

Knowledge translation in ABI rehabilitation: A model for consolidating and applying the evidence for cognitive-communication interventions

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Abstract

Primary objectives: (1) To propose a model for consolidating and disseminating existing evidence relevant to cognitive-communication interventions after ABI. (2) To present the Cognitive-Communication Intervention Review Framework (CCIRF). (3) To outline future considerations for applying evidence to clinical practice.

Research design: Employment of a model for knowledge translation.

Methods and procedures: Application of evidence requires synthesis and dissemination of information in an accessible format for end users. A literature search identified 20 systematic reviews (1997–2007) with a complex array of 72 practice recommendations relevant to cognitive-communication interventions. The CCIRF was used to synthesize the evidence within 11 intervention categories. Reviews were analysed according to: organization, population, intervention, comparison and outcome, with a focus on communication outcomes.

Main outcomes and results: Consolidated evidence revealed support for interventions relating to: social communication, behavioural regulation, verbal formulation, attention, external memory aids, executive functions and communication partner training. Research gaps were noted in the areas of comprehension (auditory/reading), written expression and vocational communication interventions. Similar recommendations emerge across reviews.

Conclusions: Implementation of the growing body of evidence for cognitive-communication interventions is challenged by variability in study populations, interventions, and research focus on communication. The CCIRF provides a means of promoting consistency in knowledge translation and application.

Keywords: Communication, cognitive-communication, speech-language pathology, speech-language therapy, speech therapy, communication therapy, intervention, treatment evidence, efficacy, evidence based practice, knowledge translation, knowledge transfer

Overview

As evidence builds in the field of acquired brain injury (ABI) rehabilitation, there exists the potential for this knowledge to translate to improved outcomes and quality of life for individuals living with ABI. However, unless this knowledge is disseminated and implemented, these benefits will not be realized. Constructing an evidence base for clinical practice involves a number of key steps including: A search for individual studies, evaluation of evidence,

generation of clinical recommendations and, finally, analysis and consolidation of findings into a format that is accessible to the end user [1–5]. Considerable attention has been paid to the first steps in this process; however, gaps continue to exist with regard to the critical final steps in constructing a clinical evidence base [6–10]. This paper focuses on the last step in the process: analysis and consolidation of the evidence into a format for end users, i.e. knowledge translation and application.

Large scale reviews of intervention studies for ABI rehabilitation have concluded that there is substantial evidence to support rehabilitation, including interventions for communication and communication-related disorders [11–13]. Now it is time to move beyond the general question of whether communication interventions work and to examine the specific factors that optimize clinical outcomes [11, 13, 14]. To do so, clinicians must analyse the specific population, intervention and outcome characteristics within evidence reviews in order to translate this evidence to clinical practice.

The challenges of translating evidence for cognitive-communication interventions

Translation of evidence for communication interventions after ABI proves to be particularly challenging due to the heterogeneity of the population, inconsistent use of terminology, wide variety of communication conditions and outcomes and a general lack of a specific focus on communication within current reviews [15, 16]. Communication deficits are among the most debilitating and complex consequences of an ABI and communication interventions warrant specific attention [15–28].

Communication deficits vary with respect to type of injury, severity, neurological presentation, cognitive and communication profiles. Additionally, studies vary in terms of aetiology. Some studies include only participants with traumatic brain injuries (TBI) caused by external force to the head (i.e. motor vehicle crashes, falls, assaults). Other select subjects from the broader category of acquired brain injuries (ABI) or non-congenital, non-progressive brain injuries of both traumatic and non-traumatic origins (i.e. meningitis, encephalitis, anoxia). Some include stroke and some do not. An added complexity is that reviews vary in their description of communication status and communication outcomes. Thus, consistency in terminology and population descriptions is required.

Cognitive-communication disorders

Cognitive communication disorders (CCD's) are the most prevalent group of communication disorders after ABI, with a reported incidence as high as 80–100% [21, 29, 30], although estimates vary as a function of severity, acuity and assessment measures. The term CCD's term was initially defined by the American Speech and Hearing Association (ASHA) in 1987 [31] and there has been growing consensus in the use of this term internationally [15, 16, 19, 20, 25, 26]. ASHA's definition of

CCD's, developed through an expert consensus panel, is as follows:

Cognitive-communication disorders encompass difficulty with any aspect of communication that is affected by disruption of cognition. Communication includes listening, speaking, gesturing, reading and writing in all domains of language (phonologic, morphologic, syntactic, semantic and pragmatic). Cognition includes cognitive processes and systems (e.g. attention, memory, organization, executive functions). Areas of function affected by cognitive impairments include behavioural self-regulation, social interaction, activities of daily living, learning and academic performance and vocational performance ([32] p. 2).

CCD's are unique from motor speech and specific language impairments as they result from generalized cognitive and self-regulatory disturbance [17, 33–38]. CCD's have the greatest impact on communication at the level of discourse and social exchange as opposed to speech sounds and words [24, 39–43]. CCD's can have a negative impact across the continuum of recovery. Impaired communication can affect the rehabilitation process, social re-integration, community independence, family interactions, successful employment and academic success [15–18, 34–37, 43–46]. Interventions that address cognitive-communication disorders can help to improve outcomes and quality-of-life [12, 13, 18, 47, 48].

Research has identified the following cognitive-communication disorders among individuals with ABI: impoverished, vague, tangential or disorganized discourse (oral or written) [49–51] impaired comprehension in the presence of length, complexity, detail, indirect content (implied, abstract, figurative, humorous), background noise, multiple speakers, rapid presentation or rapid shifts from topic to topic [52, 53]; word finding problems particularly in conversation or generative contexts [54, 55], pragmatic or social communication difficulties including problems related to initiation, turn taking, topic management, conversational repair, self-monitoring, social perception and adapting to the needs of the conversational partner and context [17, 56–58] and difficulties using language or communication to assist memory and new learning [59]. Thus, the main focus of intervention is on maximizing functional communication, including improving the understanding and competence of communication partners, in contexts that are most relevant to the individual with ABI. Recently, improved consistency in approach and terminology for cognitive-communication evidence-based practice research has been emerging in the publications of the Evidence Based Practice Committee of the Academy of Neurological

Communication Disorders (ANCDs), in conjunction with the American Hearing Association (ASHA) [23, 26, 60–62].

Further challenges: Determining ‘best evidence’

The next challenge in reviewing the evidence for cognitive-communication interventions is to determine what constitutes ‘best evidence’. With well over 300 studies of communication interventions after ABI [11] there is a sizeable body of evidence to review. Systematic reviews (SR’s) and meta-analyses are a helpful resource for end users as they evaluate multiple individual studies according to explicit procedures and recommend practice standards, guidelines and options according to pre-defined criteria based on levels of evidence [5]. Despite the compelling evidence these reviews can provide, there is still much for the end user to consider when interpreting their recommendations [14, 63]. This study identified over 72 practice recommendations in an initial analysis of systematic reviews relevant to CCD’s and noted significant variance among SR’s with respect to scope, inclusion and exclusion criteria, key search terms and ratings of the evidence. Some SR’s reviewed a broad range of multidisciplinary interventions across the rehabilitation continuum whereas others reviewed specific types of interventions. Some included only randomized controlled trials while others included studies with single subject designs. Outcome measures varied markedly with over 90 indicators of outcome reported in one SR [64]. SR’s also varied considerably in their inclusion of participant cognitive and communication profiles. These varied approaches call for an ‘evidence road map’ to assist end users in integrating and applying the evidence. Thus, this paper presents a model for the exploration, integration and clinical application of evidence relating to cognitive-communication interventions.

Purpose of the study

This paper has four objectives:

- (1) To provide a model for analysing the full scope of cognitive-communication interventions following ABI.
- (2) To consolidate the existing evidence for cognitive and communication interventions available in systematic reviews and meta-analyses for the purpose of translation to clinical practice in cognitive-communication interventions.

