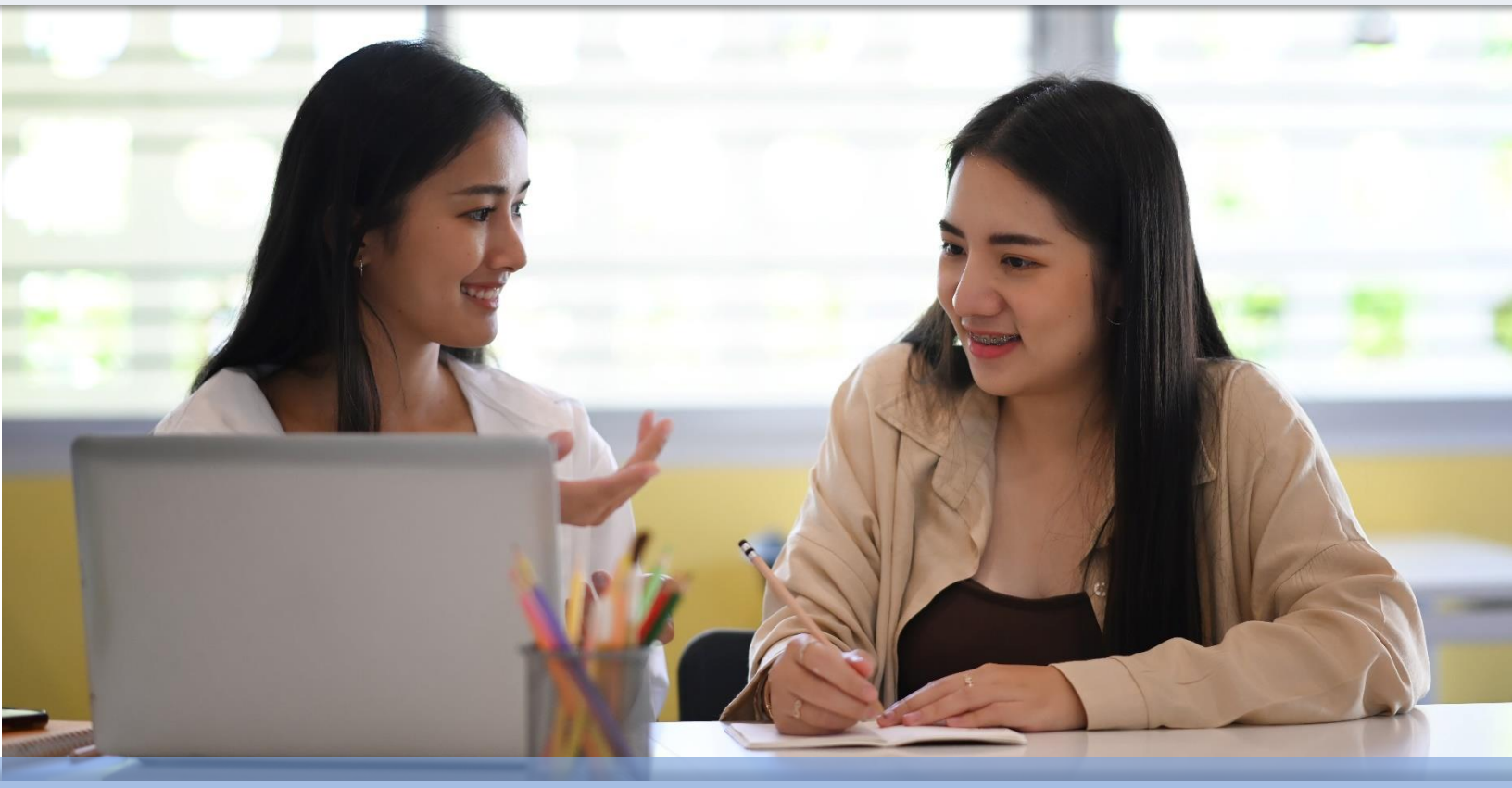
ERABI EVIDENCE-BASED REVIEW of moderate to severe ACQUIRED BRAIN INJURY



COGNITIVE COMMUNICATION

POST ACQUIRED BRAIN INJURY

Cecilia Flores-Sandoval PhD, Shawn Marshall MD FRCPC, Shannon Janzen MSc, Penny Welch-West M.CI.Sc. SLP, Amber Harnett MSc, Connie Ferri MSc SLP, Leanne Togher PhD, Robert Teasell MD FRCPC

Disclaimer

This review has been prepared based on the scientific and professional information available up to July 2021. The ERABI information is provided for informational and educational purposes only. If you have or suspect you have a health problem, you should consult your health care provider. The ERABI contributors shall not be liable for any damages, claims, liabilities, costs, or obligations arising from the use or misuse of this material.

Copyright

Funding

This work is supported by the Ontario Ministry of Health. All work produced by ERABI is editorially independent from its funding source.

Conflict of Interest

In the context of ERABI development, the term “conflict of interest” (COI) refers to situations in which an author or ERABI staff member’s financial, professional, intellectual, personal, organizational or other relationships may compromise their ability to independently conduct this evidence-based review. No limiting conflicts were identified.

Contact Information

Evidence-Based Review of Moderate to Severe Acquired Brain Injury

550 Wellington Rd South, London, Ontario, Canada N6C 0A7

Website: www.ERABI.ca

Greetings from Dr. Robert Teasell,

Professor and Chair-Chief of Physical Medicine and Rehabilitation

The Collaboration of Rehabilitation Research Evidence (CORRE) team is delighted to present the Evidence-Based Review of moderate to severe Acquired Brain Injury (ERABI) *Cognitive Communication Post Acquired Brain Injury.* Through collaboration of researchers, clinicians, administrators, and funding agencies, ERABI provides an up-to-date review of the current evidence in brain injury rehabilitation. ERABI synthesizes the research literature into a utilizable format, laying the foundation for effective knowledge transfer to improve healthcare programs and services.

