorgensen & Togher, 2009).

Goals of Treatment
- To have individuals post ABI focus on having their basic needs met
- To improve word fluency, word usage and word finding
- Organizing ideas in conversation

Treatment Strategies
- The use of a yes/no response system
- Encouraging individuals to speak clearly, with vocal effort and with proper breath support
Materials and Devices (related to articles reviewed and selected for inclusion based on evidence)

- Lee Silverman Voice treatment (LSVT®)

Treatment of Verbal Expression and Discourse

Lee Silverman Voice Treatment (LSVT®)

The LSVT has traditionally been used to address reduced speech intelligibility in patients with hypokinetic dysarthria from Parkinson’s Disease. LSVT is an intensive treatment program that requires four one-hour treatment sessions per week for four weeks. The primary goal is to increase effort during phonation by frequently encouraging the patients to “speak loudly” or “shout”. “Critical to the treatment’s success is the calibration of higher vocal effort and loudness as normal” (Solomon et al., 2001). Ramig et al. (1995) concluded that the focus on increased laryngeal adduction in LSVT is essential to maintaining increased vocal loudness and therefore to the effectiveness of the treatment program.

Several studies have been found in literature that examined LSVT as a treatment for dysarthria specifically within the ABI population (Wenke et al., 2008; Solomon et al., 2001; Solomon et al., 2004). Wenke et al. (2008) concluded “positive effects that LSVT appears to have on speech and communication with non-progressive dysarthria”. Further research using a control group was recommended by these authors and would advance the current evidence that, at this time, suggests LSVT has potential as a treatment for dysarthria post ABI.

Solomon et al. (2001; 2004) conducted two studies investigating the effectiveness of LSVT. In the initial study, Solomon et al. (2001) evaluated the effect of Combination Treatment incorporating LSVT-type exercises, direct respiration treatment and physiotherapy exercises that targeted the upper chest wall on a patient diagnosed with mixed hypokinetic-spastic dysarthria, upper body hypertonicity and cognitive and memory impairments secondary to ABI.

In the second study following Breathing for Speech Treatment, speech breathing approached normal levels and after LSVT speech breathing improved further and intelligibility markedly (Solomon et al., 2004). Gains were maintained up to 4 months, but were limited by the spastic characteristics of dysarthria and sporadic medical complications.

In a current study, Wenke et al. (2011) randomly assigned a group of ABI individuals to either the LSVT group, or the traditional dysarthria therapy (TRAD) group. Both interventions were administered 1 hour each day/4 days/4 weeks. During the LSVT sessions, participants repeated daily variables using a loud and clear voice multiple times.
times. The TRAD program included strategies to increase intelligibility by “restoring lost function or promoting the use of residual function” (pg 9). Speech abilities were assessed using the Assessment of Intelligibility of Dysarthric Speech (AIDS). Both groups improved in work intelligibility following treatment but this improvement was not seen at the post follow up assessment. Those in the LSVT had a significantly greater number of words spoken per minute than those in the TRAD group (p<0.015). Study results suggest that LSVT is comparable to TRAD.

Yes/No Response
The establishment of a consistent yes/no response is desirable when working with patients following severe brain injury, to facilitate communication between patient and care providers. It has been argued that the establishment of a yes/no response is important in differentiating between patients in a vegetative state versus those in a minimally responsive condition (Andrews 1996; Childs et al., 1993; Giacino and Zasler 1995; Grossman and Hagel 1996).

Barreca et al. (2003) attempted to better define the severity of the patient population with regard to functional communication. Barreca et al. (2003) compared two rehabilitation approaches that attempted to establish correct responses to yes/no questions. Subjects in Group A received treatment utilizing an enriched stimulus environment (e.g. Mozart sonatas played for up to 4 hours/day, decorated hospital room with personal mementos suspended from a mobile above the bed), collaborative multi-disciplinary intervention and additional yes/no training by the Communicative Disorders Assistant (CDA), 3 times/week for 30 minutes. In addition, the CDA trained healthcare team members and families to follow scripted procedures to increase arousal/attention and to elicit yes/no responses. Group B received a standard hospital environment (e.g. personal mementos on a bulletin board or on the wall, patient’s own music) and typical team interventions.

A trend towards statistical significance for treatment A over B was found despite the lower numbers. These findings offer evidence that some patients with severe head injuries improve their ability to communicate “yes/no” responses when undergoing consistent training and environmental enrichments (treatment A) (Barreca et al., 2003). Increased interactions between patients and nursing were informally observed. As well, families reported on a satisfaction questionnaire that they were better able to communicate with their loved one.

The reader is encouraged to review the aforementioned studies within Table 7.3 at the end of this module for further details
Conclusions

There is Level 2 evidence from one RCT suggesting the LSVT and TRAD programs work equally well in improving the intelligibility and everyday communication of individuals with non-progressive dysarthria (Wenke et al., 2011).

Based on a single RCT by Barreca et al. (2003), there is Level 1b evidence that some patients with severe head injuries may improve their ability to communicate “yes/no” responses after undergoing consistent training and environmental enrichments.

Although the LSVT was found to improve the total number of words spoken per minute, overall the TRAD program was just as effective in improving the speech of those with non-progressive dysarthria.

Patients with severe head injuries may improve their ability to communicate “yes/no” responses with consistent training and environmental enrichments.

7.6 Social Communication and Pragmatics

Challenges Post ABI
- Difficulties with conversation (topic introduction, topic maintenance, topic choice, turn taking and perspective taking) (CASLPO 2002)
- Issues may present in either verbal or nonverbal communication skills

Pragmatics “describes a person’s ability to perceive, interpret and respond to the contextual and situational demands of conversation” (Wiseman-Hakes et al., 1998).

Pragmatics has also been referred to as the interaction between language behavior and the context in which language occurs (Strauss Hough and Pierce 1994). In general, pragmatics deal with the intentions and attitudes that are expressed while speaking in addition to the prosodic or paralinguistic and gestural characteristics that accompany speech (Newhoff and Apel 1990; Weylman et al., 1988).

In a number of studies, the conversations of those with ABI have been rated as significantly less interesting, less appropriate, less rewarding, more effortful, and more reliant on conversation partners to maintain the flow of the conversation than their non-injured counterparts (Bond and Godfrey 1997; Coelho et al., 1996). Since it is through conversation that we form and maintain relationships, impaired communication can have a significant negative impact on social competence, vocational competence and academic competence. Social communication deficits in ABI can result
in social isolation and lead to “failure, frustration, and a sense of helplessness” (1986). This is consistent with the assertion by Kilvoc et al. (2009) that “there is general consensus in the literature reporting poor communication and social outcomes for individuals with ABI”.

However, Ylvisaker and Urbanczyk (1990) caution that, in conducting interventions to improve social communication, “careful attention must be paid to the ecological validity of the treatment. Intervention that is insensitive to the specific settings and challenges that define the individual’s communication environment is unlikely to yield noteworthy results”. Research to date has tended to focus on a combination of strategies and forms of interventions and no one program or means has been emphasized in the literature (McDonald et al., 2003).

Goals of Treatment
- To initiate conversation with others;
- To learn to read the unspoken language (body language) of others;
- To learn to understand the emotion presented in verbal language;
- To respond appropriately (reciprocity of conversation);
- To show interest in what others are saying;
- To maintain conversations

Treatment Strategies
- Environmental modification
- Cognitive rehabilitation
- Behaviour modification designed to increase the repertoire of positive interactive skills
- Counselling and support
- Pragmatic skills training and
- Targeted speech and language therapy

Materials and Devices
- Positive reinforcement of the appropriate responses
- Auditory feedback or visual feedback by self and others

Treatments to Improve Social Communication and Pragmatics

Training Emotional Processing
In an RCT conducted by Radice-Neumann et al. (2009) demonstrated that emotional processing can be effective when introduced to a group of individuals who had sustained an ABI. They assert that individuals with ABI can re-learn affective recognition skills. Two interventions to enhance emotion processing were utilized. The first intervention (Facial Affect Recognition - FAR), focused on training attention to important visual information and attention to the participant’s own emotional experience. The
second intervention (Stories of Emotional Inference – SEI) taught patients to read emotions from contextual cues presented in stories and then relate these stories to personal events.

Participants who received FAR training had more positive outcomes. They were better at reading faces (emotions) and were more descriptive in relating how they or others would feel in a similar situation. Decreased level of aggression was an additional finding. The SEI group produced fewer improvements however they were able to make more emotional inferences about how they would feel in a given context. They did not however make improvements in their ability to infer how others would feel in a given situation. The authors hypothesized that this might be related to self-centeredness, a trait often attributed to individuals post ABI.

Remediation of Emotional Prosody
In a recent study conducted by McDonald et al. (2012) 20 individuals who had sustained an ABI (n=10) were randomly assigned to either the treatment group (n=10) or the control group (n=10). Those in the treatment group received a 2 hour treatment session each week for 3 weeks. Those in the treatment group were divided into smaller groups resulting in 2 working with one therapist during each session. Those in the control group were offered treatment, at the one month follow-up.

Activities consisted of mostly games designed to focus on “prosodic cues present in the expression of emotion” (McDonald et al., 2012). Study results indicate no significant differences in the treatment groups from the pre-test to the initial post-test assessment and the follow-up assessment 30 days later. Study authors noted “there was no indication for an effect on reaction time, and no change in relative report of communication competence”. Individually, those in the treatment group did report changes with 5 indicating they felt there was improvement on one measure and one indicating improvement on three measures (McDonald et al., 2012).

Social Communication Skills Training
In a RCT conducted by Dahlberg et al. (2007) it was found that subjects in the experimental group when exposed to twelve 1.5 hour communication sessions, significantly improved their scores on 9 of the 10 subscales on the Profile of Functional Impairment in Communication, (PFIC) scale (p<0.01 - p<0.001) and the Social Communication Skills questionnaire-adapted (SCKQ-A) (p≤0.001) at the end of the 12 week period. These improvements were also noted at the sixth and ninth month follow up periods.

Group Treatment
Group treatment may be an efficient means of intervention for ABI patients with cognitive-communication deficits while also promoting generalization. Group treatment
may be used to target more complex and higher-level skills within the communication domain and with a wide array of communication partners. Within a group treatment setting, patients with ABI gain support and benefit from the experience of their peers within a non-judgmental environment to experiment with compensatory strategies and acquisition of appropriate interaction skills (CASLPO 2002).

The Braden et al. (2010) study of social communication in group therapy examined the efficacy of the Group Interactive Structured Treatment (GIST) for social competence in a cohort study examining 30 individuals greater than 1 year post ABI. Treatment involved 13 weeks of social communication skills training in a group setting. The one and a half hour session topics included: “orientation meeting, skills of the great communicator, self-assessment and goal setting, starting conversations, keeping conversations going and using feedback, assertiveness in solving problems, practice in the community, social confidence through positive self-talk, social boundaries, videotaping, video review, conflict resolution, closure and celebration” (Braden et al. 2010). Overall, data gathered from several subjective social communication tools supported the hypothesis that social communication skills and social competence can be improved several years post injury with positive effects on satisfaction on quality of life. It also lends further support of the benefits of positive group dynamic in the treatment of social communication issues.

The reader is encouraged to review the aforementioned studies within Table 7.4 at the end of this module for further details

Conclusions

Results of the study conducted by Radice-Neumann et al. (2009) indicate there is Level 1b evidence from one RCT to show that social communication skills training improve communication skills.