- (3) To provide clinicians with a set of factors to consider when weighing the evidence for cognitive-communication interventions.
- (4) To provide recommendations for future research and knowledge uptake; the translation of evidence into clinical practice.

The purpose of the study was not to conduct a new systematic review but rather to provide a comprehensive model for extracting, from existing reviews, knowledge that can be applied to cognitive-communication interventions. Currently there are no systematic reviews specific to cognitive-communication interventions published in the peer-reviewed literature. This paper is an attempt to direct clinicians to the best evidence currently available regarding both communication and cognitive interventions that have some relevance to cognitive-communication interventions after ABI. It is hoped that the proposed framework and process for knowledge translation will prompt further discussion and research to address gaps in the literature.

Method

Defining the search terms

The first step in searching for evidence relating to cognitive-communication interventions was to define a set of key search terms. This was important as cognitive-communication interventions encompass a wide variety of treatment domains and approaches with a vast array of terminology that has been used inconsistently among researchers and reviewers. Many reviews either do not include communication among their key search terms or they use terms limited to one particular aspect of communication (i.e. ‘speech’ and ‘language’). Significant limitations in evidence-based reviews can occur when a limited set of key words are utilized in the initial search for evidence. Therefore, a critical first step is to identify keywords, synonyms, and related terms, based on the conceptual framework underlying the research question [65]

To meet the need for consistency in consolidation and translation of the evidence, the Cognitive-Communication Intervention Review Framework (CCIRF) was developed. The CCIRF framework identifies 11 *intervention categories* as well as *associated key words* to be used in the evidence search. These were based on a review of the literature in cognitive-communication assessment and treatment, position statements and practice guidelines within the field of speech-language pathology [31, 32, 66, 67] and the PsycBITE database [68]. This study also utilized an expert panel review including four

speech-language pathologists with expertise in cognitive-communication intervention and research who reviewed the terms. The CCIRF is presented in Table I. The key words were then used in the literature search which will be described below.

Search strategy

A search for all systematic reviews pertaining to communication and cognitive interventions in ABI published between 1997–2007 was then conducted using the following search engines: Medline, PubMed, Scholars Portal, Google Scholar. As it is possible to miss publications in specific speech-language pathology journals when a single search engine is used, the authors also conducted manual, table-of-contents searches of specific speech-language pathology journals.

Five online resources were also used for the search. First, PsycBITE (www.psycBITE.com) is a web resource designed by researchers in Australia which lists over 1298 intervention studies in the field of ABI by subject area [11]. Secondly, the website of the Academy of Neurological Communication Disorders (ANCDs) (www.ancds.org) [69] summarizes all of the systematic reviews and meta-analyses conducted by its evidence-based practice committee, as described by Golper et al. [5]. Next, the American Speech and Hearing Association's website (www.asha.org) [70] lists systematic reviews related to communication interventions. Next, a Canadian review of acquired brain injury interventions is entitled the Acquired Brain Injury Evidence Based Review (www.abiebr.com) [71] and their website summarizes the systematic reviews of that group. Finally, the website for the Cochrane Collaboration (www.cochrane.org) [72], an international not-for-profit organization which promotes the accessibility of systematic reviews of the effects of health care interventions, was searched for communication-related interventions. Many of the systematic reviews posted on these websites are published in peer reviewed journals, whereas others are in various stages of submission.

Inclusion and exclusion criteria. This study included systematic reviews relevant to cognitive-communication interventions from these websites whether they were published in peer reviewed journals or not. The rationale for inclusion of some of these non-peer reviewed systematic reviews was 3-fold: (1) There were few relevant SR's to include at this early stage of EBP and it was felt that analysis of contrasting approaches to SR's would be illuminating; (2) Some of the SR's published online may ultimately be published in peer reviewed journals; and (3) Third party payer decisions to fund or not

fund interventions are sometimes based on on-line SR's that have not yet undergone peer review scrutiny.

Systematic reviews were included if they met the following inclusion criteria:

- Focused on ABI or TBI in the population description;
- Systematically reviewed intervention studies (any age group or severity level); and
- Included interventions relating to any of the key words in the Cognitive-Communication Intervention Review Framework (CCIRF).

Exclusion criteria were studies that were:

- Not systematic reviews;
- Did not include ABI or TBI in the population description;
- Were not available in the English language;
- Were published outside of the study period 1997–2007,
- Included interventions that did not relate to the communication key words listed in the CCRIF (i.e. ADL interventions, driving interventions, etc.); and
- Were focused on pharmaceutical interventions.

Four reviewers, speech-language pathologists with relevant expertise (i.e. familiarity with evidence-based practice in cognitive-communication interventions following ABI) were asked to review the reviews for a determination of inclusion/exclusion, review the CCIRF framework and add missing reviews. There was 100% inter-rater reliability with regard to inclusion/exclusion. All reviewers also read each paper included in the reviews. Key findings and recommendations from each of the systematic reviews were summarized under the main intervention headings established in the CCIRF. Practice standards, guidelines and options were noted where available.

Consolidation of findings into an accessible format

To ensure all of the considerations previously discussed were addressed, the systematic reviews were summarized according to the following parameters: Organization; Population; Intervention; Comparison; Outcome. This is an expanded version of the commonly used PICO format for framing evidence review questions that was proposed by Sackett et al. [1] and is recommended by ASHA [73]. The initial 'O' is added here and represents the Organization of the SR, including the focus or scope of the topic (e.g. community reintegration, cognition) and whether there was expert panel review. Population characteristics such as number of subjects, aetiology and age of the participants were noted.

Table I. Cognitive-communication intervention review framework (CCIRF).

Type of intervention	Definition	Key words
<i>Communication interventions</i>		
1. Social communication	Treatments that target discourse, pragmatics, conversation, social communication, non-verbal communications (eye contact, facial expression, proxemics or personal space, gesture) social perception (theory of mind, listener's perspective etc.). Interventions which target self-regulation or regulation of communication behaviours.	• Discourse • Pragmatics • Social communication/ Social cognition • Social perception • Listener perspective • Theory of mind • Self-regulation
2. Verbal expression	Treatments that target verbal expression, word retrieval, word finding, vocabulary, language expression, syntax or sentence formulation.	• Word finding • Word retrieval • Naming • Language formulation • Verbal expression • Sentence formulation
3. Auditory or listening comprehension	Interventions for auditory comprehension, auditory processing or understanding of spoken messages, receptive language. Studies that involve comprehension of specific types of messages (i.e. humour, inferencing, figurative language, multiple meaning words).	• Auditory comprehension • Listening comprehension • Receptive language • Auditory processing • Inferencing • Figurative language
4. Reading comprehension	Interventions for reading, oral reading, reading comprehension, interpretation of text.	• Reading comprehension • Visual processing • Oral reading
5. Written expression	Interventions targeting written expression, written formulation, spelling, functional writing of messages, note-taking or alternative means of writing messages.	• Written expression • Written discourse • Written formulation
<i>Cognitive interventions to improve communication</i>		
6. Attention	Interventions targeting attention in order to improve aspects of communication such as listening, focusing on group discussions, reading, etc.	• Attention • Speed of information processing • Multi-tasking
7. Memory	Interventions that focus on use of external memory aids. Studies that focus on internal memory strategies.	• Memory • Remembering • Recall/Retention • New Learning
8. Organization, Reasoning, Problem-Solving, Executive Functions/ Metacognition & Self-regulation	Interventions that target organization, reasoning, problem-solving, executive functions, metacognition or self-regulation in order to improve communication performance.	• Organization • Reasoning • Problem-solving • Executive Functions • Meta-cognitive • Self-regulation
<i>Communication interventions at the level of participation</i>		
9. Community & Family Communications	Provision of strategies to significant others or communication partners in order to enhance communications.	• Community reintegration • Community communications • Family interaction • Partner training
10. Academic and School Supports	Studies targeting academic and school performance (language, new learning, academic communications), including interventions focusing on the supports provided by educational staff.	• Academic • School • Study strategies
11. Vocational Communications	Studies targeting communications for work, including interventions focused on the supports provided by work place staff.	• Vocational communications • Employment • Return to work

Interventions were summarized by listing the key search terms or intervention categories as described in the SR. Comparison referred to inclusion/exclusion criteria and the number of studies reviewed

and whether a meta-analysis was conducted. Finally, the SR's were analysed with regard to outcome measures, particularly inclusion of communication evaluations as an outcome measure and whether

outcomes were analysed in terms of Impairment/Activity Limitations or Participation Restrictions [74].