We offer our heartfelt thanks to the many stakeholders who are able to make our vision a reality. Firstly, we would like to thank the Ontario Ministry of Health, which recognizes ERABI's capacity to lead in the field of brain injury evidence-based reviews and is committed to funding it. We would also like to thank the co-chairs of ERABI, Dr. Mark Bayley (University of Toronto) and Dr. Shawn Marshall (University of Ottawa) for their invaluable expertise and stewardship of this review. Special thanks to the authors for generously providing their time, knowledge and perspectives to deliver a rigorous and robust review that will guide research, education and practice for a variety of healthcare professionals. We couldn't have done it without you! Together, we are building a culture of evidence-based practice that benefits everyone.

We invite you to share this evidence-based review with your colleagues, patient advisors that are partnering within organizations, and with the government agencies with which you work. We have much to learn from one another. Together, we must ensure that patients with brain injuries receive the best possible care every time they require rehabilitative care – making them the real winners of this great effort!

Robert Teasell, MD FRCPC

TABLE OF CONTENTS

PREFACE

About the Authors

ERABI is internationally recognized and led by a team of clinicians and researchers with the goal of improving patient outcomes through research evidence. Each ERABI module is developed through the collaboration of many healthcare professionals and researchers.

Cecilia Flores-Sandoval, PhD, is a clinical research assistant and the coordinator of the Evidence-Based Review of Acquired Brain Injury (ERABI). She completed a master's degree and a PhD in Health and Rehabilitation Sciences, field of Health and Aging. Her research interests include aging and rehabilitation, patient engagement and transitional care for older adults.

Dr. Shawn Marshall is a physician specializing in Physical Medicine and Rehabilitation (Physiatrist). He is the Division Head of Physical Medicine and Rehabilitation at the University of Ottawa and The Ottawa Hospital where he manages both in-patients and out-patient clinics for patients with concussion to severe traumatic brain injury. Dr. Marshall has a Master's degree in Clinical Epidemiology and is a Full Professor at the University of Ottawa in the Department of Medicine.

Shannon Janzen, MSc, is a research associate and the project coordinator for the Evidence-Based Review of Acquired Brain Injury (ERABI). Her research interests focus on the integration of best evidence into clinical practice to optimize patient outcomes, with an emphasis on knowledge translation initiatives.

Penny Welch-West has been working as a Speech-Language Pathologist since 1998 and enjoys a very varied practice ranging from Rehabilitation through Complex/Continuing and Palliative Care. This work includes teaching, assessment and treatment in the areas of dysphagia (swallowing), voice, articulation, language, cognitive-communication and Augmentative and Alternative Communication (AAC).

Amber Harnett, MSc, RN, CNF scholar, completed her MSc in pathology and the accelerated BScN program at Western University. Passionate about supporting and advocating for those with acquired brain injuries, she works as a research coordinator to improve healthcare systems through research synthesis, guidelines development, knowledge translation, education, and outreach, in the CORRE lab at Parkwood Institute.

Connie Ferri is a speech-language pathologist at Parkwood Institute.

Leanne Togher, B.App.Sc (Speech Path), PhD, Professor of Communication Disorders Following Traumatic Brain Injury, Senior NHMRC Research Fellow, Speech Pathology, Faculty of Health Sciences, The University of Sydney, Australia.

Dr. Robert Teasell is Professor of Physical Medicine and Rehabilitation, Schulich School of Medicine and Dentistry, Western University and a Clinical Researcher at Lawson Research Institute in London, Ontario. He is a clinician at Parkwood Institute, St. Joseph's Health Care London.

Purpose

The Evidence-Based Review of Acquired Brain Injury (ERABI) is a systematic review of the rehabilitation literature of moderate to severe acquired brain injuries (ABI). It is an annually updated, freely accessible online resource that provides level of evidence statements regarding the strength of various rehabilitation interventions based on research studies. The ERABI is a collaboration of researchers in London, Toronto and Ottawa. Our mission is to improve outcomes and efficiencies of the rehabilitation system through research synthesis, as well as from providing the foundational research evidence for guideline development, knowledge translation, and education initiatives to maximize the real-world applications of rehabilitation research evidence.

Key Concepts

Acquired Brain Injury

For the purposes of this evidence-based review, we used the definition of ABI employed by the Toronto Acquired Brain Injury Network (2005). ABI is defined as damage to the brain that occurs after birth and is not related to congenital disorders, developmental disabilities, or processes that progressively damage the brain. ABI is an umbrella term that encompasses traumatic and non-traumatic etiologies.

TABLE 1 | Defining Acquired Brain Injury

Included in ABI definition	Excluded from ABI definition
Traumatic Causes • Motor vehicle accidents • Falls • Assaults • Gunshot wounds • Sport Injuries **Non-traumatic Causes** • Tumours (benign/meningioma only) • Anoxia • Subarachnoid hemorrhage (non-focal) • Meningitis • Encephalitis/encephalopathy (viral, bacterial, drug, hepatic) • Subdural Hematoma	**Vascular and Pathological Incidents** • Intracerebral hemorrhage (focal) • Cerebrovascular accident (i.e., stroke) • Vascular accidents • Malignant/metastatic tumours **Congenital and Developmental Problems** • Cerebral Palsy • Autism • Developmental delay • Down's syndrome • Spina bifida with hydrocephalus **Progressive Processes** • Alzheimer's disease • Pick's disease • Dementia • Amyotrophic Lateral Sclerosis • Multiple Sclerosis • Parkinson's disease • Huntington's disease

Given that 'ABI' can have multiple definitions, studies with an 'ABI' population can be equally heterogeneous in terms of the sample composition. Such studies may include any combination of persons with TBI, diffuse cerebrovascular events (i.e., subarachnoid hemorrhage) or diffuse infectious disorders (i.e., encephalitis or meningitis). The vast majority of individuals with ABI have a traumatic etiology; therefore, much of the brain injury literature is specific to TBI. The terms ABI and TBI have been used intentionally throughout ERABI to provide more information about populations where relevant.

Moderate to Severe Brain Injury

ABI severity is usually classified according to the level of altered consciousness experienced by the patient following injury (Table 2). The use of level of consciousness as a measurement arose because the primary outcome to understand the severity of an injury is the Glasgow Coma Scale. Consciousness levels following ABI can range from transient disorientation to deep coma. Patients are classified as having a mild, moderate or severe ABI according to their level of consciousness at the time of initial assessment. Various measures of altered consciousness are used in practice to determine injury severity. Common measures include the Glasgow Coma Scale (GCS), the duration of loss of consciousness (LOC), and the duration of post-traumatic amnesia (PTA). Another factor used to distinguish moderate and severe brain injury is evidence of intracranial injury on conventional brain imaging techniques which distinguish severity of injury from a mild or concussion related brain injury.