There is Level 1b evidence from one RCT to suggest interventions designed to improve the ability to recognize emotional prosody were minimally effective (McDonald et al., 2012).

There is Level 2 evidence from Dahlberg et al. (2007) to show that pragmatic interventions including role-playing, improve a variety of social communication skills as well as self-concept and self-confidence in social communications.

Based on the study conducted by Braden et al. (2010) there is Level 2 evidence that conversation group therapy has a beneficial effect on pragmatic and quality of life concerns in ABI patients.
Training in social skills, social communication or pragmatics is effective in improving communication following brain injury.

Conversation group therapy appears to have a beneficial effect on pragmatic and quality of life concerns; however, more research is required exploring these benefits.

7.7 Reasoning, Problem Solving and Executive Function

Challenges Post ABI

- Difficulty:
  - recognizing problems as they arise,
  - analyzing information,
  - decreased flexibility in thinking, impulsivity in decision making
- Issues switching attention easily;
- Difficulty accessing previously or recently stored information;
- Decreased ability to organize and execute plans that have been made.

Executive functions refer to higher-level cognitive functions that are primarily mediated by the frontal lobes. These functions include insight, awareness, judgment, planning, organization, problem solving, multi-tasking and working memory (Lezak 1983). Disorders of executive functions within the ABI population have been found to be heterogenous (Kennedy et al., 2008). For those who sustain an ABI, generating active solutions to problems encountered is itself a problem. Many show difficulty in identifying realistic goals, establishing priorities and time frames, weighing the pros and cons of a solution.

Goals of Treatment

- Improve ability to consider multiple solutions, perspectives
- Encourage systematic approach to problem solving
- Improve an individual’s ability to change their focus
- Improve organization, planning, initiation and impulse control

Treatment Strategies

- Define the problem;
- Develop a list of possible solutions and the pros and cons of each;
- Evaluate the success of each solution and be willing to try again
- Targeting goal setting, planning, initiation, monitoring, time management and impulse control (CASLPO 2002).
Materials and Devices

- Didactic educational instruction
- Specialized computer software
- Reading and homework activities
- Mindfulness training
- Paging systems

Treatment to Improve Reasoning, Problem Solving and Executive Functions

Enhancing Executive Function

Chen et al. (2011) in a recent study, randomized a group of individuals (n=24) who had sustained an ABI, into one of two groups: a goals training group (n=12) and an education group (n=12). The goals training program (the experimental condition) was based on a management training program. Participants attended ten 2-hour sessions of group based training, 3 individual 1-hour training sessions and 20 hours of home practice over 5 weeks. The control group attended a five week didactic educational instruction regarding brain injury. Following training, performance on tests of attention and executive control increased for 100% of participants in the experimental condition, while only 58% in the education groups showed an increase in test scores. Learning and memory performance scores increased for 92% (11/12) of those in the goals training program and 33% (4/12) in the education program.

In a RCT conducted by Vas et al. (2011) 28 individuals who had sustained an ABI and were at least 2 years post injury, were assigned to one of two groups: the Strategic Memory and Reasoning Training (SMART) group or the Brain Health Workshop (BHW) group. Each group received 15 hours of training over an eight week period. Those in the SMART group were given information about brain injuries, were asked to read pieces of literature on brain injury and were given homework assignments to be completed for the next meeting. The SMART sessions were built around three strategies: strategic attention, integration (combining important facts to form higher order abstracted meaning) and innovation (derive multiple abstract interpretations). Those in the BHW group participated in information sessions. Sessions for the BHW groups included an introduction to brain anatomy, functions of the brain, neuroplasticity, and the effects of lifestyle on the brain (diets, exercises and cognitive changes following a ABI). Study results indicate that those assigned to the SMART group showed significant improvement on gist reasoning and measures of executive function.

Rath et al. (2003) completed an RCT comparing two cognitive rehabilitation therapies: conventional (cognitive remediation and psychosocial components) versus an innovative rehabilitation approach focusing on emotional self-regulation and clear thinking. Outcomes were measured across multiple domains of cognition including attention, memory, reasoning, psychosocial functioning, and problem solving measures. Significant
changes comparing baseline to post intervention outcomes were seen for each group, however, the improvements were different for the interventions. Those in the innovative groups showed significant improvement in problem solving, problem solving self appraisal, self appraised clear thinking and emotional self-regulation and improvement on the visual memory immediate recall assessment and the self-esteem assessment. Those in the conventional group improved on test reasoning, endorsed less severe somatic symptoms. Emotional self regulation also improved.

**Group Therapy**

In a current RCT Novakovic-Agopian et al. (2011) randomly assigned 16 individuals to either a goals training (goals-edu) group or an educational instruction (edu-goals) group. The goals training program had 2 components: the first emphasized mindfulness-based attention-regulation training, and the second emphasized patient’s defined goals. Training involved ten 2-hour sessions of group training, 3 individual 1-hour session and 20 hours of home practice over a 5 week period. An example of training included the implementing a calendar or organizational system to increase completion of assignments or tasks. At the end of the five week period the groups reversed rolls. Both groups were assessed at baseline, at the end of the first 5 weeks, and again at the end of the 10th week. Those in the goals-edu group showed significant improvement on the attention and executive function summary domain compared to the edu-goals group. At the 10th week evaluation time period, the edu-goals group, once they had completed the training sessions, also showed improvement and the goals-edu group continued to show improvement despite no longer receiving the intervention (Novakovic-Agopian et al., 2011).

In an earlier RCT, Ownsworth et al. (2008) randomly assigned individuals to one of three groups: Group 1: group based support, Group 2: individual occupation support, Group 3: combined group and individual support interventions. All were evaluated pre- and post-intervention then again at the seven-month follow up. Overall, when looking at the baseline measures, they found no significant differences on the performance self-ratings, satisfaction self-ratings, relatives’ performance ratings, and relatives’ satisfaction ratings (p>0.05) for the groups. The satisfaction self-ratings between pre and post assessment, indicated an improvement after each intervention (individual p<0.001; group p<0.025; combined p<0.01). At follow-up, an improvement in self-rated satisfaction was noted for the group and combined interventions only (p<0.01). Results from the Canadian Occupational Performance Measure (CPOM) indicate that there were no significant differences when looking at the scores from the group intervention pre-to post-comparison. Significant improvement was noted when looking at the scores for the individual and combined interventions (p<0.01 and p<0.025 respectively). Pre-assessment and follow-up assessment for the relatives’ ratings of performance was significant for all three interventions (individual p<0.01; group p<0.01; combined p<0.025). Relatives’ ratings of satisfaction (pre and post) found a significant
improvement for the individual (p<0.025) and combined (p<0.01) interventions but not for the group intervention (p<0.117). A look at the psychosocial outcomes for each intervention group showed few significant differences.

**Goal Management Training versus Motor Skills Training**

Levine et al. (2000) completed a RCT comparing a group of patients using goal management training strategies to a control group who were exposed to only motor skills training. The treatment group improved on everyday paper and pencil tasks as well as meal preparation, which the authors used as an example of a task heavily reliant on self-regulation.

The reader is encouraged to review the aforementioned studies within Table 7.5 at the end of this module for further details.

**Conclusions**

*There is Level 1b evidence to suggest short term intensive training benefits gist-reasoning which benefits executive function post TBI (Vas et al., 2011).*

*There is Level 2 evidence from one study to suggest group treatment of problem solving deficits is effective in improving executive function, problem solving self-appraisal and self-appraised emotional self-regulation (Rath et al., 2003).*

*Based on the findings from Chen et al. (2011), there is Level 2 evidence suggesting a goals training group is effective in improving attention and executive control.*

*There is conflicting evidence supporting the use of group-based interventions to treat executive dysfunction post ABI (Novakovic-Agopian et al., 2011; Parente et al., 1999; Ownsworth et al., 2008).*

*There is Level 2 evidence, based on a single RCT conducted by Levine et al. (2000), that goal management training is effective for improving paper and pencil everyday tasks and meal preparation skills for persons with an ABI.*

**Group cognitive initiatives appear to be successful in improving attention and executive control post ABI.**

**Goal management training is effective for treating some executive function deficits.**
7.8 Augmentative and Alternative Communication (AAC)

Following severe traumatic brain injury, patients present with significant communication challenges that interfere with daily communication needs. Those who sustain a mild or moderate ABI may be more readily able to communicate using natural speech with minor difficulties. On the other hand, those who suffer from a severe ABI may not be able to meet communication needs through speech alone and may benefit from an augmentative or alternative communication strategy (Johannsen-Horbach et al., 1985; Bourgeois et al., 2001; Fager et al., 2006; Burke et al., 2004; de Joode et al., 2012). Although many individuals post ABI do recover their speech abilities, there are still many who remain unable to speak for extended periods of time (Fager et al., 2006). For this specific group, assessments and AAC intervention may be a continual process. Multiple changes the individual’s level of function may occur over time thus the introduction of new systems (from the simple to the more sophisticated) is needed to allow for effective communication (Fager et al., 2006).

In the AAC domain there are divisions of complexity. These include easy to make, low tech options (e.g. alphabet boards, picture based communication boards, memory books, reminiscent/conversation books, day planners) and high tech options that include VOCA devices (Voice Output Communication Aid) including Dynavox, McCaw, Message Mate, Big Mack, Voice Pal and Boardmaker. Notably, both low tech and high tech solutions to communication difficulties maybe have access that is either direct (i.e. touching/pointing) or indirect (i.e. switch access or partner assisted scanning).

Those clinicians working in the area of AAC or Assistive/Enabling Technology are well acquainted with the recent explosion of technology options available. Traditional and most familiar AAC devices and software include, but are not limited to, voice output (VOCA) systems as noted above. Presently clinicians and patients have access to a wider, more universally available set of devices and peripherals including, but not limited to, iPad, Android and Windows based tablets as well as the wide variety of associated apps and software (e.g. Proloquo2go, Talking Tiles). Changes in cost, improved ease of access/availability in mainstream retail, rapid changes in the technology itself and associated applications have resulted in AAC clinical practice that is both invigorating and exhausting.

Presently, we are in the midst of a time of technology growth and changes that is unprecedented. Consequently, the research in this area is not able to keep pace and we rely on limited or dated studies. Given the scope and methodology of the ERABI project, reviewing the strongest evidence available, there was an unfortunate gap in evidence to support what is actually being implemented in the practice of front line clinicians.
Difficulties Sustained Post ABI
- Difficulty with verbal expression
- Severe dysarthria

Goals of Treatment
- To allow individuals with severe ABI to efficiently access and communicate effectively via AAC.

Treatment Strategies
- Assess needs of the individual from access and communication perspectives
- Determine the best device and method of access for individuals on a 1:1 basis
- Age and gender must be taken into account when choosing a device
- Allow time for training and teaching of both patient and communication partners (i.e. Facilitator)

Materials and Devices
- Non-electronic Communication Boards
- Alphabet Communication Boards
- Lexical Communication Board
- Eye-Gaze Communication Board
- Communication Board
- Picture Communication Board
- Pictograms
- Sign Language
- Blissymbol Communication board
- Synthetic voice
- Memory Aids

Augmentative and Alternative Communication (AAC) Treatments
While there is a great deal of discussion around the importance of augmentative and alternative communication devices, there is a paucity in the literature supporting the effectiveness of the programs and devices currently available. In order to understand how these devices work, why they work and the benefits to those who use them, more research is required.