Results

Twenty systematic reviews published between 1997–2007 were identified, each involving participants with ABI that included interventions related to communication or cognition as defined in the CCRIF [12, 13, 34, 60, 61, 64, 75–88]. Two of the reviews, initially reviewed on the ANCDs website prior to 2007, were later published in peer reviewed journals in 2008. One systematic review, published in a book chapter [86], was identified as it was described in another review. The decision to include this review was based on the fact that it met the inclusion criteria, was specific to social communication interventions for ABI and could inform clinical practice. The 20 systematic reviews are summarized in Table II.

Overall findings

Organization and scope of reviews.

- Only two of the reviews had communication interventions as a primary focus. This is a reflection of the literature at its current state of evolution. The Struchen [86] review focused specifically on social communication and reviewed 19 social communication intervention studies. The review by Welch-West et al. [88] analysed communication interventions broadly without inclusion of cognitive interventions and included a total of 20 studies. The main focus of the remaining 18 reviews is as follows: multi-disciplinary cognitive rehabilitation (five reviews); paediatric interventions (three reviews); community re-integration (one review); attention (two reviews); instructional techniques (two reviews); memory (two reviews) behavioural interventions (two reviews); and meta-cognitive and executive functions (one review). Systematic reviews are required that include studies with communication measures to evaluate their outcomes. However, as one awaits further reviews specific to cognitive-communication interventions it is both reasonable and important to turn to systematic reviews for cognitive interventions and communication interventions to inform clinical practice and as a basis for further investigation.
- The systematic reviews varied in terms of expert review which is believed to be an important consideration and one which has a direct impact on the quality and merit of the review. Fourteen of the systematic reviews had undergone peer review

for publication in scientific journals at the time of writing, whereas five [79–81, 83, 87, 88] were available online and one in a book chapter [86]. Only nine of the studies indicated that they utilized an expert review process to advise on the review format, key word search terms, definitions, diagnostic categories, intervention categories or ratings for outcome measures. For example, the reviews of the Academy of Neurological Communication Disorders (ANCDs) evidence-based practice committee were conducted by teams of three-to-eight speech-language pathologists at the doctorate level who are experts in the field of cognitive-communication disorders and also benefited from the expertise of external review panels [34, 60, 61, 84, 85]. The use of an expert review panel acknowledges that clinical expertise is required for interpretation of clinical indicators, measurement of current status and analysis of outcome [5]. Although end users such as clinicians and researchers will likely make the distinction between reviews that have undergone peer review and expert panel review and those that have not, funding sources may not be so discerning. The hope here is that knowledge translation will evolve to a point where end users make such distinctions and where intervention will be guided by SR's of the highest quality (i.e. expert panel review, defined terms for search strategy, meta analysis, peer review).

- Only three of the reviews included a meta-analysis to measure treatment effects across studies: the review of executive functioning by Kennedy et al. [61], the review of attention interventions by Park and Engles [82] and the review of memory interventions by Kessels and DeHaan [77]. Factors such as inclusion of meta-analysis and/or expert panel involvement should be taken into consideration when weighing the evidence.

Participant or population characteristics.

Participant characteristics varied among reviews in terms of medical diagnosis (ABI, TBI, stroke), time post-injury, severity and age (paediatric vs adult), as can be seen in Table II. Few of the systematic reviews listed communication features as part of their analysis of study participants. Although cognitive status of research participants is usually detailed, it is less common (although desirable) for communication profiles such as comprehension and discourse performance measures to be included in participant descriptors. The systematic reviews conducted by the Academy of Neurological Communication Disorders (ANCDs) present an increased level of specificity with regard to the description of baseline and post-intervention

Table II. Analysis of systematic reviews relevant to ABI communication interventions using OPICO.

	Systematic review (Authors, Year, Country; Organization)	Organization (Scope; External expert review panel)	Population • Aetiology • Age • Severity • Total # subjects	Interventions (key words or intervention categories identified by the authors of the study)	Comparison methodology (# studies that met inclusion criteria)	Outcome measures • Were outcomes analysed in terms of impairment/ activity/participation? • Were communication outcomes analysed specifically? (Communication)
1	Carney et al. (1999); USA	Cognitive rehabilitation	• TBI • Adult • All severities • <i>n</i> = 137	Attention Memory & Learning Thinking/Mental Organization Affect & Expression, Executive Functions Key questions 1. Effectiveness of early inter- vention 2. Referral of children with TBI to special education 3. Effectiveness of special edu- cation for children with TBI 4. Effect of developmental phase on prediction and outcome 5. Effect of support for families.	32	• Impairment/activity/participation: Yes • Communication: No
2	Carney et al. (1999); USA	Paediatric rehabilitation	• TBI • Child & adolescent • <i>n</i> = not stated	Key questions 1. Effectiveness of early inter- vention 2. Referral of children with TBI to special education 3. Effectiveness of special edu- cation for children with TBI 4. Effect of developmental phase on prediction and outcome	88 # studies for each key question 1. 1 2. 15 3. 8 4. 61 5. 3	• Impairment/Activity/ Participation: Yes • Communication: No
3	Cicerone et al. (2000); USA; BISIG-ACRM*	Cognitive rehabilitation	• TBI & Stroke • Adult • All severities • <i>n</i> = not stated	5. Effect of support for families. • Cognition • Language • Visual perception • Executive functions & problem solving	171	• Impairment/Activity/ Participation: Yes • Communication: Yes (for Language section)
4	Cicerone et al. (2005); USA; BISIG-ACRM*	Cognitive rehabilitation	• TBI & Stroke • Adult • All Severities • <i>n</i> = not stated	• Attention • Visual Perception • Apraxia • Language & Communication • Memory • Executive Functioning • Problem Solving & Awareness • Comprehensive or Holistic Cognitive Rehabilitation	87	• Impairment/Activity/ Participation: Yes • Communication: Yes (for Language & Communication section)
5	Ehlhardt et al. (2008)*; USA; ANCDs * initially posted on	Instructional techniques for those with Memory impairments	• Acquired memory impairment as primary diagnosis • Multiple aetiologies	• DX (brain injury, head trauma, dementia, schizophrenia, amnesia, • TX (memory, instruction, errorless learning, spaced	51 38 ABI 7 Dementia 6 Schizophrenia	• Impairment/Activity/ Participation: Yes Outcomes were classified in terms of: ◦ Immediate outcomes