TABLE 2 | Defining Severity of Traumatic Brain Injury, adapted from Veterans Affairs Taskforce (2008) and Campbell (2000)

Criteria	Mild	Moderate	Severe	Very Severe
Initial GCS	13-15	9-12	3-8	Not defined
Duration LOC	< 15minutes*	<6 hours	6-48 hours	>48 hours
Duration PTA	< 1hour*	1-24 hours	1-7 days	>7 days
	*This is the upper limit for mild traumatic brain injury; the lower limit is any alteration in mental status (dazed, confused, etc.).			

Methods

An extensive literature search using multiple databases (CINAHL, PubMed/MEDLINE, Scopus, EMBASE, and PsycINFO) was conducted for articles published in the English language between 1980–July 2021 that evaluate the effectiveness of any intervention/treatment related to ABI. The references from key review articles, meta-analyses, and systematic reviews were reviewed to ensure no articles had been overlooked. For certain modules that lacked research evidence the gray literature, as well as additional databases, were searched in order to ensure the topic was covered as comprehensively as possible.

Specific subject headings related to ABI were used as the search terms for each database. The search was broadened by using each specific database's subject headings, this allowed for all other terms in the database's subject heading hierarchy related to ABI to also be included. The consistent search terms used were "head injur*", "brain injur*", and "traumatic brain injur*". Additional keywords were used specific to each module. A medical staff librarian was consulted to ensure the searches were as comprehensive as possible.

Every effort was made to identify all relevant articles that evaluated rehabilitation interventions/ treatments, with no restrictions as to the stage of recovery or the outcome assessed. For each module, the individual database searches were pooled, and all duplicate references were removed. Each article title/abstract was then reviewed; titles that appeared to involve ABI and a treatment/intervention were selected. The remaining articles were reviewed in full.

Studies meeting the following criteria were included: (1) published in the English language, (2) at least 50% of the study population included participants with ABI (as defined in Table 1) or the study independently reported on a subset of participants with ABI, (3) at least three participants, (4) ≥50% participants had a moderate to severe brain injury (as defined in Table 2), and (5) involved the evaluation of a treatment/intervention with a measurable outcome. Both prospective and retrospective studies were considered. Articles that did not meet our definition of ABI were excluded.

Interpretation of the Evidence

The levels of evidence (Table 3) used to summarize the findings are based on the levels of evidence developed by Sackett et al. (2000). The levels proposed by Sackett et al. (2000) have been modified; specifically, the original ten categories have been reduced to five levels. Level 1 evidence pertains to high quality randomized controlled trials (RCTs) (PEDro ≥6) and has been divided into two subcategories, level 1a and level 1b, based on whether there was one, or more than one, RCT supporting the evidence statement.

The evidence statements made in evidence-based reviews are based on the treatment of groups rather than individuals. There are times when the evidence will not apply to a specific case; however, the majority of patients should be managed according to the evidence. Ultimately, the healthcare professional providing care should determine whether an intervention is appropriate and the intensity with which it should be provided, based on their individual patient's needs. Furthermore, readers are asked to interpret the findings of studies with caution as evidence can be misinterpreted. The most common scenario occurs when results of a trial are generalized to a wider group than the evidence allows. Evidence is a tool, and as such, the interpretation and implementation of it must always be done with the known limitations in mind.

TABLE 3 | Levels of Evidence

Level	Research Design	Description
1A	Randomized Controlled Trial (RCT)	More than one RCT with PEDro score ≥6. Includes within subject comparisons, with randomized conditions and crossover designs
1B	RCT	One RCT with PEDro ≥6
2	RCT	One RCT with PEDro <6
	Prospective Controlled Trial (PCT)	Prospective controlled trial (not randomized)
	Cohort	Prospective longitudinal study using at least two similar groups with one exposed to a particular condition
3	Case Control	A retrospective study comparing conditions including historical controls
4	Pre-Post Trial	A prospective trial with a baseline measure, intervention, and a post-test using a single group of subjects
	Post-test	A prospective intervention study using a post intervention measure only (no pre-test or baseline measurement) with one or more groups
	Case Series	A retrospective study usually collecting variables from a chart review
5	Observational study	Using cross sectional analysis to interpret relations
	Clinical Consensus	Expert opinion without explicit critical appraisal, or based on physiology, biomechanics or “first principles”
	Case Reports	Pre-post or case series involving one subject

Strength of the Evidence

The methodological quality of each randomized controlled trial (RCT) was assessed using the Physiotherapy Evidence Database (PEDro) rating scale developed by the Centre for Evidence-Based Physiotherapy in Australia (Moseley et al., 2002). The PEDro is an 11-item scale; a point is awarded for ten satisfied criterion yielding a score out of ten. The first criterion relates to external validity, with the remaining ten items relating to the internal validity of the clinical trial. The first criterion, eligibility criteria, is not included in the final score. A higher score is representative of a study with higher methodological quality.

COGNITIVE COMMUNICATION

POST ACQUIRED BRAIN INJURY

SUMMARY OF THE EVIDENCE

Intervention	Key Points Level of Evidence
Verbal and Written Communication	
Verbal or Written Communication	Communicating "yes/no" responses with consistent training and environmental enrichments does not improve communication responses in individuals with ABI. - *There is level 1b evidence that yes/no training and an enriched environment does not significantly improve communication responses in individuals with an ABI.* Targeted figurative language therapy improves communication and comprehension in individuals with TBI, although the severity of the injury may moderate these effects. - *There is level 4 evidence that targeted therapy towards figurative language improves communication in individuals with chronic TBI.* Metacognitive strategy instruction may not improve receptive language in individuals with ABI. - *There is level 4 evidence that metacognitive strategy instruction (MSI) may not be effective for improving communication following an ABI.* .
Reading Remediation	Text-to-speech technology improves reading rate, but not reading comprehension in individuals with severe TBI. - *There is level 4 evidence that text-to-speech technology improves reading rate post TBI but not reading comprehension.*
Social Communication Skills Training for Individuals and Communication Partners	
Social Communication Skills Training	Training in social skills is effective in improving communication following brain injury. - *There is level 1b evidence that the Social Cognition and Emotion Regulation Treatment (t-ScEmo) program is effective for the remediation of social communication skills, when compared to general cognitive gains treatment (Cogniplus) in individuals with an ABI.* - *There is level 1b evidence that group social communication intervention programs may improve social communication skills in individuals with an ABI.* A communication-specific coping intervention (CommeCope-1) may improve communication-specific coping and functional communication post ABI. - *There is level 4 evidence that a communication-specific coping intervention (CommCope-I) may improve communication-specific coping and functional communication, as well as stress in individuals with ABI.*