Organizational Word Retrieval Strategies:
Burke et al. (2004) studied the use of three organizational word retrieval strategies for adults with ABI who use AAC. These organizational strategies include semantic topic, geographic place and first letter or alphabet. While the subjects retrieved words more accurately when using the alphabet organization strategy, they expressed the preference for use of the semantic topic strategy. Clinicians may consider providing these three strategies for clients using AAC, and assisting with identification of the most beneficial and preferred strategy for the individual client.
Bliss Symbols:
Bliss symbols or bliss boards have been available and used for several years now. The use of Blissymbols has been found to be very effective with those who have been diagnosed with aphasia or Broca’s aphasia (Rajaram et al., 2012). There is little in the literature specific to the ABI population.

Picture/Symbol Based Boards:
Despite the surge in technology, picture and symbol based boards remain in high use today (e.g. pictograms, Boardmaker). These symbols or pictures may represent a concept, object, activity place or event. Symbols, pictures and boards in general may be used with minimal training and software may be individualized (Bhatnagar and Silberman 1999). The selection of symbols should be appropriate to the individual’s communicative needs. Picture/symbol software is also available for use on home computers, iPads, and iPhones. To see a selection of symbols please see Figure 4.

Alphabet Boards:
Individuals with dysarthria or who are non-verbal may benefit from an alphabet board. These boards are helpful for spelling single word or short phrase messages. Board sizes may vary depending on the person’s abilities, necessity or access (Bhatnagar and Silberman 1999).
Further research needs to be conducted regarding AAC and the ABI population. Early and limited studies however, report favorable use of organizational strategies to facilitate word recognition (by the communication partner).

Despite the limited amount of research that has been done, augmentative communication intervention designed to assist with organization, access, and efficiency of AAC use, may be beneficial for individuals with severe ABI.

7.9 Training Communication Partners
The success of communication interventions often relies on the understanding, compliance and competence of communication partners. Training of communication partners has become a central component of communication interventions with many populations. This development is consistent with the World Health Organization (2001) emphasis on context (environmental and attitudinal) as a determinant in health and disability outcomes. Training of communication partners has been shown to have a positive effect on communication effectiveness and re-acquisition of communication skills in toddlers and preschoolers with language disorders and developmental disabilities (Girolametto et al., 1994), adults with aphasia (Kagan et al., 2001) adults with dementia (Ripich et al., 1999) and adults with ABI (Togher et al., 2004).

Difficulties Sustained Post ABI
• Post ABI, individuals may have difficulty engaging in meaningful conversation with others.

Goals of Treatment
• To assist others in successfully facilitating communication with those with moderate to severe ABI

Treatment Strategies
• Short, simple sentences
• Asking patient to repeat messages
• Asking patient to clarify they have understood the information
• Allowing time to answer
• Writing information down
• Reducing distractions
• Making eye contact
• Presenting choices
• Repeating information
• Clarifying intent of message
• Announcing topic/activity change
• Use of a variety of modes in communicating
• Use of nonverbal communication techniques or devices

Treatments

Communication Partners
In a RCT conducted by Togher et al. (2004), a small group of police officers (n=20) were trained to respond to individuals with a traumatic brain injury; the remaining officers who volunteered did not participate in the training. Individuals with ABI called the police department to inquire about regaining their driver’s licenses. Officers in the experimental group received 2 hours of communication strategies training while those in the control group received standard baton and weapons training. Overall, it was noted that those in the experimental group significantly reduced the number of moves (inquiries) required to gain the necessary information from their callers. The experimental group (compared to the control group) following the training sessions spent less time establishing the nature of the service request and more time answering the questions being presented to the officers by those with a ABI.

Behn and colleagues (2012) investigated the effectiveness of a communication-training program aimed at caregivers to help them improve their abilities to engage in conversation with those who had sustained an ABI. Those in the treatment group (n=5) used a number of didactic and performance-based approaches such as modeling, role-playing, feedback and rehearsal to improve their communication skills. Strategies used were both elaborative and collaborative. Results suggest paid caregivers may improve their communication skills, thus allowing individuals to express themselves more easily (Behn et al., 2012).

The reader is encouraged to review the aforementioned studies within Table 7.6 at the end of this module for further details.

Conclusions:

There is Level 2 evidence to support the effectiveness of interventions that focus on training the communication partners of individuals with severe ABI (Togher et al., 2004).

There is Level 2 evidence supporting the training of paid caregivers to allow them to communicate more effectively with those who sustain an ABI; thus allowing those with ABI to improve their communication skills (Behn et al., 2012)
Training of communication partners including paid caregivers may improve the communication efficiency of people with severe ABI.

7.10 Pharmaceutical Treatments

Memory dysfunction following an ABI is a common occurrence. The long term impairment of an ABI affects a person’s ability to return to work, school and it may affect their ability to live alone (Katz et al., 1989).

Difficulties Sustained Post ABI

Following an ABI, many have been found to have: personality changes, memory issues, judgement deficits, a lack of impulse control, and poor concentration.

Goals of Treatment

- To improve verbal reaction times
- To improve the ability to concentrate and focus
- To improve overall executive control
- To improve working memory

Therapies to Treat Cognitive-Communication Disorders post ABI.

Methylphenidate (Ritalin)

Methylphenidate, a medication that has been shown to successfully treat ADHD in children, is being used to treat cognitive impairments in adults post ABI (Kim et al., 2006). Results from an earlier systematic review found that Methylphenidate helped improve memory, attention, learning, concentration and mental processing (Siddall 2005). Recently Cernich et al. (2010) found strong evidence supporting the use of Methylphenidate in the treatment of memory and attention post ABI.

In a double blind placebo controlled study, conducted by Kim et al. (2006) the effects of a single-dose treatment of Methylphenidate on cognitive performance with a focus on the reaction times of working memory was conducted. Prior to treatment both the placebo and treatment groups the reaction times were similar. Post treatment there was significant improvement (p<0.05) in reaction times for the Methylphenidate group. On the working memory tests, the treatment group performed slightly better than the control group. Overall study authors reported the single dose of Methylphenidate did improve cognitive function with the most prominent impact on reaction times.
**Donezepil**

Zhang et al. (2004) conducted a randomized placebo controlled double-blind cross-over trial of 18 post-acute ABI patients which demonstrated that Donezepil significantly increased scores on tasks of sustained attention and short-term memory when compared to placebo and results were sustained after the wash-out period.

**Bromocriptine**

Bromocriptine is a dopaminergic agonist, which primarily affects D2 receptors (Whyte et al., 2008). It has been suggested that dopamine is an important neurotransmitter for prefrontal function (McDowell et al., 1998). In a study looking at the effects of Bromocriptine on rats, Kline et al. (2002) noted that the animals showed improvement in working memory and spatial learning; however, this improvement was not seen in motor abilities. Four studies have been identified investigating the use of Bromocriptine as an adequate treatment for the recovery of cognitive impairments following brain injury.

Bromocriptine is a dopaminergic agonist, which is believed to have an effect on frontal lobe functioning. In a randomized placebo controlled cross over study. Whyte et al. (2008) administered Bromocriptine to a group of individuals. Administration of Bromocriptine was begun at 1.25mg/BID and increased to 5mg/BID. Individuals received the medication for 3 weeks before being titrated off the medication and placed on a placebo. Test results for all subjects indicate Bromocriptine had little significant effect on their abilities to perform on a range of measures of attentional function. It was noted that several participants did experience moderate to severe drug effects and withdrew or were withdrawn from the study. In an earlier study, McDowell et al. (1998) examined the effects of low dose Bromocriptine in a double-blinded, placebo-controlled cross-over design trial. Testing revealed that a low dose of Bromocriptine (2.5 mg/daily) improved functioning on tests of executive control including a dual task, Trailmaking Test, the Stroop test, the Wisconsin Card-Sorting Test and the controlled oral word association test (FAS Test). However, bromocriptine did not significantly influence working memory tasks.

Although the McDowell et al. (1998) study demonstrated benefits following administration of Bromocriptine, there was only a single administration of Bromocriptine or placebo and the dose was considerably lower than that given by Whyte et al. (2008). Spontaneous recovery may have been a factor leading to the improved abilities in individuals receiving a single dose (2.5mg daily) of the medication; however, study results did not answer this question. Results from Whyte et al. (2008) noted that the placebo group demonstrated better (although not significant) trends in improvement on the various tasks administered.
Amantadine
In this RCT completed by Schneider et al. (1999) the effects of Amantadine on cognition and behaviours was assessed. In this study twenty patients were included in the study and each was prescribed Amantadine for 2 weeks. Statistical comparison of results evaluating the five subsets of attention, executive/flexibility, memory, behaviour and orientation did not demonstrate any significant effect for the use of Amantadine.

Citicoline
A study to test the effectiveness of Citicoline in improving the functional and cognitive status of those who had sustain an ABI (mild to severe) was recently undertaken by Zafonte and colleagues (2012). Over twelve hundred individuals were randomized to the Citicoline group or the placebo group. 2000 mg of Citicoline and the placebo was given daily via enteral route. Study results found no significant differences on any of the tools used to measure cognitive improvement. Included in this list are the Trail Making Test (A&B), the Glasgow Outcome Measure-Extended, the controlled oral work association test, the California Verbal Learning Test, the Processing Speed Index, the Digit Span, and the Stroop Test (parts 1&2). Results indicate there were no significant differences between the groups on any of the measures. The citicoline did not help to improve or enhance cognitive functioning post ABI regardless of the severity.

The reader is encouraged to review the aforementioned studies within table 7.7 at the end of this module for further details

Conclusions

The findings of one RCT suggest there some evidence to support the use of Methylphenidate to enhance cognitive function post ABI, although the findings were not significant (Kim et al., 2006).

Based on a single RCT, there is Level 1b evidence that Donepezil improves attention and short-term memory post ABI (Zhang et al., 2004).

Based on a two RCTs there is conflicting evidence supporting the use of Bromocriptine to enhance cognitive functioning (Whyte et al., 2008; McDowell et al., 1998).

There is Level 2 evidence that Amantadine does not help to improve learning and memory deficits based on the conclusions of one study (Schneider et al. 1999).

There is Level 1b evidence that Citicoline does not enhance functional or cognitive functioning in individuals who have sustained a TBI (Zafonte et al., 2012).
Methylphenidate has been found to improve working memory; however further study is needed to support its efficacy.

Donepezil helps to improve attention and short-term memory following brain injury.

Bromocriptine improves some executive cognitive functions such as dual-task performance and motivational deficits, but it does not consistently improve memory. More research is needed before the benefits of using bromocriptine to enhance cognitive functioning are known.

Amantadine may not be an effective treatment to improve learning and memory deficits and executive function following.

Citicoline has not been found to enhance the functional and cognitive functioning in individuals who have sustained an ABI. The administration of the medication for this purpose appears to be under question.
7.11 Conclusions

1. There is Level 2 evidence from one study conducted by Novack et al., (1996) suggesting specific structured training programs are not effective in improving attention post ABI.

2. There is conflicting evidence supporting the use of group-based interventions to treat executive dysfunction post ABI (Novakovic-Agopian et al., 2011; Parente et al., 1999; Ownsworth et al., 2008).

3. Results from several studies indicate there is Level 2 evidence that dual task training has a positive effect on divided attention and is effective on speed of processing (Couillet et al., 2010; Fasotti et al., 2009).

4. There is Level 1b evidence suggesting Attention Process training (APT) improves cognitive function (Sohlberg et al., 2000).

5. Based on the results of an earlier study conducted by Ruff et al. (1994) there is Level 2 evidence supporting the use of computer assisted technology to enhance concentration attention post ABI.