the ANCDs
website < 2007

- Ecological validity
- Generalization & Maintenance
- Communication: No

6	Kennedy et al. (2008)*; ANCDs * initially published on the ANCDs website in 2007	Interventions for executive functions, problem-solving, planning, organization & multitasking	✓	• TBI, ABI • Adults and Children • $n = 268$	retrieval, expanded rehearsal, distributed practice, vanishing cues, trial & error, errorful learning, discovery learning, standard anticipation, backward & forward chaining, memory, cognitive, executive function, computer assisted remediation). • Disability (executive functions, metacognition, awareness, self-awareness, planning, problem-solving, self-monitoring, self-control, strategies, self-instruction, self-regulation, goals metamemory, reasoning). Intervention (intervention, treatment, compensation, therapy, remediation, training). • Memory rehabilitation techniques: errorless learning; the method of vanishing cues	15 Meta-analysis	• Impairment/Activity/Participation: Yes • Communication: Yes (for some studies)
7	Kessels and de Haan (2003); Netherlands	Memory	–	• ABI (+ a variety of aetiologies, schizophrenia, dementia, etc.) • Adults • $n = 215$		27 Meta-analysis Included: original memory intervention studies, with control task or control group & sufficient data to calculate effect sizes	Impairment/Activity/Participation: No Communication: No
8	Laatsch et al. (2007); USA	Pediatric rehabilitation	–	• ABI • All severities • Children & Youth • Aged 0–19 • $n = 366$	• Comprehensive Treatment • Attention/Memory • Speech-Language • Academic • Behavioural Treatment	28 Class I, 1; II, 2; III, 1; IV, 4	Impairment/Activity/Participation: No Communication: Yes
9	Lippert et al. (2007); Canada; ABIEBR	Community reintegration	–	• ABI • Moderate–severe • Adults • $n = 4368$	• Independence & Social • Reintegration • Caregiver Burden • Life Satisfaction • Productivity • Return to Driving	54	• Impairment/Activity/Participation: Yes • Communication: No
10	Marshall et al. (2007); Canada; ABIEBR	Cognition	–	• ABI • Moderate–severe • Adult • $n = 2502$	• Attention, Concentration & Processing Speed • Learning & Memory • Executive Functions • General Cognition (Pharmacological studies included)	92	• Impairment/Activity/Participation: No • Communication: No

(continued)

Table II. Continued.

	Systematic review (Authors, Year, Country; Organization)	Organization (Scope; External expert review panel)	Population • Aetiology • Age • Severity • Total # subjects	Interventions (key words or intervention categories identified by the authors of the study)	Comparison methodology (# studies that met inclusion criteria)	Outcome measures • Were outcomes analysed in terms of impairment/ activity/participation? • Were communication outcomes analysed spe- cifically? (Communication)
11	McCormick et al. (2007); Canada; ABIEBR	Paediatric	• ABI • Moderate-severe • Children & Youth • Age range not specifically stated but studies included subjects up to age 19 • $n = 742$	• Acute Interventions • Behavioural • Cognitive • Communication • Family Supported Interventions • Community-based • Social Reintegration • Pharmacological • Motor Rehabilitation • Mild Head Injury • Articles that evaluated the effectiveness of intervention for attentional disorders, specifi- cally treatments that involved practice performing either cog- nitive exercises or specific skills that critically require attention. • Key words: Attention, percep- tion, cognition, neuropsychol- ogy, rehabilitation, retraining, remediation. • Studies qualifying for inclusion had to have at least one quanti- tative outcome measure and results had to have sufficient detail for effect size estimates to be computed.	42	• Impairment/Activity/ Participation: No • Communication: Yes (for Communication section)
12	Park and Ingles (2001); Canada	Attention	• ABI & stroke • (57% TBI; 13% stroke; 30% other ABI) • Adults • $n = 359$	• Articles that evaluated the effectiveness of intervention for attentional disorders, specifi- cally treatments that involved practice performing either cog- nitive exercises or specific skills that critically require attention. • Key words: Attention, percep- tion, cognition, neuropsychol- ogy, rehabilitation, retraining, remediation. • Studies qualifying for inclusion had to have at least one quanti- tative outcome measure and results had to have sufficient detail for effect size estimates to be computed.	30 studies Meta-analysis 26 = direct retraining of attention 4 = specific skills studies	• Impairment/Activity/ Participation: No • Communication: No • Outcomes = psychometric tests primarily. A few studies measured partic- ipant rating of mood using depression & anx- iety inventories. Subjective ratings of attention by participant and observers were used on some.
13	Rees et al. (2007); Canada; ABIEBR	Behaviour	• ABI • Moderate-severe • Adults • $n =$ not stated	• Pharmacological • Behaviour Management • Specific Behavioural • Multi-interventional • Music Therapy	17 studies related to Behaviour Management (non- pharmacological)	• Impairment/Activity/ Participation: No • Communication: No

14	Sohlberg et al. (2003); USA; ANCDs	Attention	✓	• TBI • Adult • All Severities • <i>n</i> = 208 total	Key words • Attention • Remediation • Rehabilitation • Training • Brain Injury • Closed head injury • Direct Instruction • Strategy based instruction • Spaced retrieval • Errorless learning	9	• Impairment/Activity/ Participation: Yes • Communication: No
15	Sohlberg et al. (2005); USA; ANCDs	Instructional techniques	–	• Reviewed instruction studies of several populations, special education, dementia, schizophrenia, ABI • Reviewed TBI literature • <i>n</i> = not stated • ABI • All ages • All severities • <i>n</i> = 267 • Majority of participants were adult males in chronic stage post-injury	Special Education 180 studies TBI 30 studies	• Impairment/Activity/ Participation: No • Communication: Yes	
16	Sohlberg et al. (2007)	Memory: External Aids	✓	Memory notebook (9) Neuropage (1) Key words • Traumatic brain injury • Closed head injury • Acquired brain injury • Memory • Intervention/therapy/remediation/rehabilitation	19	Impairment/Activity/ Participation: Yes Outcomes analysed: • Laboratory based measures • Performance on structured tasks • AX of everyday memory performance. • Performance on tasks cued by the aid • Frequency of use of external aids • Participant preference Communication: No	
17	Struchan (2005); USA	Social communication	–	• Traumatic brain injury • Social communication • Modelling, role-playing, feedback, self-monitoring, behavioural rehearsal, social reinforcement.	19	13 = case series, single subject 6 = group (1 RCT)	• Impairment/Activity/ Participation: Yes • Communication: Yes
18	Turner-Stokes et al. (2005); UK; Cochrane	Multi-disciplinary rehabilitation	–	• ABI • Adults aged 16–65 • <i>n</i> = not stated	14	RCT's Quasi Randomized and Quasi Experimental Designs providing they met predefined criteria.	• Impairment/Activity/ Participation: No • Communication: No

(continued)

Table II. Continued.

Systematic review (Authors, Year, Country; Organization)	Organization (Scope; External expert review panel)	Population	Interventions (key words or intervention categories identified by the authors of the study)	Comparison methodology (# studies that met inclusion criteria)	Outcome measures
19 Welch West et al. (2007); Canada; ABIEBR	Communication	• Aetiology • Age • Severity • Total # subjects	• Communication • Speech • Telephone Use • Dysarthria • Yes/No Response • Coma • Computer Based • Augmentative • Communication Partner Training • Social Communication • Motor Aprosodia • Group treatment • Differential reinforcement of Alternative Vocalization	20	• Were outcomes analysed in terms of impairment/activity/participation? • Were communication outcomes analysed specifically? (Communication) • Impairment/Activity/Participation: No • Communication: Yes
20 Ylvisaker et al. (2007); USA; ANCDS	Behavioural & Social Interventions	• TBI • All severities • Adults & Children • 172 experimental participants	• Traditional contingency Management • Positive Behavioural Supports • Combined approaches	65	• Impairment/Activity/Participation: Yes • Outcomes analysed in terms of dependent variables, reliability, results, maintenance, transfer and social validity. • Communication Outcomes: Yes • Communication outcomes were not specifically analysed; however, aspects of social functioning were analysed under the social validity heading.

BISIG-ACRM, Brain Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine; ANCDS, Academy of Neurological Communication Disorders; ABIEBR, Acquired Brain Injury Evidence Based Review; Cochrane, The Cochrane Collaboration.