	Group Interactive Structured Treatment (GIST) is effective for improving social communication skills following an ABI. - *There is level 2 evidence that the Group Interactive Structured Treatment program (GIST) is effective for improving social communication skills in those with a TBI as well as other neuropsychological comorbidities.*
Virtual Reality	A virtual reality touch screen game targeting reasoning, knowledge, cohesion, and action may be effective for improving social skills in individuals with ABI. - *There is level 4 evidence that interactive virtual reality touch screen games focused on areas of reasoning, knowledge, cohesion, and action may be effective for improving social skills following an ABI.*
Metacognitive Strategies	Metacognitive strategy instruction may assist individuals with TBI to achieve their social communication goals. - *There is level 4 evidence suggesting that a goal-driven, metacognitive strategy intervention may be beneficial in assisting individuals with TBI to achieve social communication goals.*
Cognitive Pragmatic Treatment	Cognitive Pragmatic Treatment may improve communicative-pragmatic abilities in individuals with TBI; however, further research is needed. - *There is level 4 evidence that the Cognitive Pragmatic Treatment may improve communicative-pragmatic abilities in individuals with TBI; however, randomized controlled trials are needed to determine the effectiveness of this intervention.*
Training Communication Partners	Providing communication training to individuals in the community who interact with people with TBI is effective and encourages two-way dialogue. - *There is level 1b evidence to support the effectiveness of interventions that focus on training communication partners in the community, compared to no training, for improving interactions between responders and those with an ABI.* Providing training to the communication partner and the individual with TBI together is more effective than training the individual with TBI alone. - *There is level 1b evidence that providing training to both the communication partner and the individual with a TBI together is more effective than only training the individual with TBI alone or no training at all.*
Emotion Recognition	The Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo) is effective for improving facial affect recognition in individuals with an ABI. - *There is level 1b evidence that the Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo), when compared to Cogniplus, is effective for improving facial affect recognition in individuals with an ABI.* Facial affect recognition and emotional interference training may improve emotional recognition post ABI.

	- *There is level 1b evidence that facial affect recognition training and emotional inference training may improve emotion recognition in individuals with ABI.* A short intervention designed to improve emotional prosody may not be effective post ABI. - *There is level 1b evidence that a short intervention designed to improve the ability to recognize emotional prosody may not be effective in individuals with ABI.* Cognitive Pragmatic Treatment (CPT) program is effective in improving communicative-pragmatic abilities such as voice tone and gaze to communicate emotions. - *There is level 4 evidence that a Cognitive Pragmatic Treatment (CPT) program is effective in improving communicative-pragmatic abilities in individuals with ABI, particularly use of voice tone and gaze to communicate emotions.*
Alternative and Augmentative Communication	
Text-to-Speech Technology	Text-to-speech technology improves reading rate, but not reading comprehension in individuals with severe TBI. - *There is level 4 evidence that text-to-speech technology improves reading rate post TBI but not reading comprehension*. Augmentative and alternative communication interventions designed to assist with organization, access, and efficiency of communication may be beneficial for individuals with severe ABI.

INTRODUCTION

Due to impairments in cognitive abilities, individuals with ABI may experience cognitive-communicative impairments, including difficulties with linguistic and non-linguistic cognitive functions (Coelho et al., 1996). According to the College of Audiologists and Speech Language Pathologists of Ontario (2002), cognitive-communication disorders refer to impairments that resulted from cognitive deficits due to neurological impairment (e.g., TBI), different from other neurological communication disorders (e.g., aphasia). Cognitive-communication deficits in expressive and receptive language use may impact individuals' everyday activities, such as social interactions and employment (Norman et al., 2022). Speech-language pathologists (SLP) play a crucial role in the care of individuals with ABI who present with cognitive-communication impairments, particularly by conducting early assessments and providing education to individuals and families throughout the continuum of care (Morrow et al., 2020).

Treatments to improve communication in individuals with ABI have focused on improving narrative and structured conversations post injury (Kilov et al., 2009), as well as on the individual's ability to

communicate using naturalistic jointly-produced narrative with a communication partner (Jorgensen & Togher, 2009). Group treatment may be an effective intervention for individuals post ABI with cognitive-communication deficits and 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 (College of Audiologists and Speech Language Pathologists of Ontario, 2002).

Some specific goals of group treatment include helping individuals with ABI to communicate their basic needs, improving word fluency, facilitate word usage and word finding, and using tools to better organize ideas in conversation. Other interventions to facilitate communication in individuals with ABI have focused on the use of a yes/no response system (Barreca et al., 2003) and word retrieval strategies (Sumowski et al., 2014). Individuals can also benefit from intense voice programs, such as the Lee Silverman Voice treatment (LSVT®), to improve clarity of speech and phonation, as well as to treat dysarthria (Solomon et al., 2004).

Remediation of Verbal and Written Communication

Interventions for Verbal and Written Communication

Several authors have examined cognitive-communication therapies used to assist individuals with ABI (Coelho et al., 1996; Kennedy et al., 2008; MacDonald & Wiseman-Hakes, 2010). Although interventions directed at particular cognitive deficits in a clinical environment are important, implementing cognitive remediation strategies in the individual's home and community, as well as addressing social skills, can result in greater functional gains (Coelho et al., 1996). In addition, focusing on communication skills within natural contexts can help ensure appropriate communication in the social, educational, ethnic and cultural context of the individual (Togher et al., 2014).