6. Although TEACHware is no longer available, based on this one RCT, there is Level 2 evidence that this computer-based program designed to remediate cognitive-communication skills, improved cognitive and communication outcomes in individuals with ABI (Thomas-Stonell et al., 1994).

7. Based on the results of a study conducted by Watanabe et al., (1998), there is Level 2 evidence suggesting the presence of a calendar did not improve patients’ orientation to time and date.

8. There is Level 2 evidence supporting the use of electronic calendars to assist in improving memory post ABI (McDonald et al., 2011; Bergquist et al., 2009).

9. Results from a study conducted by Grealy et al. (1999) show there is Level 2 evidence suggesting virtual reality exercise programs have a positive impact on learning and working memory.

10. There is Level 2 evidence suggesting memory group interventions can improve everyday memory functioning (Thickpenny-Davis and Barker-Collo, 2007)

11. There is Level 1b evidence from one RCT that cranial electrotherapy stimulation did not help it improve memory and recall following brain injury (Michals et al., 1993).
12. There is Level 2 evidence that internal memory strategies appear to be an effective aid in improving recall performance (Berg et al., 1991; Milders et al., 1995)

13. Potvin et al. (2011) found Level 2 evidence to support the use of visual imagery techniques to improve prospective memory.

14. There is Level 1b evidence, based on a study by Zlotowitz et al. (2010), suggesting that modeling techniques (patient mirroring target) are more effective than hand-over-hand moulding techniques.

15. There is Level 2 evidence from one RCT suggesting the LSVT and TRAD programs work equally well in improving the intelligibility and everyday communication of individuals with non-progressive dysarthria (Wenke et al., 2011).

16. Based on a single RCT by Barreca et al. (2003) there is Level 1b evidence that some patients with head injuries may improve their ability to communicate “yes/No” responses after undergoing consistent training and environmental enrichments.

17. Results of the study conducted by Radice-Neuman et al. (2009) indicate there is Level 1b evidence from one RCT to show that social communication skills training improve communication skills.

18. There is Level 1b evidence from one RCT to suggest interventions designed to improve the ability to recognize emotional prosody were minimally effective (McDonald et al., 2012).

19. There is Level 2 evidence from Dahlberg et al. (2007) to show that pragmatic interventions, including role-playing improve a variety of social communication skills as well as self-concept and self-confidence in social communications.

20. Based on the study conducted by Braden et al (2010) there is Level 2 evidence that conversation group therapy has a beneficial effect on pragmatic and quality of life concerns in ABI patients.

21. There is Level 1b evidence to suggest short-term intensive training benefits gist-reasoning and this generalizes to executive function post TBI (Vas et al., 2011).

22. There is Level 2 evidence from one study to suggest group treatment of problem solving deficits is effective in improving executive function, problem solving self-appraisal and self-appraised emotional self-regulation (Rath et al., 2003).
23. Based on the findings from Chen et al. (2011), there is Level 2 evidence suggesting a goals training group is effective in improving attention and executive control.

24. There is Level 2 evidence suggesting computer assisted cognitive retraining is not more effective than therapist administered memory rehabilitation training in enhancing the memories of individual post brain injury (Dou et al., 2006).

25. There is conflicting evidence supporting the use of group-based interventions to treat executive dysfunction post ABI (Novakovic-Agopian et al., 2011; Ownsworth et al., 2006; Amos 2002; Parente et al., 1999).

26. There is Level 2 evidence based on a single RCT conducted by Levine et al. (2000) that goal management training is effective for improving paper and pencil everyday tasks and meal preparation skills for persons with an ABI.

27. There is Level 2 evidence to support the effectiveness of interventions that focus on training the communication partners of individuals with severe ABI (Togher et al., 2004).

28. There is Level 2 evidence supporting the training of paid caregivers to allow them to communicate more effectively with those who sustain an ABI; thus allowing those with ABI to improve their communication skills (Behn et al., 2012).

29. The findings of one RCT suggest there some evidence to support the use of methylphenidate to enhance cognitive function post ABI, although the findings were not significant (Kim et al., 2006).

30. Based on a single RCT, there is Level 1b evidence that Donepezil improves attention and short-term memory post ABI (Zhang et al., 2004).

31. Based on a two RCTs there is conflicting evidence supporting the use of bromocriptine to enhance cognitive functioning (Whyte et al., 2008; McDowell et al., 1998).

32. There is Level 2 evidence that amantadine does not help to improve learning and memory deficits based on the conclusions of one study (Schneider et al. 1999).

33. There is Level 1b evidence that citicoline does not enhance functional or cognitive functioning in individuals who have sustained a TBI (Zafonte et al., 2012).
### Table 7.1 Treatment to Improve Attention and Concentration Post ABI

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amos (2002) Australia RCT PEDro = 4</td>
<td>N=32 subjects (24 with ABI, eight without) were randomly assigned into three treatment groups: no treatment, external inhibition and increased stimulus salience. All treatment groups were compared to the normal controls. The Wisconsin Card Sorting Test (WCST) was employed to measure preservative error and random error.</td>
<td>There were no significant differences in total errors between groups, but groups differed significantly in total number of trials (p=0.025), perseveration (p=0.033) and categories achieved (p=0.001). Comparisons between the unaided ABI group and the aided ABI groups and between the aided ABI groups and the control group showed that neither aid significantly improved deficits in the ABI population on all measures. Comparisons between the inhibition and salience group revealed significance only for perseveration (p&lt;0.045); the external inhibition group displayed much less.</td>
</tr>
</tbody>
</table>

### Drill and Practice

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novack et al., (1996) USA RCT PEDro = 5</td>
<td>N=44 Individuals suffering from severe TBI, but able to communicate, were provided 30 min. of cognitive remediation five times per week in either a focused hierarchical stimulation program (attention skills) or an unstructured intervention program. The following tests were used to measure change: Wechsler Memory Scale-Revised (WMS-R), the simple and choice reaction time, functional independence, FIM scores pre and post treatment.</td>
<td>Analysis of digit span, mental control sub-tests of WMS-R, simple &amp; choice reaction time, and functional independence revealed no significant differences in attention &amp; function skills, general cognitive abilities, or daily living activities between groups.</td>
</tr>
</tbody>
</table>

### Mindfulness Based Medical Techniques

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study</th>
<th>Methods</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>design/PEDro Score</td>
<td>N=145 Individuals who sustained a TBI were randomly assigned to one of 3 treatment groups: ACT group (n=44), PE group (n=38), Controls (n=48). In total 25 individuals did not complete the treatment. Those in the ACT group received 5-45 min session of supervised practice over a 4 week period; those in the PE group received audio-tape based training, and therapist contact. Control group individuals received no therapist contact. All were assessed pre-post treatment and a 12 months follow-up.</td>
<td>Results showed no significant differences at either of the post-treatment follow-up assessments between the groups. The exception to this was the results of the Cognitive Failure Questionnaire where those in both treatment groups had lower scores following treatment. Overall, ACT training was not found to result in any significant changes or worthwhile changes.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Dual Task Training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author/Year/Country/Study design/PEDro Score</td>
<td>Methods</td>
<td>Outcome</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Couillet et al., (2010) France RCT PEDro = 5</td>
<td>N=12 Each phase of the study consisted of 6 weeks of training. During this time period, participants received four 1-hour training sessions per week. The “A” of the AB/BA design referred to the control training, while the “B” referred to experimental rehabilitation. The control trainings used various cognitive tasks that did not tap on divided attention or working memory. During the experimental phase, patients were given specific dual task training. The object of the experimental phase was to train the participants to perform 2 tasks concurrently. Participants were initially trained to perform each task independently, then simultaneously. Treatment began with simple and automatic tasks building to more complex demanding tasks.</td>
<td>Following treatment, there was a significant improvement in the 2 tasks that targeted divided attention. Those who received the experimental rehab training performed better than the group who received the control training. On the digit span dual-task the BA performed significantly better than the AB group (p&lt;0.02). Experimental training was also found to have a large effect on reaction times and omissions as reported on the divided attention subtest of the TAP (Test Battery for Attentional Performance). The control training lead only to minor changes.</td>
</tr>
<tr>
<td>Fasotti et al., (2000) Netherlands RCT PEDro = 5</td>
<td>N=22 Severe, closed TBI patients with evidence of slowed speed of information processing (assessed by PASAT, ACT, and CRT) randomized into a Time Pressure Management (TPM) treatment group (mean age: 26.1 years; chronicity 9.8 months)</td>
<td>Scores on two of three standardized memory variables and all three attention variables increased significantly in treatment group; No memory variables and 1 of 3 attention variables increased significantly for the control group. Follow-up data for 10 in</td>
</tr>
</tbody>
</table>
Evidence-Based Review of Moderate to Severe Acquired Brain Injury

2013

Module 7 - Cognitive Communication Treatments Post ABI-V9-2013

http://www.abiebr.com

Update August 2013

for 1 hour sessions 3x/week and a concentration training control group (mean age: 30.1 years, chronicity: 8.3 months) for 2-5 hrs/week over 3-4 weeks both using Waterbed (WB) and Harvard Graphics (HG) tasks. Neuropsychological tests and psychosocial questionnaires administered 2 weeks prior, at end, and 6 months following training. the treatment group and 9 of control group: pre-training follow-up showed a significant time effect (p < .05) but no significant group time interaction (p = .23) indicating that there still was a significant improvement after 6 months but that this improvement could not be attributed specifically to the treatment or control group.

Cognitive Rehabilitation Strategies

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sohlberg et al., (2000) USA RCT Pedro = 8</td>
<td>N=14 Those in Condition A (n=7) received 24 hours of attention process training (APT), in 3 one-hour sessions each week for a total of 10 weeks. Attention process training is a cognitive rehab program that has been used to remediate attention deficits following an ABI. Tasks chosen for each subject were specific to his or her needs. Tasks were designed to place increasing demands on complex attentional control and working memory. Those assigned to Condition B (n=7) received a combination of brain injury education, supportive listening and relaxation training. Sessions ran for 10 weeks, one hour per week. All subjects worked directly with a therapist for the length of the study. Following therapy subjects were assessed using various scales (Paced Auditory Serial Addition Task (PASAT), Gordon Diagnostic Vigilance and Distraction, Controlled Oral Word Association Task (COWAT)) and interviews.</td>
<td>Those in the APT group reported significantly more changes following intervention then those in the brain injury education group (p&lt;0.05). The greatest number of changes was reported in attention and memory than in psychosocial functions. Changes in PASAT scores were greater for those who reported more than 2 cognitive changes. Results of the PASAT also found that those with higher levels of vigilance had higher PASAT scores. Those with higher vigilance scores had higher COWAT scores.</td>
</tr>
</tbody>
</table>