✓/External expert review process described in the paper; – External expert review process not described.

communication status of study participants. In order for speech-language pathologists to apply evidence to treatment of individuals, they will need to be provided with clear descriptions of the communication profiles of study participants.

Levels of evidence.

- The reviews also varied with regard to the level of evidence included; One out of 20 systematic reviews of cognitive and communication interventions limited inclusion to randomized control trials or quasi randomized experimental designs; five of the 20 included primarily group studies; and 14/20 included all types of research design, including single-subject design. There was general agreement across systematic reviews that RCT studies are few in ABI research. This observation is consistent across all areas of rehabilitation as evidenced by Perdices et al.'s [11] review of 1298 ABI intervention studies wherein the largest proportion of studies were single-subject design (39%), followed by case series (22%), randomized control trials (21%), non-randomized control trials (11%) and systematic reviews (7%). Among the difficulties identified with RCT's were: heterogeneity of the ABI population requiring individualized treatment approaches; averaged group results masking individual treatment effects; ethical and practical obstacles to randomization and establishment of control conditions; and the need for measurement of real life or contextually-based outcomes that are more challenging to measure than clinic-based measures or standardize tests [85, 86]. A compelling rationale for inclusion of single-subject design studies was provided in many systematic reviews [34, 76, 85]. Single-subject design studies can be made more rigorous by including multiple baselines across subjects and behaviours, randomization of the order of active treatment phases and effect sizes [11, 89]. A well-designed single-subject experiment offers the best evidence that an intervention has worked for an individual patient and can be used to support a similar intervention for patients who closely resemble the studied patient [27]. Furthermore, single-subject design may be the most appropriate design to investigate interventions in earlier phases to build support for proceeding to group trials [89]. In conclusion, research designs other than RCT's, such as case series and single-subject design may be better suited to the challenges of evaluating the complexities of ABI intervention.
- Some well-designed RCT's have emerged to support social communication interventions [18, 48], yes/no communication intervention in coma or minimally responsive states [90],

communication partner training [47] and family-focused interventions [91] for individuals with ABI.

Outcome measures.

There was a consistent call across the reviews to report measurement of outcomes in daily functioning. Ten of the 20 included some analysis of outcome in terms of impairment, activity and/or participation measures and these were primarily the ANCDS reviews. Communication outcomes were not initially specified in ABI intervention research; however, there has been an increased focus on communication outcomes in recent systematic reviews. Nine out of 20 SR's presented outcomes specific to communication. Future evidence-based practice research will be most relevant to clinical practice in speech-language pathology if it provides: (i) analysis of communication outcomes; (ii) analysis of outcomes at the level of activity and participation in the real world and (iii) consistency in outcome markers to better equate the effects of interventions across studies [34, 51, 60, 61, 64, 82, 85, 86].

Evidence for cognitive and communication interventions

All 20 systematic reviews provided evidence to support the effectiveness of a variety of communication and cognitive interventions. To date the research of cognitive and communication interventions appears to be in parallel rather than integrated. That is, there are communication intervention studies demonstrating improved communication functioning and cognitive intervention studies demonstrating improved cognitive functioning, but there has not yet been a systematic review to demonstrate the relative impact of interventions for one on the other.

In the next section the results of each of the reviews will be analysed according to the previously described Cognitive-Communication Intervention Review Framework in an attempt to determine which types of cognitive-communication interventions work for which types of participants under what conditions, and for what functional, real-life outcomes.

Social communication and behavioural/self-regulation. Social communication interventions following ABI have taken many forms, as indicated in the key word list in Table I. The approach to social communication interventions is evolving with increased awareness of the impact of frontal lobe impairment on social competence including: impulsivity, initiation, disinhibition, social imperceptions

and impaired ability to learn from consequences [17–19, 27, 28, 34]. Initial efforts to improve social communication applied a social skills training approach (SST). According to Ylvisaker et al. ([27], p. 261) the SST approach, ‘assumed that the identified individuals: lacked knowledge of relevant social rules; were motivated to change their social behaviour and possessed the capacity to transfer skills acquired in a decontextualized training setting to varied real world environments’. For those with ABI, the problem is not a lack of social skills knowledge but rather with self-regulation, self-awareness and social perception. Instead of focusing on training of social skills knowledge, current practice tends to focus on training of self-control strategies and opportunities for guided communication practice in the real world [27, 28, 36–38].

There were eight systematic reviews that presented evidence and recommendations related to interventions for social communication. Only one review had a primary focus on social communication [86]. One review summarized communication interventions in general [88], one focused on paediatric interventions [90], three focused on cognitive interventions [12, 13, 80] and two focused on behavioural interventions [34, 83].

Carney et al. [64, 75] conducted two of the earliest systematic reviews in 1999, examining a total of 32 cognitive intervention studies for adults [64] and 88 cognitive intervention studies for children [75]. Neither of these studies addressed social communication specifically. However, the review of adult interventions concluded that, based on two randomized controlled trials and one observational study, there was evidence to support specific forms of cognitive rehabilitation to reduce memory failures and anxiety and improve self-concept and interpersonal relationships for persons with TBI. The authors recommended improved operational definition, consistency in describing interventions and functional outcome measures to further evidence research.

Cicerone et al. [12, 13] analysed aspects of social communication interventions within two multidisciplinary reviews of cognitive rehabilitation conducted by the Brain Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine. The first review in 2001 [12] examined 171 studies of cognitive interventions including ‘language’ interventions and their 2005 review [13] examined an additional 81 studies including ‘language and communication interventions’. These reviews classified the evidence according to pre-defined criteria and formulated practice standards, guidelines and options according to a set of decision rules. All practice recommendations were reviewed by the expert panel to ensure consensus.

The 2005 review recommended, as a practice standard, specific interventions for functional communication deficits including pragmatic conversation skills [13].

Welch-West et al. [88] review focused specifically on communication interventions and included 20 studies. This was part of a larger Canadian evidence review called the Evidence Review of Acquired Brain Injury (ERABI). The ERABI reviewed interventions for moderate-to-severe ABI and two reviewers rated the evidence according to pre-defined criteria. This communication review was presented online and had not had the benefit of peer review for publication or expert panel review to advise on search key terms. The communication module included 20 intervention studies. The key search terms focused predominantly on motor speech and augmentative communication for individuals with minimal verbal output. The review identified five studies relating to social communication interventions and, based on these, concluded that training in social skills, social communication or pragmatics is effective in improving communication following brain injury. McCormick et al. [81] conducted a review of paediatric interventions as part of the ERABI review and concluded that pragmatic skills training may help to improve communication in children, but more research is required.

The review by Struchen [86] focused more specifically on social communication interventions for adults with TBI and identified 19 studies that met inclusion criteria. Struchen reviewed the methodological weaknesses among the various studies, pointing out that only one of 19 provided Class 1 evidence from an RCT; while five of 19 were non-RCT group studies and 13/19 were case series including single-subject design. Struchen concluded that social communication interventions could be considered evidence-based, but advised that more caution is required before formulating practice recommendations with these data. Behavioural interventions are included in this section due to the integral nature of behavioural self-regulation and social communication [27]. Cognitive, social and behavioural dimensions of disability are within the scope of speech-language pathology practice as a result of their impact on communicative competence [27, 33, 34]. The evidence from three systematic reviews of behavioural interventions indicates that socially unsuccessful behaviours can be decreased in a variety of types of interventions. Based on a review of 65 studies with 171 participants, Cicerone et al. [12] concluded that there was sufficient evidence to recommend behavioural intervention in general for both children and adults as a practice guideline in both the acute and post-acute stages of recovery. Rees et al. [83] conducted a review of behavioural

interventions as part of the ERABI evidence reviews and concluded that there was sufficient evidence to support the use of antecedent management, feedback or consequences, anger management and social skills training to reduce undesirable or aggressive behaviours. Ylvisaker et al.'s [34] review of 65 studies including 172 participants (adults and children) concluded that behavioural interventions should be considered a practice guideline. The review revealed an increasing trend toward the positive behavioural supports approach which focuses on control of antecedents, positive daily routines and increased choice and control and positive communications. However, there was not sufficient evidence to recommend one form of behavioural intervention over another. Maintenance and transfer of positive communication behaviours to real world communications appears to require a treatment focus on self-regulation [34].