TABLE 4 | Interventions for Improving Verbal and Written Communication post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Barreca et al. (2003) Canada RCT PEDro=6 N=13	**Population:** ABI; Mean Age: 41.3 yr; Gender: Male= 10, Female= 3; Mean Time Post Injury=33 mo; Mean GCS=4.8. **Treatment:** Participants were assigned to an ABAB (n=7) or BABA (n=6) treatment sequence. Group A received an enriched stimulus environment, collaborative multi-disciplinary	1. No order effect (AB vs BA; F=0.29; p=0.06) but a treatment trend was found for the effectiveness of group A over group B (A vs B; F=3.84; p=0.07). 2. No significant differences in Western Aphasia Battery scores between treatments at admission or 6 mo later (p>0.05).

	intervention, and additional yes/no response training (30 min, 3x/wk). Group B received standard intervention within a hospital environment. This took place over 8 wk, each interval being 2 wk. **Outcome Measure:** Western Aphasia Battery.	
Brownell et al. (2013) USA Pre-Post N=8	**Population:** TBI=8; Mean Age=43 yr; Gender: Male=5, Female=3; Mean Time Post Injury=8.5 yr; Severity: Moderate to severe. **Intervention:** Therapy targeting difficulties interpreting figurative language. Participants were assessed at baseline and then performed metaphor interpretation probes and untrained line orientation tasks during the three study phases: (1) baseline phase (10 session, 2x/wk); (2) training phase with word tasks ranging in difficulty (2x/wk); and (3) post training phase (10 sessions, 2x/wk). The exact number of sessions varied (total 23 to 34). Follow-up conducted at 3 to 4 mo post training. **Outcome Measure:** Oral Metaphor interpretation, Benton Line Orientation-Judgment Task Short Form Q.	1. The group significantly improved on the Oral Metaphor Interpretation following treatment compared to baseline (Mean difference score=5.9, p<0.001). 2. Scores on the Benton line Orientation task did not improve significantly (Mean difference score=-0.2, p=0.585) from pre to post training. 3. 6 of 8 participants improved significantly on metaphor interpretation following training, 3 of which maintained these improvements at follow-up.

Discussion

Barreca et al. (2003) compared two rehabilitation approaches that attempted to establish correct responses to yes/no questions. In addition to providing an enriched environment to the first group, a communicative disorders assistant provided yes/no training to the individuals. The assistant trained healthcare team members and families to follow scripted procedures to increase arousal/attention and to elicit yes/no responses. This was compared against standard care. Despite no significant differences on the Western Aphasia Battery, families reported on a satisfaction questionnaire that they were better able to communicate with their loved one (Barreca et al., 2003).

Brownell et al. (2013) utilized therapy targeting deficiencies in figurative language. All participants completed 10 sessions of word task training resulting in significant improvements in oral metaphor interpretation. Participants in the study were approximately eight years post injury suggesting that individuals with TBI are capable of advanced improvements in non-literal language even after the period of rapid and pronounced spontaneous recovery (Brownell et al., 2013).

Conclusions

There is level 1b evidence that yes/no training and an enriched environment does not significantly improve communication responses in individuals with an ABI (Barreca et al., 2003).

There is level 4 evidence that targeted therapy towards figurative language improves communication in individuals with chronic TBI (Brownell et al., 2013) .

KEY POINTS

- Communicating "yes/no" responses with consistent training and environmental enrichments does not improve communication responses in individuals with ABI.
- Targeted figurative language therapy improves communication and comprehension in individuals with TBI, although the severity of the injury may moderate these effects.

Metacognitive Strategies

Metacognition is the highest level within the cognitive system, and it involves personal values, motivations, and beliefs about 'self', as well as ongoing self-monitoring and self-assessment during activities (Kennedy & Coelho, 2005). Metacognition has been described as 'self-awareness' or 'insight', as well as 'knowing about knowing', and it relates to the awareness and the regulation of the individual's cognitive functioning (Yeo et al., 2021).

TABLE 5 | Metacognitive Strategies for Communication Post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Copley et al. (2015) Australia Pre-Post N=8	**Population:** ABI; Mean Age=44.5 yr; Gender: Male=5, Female=3; Mean Time Post Injury=12 mo; Severity: Moderate-Severe. **Intervention:** All participants completed a treatment consisting of metacognitive strategy instruction (MSI) during 3 components. 1) Individualized sessions (IS) consisted of identifying language-based goals and strategies to accomplish them (2 hr x2 sessions). 2) Group sessions (GS) where participants work on their goals in a group setting completing auditory and written comprehension tasks (1.5 hrs.). 3) Daily home practice sessions (HS) involved transferring the skills learnt in the first 2 components into everyday life by teaching the significant other how to implement MSI. **Outcome Measure:** Measure of Cognitive-Linguistic Abilities Subtests: Paragraph Comprehension, Story Recall, Verbal Abstract Reasoning, Functional Reading, Factual Comprehension, Inferential Reasoning Skills (Low Level and High Level).	1. There was no significant difference in pre-post scores for paragraph comprehension (p=0.340). 2. There was no significant difference in pre-post scores for story recall (p=0.028). 3. There was no significant difference in pre-post scores for verbal abstract reasoning (p=0.111). 4. There was no significant difference in pre-post scores for functional reading (p=0.204). 5. There was no significant difference in pre-post scores for factual comprehension (p=0.891). 1. There was no significant difference in pre-post scores for inferential reasoning skills, both low level (p=0.125) and high level (p=0.020).

Discussion

In a pre-post study, Copley et al. (2015) investigated the effects of a Metacognitive Strategy Instruction (MSI) intervention on receptive language and cognitive-communication post ABI. The program was

delivered individually, in a group-setting, and at home. The authors did not find any statistically significant results in the language subtests; however, participants' raw scores indicated some improvements in receptive language (Copley et al., 2015).

Conclusions

There is level 4 evidence that metacognitive strategy instruction (MSI) may not be effective for improving communication following an ABI (Copley et al., 2015).

KEY POINTS

- Metacognitive strategy instruction may not improve receptive language in individuals with ABI.

Interventions for Reading Remediation

Reading is an essential activity for daily living that is often difficult for individuals who sustained an ABI, with symptoms often related to problems with eye movements , affecting both sensory and motor-based aspects of reading (Ciuffreda et al., 2006).