Computer Assisted Technology for Attention

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas-Stonell et al., (1994) Canada RCT PEDro = 4</td>
<td>N=12 Patients (6 treatment, 6 control) participated in an individualized 8 week period of a computer-based program called TEACHware of remediating</td>
<td>Significant group differences on several of the standardized test measures with the remediation group performing significantly better than the control group in all cases. The remediation</td>
</tr>
<tr>
<td>Author/Year</td>
<td>N</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>---</td>
<td>-------------</td>
</tr>
<tr>
<td>Gray et al., (1992) UK PEDro=5</td>
<td>N=31</td>
<td>Individuals were randomized to either the treatment group (n=17) or the control group (n=14). The experimental group received micro-computerized attentional retraining and the control group received recreational computing. Working memory function was assessed using the Digit span, backward digit span, PASAT score, longest string, Wisconsin Card Sorting Test. Pre-testing indication only the comprehension score indicated a non-significant difference between the groups. The post-testing, the experimental group showed significant improvement on the WAIS-R picture completing and the PASAT. At the 6th month follow-up, differences between the groups indicated significant improvement on the Backward Digit Span (p=0.007), the WAIS-R arithmetic (p=0.014), information processing rate and the PASAT (p&lt;0.05) and the WAIS-R Block Design (p=0.44). Course improvement was seen in the experimental group during the intervention phase. The control group also showed improvement but this was less strong.</td>
</tr>
<tr>
<td>Ruff et al., (1994) USA RCT PEDro = 3</td>
<td>N=15</td>
<td>Severe head injured subjects between 16 and 50 with GOAT entry score &gt; 70, 6 months post-injury, and a DRS score &gt; 100 were divided into 2 attention and memory training groups – the first (A) received attention followed by memory training, the second (B) vise versa through prototypical exercise modules with variable difficulty levels developed from the THINK-able computer program. Analysis performed on entire sample due to group size. <strong>Attention:</strong> Computer based attention training results in significant improvement (p=0.003) <strong>Memory:</strong> Significant improvement in Memory-II (p=0.021). Gains were significant for Rey Verbal (p=0.004) and Corsi Block Learning (p=0.03) total correct; Patient and observer memory ratings (p=0.04, p&lt;0.001). WMS-part III (p=0.004), and part IV (p=0.013). <strong>Psychometric:</strong> Significant improvements in digital symbol scores (p&lt;0.001).</td>
</tr>
<tr>
<td>Country/Study design/PEDro Score</td>
<td>Methods</td>
<td>Outcomes</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>Watanabe et al., (1998) USA RCT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEDro = 3</td>
<td>N=30 Severe TBI subjects (determined by length of PTA @ acute rehabilitation admittance) consecutively admitted to a BI inpatient unit (16 traumatic, 14 non-traumatic- without aphasia or severe visual deficits) were randomized into treatment (n=14), and control groups (n=16) to determine whether the presence of a calendar affected the score from the Temporal Orientation Test (TOT).</td>
<td>Presence of a calendar did not significantly affect TOT scores.</td>
</tr>
</tbody>
</table>
### 7.4 Verbal Memory and New Learning

#### Individual Studies

**Table 7.2 Treatments to Improve Verbal Memory and New Learning**

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Aids:</strong> Trial and Error Learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powell et al., (2012) USA RCT PEDro=7</td>
<td>N=29 Participants were randomly assigned to one of two groups, the conventional instruction group (trial and error learning, errorful learning) or the systematic instruction. The systematic instruction condition emphasized mastery, while the conventional instruction emphasized exploratory learning, not mastery. Training sessions were implemented using a specific format that paralleled each key element for each instructional condition. PDAs were not allowed to be taken home during the 4-6 weeks. All participants (n=29) received 12 individualized, 45 minute training session, 2-3 times weekly for 4 to 6 weeks.</td>
<td>Pre-tests indicated the groups were equal prior to the introduction of the intervention. Those exposed to the intervention (systematic instruction) performed significantly more (p&lt;0.01) correct tasks at the 30 day assessment. Fluency scores (their ability to follow through with a task) were also found to increase in those in systematic instruction group compared to those in the conventional instruction group. Overall systematic instruction resulted in better skill maintenance and generalization compared to trial and error learning.</td>
</tr>
</tbody>
</table>

| **Cognitive Teletherapy** |         |          |
| Author/Year/Country/Study design/PEDro Score | Methods | Outcomes |
| Bourgeois et al., (2007) USA Quasi-RCT PEDro=2 | N=38 Individuals were quasi-randomized into either the spaced retrieval (SR) group or the didactic strategy instruction (SI) group. Daily memory logs noted areas where the participant was having difficulties and specific goals to work on were selected. 30 minute training sessions were scheduled 4 or 5 per week. Those in the SR treatment group began with a prompt question and a treatment goal. Participants were encouraged to answer the question(s) the same way each time it/they was | The frequency of memory problems decreased in both groups over time. Those in the SR group showed significant improvement in goal mastery (p<0.05) compared to the SI group. This was maintained at the one month post intervention time period. Results on the Cognitive Difficulties Questionnaire (CDS) showed both groups reported having fewer difficulties following treatment. There were no significant differences between the two groups on the CIQ post treatment. Changes in community integration were not noted over time. |
asked. Those in the SI group common memory strategies were discussed. Participants were encouraged to identify problems and then apply a specific strategy to help deal with this problem. Contact with all participants was done over the phone.

## Computer Calendars vs Standard Diary

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDonald et al., (2011) UK RCT PEDro=5</td>
<td>N=12 Participants were randomly assigned to one of two groups (Group A or Group B). All were asked to complete weekly monitoring forms indicating what activities they would like to complete within the next 15 weeks. Those assigned to Group A (the Google calendar group) were shown how to use the calendar to remind them of upcoming activities. They were discouraged from using other reminder strategies during the next 5 weeks. Group B was the standard diary group. At the end of the 5 weeks, group B began using the Google calendar while Group A began using the standard diary.</td>
<td>Overall the use of memory aids assisted individuals in completing tasks as opposed to no memory aids. During the Google Calendar intervention phase, there was 40.6% increase in completing their prospective intention compared to the standard diary phase. Overall 82% of targets were reached using Google calendar but only 55% using the standard diary.</td>
</tr>
<tr>
<td>Bergquist et al., (2009) USA RCT PEDro=5</td>
<td>N=14 Participants were placed in one of two intervention groups: an active calendar acquisition intervention group or the control diary intervention group. Throughout each intervention participants had 30 sessions with a therapist and sessions were completed via the internet using instant messaging. Participants were placed in one of the 2 groups and at the end of the 30 sessions they began “other” condition. During the calendar condition, participants were encouraged to use the on-line calendar to plan events and to remind them of these events. During the diary condition, participants were asked to use their diary to keep track of their day to day events and occurrences. The IM sessions were used to review what (work, There were no significant difference between the two sessions on memory functioning as noted on the neurobehavioral functioning inventory (NFI) (p&gt;0.05). From time 1 to time 2, improvement was found on the compensation techniques questionnaire (CTQ): specifically the notes on calendar (p&lt;0.02) and the use of cue cards (p&lt;0.01). Family members also noted improvement in levels of depression (p&lt;0.02) from time 1 to time 2. Family also felt the patient’s memories had improved.</td>
<td></td>
</tr>
</tbody>
</table>
appointments) was completed during both types of sessions.

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Television Assisted Prompting vs Assistive Technology for Cognition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lemoncello et al., (2011) USA RCT PEDro=5</td>
<td>N=23 Participants were randomly assigned to either the Television Assisted Prompting (TAP) group or the Assistive Technology for Cognition (ATC) group. The TAP system was a set-top box to allow the participant to interact with the system through the television. This system delivers reminders (either text or audio-video) at pre-specified times to participants. The ATC system was individualized to meet the needs of each person.</td>
<td>No significant differences were found between groups A or B; therefore data from the two groups was collapsed. Following this, the TAP group (n=23) had a higher task completion rate compared to their typical practice strategies. The TAP system improved task completion from 43% pre intervention to 72% post intervention.</td>
</tr>
</tbody>
</table>

| **Compensatory Prospective Memory Training vs Self-Awareness Training** |
| Shum et al., (2011) Australia RCT PEDro=7 | N=45 Individuals were assigned to 1 of 4 treatment groups using a restricted randomization with blocking procedure. All interventions involved 8 weekly attendances (1.5hrs each) at an individual therapy session. In total there were 4 programs, with each one compromising 2 weeks' self awareness training or active control plus 6 weeks compensatory prospective memory (PM) training or active control. Programs included: self-awareness compensatory prospective memory training; self-awareness training plus active control; active control plus compensatory prospective memory training; and active control only. | All 4 groups showed no significant differences on the Cambridge Prospective Memory Test (CAMPROMPT) during the pre-intervention phase. Following intervention, those with a self-awareness training component were not significantly different from those without on the change scores. Groups with a compensatory training component were found to have a significantly larger change score than those with out. Overall, the group that received self-awareness and compensatory PM training did not have the largest change score on the CAMPROMPT. An assessment of the number of valid diary entries per week did not differ between the four groups pre interventions. Post intervention the groups with a compensatory training component were found to have larger change scores than those without (p<0.017). |

<p>| <strong>Personal Digital Devices (PDAs)</strong> |</p>
<table>
<thead>
<tr>
<th>Author/Year/Country/Study</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
### Evidence-Based Review of Moderate to Severe Acquired Brain Injury

**2013**

#### Module 7 - Cognitive Communication Treatments Post ABI

**V9 - 2013**

[http://www.abiebr.com](http://www.abiebr.com)

**Update August 2013**

---

<table>
<thead>
<tr>
<th><strong>Author/Year/Country/Study design/PEDro Score</strong></th>
<th><strong>Methods</strong></th>
<th><strong>Outcomes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dowds et al., 2011 USA RCT PEDro=5</strong></td>
<td><strong>N=36</strong> Participants were trained how to use 2 memory aids (a PDA or a paper organizer) to assist them in organizing activities that needed to be completed throughout the week.</td>
<td>When using the PDAs the individuals had a higher task completion rate then when they used paper memory aids. Results also indicated that those using the Palm OS PDA had a higher completion rate than those using the Microsoft pocket PDA.</td>
</tr>
</tbody>
</table>

#### Diary to Improve Memory

<table>
<thead>
<tr>
<th><strong>Author/Year/Country/Study design/PEDro Score</strong></th>
<th><strong>Methods</strong></th>
<th><strong>Outcomes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ownsworth &amp; McFarland (1999) Australia RCT PEDro = 3</strong></td>
<td><strong>N=20</strong> Volunteer subjects with ABI were randomized into a diary only (DS) and a diary &amp; self-instructional training (DSIT) group intervention. The DS group participated in a 6 week “Bottom-Up” approach program that emphasized the development of functional skills using compensation based, on task, specific learning. The DSIT group participated in a 10 week “Top-Down” approach program that emphasized the capacity for self-regulation and self-awareness using “Self Instructional Training.”</td>
<td>All subjects reported significantly fewer problems with memory (p&lt;0.001) and lower levels of distress (p&lt;0.01) during treatment phase when compared to baseline. There was a significant increase in the degree of strategy use during treatment (p&lt;0.05) regardless of type of diary training. There were no significant differences between the DS and DSIT groups (p&gt;0.05).</td>
</tr>
</tbody>
</table>

#### NeuroPaging System

<table>
<thead>
<tr>
<th><strong>Author/Year/Country/Study design/PEDro Score</strong></th>
<th><strong>Methods</strong></th>
<th><strong>Outcomes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wilson et al., (2001) UK RCT PEDro = 4</strong></td>
<td><strong>N=143</strong> A randomized controlled cross-over study of subjects with memory impairments were divided into one of two treatment groups: group A (pager first) and group B (waiting list first). Patients chose their own tasks in which they wanted to be reminded. Outcomes measured included patients’ ability to successfully carry out everyday tasks.</td>
<td>During the last 2 weeks of the 7-week treatment period, the participants using the pager were significantly more successful in achieving target behaviours than the waiting list group (p&lt; 0.001).</td>
</tr>
</tbody>
</table>

#### Virtual Reality

<table>
<thead>
<tr>
<th><strong>Author/Year/Country/Study design/PEDro Score</strong></th>
<th><strong>Methods</strong></th>
<th><strong>Outcomes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grealy et al., (1999)</strong></td>
<td><strong>N=13</strong> Ambulatory TBI subjects with no perceptual disabilities participated in</td>
<td>Intervention group (n=13) performed significantly better than control group</td>
</tr>
</tbody>
</table>
Scotland Non-RCT  | a random allocation crossover study that used non-immersive virtual reality (VR) exercises to test attention, information processing, learning, memory, reaction and movement times. Information for 320 patients was collected and acted as the control for this study. (n=320) on digit symbol (p<0.01), verbal (p>0.01) and visual (p>0.05) learning tasks. Reaction (p<0.01) and movement (p<0.05) times improved significantly after a single VR session.