Finally, an important area of social communication intervention that has received inadequate attention is social perception. Individuals with ABI have been found to be significantly impaired in terms of the ability to read social cues accurately and conduct social problem-solving [38, 48]. There is now at least one well controlled RCT investigating intervention methods for social perception [48]. Use of a consistent framework such as the CCIRF may result in increased consideration of previously ignored areas of social communication intervention.

Overall the evidence supports the use of social communication interventions; however, it indicates that more evidence is required to recommend specific forms of social communication intervention [12, 13, 34, 86, 88]. Evidence to date suggests that social communication interventions are most likely to be effective when they are: individualized, contextualized, involve practice in real world communications, focus on self regulation or meta-cognitive approaches and incorporate provision of natural feedback, videotaping self-monitoring. An RCT by Dahlberg et al. [18], published since these systematic reviews, utilized similar techniques and adds further support to these approaches to social communication [69].

Verbal expression. Verbal expression interventions include treatments that target word retrieval, vocabulary, language expression or sentence formulation. Interventions of this type have been widely studied in a number of populations. Three systematic reviews were identified that included review of language expression interventions for ABI [12, 13, 78]. The reviews by Cicerone et al. [12, 13] reviewed language interventions for adults, after ABI, including stroke. The 2000 review concluded that there

was sufficient evidence from two well-controlled prospective (Class I) studies to support the use of intervention for language formulation following TBI. The 2005 review analysed sufficient evidence to recommend as a practice standard 'cognitive-linguistic therapies' during acute and post-acute rehabilitation for persons with language deficits due to left hemisphere stroke. Interventions for specific language impairments such as language formulation difficulties after TBI were recommended as a practice guideline. Specifically, Cicerone et al. concluded there is evidence supporting the use of cueing techniques and semantic analysis to improve naming ability by people with aphasia and TBI (traumatic brain injury). However, there was no evidence to indicate that one method is more effective than another [13]. Laatsch et al. [78] conducted a systematic review of paediatric interventions which reviewed 28 studies involving a total of 366 participants. Although their review revealed Class II–IV paediatric studies that showed positive trends toward effectiveness of language and pragmatic interventions, there was insufficient evidence to form practice standards or guidelines.

Overall there is general support for interventions to assist verbal expression or language formulation after ABI in adults. Further research is required to delineate the most effective methods from a range of language formulation and word retrieval techniques. Although there was insufficient evidence to form practice guidelines for children with ABI, there is a well established body of evidence for language interventions among children with a variety of aetiologies [92]. Also, there is an established body of evidence for language interventions for adults with aphasia or language deficits due to stroke [12, 13, 93–95]. Converging evidence in the aphasia and ABI literature suggests that 'active ingredients' in language interventions include individualized goal-setting, context-sensitive intervention, opportunities for practice in daily communications and communication partner training [18, 34, 47, 61, 84, 86, 91, 94–97]. These would be reasonable components to language intervention as one awaits more definitive studies providing evidence to support specific techniques for individuals with ABI.

Auditory comprehension and information processing. Auditory comprehension was an area of intervention that was significantly under-represented in the systematic reviews for ABI. None of the reviews discussed studies of auditory comprehension or information processing from the perspective of language comprehension. As will be discussed in future sections, there are several reviews that approached information processing, but from the

perspective of attention and memory interventions. Until research is available for the ABI population, clinicians will need to infer from research of auditory comprehension interventions for other populations such as stroke or learning disability. It is possible that comprehension interventions have not been reviewed separately, but rather incorporated within interventions targeting improved activity or participation level communications. For example, interventions directed at improving social communication, academic success or vocational success may have focused on aspects of comprehension or as part of a global set of treatment goals (i.e. understanding telephone conversations; comprehension of the language of instruction; following directions at work, etc.). Evaluation of intervention techniques for auditory comprehension and information processing after ABI is an important area for future research.

Reading comprehension. Two systematic reviews provided recommendations specific to interventions for reading comprehension after ABI. The review by Cicerone et al. [12] analysed evidence from two well-controlled prospective (Class 1) studies to support the use of intervention for specific areas of language impairment including reading comprehension after TBI to form a practice guideline. Their review in 2005 [13], which added to the earlier evidence, also formulated a practice guideline for interventions for specific language impairments such as reading comprehension after left hemisphere stroke or TBI. As with the other areas of cognitive-communication intervention, the evidence for reading comprehension treatment is broadly supportive but requires more specific details for practicing clinicians. Recommendations for specific reading interventions after ABI, including reading interventions for primary school students, reading interventions for the college curriculum and reading assistance for vocational purposes, would be beneficial.

While awaiting more specific recommendations for those with ABI, clinicians may turn to evidence from similar populations. It may be that cognitive (i.e. attention deficits; visual scanning deficits) or communication factors (vocabulary deficits) are more important than factors relating to aetiology (ABI, learning disability, cerebral palsy, etc.). A systematic review that reviews trends across reading interventions for a number of populations could be more beneficial than a narrow focus on reading evidence for the ABI population alone. For example, a review of the National Reading Panel [98] in the US identified 205 experimental studies of reading comprehension instruction, yielding 16 kinds of

effective procedures, several of which are supported by firm scientific evidence. Validated strategies included the following: comprehension monitoring, co-operative learning, graphic and semantic organizers, story structure and story maps, question answering, question generation and summarizing. The panel emphasized the importance of active involvement of learners, natural learning or reading contexts and flexible use of a number of strategies integrated into the curriculum. Additional research is required to investigate beneficial components of interventions for reading comprehension after ABI.

Written expression. Current systematic reviews of ABI interventions tend not to identify a specific category for interventions relating to written expression. Key search terms specific to written expression or written formulation need to be utilized in order for reviewers to capture these studies. The two reviews by Cicerone et al. [12, 13] were the only reviews that provided recommendations relating to specific language interventions; however, they did not specifically describe written expression. Until reviews of written expression interventions for ABI are available, clinicians would benefit from reviewing the evidence from similar populations. Glang et al. [45] summarized evidence from over 36 studies, including the results of a meta analysis, that support the use of self-regulated strategy development and use of advance organizers to assist individuals with written expression and other learning needs. These findings may promote additional analysis of written expression interventions for those with ABI.

Attention. Although the relationship between attention deficits and communication impairment is well understood clinically, the impact of attention interventions on communication after ABI has yet to be explored scientifically. A first step in understanding the potential effects of attention training on communication is to review the evidence for attention training as a whole. To this end, interventions for attention were evaluated in two systematic reviews that focused specifically on attention [60, 82], as well as three general reviews of cognitive rehabilitation [12, 13, 80]. Park and Ingles' [82] 2001 review included a meta analysis to measure the efficacy of attention interventions across 30 studies with a total of 359 participants. They concluded that there was not strong evidence for attention training through repetitive drill exercises. There was some support for the specific skill approach that focuses on training of specific skills of functional significance (i.e. driving). The systematic review by Sohlberg et al. [60] considered the findings of Park and Ingles and then reviewed an additional nine studies of interventions

for attention involving 208 participants. This review also attempted to sort through the heterogeneity within the studies by analysing nine participant characteristics; six intervention characteristics, two outcome characteristics and three aspects of study design. They concluded that direct attention training could be considered a practice guideline for use with individuals in the post-acute stage who are mildly injured and have intact vigilance. Further they advised that direct attention training is best provided in an individualized manner in conjunction with meta-cognitive training (feedback, self-monitoring, strategy training, self-reflective logs and anticipation/prediction activities).