TABLE 6 | Interventions for Reading Remediation Post TBI

Author, Year Country Study Design Sample Size	Methods	Outcome
Harvey et al. (2013) USA Pre-Post N=9	**Population:** Severe TBI=9; Mean Age=35.78 yr; Gender: Male=8, Female=1; Mean Time Post Injury=10.89 yr. **Intervention:** Participants read 24 passages in two different scenarios, once without any training and once after receiving 6 sessions of computerized text-to-speech training. **Outcome Measure:** Reading rate, comprehension accuracy.	1. Reading rates were significantly faster after receiving training (p=0.036). 2. No significant difference between text-to-speech and no text-to-speech conditions were noted for comprehension accuracy (p=0.950).

Discussion

Harvey et al. (2013) examined comprehension, rate and perceptions and reading preferences of individuals with severe TBI. Participants completed six sessions of computerized text-to-speech (TTS) training. Results showed a significant improvement in reading rates during the TTS conditions compared to the no text-to-speech conditions; however, the use of TTS did not affect reading comprehension. The authors found that participants in the TTS condition read faster than those in the non-TTS condition These findings suggest that text-to-speech technology is a useful tool in improving reading rates among

individuals with a TBI. In addition, participants reported perceived benefits related to the use of TTS in visual scanning, pronouncing unfamiliar words and sustaining attention (Harvey et al., 2013).

According to a systematic review by Pei and O'Brian (2021), the ability to read, including reading speed and comprehension, is often affected in individuals with TBI. Social cognition deficits may impact the ability to draw inferences based on the context and comprehend the reading material. Reading abilities in individuals with TBI may also be impacted by vision difficulties (e.g., blurred vision), eye discomfort and light sensitivity, as well as eye movement. According to the authors, interventions that target underlying the processes of reading are more likely to improve reading speed and comprehension in individuals with TBI (Pei & O'Brien, 2021).

Conclusions

There is level 4 evidence that text-to-speech technology improves reading rate post TBI but not reading comprehension (Harvey et al., 2013).

KEY POINTS

- Text-to-speech technology improves reading rate, but not reading comprehension in individuals with severe TBI.

Social Communication Skills Training for Individuals and Communication Partners

After an ABI, individuals often experience difficulties in social communication or pragmatic language skills, resulting in loss of social contact, interpersonal conflicts and feelings of loneliness (Dahlberg et al., 2006). Pragmatics describe "a person's ability to perceive, interpret and respond to the contextual and situational demands of conversation" (Wiseman-Hakes et al., 1998). In other words, pragmatics refers to the interaction between language behavior and the context in which language occurs (Strauss HM & RS, 1994). Given the empirical link between cognition and pragmatics, individuals who have sustained a TBI and present with cognitive impairments may also be at risk of experiencing associated pragmatic interpretation difficulties, including displaying poor social judgement, reduced empathy, apathy, and behaving in socially inappropriate ways (Rowley et al., 2017).

Studies have shown that the conversations of individuals with ABI, compared to individuals without injury, 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 (Bond & Godfrey, 1997; Coelho et al., 1996). Given that we form and maintain relationships through conversation,

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, frustration, and a sense of helplessness (Kilov et al., 2009; Sarno et al., 1986).

Social Communication Skills Training

Individuals with a brain injury may experience difficulties related to social functioning that can potentially impact their ability to interact with others, establish relationships, work and navigate social situations (Steel & Togher, 2019). Social communication training addresses social competence and removing barriers to returning to a meaningful and productive life, which includes having the ability to sustain interpersonal relationships (Braden et al., 2010).

TABLE 7 | The Effectiveness of Social Communication Skills Training Post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Westerhof-Evers et al. (2017) Netherlands RCT PEDro=7 $N_{Initial}$=61 N_{Final}=56	**Population:** TBI; Mean Age=43.2 yr; Gender: Male=83, Female=17; Severity: Moderate to severe. **Treatment:** Participants were randomly assigned to receive Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo, n=30) protocol or Cogniplus (n=29) training. The T-ScEmo protocol is aimed at enhancing emotion perception, perspective taking, theory of mind, goal-directed social behaviour through 20 individual treatment sessions offered 1-2x/wk by neuropsychologists. Cogniplus is an individually administered computerized attention training aimed at improving general cognition. Outcomes were assessed baseline (T0), post-intervention (T1), and 3-5 mo follow-up (T2). **Outcome Measure:** The Awareness of Social Inferences Test (TASIT-short), Sixty faces test (FEEST), Cartoon test, Faux Pas test (FP), Wechsler Adult Intelligence Scale (WAIS-III digit span), Trail Making Test (TMT A and B/A), Test of Everyday Attention Lottery (TEA lottery), Dysexecutive Questionnaire-Social scales (DEX-Soc-self, DEX-Soc-proxy), Brock's Adaptive Functioning Questionnaire-Social monitoring scale (BAFQ-SM-self, BAFQ-SM-proxy), BAFQ empathy scale (BAFQ-Emp-self, BAFQ-Emp-proxy), Role Resumption List (RRL), Quality of Life after Brain Injury (QOLIBRI satisfaction,	1. For the primary outcome of TASIT-short, there was no significant improvements over time in either group or no significant differences between groups. 2. Significant Time x Group interactions from T0 to T1 were observed for FEEST (p=0.01), CT (p=0.02), RRL (p<0.01), and TGA (p<0.01). No significant interactions from T0 to T1 were observed for FP, DEX-Soc-self, DEX-Soc-proxy, BAFQ-SM-self, BAFQ-SM-proxy, BAFQ-Emp-self, BAFQ-Emp-proxy, QOLIBRI satisfaction, QOLIBRI burden, RQS-self, RQS-life partner, WAIS-III digit span, TMT A, TMT B/A, or TEA lottery. 3. Significant Time x Group interactions from T0 to T2 were observed for FEEST (p<0.01), CT (p=0.02), BAFQ-Emp-proxy (p=0.02), RRL (p<0.01), QOLIBRI burden (p=0.04), RQS-life partner (p=0.02), and TGA (p<0.01). No significant interactions from T0 to T2 were observed for FP, DEX-Soc-self, DEX-Soc-proxy, BAFQ-SM-self, BAFQ-SM-proxy, BAFQ-Emp-self, QOLIBRI satisfaction, RQS-self, WAIS-III digit span, TMT A, TMT B/A, or TEA lottery.