### Computer Assisted Memory Retraining

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tam and Man (2004) China Non-RCT</td>
<td>N=34 A study of adults with post-head injury amnesia due to closed-head injury was conducted to assess the effectiveness of computer-assisted memory retraining programs. Participants were randomly assigned to one of four treatment groups (matched diagnostically and demographically): (1) self-paced group; (2) feedback group; (3) personalized group; and (4) the visual presentation group. Each group went through one of the four computer-assisted memory re-training strategies. Each participant was involved in 10 sessions, approximately 20-30 minutes in length. The Rivermead Behavioural Memory Test (RBMT) was used to evaluate self-efficacy After intervention, in any one of the four computer-assisted memory programs, patients performed significantly better in memorizing and remembering ‘drilled content’ (p&lt; 0.05). All four memory-training conditions showed a positive trend in the treatment group as compared to the control group although there were no statistical differences between measures.</td>
<td></td>
</tr>
</tbody>
</table>

### Memory Retraining Programs

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickpenny-Davis &amp; Barker-Collo 2007 New Zealand RCT PEDro = 5</td>
<td>N=14 Individuals were randomly assigned to either the treatment group (memory rehab group) or the waitlist control group. Those assigned to the treatment group participated in a memory rehabilitation program. The memory group consisted of 8 learning modules, each 1 hr in length and held 2x a week for 4 weeks. Didactic teaching about memory and memory strategies, small group Overall improvement was seen for the treatment group across the various time periods. When comparing pre-group results on the various memory scales, improvement was seen at time of post group testing and again at follow-up.</td>
<td></td>
</tr>
</tbody>
</table>
activities, discussions, problem solving, practice implementing memory strategies was used. Errorless learning was also used when reviewing materials.

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>O’Neil-Pirozzi et al., (2010) USA Non-RCT</td>
<td>N=98 Individuals were assigned to either the experimental group (n=57) or the control (wait-list group n=41). 12-90 minute sessions, held 2 x weekly for 6 weeks intervention sessions were held. The intervention included memory education and emphasized internal strategy acquisition to improve memory function from encoding, storage and retrieval perspectives. Primary emphasis was placed on semantic association (categorization and clustering), followed by semantic elaboration/chaining and imagery.</td>
<td>Pretesting revealed a significant difference between both groups on the Hopkins verbal learning test-revised (HVLT-R) only. Individuals who had had a severe TBI performed more poorly on the HVLT-R than those with moderate injuries. Although those with a severe injury did not improve as much as those with a mild or moderate injury, they did improve more than those in the control group from week 1 to week 7. Results of the Rivermead Behavioural Memory Test II revealed similar results. Overall memory performance was improved for all those in the experimental group compared to the control group.</td>
</tr>
</tbody>
</table>

### Cranial Electrotherapy Simulation

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michals et al., (1993) USA RCT PEDro = 7</td>
<td>N=24 A double blind, sham controlled trial was performed on a group of individuals who had sustained a BI. The purpose of the treatment was to evaluate the effectiveness of cranial electrotherapy stimulation (CES) on post-traumatic memory impairment. After a four-week study period, memory performance was measured using subtests from the Wechsler Memory Scale-Revised, California Verbal Learning Test, and Recurring Figures Test.</td>
<td>Results revealed that CES stimulation in brain-injured patients did not improve memory or immediate and delayed recall compared with controls. Repeated trial effects showed no significant differences between groups.</td>
</tr>
</tbody>
</table>

### Computer Assisted Training

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dou et al., (2006) Hong Kong, (China) RCT PEDro = 5</td>
<td>N=37 Participants were randomized to 2 memory training programs: the computer assisted memory training group (CAMG) and the therapist administered memory training group</td>
<td>Scores from the NCSE indicate that was a significant increase in the TAMG (p&lt;0.015) and the CAMG (p&lt;0.02) on the memory sub-test of each scale compared to the control group. When looking at the results</td>
</tr>
</tbody>
</table>
Each group received 1 month memory training programs that were similar in content but delivered differently. The control group received no training. Those in the treatment groups received 20 training sessions. Sessions ran for 6 days each week and last approx 45 mins. Post treatment follow up last for one month. Sessions consisted of training a basic component memory skills, in the management of typical daily tasks utilizing/integrating the component memory skills, in customized programs and skill consolidation as well as in the generalization of those skills in practice.

### Internal Aids:
Aids to Improve Verbal Memory and New Learning

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twum and Parente (1994) USA RCT PEDro = 3</td>
<td>N=60 Consecutively referred TBI subjects from Maryland State Dept. of Vocational Rehabilitation (mean age: 21 years) were randomized into four groups: no imagery / verbal labeling; imagery / no verbal labeling; imagery / verbal labeling and a no imagery / no verbal labeling (control). Delayed recall and trials to criterion were measured on the VerPA and VisPA tasks.</td>
<td>MANOVA analysis revealed an overall significant main effect of mental imagery instructions (p &lt; 0.0001) and a main effect of verbal labeling instructions on the VisPA (p &lt; 0.0001).</td>
</tr>
<tr>
<td>Potvin et al., (2011) Canada Non-RCT</td>
<td>N=30 Individuals were assigned to either the experimental group (n=10) or the control group (n=20). Those assigned to the experimental group participating in a 10 prospective memory rehabilitation groups lasting 90 minutes. The Test Ecologique de Memoire Prospective (TEMP) was used to evaluate change in the experimental group.</td>
<td>The experimental group performed significantly better on the TEMP post PM training (p&lt;0.05) than the control group. During the learning phase cued recall improved for those in the experimental group, although this improvement was not found to be significant. Participants who took part in the rehabilitation program improved their performance on the PM experimental task. These changes were seen when performing everyday tasks.</td>
</tr>
</tbody>
</table>

### Errorless Learning and Impact on Memory

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
Tailby & Haslam (2003) Australia Non-RCT

**N=24** TBI subjects with acquired deficits in explicit memory were divided into groups of 8 based on Verbal Memory Index (VMI) score, and matched across groups in terms of age, gender, premorbid and current intellectual functioning. Ninety-six 5-6 letter concrete nouns were used over two sessions to practice 3 learning conditions: errorful, errorless (examiner generated), and errorless (self-generated). Following the learning tasks, memory was tested explicitly and implicitly 5 and 30 minutes after study phase generating 6 scores for each learning condition at both testing times.

Cued recall performance following self-generated errorless learning was significantly better than standard errorless learning conditions (p<0.0001). Level of priming did not differ significantly between groups (p>0.05). Memory performance was significantly better following errorless learning (examiner generated) activity (p<0.0001). Mild and moderate groups performed significantly better than severe group (defined by VMI – p<0.0001)

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tailby &amp; Haslam (2003) Australia Non-RCT</td>
<td>N=24 TBI subjects with acquired deficits in explicit memory were divided into groups of 8 based on Verbal Memory Index (VMI) score, and matched across groups in terms of age, gender, premorbid and current intellectual functioning. Ninety-six 5-6 letter concrete nouns were used over two sessions to practice 3 learning conditions: errorful, errorless (examiner generated), and errorless (self-generated). Following the learning tasks, memory was tested explicitly and implicitly 5 and 30 minutes after study phase generating 6 scores for each learning condition at both testing times.</td>
<td>Cued recall performance following self-generated errorless learning was significantly better than standard errorless learning conditions (p&lt;0.0001). Level of priming did not differ significantly between groups (p&gt;0.05). Memory performance was significantly better following errorless learning (examiner generated) activity (p&lt;0.0001). Mild and moderate groups performed significantly better than severe group (defined by VMI – p&lt;0.0001)</td>
</tr>
</tbody>
</table>

### Using Visual Imagery to Enhance Recall of Names and Faces

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milders et al., (1998) Netherlands Prospective Control</td>
<td>N=26 13 closed-head injury subjects (mean PTA 36 days) and 13 healthy controls matched on age and level of education participated in 8 individual 60-90 minute sessions over four months using exercises with standardized instructions that help make the new name more significant to the learner.</td>
<td>ANOVA (cases vs controls, baseline vs post-training were significant for group (p&lt;0.01), evaluation moment (p&lt;0.001), and interaction (p&lt;0.001). At follow up, only verbal learning scores reached significance (p&lt;0.01).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glisky &amp; Delaney (1996) USA Prospective Control</td>
<td>N=16 TBI patients (mean LOC 10 days) who experienced PTA (mean of 53 days) participated in 3 separate sessions practicing stem completion of 4-7 letter words using cued recall, free recall and recognition.</td>
<td>Priming effect in PTA patients was not significant from the controls (p&gt;0.05), but was significant within the PTA group (p&lt;0.05) – compared to those without prior exposure to word lists. Controls substantially improved their results when given explicit instructions while PTA patients performed equivalently. Control group recalled significantly more words than the PTA group (p&lt;0.01). None of the PTA patients were able to recall any of the list items, made significantly more false alarms (p&lt;0.01).</td>
</tr>
</tbody>
</table>

### Modeling vs Hand over Hand for Learning and Recall

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Zlotowitz et al., 2010
UK
RCT
PEDro=6

Participants were randomly assigned to either the modeling or moulding group. All learned a hand movement sequence (A). During their first learning trial and hand movement (B) during their second. The moulding technique involved a hand over hand technique and the modeling technique had the participant copy the experimenter.

Test on recall occurred twice. The first time was after a short delay and the second time was after a longer delay. No significant differences were seen after the short delay; however, after the longer delay, recall was significantly better after using the modeling technique.