The main themes emerging from these reviews are that intervention for attention is best begun in the post-acute stage of intervention, utilizing an individualized approach, within contextualized or functional tasks, with inherent training of strategies or meta-cognitive approaches, varying levels of complexity, and with measurement of functional, generalizable outcomes. Computer training for attention, particularly without clinician support or functional targets, appears not to be supported by the reviews.

Although none of the reviews of attention training explored the impact of attention interventions on communication specifically, these themes provide a good basis for future research of the impact of attention remediation on communication. These reviews indicate that attention is best trained in the context of functional, complex tasks that required regulation of attention. Communication is a functional complex task. A reasonable approach based on these reviews could be to train attention using meta-cognitive strategies and to utilize functional communication indicators as outcome measures (i.e. eye contact, conversational response times and note taking accuracy). Future research exploring the impact of cognitive interventions on functional communication would be beneficial.

Memory and new learning. There were three systematic reviews of memory interventions after ABI [76, 77, 84]. In addition, memory interventions were reviewed as part of three broad reviews of cognitive interventions [12, 13, 80]. Sohlberg et al. [85], as part of the ANCDs evidence-based practice reviews, conducted a systematic review of 19 studies relating to use of external memory aids and concluded that there was sufficient evidence to recommend external memory aid use as a practice guideline. Marshall et al. [80], as part of the ERABI project, conducted a systematic review of cognitive interventions and identified 26 studies involving the use of external memory aids. Nineteen of these 26 studies reported

improvements in everyday memory functioning (fewer memory problems on self-report, increased success in achieving their self-selected target behaviours, successful task achievement, decreased human prompts required, increased recall of goals, improved task completion, increased homework completion, increased arrivals to appointments, fewer reminders and self-report of improvements). These reviews did not analyse the impact of compensatory memory strategies on communication. However, the practice of utilizing external memory aids to facilitate recall of appointments, homework completion and recall of daily events has considerable relevance to cognitive-communication intervention both in terms of promoting recall of current events and new information for social communication and in terms of attendance at therapy and generalization and maintenance of communication targets. These findings support current cognitive-communication intervention practices such as the use of day planners or electronic devices.

Another area of memory intervention relevant to cognitive-communication treatment is instructional practices. Clinicians from all disciplines can benefit from learning how to present new information or strategies in a manner that facilitates recall and their adoption within the individual's daily routines. Kessels and de Haan [77] conducted a meta analysis of 27 studies to examine the effects of errorless learning and vanishing cues methods in memory rehabilitation. A large and statistically significant effect size was demonstrated for errorless learning treatment, but no significant effect size for the vanishing cues method. This support for the errorless learning method prompts questions as to how errorless learning techniques can be applied to cognitive-communication intervention. A recent study has demonstrated positive effects of an errorless learning approach to improve social communication [99].

Ehlhardt et al. [76] conducted a systematic review of instructional techniques used to assist individuals with memory impairment. They reviewed 51 studies including 38 studies with participants with ABI. This review systematically analysed 17 population characteristics, seven intervention parameters, five study design features and five treatment outcome factors. The authors noted considerable variance among studies in terms of instructional methods, descriptive detail of treatment procedures, treatment targets and outcome measures. This detailed analysis highlights the many factors that need to be evaluated in order for a systematic review to guide clinical practice. The instructional techniques reviewed fell into two broad categories: (a) systematic instructional methods (e.g. method of vanishing cues, errorless learning and spaced retrieval) and (b) conventional methods

(e.g. errorful learning or trial and error learning). The authors concluded that across studies there is strong research support for use of a number of key instructional practices to promote learning for individuals with acquired memory impairments.

The combined evidence presented in these systematic reviews for memory interventions point to a number of best practices including: use of external memory aids, clear delineation of intervention targets, errorless learning, provision of sufficient, distributed practice, multiple exemplars, strategy training and ecologically valid targets. All of these practices can be applied to cognitive-communication interventions, although further research will be required to delineate the impact of specific techniques (i.e. errorless learning) on daily communications.

Organization, reasoning, problem-solving, executive function and self-regulation. Deficits in organization, reasoning, problem-solving, executive functions and self-regulation are linked to difficulties with communication after ABI [34, 37, 100–102]. Cognitive-communication interventions usually incorporate strategies and procedures designed to improve these aspects of functioning. Organization, reasoning, problem-solving, executive functioning and behavioural self-regulation are integrated concepts and until there are evidence-based operational definitions to distinguish them, it is reasonable to review them as one area of intervention.

A thorough systematic review with meta analysis, conducted by Kennedy et al. [61], focused specifically on interventions for executive functions. Two systematic reviews relating to behavioural interventions or self-regulation were discussed previously under social communication [34, 83]. Three systematic reviews relating to general cognitive rehabilitation for adults [12, 13, 80] and one SR for paediatric [78] cognitive rehabilitation presented recommendations relevant to this area.

Kennedy et al.'s [61] review of executive functions interventions analysed 15 studies that met search criteria. Variance among the studies was analysed including: 27 population characteristics, 14 study design variables, four types of outcome, a range of interventions times (i.e. 30 minutes–48 hours), treatment settings (home, clinic, university, school) and types of intervention. Three kinds of intervention were used across studies including: (1) Training of multiple steps which included meta-cognitive strategy instruction (11 studies); (2) Training of strategic thinking (two studies); and (3) Training of multi-tasking (two studies). The authors noted that approaches to problem-solving in most studies included self-regulation through the use of meta-

cognitive strategies. All of the studies reported immediate positive treatment outcomes and 12/15 reported activity or participation outcomes in addition to impairment level outcomes. Nine studies (60%) reported maintenance of positive treatment effects over time and eight studies (53%) reported generalization of treatment effects to other settings or activities. The researchers concluded there was sufficient evidence to recommend meta-cognitive strategy instruction as a practice standard with young-to-middle aged adults with TBI for difficulty with problem-solving, planning and organization. Evidence was also found in support of strategic thinking interventions for verbal reasoning in middle aged adults with chronic disability. Overall the authors recommended provision of real world practice and a focus on self-regulation and self-monitoring, as well as participation level outcome measures, as opposed to sole reliance on standardized test measures at the impairment level. These recommendations were consistent with those presented in an earlier systematic review by Cicerone et al. [12], who recommended cognitive interventions that promote internalization of self regulation strategies through use of verbal self-instruction, self-questioning and self-monitoring as a Practice Option for the remediation of deficits in executive functioning.

The evidence for executive functions interventions for children was less conclusive, as both reviews of paediatric studies concluded there was insufficient evidence of the effectiveness of interventions used to improve executive functioning in children [78].

A general review of cognitive interventions by Marshall et al. [80] concluded that cognitive interventions may be effective for improving executive functions.

Overall these reviews indicate that cognitive interventions, including interventions for organization, reasoning, executive functioning and self-regulation, are beneficial whether offered in group or individual format. Although further research into the specific components of intervention are required, some potential 'active ingredients' or successful characteristics of intervention are: individualized goal-setting, use of meta-cognitive approaches that encourage self-regulation or self-monitoring, internalization or self-instruction, structure and practice in a variety of real-life environments; and explicit feedback or training in self-evaluation systems (i.e. videotaping) [61]. Also, further research into the effectiveness of executive functions interventions in children and adolescents is necessary [61, 78].

Community and family communication. Six of the systematic reviews provided analysis and

recommendations related to interventions for community and family communications. These included the review by Lippert et al. [79] on community re-integration, the Turner-Stokes et al. [87] review of multidisciplinary intervention; the Laatch et al. [78], McCormick et al. [81] and Carney et al. [75] reviews on paediatric interventions; and the Welch-West et al. [88] review on communication interventions. Involvement of family members in interventions after ABI was recommended in three of these reviews [75, 78, 81]. In the area of communication interventions the involvement of family and significant others has progressed from provision of general education to empowering communication partners in active training and provision of skills. Communication partner training has been shown to be effective in aphasia [96], child language [97] and ABI [47]. The systematic review by Welch-West et al. [88] concluded that training of communication partners can improve the communication efficiency of people with severe TBI.