	QOLIBRI burden), Treatment Goal Attainment (TGA), Relationship Quality Scale (RQS-self, RQS-life partner).	
Dahlberg et al. (2007) USA RCT PEDro=6 N=52	**Population:** TBI; Mean Age=41.17 yr; Gender: Male=44, Female=8; Mean Time Post Injury=9.67 yr; Severity: Severe=40, Moderate to mild=12. **Treatment:** Participants were randomly assigned to either the experimental (n=26) group or the control group (n=26). Individuals receiving the training focused on listening to others, communicating needs, and regulating their emotions during social interactions. There were 12 sessions each lasting 1.5 hr. The control group waited 3 mo before undergoing treatment. Participants were assessed 5 times: baseline (wk 0), end of treatment (wk 12), at wk 24, 36 and 48. **Outcome Measure:** Profile of Functional Impairment in Communication (PFIC), Social Communication Skills Questionnaire-Adapted (SCSQ-A), Goal Attainment Scale (GAS).	1. Results of the PFIC rating scale showed significantly greater improvements on 7 of the subscales included on the PFIC: general participation (p=0.001), quantity (p=0.024), internal relation (p=0.009), external relation (p=0.005), clarity of experience (p=0.024), social style (p<0.001) and aesthetics (p=0.014). 2. The SCSQ-A showed significant improvement (p=0.005) for the treatment group compared to the control, pre- and post-intervention. 3. Over time significant improvement were noted between baseline scores and post-treatment scores for all participants receiving training on the PFIC (21 of the 30 subscales: p<0.001). Significant improvement was noted on the SCSQ-A (p<0.001) as well. 4. Significant improvements were made on the GAS from baseline to all post-treatment evaluations (p<0.001).
Keegan et al., (2020) USA Pre-Post $N_{Initial}$=10, N_{Final}=6	**Population:** TBI=9; Age Range=28-58yr; Gender: Male=8, Female=2; Mean Time Post Injury= 18yr; Severity: Mild=0, Moderate=1, Severe=5. **Intervention:** Participants attended a group program (INSIGHT) that was focused on improving cognitive-communication skills 2h/wk for 35 sessions. Outcome measures were assessed at baseline, 2mo, 6mo and 1yr. **Outcome Measures:** Goal Attainment Scaling (GAS), Exchange Structure Analysis (Qualitative).	1. GAS significantly improved over time (p<0.05), indicating progress towards set goals. 2. Exchange structure analysis revealed improvement in interaction and communicative participation in all participants.
Douglas et al., (2019) Australia Pre-Post $N_{Initial}$=13, N_{Final}=13	**Population:** TBI=13; Mean Age=27.54±10.51yr; Gender: Male=Not Reported, Female=Not Reported; Mean Time Post Injury=7.62±5.16yr; Severity: Mild=0, Moderate=0, Severe=13. **Intervention:** Participants completed a communication-specific coping intervention (CommCope-1) program in two group sessions per wk for 6wk. The program focused on cognitive behavioural therapy, self-coaching and social communication therapy. Outcome measures were assessed at baseline, 6 and 12wk. **Outcome Measures:** Communication-Specific Coping Scale- Research Version (CommSPeCS), Discourse Coping Scale-Clinician Rating (DCS-CR), La Trobe Communication Questionnaire (LCQ), Stress Subscale of the Depression Anxiety Stress Scales-21(DASS-21).	1. A significant improvement in functional communication (LCQ, p=0.017), stress (DASS-21, p=0.026) as well as self, close other and clinician rated communication-specific coping strategies (CommSpeCS, p<0.05; DCS-CR; p<0.05) was observed at 12wk follow-up when compared to baseline.
Braden et al. (2010) UK	**Population:** TBI; Mean Age=42.11 yr; Gender: Male=21, Female=9; Mean Time Post Injury=7.85 yr.	1. Social communication skills, as assessed by SCSQ-A, GAS and SWLS, improved significantly pre- to post-assessment (p<0.05).

Cohort $N_{initial}$=30 N_{final}=17	**Treatment:** Participants received Group Interactive Structured Treatment (GIST) for social competence. This program was provided in a rehabilitation facility or in the community. A treatment workbook, developed specifically for GIST, was given to each participant. Each group member was asked to attend 13, 1.5 hr/wk sessions to discuss various topics related to effective communication. Participants were assessed at baseline, post-treatment, and at 3 and 6 mo. **Outcome Measure:** Profile of Pragmatic Impairment in Communication (PPIC), Social Communication Skills Questionnaire-Adapted (SCSQ-A), Goal Attainment Scale (GAS), Satisfaction with Life Scale (SWLS).	2. For those in the TBI+ group (those with a substance disorder, a psychiatric disorder, or other neurological complications) significant improvement was noted on their SCSQ-A, GAS, SWLS scores ($p<0.01$, $p<0.000$ and $p=0.01$ respectively). The improvement on the PPIC was not significant ($p=0.40$). 3. There were no significant differences comparing the groups (TBI only to TBI+) at baseline, post-intervention or 6 mo post-intervention for the PPIC, person ratings on SCSQ-A, GAS and SWLS.

Discussion

An RCT by Westerhof-Evers et al. (2017) compared the use of a Social Cognition and Emotion Regulation Treatment (T-ScEmo) to a treatment for general cognitive gains (Cogniplus), to evaluate how participants performed on emotion perception, social understanding, and social behavior. The T-ScEmo group had statistically significant improvements on emotion perception (facial affect recognition), theory of mind, proxy-rated empathic behavior, societal participation, and treatment goal attainment, when compared with the Cogniplus control group. The authors also found that the T-ScEmo group showed improved quality of life and quality of their relationship with their life partner, with effects lasting 5 months after the intervention (Westerhof-Evers et al., 2017).

In a pre-post study, Douglas et al. (2019) examined the effects of a communication-specific coping intervention (CommCope-I) for individuals with TBI, a treatment that targets coping during communication breakdown by incorporating principles of cognitive behavioral therapy, self-coaching and social communication therapy that is context sensitive. The authors found a significant improvement in communication-specific coping, functional communication, and stress; additionally, the observed effects were maintained for three months after the intervention(Douglas et al., 2019).