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berg et al., (1991) Netherlands RCT PEDro=5</td>
<td>N=39 Individuals were randomly assigned to either the treatment or control conditions. The strategy rehabilitation group participated in daily homework exercises, 3 times a week for 6 weeks, with each session lasting 1 hour. Training which was individualized was based on the memory problems individuals identified. Group 2, The drill and practice (pseudo-rehab) group participated in sessions consisted of memory tasks and games that were practiced in the lab and at home. The no treatment group were tested on the same time schedule as the trained groups but received no training. Individuals were assessed 4 different times pre and post intervention.</td>
<td>Following training, both groups 1 and 2 reported being happy with training. At the final follow-up (4 months post interventions), the strategy training group performance significantly better on the 3 memory tests (memory sum score, acquisition score, delayed recall score) than those in the other groups.</td>
</tr>
<tr>
<td>Milders et al., (1995) Netherlands Follow-up to Berg et al. (1991)</td>
<td>N=31 of the original 39 subjects participated in a four year follow up of the Berg et al. (1991) RCT that compared Memory Strategy training vs. Drill and Practice vs. no treatment. Follow-up consisted of control tasks, and subjective reports.</td>
<td>Standardized memory sum scores at long-term are significantly lower in the three patient groups than in the normal control group (p&lt;0.05). Drop out effect on follow-up results was significant (p&lt;0.05). The strategy groups 1995 results were significantly lower than in 1991 (p&lt;0.05). Drill &amp; Practice improved significantly (p&lt;0.05), and no training improved but not significantly. The difference between groups at the 4 yr follow-up is no longer significant (p&gt; 0.1).</td>
</tr>
</tbody>
</table>

PEDro = Physiotherapy Evidence Database rating scale score (Moseley et al., 2002).
### 7.5 Verbal Expression and Discourse

#### Individual Studies

**Table 7.3 Treatments Used to Improve Verbal Expression and Discourse Post ABI**

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lee Silverman Voice Treatment (LSVT®)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wenke et al., (2011) Australia RCT PEDro=5</td>
<td>N=26 Participants were randomized to either the LSVT (n=13) or TRAD (n=13) treatment groups. Both treatments were administered for 1 hour each day/4 days per week/4 weeks. Home work assessments were given each day and took about 5-10 minutes to complete. Maintenance exercises were given for the 6 months post interventions.</td>
<td>A comparison of the groups found no significant differences on the ASSIDS, although both group did increase mean percent work intelligibility following treatment. There was a 6% increase in the LSVT group and a 3.5% increase in the TRAD group. Those in the LSVT group also demonstrate a slower speaking rate following the intervention compared to the TRAD (p&lt;0.015). Following treatment, speech in the LSVT group was easier to understand compared to pre-treatment. Although the speech of those in the TRAD group was easier to understand post treatment, the improvement was not found to be statistically significant. Differences between the two groups were also not found to be statistically significant. Even though there were some differences between the two groups on performance, these differences were not statistically significant. Results of the AusTOMs indicate both groups showed improvement following treatment; however, statically significant differences were not found between the groups.</td>
</tr>
</tbody>
</table>

| **Yes/No Training in ABI** |
| Author/Year/Country/Study design/PEDro Score | Methods | Outcomes |
| Barreca et al., (2003) Canada RCT PEDro = 6 | N=13 ABI patients who were unable to provide a consistent yes/no response 80% of the time, were assigned to A or B treatment group. Group A received an enriched stimulus environment, collaborative multi-disciplinary intervention, and additional yes/no No order effect (AB vs BA) (p=.06) but a treatment trend was found (A vs B. p=.07) for treatment over control. Significant increased responsiveness for four patients following treatment A (p<.001). No significant differences in Western Aphasia Battery (WAB) scores |

---

**http://www.abiebr.com**

Update August 2013
| response training. Group B received a standard hospital environment and interventions. | between treatments at admission or 6 months later (p>.05). |

PEDro = Physiotherapy Evidence Database rating scale score (Moseley et al., 2002).
### 7. 6 Social Communication and Pragmatics

#### Individual Studies

**Table 7.4 Treatment to improve Social Communication and Pragmatics Post ABI**

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/ PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radice-Neumann et al., (2009) RCT PEDro=5</td>
<td>N=19 Ten subjects were randomly assigned to receive the facial affect recognition (FAR) intervention, while the remaining 9 received the stories of emotional inference training (SEI). Both groups received 2 pre-tests one week apart. Once completed subjects were subjected to one-on-one session, 3 times each week and 1 hour each session for 2 to 3 weeks. Emotional inference from context, facial and vocal affect and affect recognition were measured. Social emotional behaviour was also measured.</td>
<td>Scores on the evaluation tools used indicated both the FAR and the SEI groups improved from pre-test 1 to the post test. On the DANVA2-AF those in both groups, showed improvement in recognizing facial affect. Subjects in the FAR group achieved a score within normal range after the intervention. Result of the DANVA2-AP showed no significant improvement over time for either group. The EET scores indicated the neither groups improved significantly in their ability to infer emotions from the video presentations. The LEAS results showed the FAR group showed significant improvement in their ability to infer how they would feel in certain situations. The SEI group showed no significant changes. Care givers, indicated those in the FAR group showed improvement significantly in their ability to infer emotions from the video presentations. Caregivers for the SEI groups did not notice any significant changes.</td>
</tr>
<tr>
<td>McDonald et al., (2012) Australia RCT PEDro=6</td>
<td>N=20 Individuals were randomized to either the treatment group (n=10) or the control group (n=10). Treatment group attended 2-hr weekly treatment sessions for 3 wks. Sessions consisted of a therapist and 2 participants. All were tested pre and post intervention (immediately following treatment and one month later). Following the second assessment period, those in the control</td>
<td>No significant effects were noted for those in the treatment group at either the initial posttest assessment or at one month follow-up. Communication competence was not found to improve significantly as a result of treatment. Individually 5 improved on one measure and 1 improved on 3. None in the control group were found to improve on any of the measures used.</td>
</tr>
</tbody>
</table>

---

**http://www.abiebr.com**

Update August 2013
The group were offered treatment. The program was tailored to focus on prosodic cues that may be seen in expressions of emotions. A varied of techniques were used. Awareness of social interference test form B-Part 1 (audio presentation); Prosodic emotion labelling task; and questionnaires completed by participants and family.

### Social Communication Skills Training

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/ PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dahlberg et al., (2007) USA RCT PEDro=6</td>
<td>N=52 Individuals with a moderate to severe ABI were participated in 12 sessions (to improve communication skills) with each session lasting 1.5 hours. The experimental group received treatment while the control group waited 3 months before undergoing treatment. The experimental group worked on social communication skills (listening to others, communicating needs, regulating their emotions during social interactions). Individuals were assessed using a variety of instruments, however, the two primary outcomes were the profile of functional impairment in communication (PFIC), social communication skills questionnaire-adapted (SCKQ-A))</td>
<td>Results of the PFIC rating scale showed a significant improvement (p&lt;0.001) in 7 of the subscales included on the PFIC for the treatment group only. Result of the SCSQ-A also showed significant improvement (p&lt;0.005) for the treatment group compared to the control group, before and after intervention. At the 6th month period, significant improvement was noted between baseline scores and post-treatment scores on the PFIC (21 of the 30 subscales (p&lt;0.012 to p&lt;0.001)). On the self-reported ratings scales, significant improvement was noted on the SCSQ-A (p&lt;0.001). Baseline scores compared to those recorded at 9 mths post interventions, significant improvement could only be seen on 5 of the subscales of the PFIC scale (P&lt;0.034-p&lt;0.001). Significant improvement could also be seen on the self-report ratings and the SCSQ-A (p&lt;0.002).</td>
</tr>
</tbody>
</table>

### Group Treatment

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braden et al., (2010) UK Cohort</td>
<td>N=30 Participants were divided into 1 of 4 groups. For those in groups 1 and 2 treatment was provided at the rehab facility, for those in groups 3 and 4 treatment was provided in the community. A treatment workbook was given to each participant regardless of the group they were assigned to. The workbook was originally developed for</td>
<td>Social communication skills improved significantly pre to post assessment (p&lt;0.05). At the 6 month post treatment assessment significant improvement (p&lt;0.05) was also noted. For those in the TBI plus group (those with a substance disorder, a psychiatric disorder, or other neurological complications) significant improvement was noted on their SCSQ-</td>
</tr>
</tbody>
</table>
“group interactive structured treatment for social competence (GIST)”. Each group member was asked to attend 13 1.5 hr weekly sessions to discuss various topics related to effective communication. To assess the participants’ improvement the following tools were used: the profile of pragmatic impairment in communication (PPIC); social communication skills questionnaire-adapted (SCSQ-A); goal attainment scale; satisfaction with life scale (SWLS); Latrobe communication questionnaire (LCQ); awareness questionnaire (AQ); Participation assessment with recombined tools (PARTS). A, GAS, SWLS scores (p<0.002, p<0.000 and p<0.01 respectively). Of note scores on the PPIC, although improvement was noted, they did not reach significance. Overall improvement was also noted when assessing the gains made during the social skills treatment phase and satisfaction with life. Having a family member or friend involvement with the training did not lead to any significant changes in the results of the PPIC. Overall results suggest that the GIST is beneficial to individuals with a TBI.

PEDro = Physiotherapy Evidence Database rating scale score (Moseley et al., 2002).
7.7 Reasoning and Problem Solving and Executive Function

Individual Studies

Table 7.5 Treatments Designed to Enhance Reasoning, Problem Solving Skills and Executive Function

<table>
<thead>
<tr>
<th>Author/Year/ Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vas et al., (2011) USA RCT PEDro = 6</td>
<td>N=28 Subjects were randomly assigned to 1 of 2 groups: Top down SMART group (exp group) and the information based BWH (control group). A comparison of the benefits of the two groups was conducted. Training was offered for a total of 18 hrs during 12 group sessions over an 8 week period. The first 15 hrs took place over the first 5 week, 10 sessions (2/week). The remaining 2 sessions took place over the remaining 3 weeks (booster sessions). Each SMART session covered various topics which were discussed by participants. Homework assignments were also given to prepare participants for the next session. BHW sessions were designed to be information based sessions covering everything from brain anatomy to health life style and cognitive changes. Reading assignments were also given each week. Pre, Post and Post testing was conducted (3 weeks prior to session beginning, 3 weeks following sessions completing and 6 months post session completion). The examiner was blinded to the group each participant was assigned to.</td>
<td>Following treatment, results indicate that those in the SMART group showed significant improvement on GIST reasoning (p=0.03) on the community integration questionnaire (CIQ) (p=0.02) and the working memory (listening span task) (p&lt;0.001) compared to the BWH group. Pretraining scores were similar for the groups. Those in the SMART group showed significant improvement on 3 executive functions following training (inhibition, nonverbal reasoning, and cognitive flexibility). Overall SMART was found to enhance gist reasoning, of which the benefits were seen in other domains (listening span and increased participation). Six months later the benefits were still evident.</td>
</tr>
<tr>
<td>Chen et al., (2011) USA RCT PEDro=5</td>
<td>N=12 Participants were randomly assigned to 1 of 2 groups and at the end of the 5 th week they began the alternative intervention. Two interventions were used: goals training and education. The goals training protocol was based on a goal management training intervention. Participants attending 10 2 hrs</td>
<td>On the domain of attention and executive functions, all (n=12) in goals training showed an increase from pre to post goals training while only 7 of 12 showed an increase from pre to post education. Performance scores increased significantly after the goals training sessions compared to the education sessions. For the group that began in the education session,</td>
</tr>
</tbody>
</table>
sessions of group based training, 3 individual 1hr training sessions and 20 hrs of home practice over 5 weeks. The education program was a 5 week didactic educational instruction regarding brain injury.