Community involvement has also been shown to be a beneficial adjunct to therapy. The systematic review by Lippert et al. [77] recommended that a rehabilitation programme with a focus on social support and integration is effective in promoting gains in independence and productivity in patients with ABI. This finding supports the practice of extending intervention beyond individual therapy sessions toward building of social networks and productive activity. Such approaches as 'Participate to Learn' [103] and Context Sensitive therapy [36] advise that interventions for those with ABI will be most effective when individuals are meaningfully engaged in productive activities and have regular opportunities to interact. Evidence in this direction suggests that speech-language pathologists will be more effective in improving cognitive-communication functioning if they incorporate communication practice in real world environments during meaningful activities.

Evidence reviews of comprehensive therapies following ABI have provided strong evidence of benefit from formal intervention [87] and strong evidence of more intensive programmes [87]. Future evidence reviews will be most beneficial if they can provide practice recommendations analysing the contexts of intervention such as communication partner training, community integration opportunities and community communications.

Academic communications and school supports. The systematic review by Carney et al. [75] analysed studies to answer five key questions, two of which were relevant to the provision of academic supports

for students following ABI, and these questions were as follows:

- (1) Among children diagnosed with TBI, how many are provided with special education that is designed to accommodate the needs of TBI?
- (2) Do children with TBI who receive special education designed to accommodate the needs of TBI have better outcomes than those who are provided with special education that is not so designed and those who do not receive special education?

Carney et al. analysed the effects of special education programmes for children with TBI in one non-randomized comparative study, one small case series, one survey and five case studies. They concluded that the evidence at that time was primarily exploratory and the study designs in general were not capable of providing evidence for effectiveness of interventions for children and adolescents with TBI. They recommended looking to literature in related fields by identifying shared characteristics and incorporating what has been learned in other fields when designing interventions.

In their review of instructional practices, Glang et al. [45] analysed techniques shown to be effective for other student populations. They concluded that two instructional practices, direct instruction and cognitive strategy intervention, have significant evidence supporting their use with many populations of children. They postulated that the efficacy of these approaches with students with similar learning and behavioural characteristics presented a good basis for further research of these methods with students with ABI. A systematic review of current practices in transitioning students back to school would be a helpful addition to the literature in evidence-based practice. In the meantime, a helpful resource is a report by Ylvisaker et al. [37] which summarizes 20 years of paediatric rehabilitation and ongoing supports after TBI, including an analysis of educational supports. Increasingly the evidence points to the benefits of strategy training within natural contexts [37]. A beneficial next step in evidence-based research would be a SR that analyses the effectiveness of cognitive-communication strategy training within the academic context.

Vocational communication. There were no systematic reviews of the impact of cognitive-communication interventions on vocational re-entry. The review of interventions for community reintegration by Lippert et al. [79] was most relevant to this area of practice. They concluded that interventions incorporating cognitive strategies increase the number of individuals with ABI that return to full

time vocational activity. They also concluded that vocational rehabilitation strategies are most effective when implemented earlier after ABI. They also noted that supported employment interventions improve job placement and retention following ABI. Scollon [104] reviewed 600 articles on return-to-work issues as part of a review of factors that affect return-to-work following TBI. Although the review is not a systematic review of interventions, the review makes 19 practice recommendations related to vocational re-entry that are of some clinical utility as one awaits systematic reviews specific to vocational communication interventions. Scollon's review concluded that communication skills are an important determinant of successful return to work. Scollon's review also noted improved vocational re-integration as a function of earlier intervention. Given that communication skills are an important factor in vocational success [46, 104, 105] further research into the impact of cognitive-communication interventions on vocational reintegration is necessary.

Conclusion

Evidence to support cognitive-communication interventions

There is a growing body of evidence to support the effectiveness of interventions for deficits in the following areas related to cognitive-communication functioning after ABI: social communication; behavioural self-regulation, verbal expression, attention, external memory aids, instructional techniques, executive functions/meta-cognitive training and communication partner/family training. The following approaches appear to be helpful across intervention domains: individualization of goals, feedback and outcome measures; context sensitive interventions that are embedded in the communications and environments of daily life; self-evaluation and self-regulation techniques; use of meta-cognitive strategies; focus on activity and participation levels of intervention and outcome rather than impairment level drill and training; and employment of instructional techniques that have been validated on many populations (i.e. errorless learning and direct instruction).

Future research directions

While additional research is required in all areas, this analysis revealed considerable need for research in the following areas of intervention for those with ABI: comprehension and information processing, written expression, academic and vocational communications.

Challenges in translating the evidence to clinical practice

Cognitive-communication interventions present particular challenges in translating evidence to clinical practice due to: (1) the broad spectrum of cognitive and communication presentations and interventions; (2) the evolution of terminology and clinical approaches over time, (3) the complex interplay between cognition, communication, emotion and behavioural self-regulation prompting consideration of a wide range of therapeutic approaches, (4) the heterogeneity of the ABI population (i.e. age, severity and neurobehavioural presentation), (5) discrepancies in what constitutes strong evidence for a particular type of treatment and (6) variation in the extent to which communication is included in the population description, intervention and evaluation of outcomes.

Recommendations for knowledge transfer and application of evidence

This review of the reviews has generated a number of recommendations for knowledge transfer and application of clinical evidence. To improve consistency and clinical application, intervention studies need to specify participant characteristics, cognitive-communication profiles, individualized treatment goals, treatment characteristics and real world outcome measures, including communication outcomes. End users (clinicians, researchers, policy-makers, survivors) can be guided in their analysis of evidence by the OPICO guiding questions (Overall focus, Population, Intervention, Comparison and Outcome). Also, consistent use of a peer reviewed framework for evidence search and consolidation is recommended to promote comparison across reviews. The Cognitive-Communication Intervention Review Framework is one approach to defining key search terms and consolidating evidence in a consistent manner that allows for comparison of intervention recommendations over time. Expert panel review is increasingly being used to ensure optimal definition of search terms, as well as search and evaluation approaches. Finally many studies advised the review of a broader range of design methodologies including single-subject design, rather than exclusive attention to randomized control trials. Although RCTs have been considered to be the 'gold standard' of evidence, there have been a number of critiques of RCT's as a measure of treatment effectiveness [26, 63, 106, 107]. Single-subject design (SSD) studies are the most prevalent study methodology used in ABI rehabilitation research [11], owing to the heterogeneous ABI population, the need for individualized goal-setting, individually tailored treatment techniques such as self-regulation

and use of real life, activity and participation based outcome measures. Until ABI research has evolved to a stage where multiple RCT's are available, it seems prudent to consider the findings of single subject design studies in evidence reviews. Finally, those wishing to apply evidence to clinical practice can be greatly assisted in their search for intervention studies and systematic reviews by two databases. PsycBITE (www.psycBITE.com) [68] categorizes and reviews all studies of psychologically-based interventions after ABI and SpeechBITE (www.speechBITE.com) [108] categorizes and reviews all communication interventions for speech-language pathologists. These databases will be invaluable to end users, particularly the majority of clinicians who are not affiliated with institutional library services.

As end users grapple with the task of integrating and implementing evidence from a variety of sources, consistent approaches are required for knowledge exchange, transfer and application, The CCIRF provides a model for consolidating the evidence for cognitive-communication interventions. It is hoped that additional efforts to consolidate and apply available evidence will help to bridge the gap between research produced and evidence applied, with the ultimate end of improving communication outcomes for those with acquired brain injuries.

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