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
USA
RCT
PEDro = 2 | N=46 Subjects with mild to severe TBI (mean age: 43.6 yrs; mean chronicity: 48.2 mths) with a higher level of functioning were randomized into two groups, the first of which received 1 individualized 2 hr session / week for 24 weeks of a group treatment protocol (emotional self-regulation strategies, problem solving skills) and the second a conventional neuropsychological rehabilitation program. Treatment group showed significant improvement in problem-solving (WCST, PSI, PSQ) and emotional self-regulation (PSQ), objective observer ratings of role-play scenarios (PSRPT), visual memory (immediate recall- WMS III: p < 0.001), self-esteem (RSES: p< 0.05), fewer perseverative responses (WCST: p< 0.05), gains in PSI total score (p = 0.005), PSQ Clear Thinking and Self-Regulation (p = 0.01 and p< 0.05), and PSRPT (p< 0.005). |

## Group Therapy

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Novakovic-Agopian et al., (2011)
USA
quasi RCT
PEDro = 5 | N=16 Participants were assigned to one of two groups (the goals-edu n=8 or the edu-goals group n=8). The goals training (goals-edu) group started with goal orientated attentional self-regulation, while the educational instruction (edu-goals) group began with brain health sessions. Each group ran for 5 weeks, at which time the goals-edu group began the edu-goals training and vise versa. All participants were assessed at baseline, week 5 and again at week 10. The goals-edu sessions consisted of 10 - 2hour sessions of group training, 3 individual 1 hour training sessions and 20 hours of home practice over 5 weeks. Results of the first 5 weeks of training, showed those in the goals-edu group showed significant improvement (p<0.0001) on the Attention and Executive Function summary domain and the memory domain (p=0.006), while those in the edu-goals group showed no change or minimal change. Following the change in groups, those in the edu-goals group, once they completed the goals training session showed significant improvement on the Attention and Executive Function Domain (p<0.0001). Those in the goals-edu group who had completed the training session were able to maintain their gains. Following the completion of the goals training sessions all showed a decrease in task failures on complex functional tasks. |

| Ownsworth et al.,
(2008)
Australia
RCT
PEDro = 9 | N=31 subjects with an ABI were randomly assigned to 1 of 3 groups and each group had a weekly 3 hour session for 8 weeks. Group 1: group based support, Group 2: individual occupation support, Group 3: combined group and individual support interventions. The following measures were used to evaluate |

Data was analyzed over three time periods (pre, post and follow-up). When looking at the results of the pre-assessment data for each intervention group, no significant differences were noted on any of the measures: COPD, PCRS, BR-CRO and level of goal attainment (p>0.05). |

Looking at the satisfaction self ratings...
participants: Canadian Occupational Performance Measure (COPD); Patient Competency Rating Scale (PCRS); Brain Injury Community Rehab Outcome (BR-CRO 39); level of goal attainment was the primary outcome assessed.

between pre and post assessment, an improvement was noted after each intervention (individual p<0.001; group p<0.025; combined p<0.01). Results indicated that at follow-up an improvement in self-rated satisfaction was noted for the group and combined interventions only (p<0.01).

Results from the CPOM indicate that there was no significant difference between the group intervention pre to post comparison (p<0.028). A significant improvement was noted for the individual and combined interventions (p<0.01 and p<0.025 respectively) pre-post testing.

Pre assessment and follow-up assessment for the relatives’ ratings of performance was significant for all three interventions (individual p<0.01; group p<0.01; combined p<0.025). Relatives’ ratings of satisfaction (pre and post) found a significant improvement for the individual (p<0.025) and combined (p<0.01) interventions but not for the group intervention (p<0.117). Pre to post assessment found an improvement for the combined intervention (p<0.025) but not for the other two. A look at the psychosocial outcomes for each intervention group showed few significant differences. Gains made pre to post assessment were not maintained at follow-up; however, gains not significant at post assessment were significant at follow-up.

### Goal Management Training

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levine et al., (2000) CanadaUK RCT PEDro=4</td>
<td>N=30 Subjects with moderate to severe ABI as indicated by GCS and PTA were randomized into Goal Management Training (derived from Duncan’s theory of goal neglect on disorganized behaviour following TBI) and a Motor Skills Training groups.</td>
<td>Although both groups improved, GMT was associated with significant gains on everyday paper-and-pencil tasks designed by the authors to mimic problematic tasks for patients with goal neglect (p&lt;0.05).</td>
</tr>
</tbody>
</table>

PEDro = Physiotherapy Evidence Database rating scale score (Moseley et al., 2002).
7.10 Training Communication Partners

Individual Studies

Table 7.6 Training Communication Partners

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Togher et al., (2004) Australia RCT-cross over design PEDro=5</td>
<td><strong>N=20</strong> Intervention focused on the communication partners of people with ABI and educating them about normal discourse patterns. 20 police officers were assigned to one of 2 groups (training or control). Those in the training group were provided with a 6-week training program. Pre- and post-training communications with individuals with ABI during a telephone service inquiry were transcribed and analyzed using generic structure potential analysis.</td>
<td>The trained communication partners interacted significantly differently (p&lt;0.05) with people with severe ABI when compared to an untrained control group. Partner training resulted in more efficient and focused interactions, and fewer episodes of unrelated utterances by the people with ABI. Trained communication partners were able to use strategies such as providing appropriate feedback and support during service encounter interactions, which enabled people with ABI to respond in an appropriate manner.</td>
</tr>
<tr>
<td>Behn et al., (2012) UK/Australia RCT PEDro=6</td>
<td><strong>N=10</strong> Paid care givers (n=5) were randomly assigned to a programme on how to facilitate better conversations with individuals who had had a TBI. The control group (n=5) was not trained. Those in the treatment group participated in in a range of collaboration and elaboration conversational strategies. Collaborative strategies were designed to encourage those with a TBI to participate more in conversations; to become active participants in the conversation. Strategies were designed to introduce topics of interest to the individual with the TBI and to encourage them to make comments thus encouraging a 2 way dialogue.</td>
<td>Study results found paid care givers were able to benefit from training; all were able to improve their communication skills with those who had sustained a brain injury. These finding were noted immediately following training and again at the 6th month follow-up. Trained care givers also found they experienced greater levels of burden and described negative aspects of caring often then those who were not in the paid group.</td>
</tr>
</tbody>
</table>

PEDro = Physiotherapy Evidence Database rating scale score (Moseley et al., 2002).
## 7.11 Pharmaceutical Treatments

### Individual Studies

#### Table 7.7 Pharmaceutical Therapies to Enhance Cognitive-Communication Skills

<table>
<thead>
<tr>
<th>Author/Year/Country/Study design/PEDro Score</th>
<th>Methods</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methylphenidate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kim et al., (2006) Korea RCT PEDro = 6</td>
<td>N=18</td>
<td>Improvements in response accuracy were demonstrated in favour of the treatment group although not to a level of statistical significance.</td>
</tr>
<tr>
<td><strong>Donezepil</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zhang et al., (2004) USA RCT PEDro = 7</td>
<td>N=18</td>
<td>Group A (donepezil phase) showed significant improvement over group B (placebo phase) on immediate auditory (p=0.002) and visual memory (p&lt;0.001) measures of WMS-III and PASAT (p&lt;0.001) at wk 10. Increased scores in Group A were continued following washout. Group B improved following donepezil phase (wk 24)-- but inter-group comparisons were not significant (audio: p=0.588; visual: p=0.397, PASAT presentation rates p=0.545, 0.12, 0.783, 0.410) due to Group A’s sustained high scores.</td>
</tr>
<tr>
<td><strong>Bromocriptine</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whyte et al., (2008) USA RCT PEDro=7</td>
<td>N=12</td>
<td>It was noted that several participants did experience moderate to severe drug effects and withdrew or were withdrawn from the study. Test results for all subjects indicate bromocriptine had little significant effect on their abilities to perform on a range of measures of attentional function.</td>
</tr>
</tbody>
</table>

---

**Table 7.7 Pharmaceutical Therapies to Enhance Cognitive-Communication Skills**

- **Methylphenidate**
  - **Kim et al., (2006) Korea RCT PEDro = 6**
    - N=18
    - Double-blind placebo-controlled trial of subjects with TBI. The participants were randomly divided into one of two treatment groups: (1) single-dose (20mg) of methylphenidate; or (2) placebo. Outcome measured using visuospatial attention tasks.
    - Outcome measured using visuospatial attention tasks.

- **Donezepil**
  - **Zhang et al., (2004) USA RCT PEDro = 7**
    - N=18
    - Individuals with a history of TBI of any severity with attention or short-term memory impairments as shown by WMS III, and PASAT were randomly assigned to treatment group A (received donepezil orally for 10 weeks, followed by a 4 week washout period, followed by 10 weeks of a placebo) and group B (opposite order as group A). Outcomes measured at baseline, wk 10 and wk 24. There were no statistical differences between groups at baseline.
    - Group A (donepezil phase) showed significant improvement over group B (placebo phase) on immediate auditory (p=0.002) and visual memory (p<0.001) measures of WMS-III and PASAT (p<0.001) at wk 10. Increased scores in Group A were continued following washout. Group B improved following donepezil phase (wk 24)-- but inter-group comparisons were not significant (audio: p=0.588; visual: p=0.397, PASAT presentation rates p=0.545, 0.12, 0.783, 0.410) due to Group A’s sustained high scores.

- **Bromocriptine**
  - **Whyte et al., (2008) USA RCT PEDro=7**
    - N=12
    - Bromocriptine or placebo was administered for 4 weeks, (starting dose was 1.25 mg/BID, final dose was 5 mg/BID). Medication was increased every 2 days until the dose reached 5 mg BID. During week 4 the medication was tapered until it was eliminated. Once this phase was complete the group was put on the placebo. The placebo group then became the bromocriptine group. Study continued
    - It was noted that several participants did experience moderate to severe drug effects and withdrew or were withdrawn from the study. Test results for all subjects indicate bromocriptine had little significant effect on their abilities to perform on a range of measures of attentional function.
Evidence-Based Review of Moderate to Severe Acquired Brain Injury

Module 7 - Cognitive Communication Treatments Post ABI

McDowell et al., (1998)  USA RCT PEDro = 4

N = 24 Subjects suffering a TBI (closed or open) with loss of consciousness (GCS < 8). Patients randomized into treatment (Bromocriptine 2.5 mg) and placebo groups. Measures required prefrontal cortex function (working memory, executive control) and were administered using a laptop computer (except trail making and control task). Testing took place 90 minutes after pill administration.

Central executive testing: following drug treatment there were significant improvements on dual task counting (p = 0.028), dual task digit span (p = 0.016), trail making test (p = 0.013), Stroop Interference Test (p = 0.05), FAS Test (p = 0.02), Wisconsin Card Sorting (p = 0.041). The treatment drug had no significant effects on working memory tasks (p = 0.978), or control tests (p = 0.095).

Amantadine

Schneider et al., (1999)  USA RCT PEDro = 5

N = 20 TBI rehabilitation subjects randomly assigned to treatment and placebo groups to test the effectiveness of amantadine on cognitive and behavioural rehabilitation.

Although there was a general trend towards improvement, results did not reach significance when treatment and placebo groups were compared using ANOVA and regression analysis (p = 0.732).

Citocline

Zafonte et al., (2012)  USA RCT PEDro = 8

N = 1213 Individuals who had sustained a TBI (Mild to Severe) were recruited for the study. Participants were randomly assigned to the treatment group, receiving 200 mg/day of citocline or a placebo. All were placed on the medication for 90 days.

At the 90 day evaluation, no differences were found between the two groups. Results from the GOS-E showed equal improvement in both groups. Results from the remaining test also showed similar levels of improvement between the groups. Overall, Citocline was not found to be more effective in improving function and cognitive status than the placebo regardless of level of injury (mild to severe).

PEDro = Physiotherapy Evidence Database rating scale score (Moseley et al., 2002).
7.12 References


Google Calendar: http://www.google.com/calendar


McDonald S, Togher L, Tate R, Randall R, English T, Gowland A. A randomised controlled trial evaluating a brief intervention for deficits in recognising emotional prosody following severe ABI. Neuropsychol Rehabil 2012.


Michals ML, Crismon ML, Misko JS, Childs A. A double-blind, sham-controlled evaluation of cranial electrotherapy stimulation in posttraumatic memory impairment. J Head Trauma Rehabil 1993; 8: 77-86.