In an RCT, Dahlberg et al. (2007) evaluated the effectiveness of a group intervention to improve social communication skills in individuals with TBI. The authors found that participants in the experimental group, when exposed to twelve, 1.5-hour communication sessions, significantly improved their scores on the general participation in conversation subscale on the Profile of Functional Impairment in Communication and the Social Communication Skills questionnaire-adapted. These improvements were also noted at 6- and 9-month follow-up periods (Dahlberg et al., 2007). The effectiveness of a group treatment for social communication was also examined by Keegan et al. (2020) in a pre -post study. The authors investigated the effects of the program on perceived progress towards collaboratively setting goals and on pragmatic and social skills. The results of this study indicated that progress was made towards communication goals (Keegan et al., 2020).

Braden et al. (2010) examined the efficacy of the Group Interactive Structured Treatment (GIST) for social competence in a cohort study examining 30 individuals greater than one year post ABI. The 13-week training reviewed the following topics: 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. Results of this study suggested significant positive effects of GIST on social communication (Braden et al., 2010).

Conclusions

There is level 1b evidence that the Social Cognition and Emotion Regulation Treatment (t-ScEmo) program is effective for the remediation of social communication skills, when compared to general cognitive gains treatment (Cogniplus) in individuals with an ABI (Westerhof-Evers et al., 2017).

There is level 1b evidence that group social communication intervention programs may improve social communication skills in individuals with an ABI (Dahlberg et al., 2007; Keegan et al., 2020).

There is level 4 evidence that a communication-specific coping intervention (CommCope-I) may improve communication-specific coping and functional communication, as well as stress in individuals with ABI (Douglas et al., 2019).

There is level 2 evidence that the Group Interactive Structured Treatment program (GIST) is effective for improving social communication skills in those with a TBI as well as other neuropsychological comorbidities (Braden et al., 2010).

KEY POINTS

- Training in social skills is effective in improving communication following brain injury.
- The Social Cognition and Emotion Regulation Treatment (t-ScEmo) program is effective for the remediation of social communication skills in individuals with ABI.
- A communication-specific coping intervention (CommCope-I) may improve communication-specific coping and functional communication post ABI.
- Group Interactive Structured Treatment (GIST) is effective for improving social communication skills following an ABI.

Virtual Reality

Virtual reality (VR) allows individuals to interact with and experience a virtual environment in three-dimensions, realistically simulating different situations/environments/tasks through immersive (head-mounted display) or non-immersive (computer monitor or projector screen) multimedia (Sisto et al., 2002). VR training has advantages over conventional therapies, as it has the potential to simulate real-life or imaginary circumstances in a safe environment (Alashram et al., 2019). In addition, VR systems

provide the option to adjust the task complexity according to individual skills and goals (Brassel et al., 2021).

TABLE 8| The Effectiveness of Virtual Reality on Social Communication Skills Post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Llorens et al. (2012) Spain Pre-Post N=10	**Population:** ABI=10; Mean Age=41.1yr; Gender: Male=7, Female=3; Mean Time Post Injury=402.2d. **Intervention:** Participants underwent sessions (1hr/wk for 8mo) using an interactive touch screen-based game asking questions related to knowledge, reasoning, action, and cohesion in groups of ≤4. Testing of participants occurred at baseline and post intervention. **Outcome Measure:** Self-Awareness Deficits Interview (SADI), Social Skills Scale (SSS).	1. On the SADI, after treatment all participants perceived their deficits properly compared to only 4 participants at baseline; 2 participants had difficulty perceiving their disability post treatment compared to 7 participants at baseline and 5 participants had difficulty establishing realistic goals post treatment compared to 7 at baseline. 2. On the SSS at baseline, 6 participants showed altered levels in social skills, compared to 2 following treatment.

Discussion

Llorens et al. (2012) examined the effectiveness of a multitouch virtual reality system on self-awareness and social skills in individuals with ABI. The virtual reality system consists of a board game where participants are required to answer a question related to knowledge (anatomical and pathological), reasoning (situational exercises), action (role-play exercises) or cohesion (jokes and sayings). The system aimed to facilitate cognitive functioning through social interaction. Although formal statistical analysis was not performed, 6/10 participants initially showed altered levels of communication on the Social Skills Scale, compared to only 2/10 post-treatment (Llorens et al., 2012).

Conclusions

There is level 4 evidence that interactive virtual reality touch screen games focused on areas of reasoning, knowledge, cohesion, and action may be effective for improving social skills following an ABI (Llorens et al., 2012).

KEY POINTS

- A virtual reality touch screen game targeting reasoning, knowledge, cohesion, and action may be effective for improving social skills in individuals with ABI.

Metacognitive Strategies

Metacognition is the highest level within the cognitive system, and it involves personal values, motivations, and beliefs about 'self', as well as ongoing self-monitoring and self-assessment during

activities (Kennedy & Coelho, 2005). Metacognition has been described as 'self-awareness' or 'insight', as well as 'knowing about knowing', and it relates to the awareness and the regulation of the individual's cognitive functioning (Yeo et al., 2021).

TABLE 9 | Metacognitive Strategies for Social Communication Skills Post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Finch et al. (2017) Australia Pre-Post N=8	**Population:** TBI; Mean Age=36.25 yr; Gender: Male=4, Female=4; Mean Time Post Injury=24.6 mo; Mean GCS=8.25; Severity: moderate=1, severe=7. **Treatment:** Participants received one 1 hr group and one 1 hr individual therapy session per wk for 8 wk. Therapy sessions were led by a speech-language pathologist and focused on remediating impaired social communication skills using metacognitive strategy instruction training and goal-based therapy. Outcomes were assessed at baseline (4 wk baseline prior to intervention, pre-intervention, post-intervention, and 4 wk follow-up. **Outcome Measure:** Profile of Pragmatic Impairment in Communication (PPIC), LaTrobe Communication Questionnaire (LCQ), Goal Attainment Scaling (GAS).	1. For PPIC, only the literal content (p=0.005), general participation (p=0.02), internal relation (p=0.008), clarity of expression (p=0.026), and aesthetics (p=0.016) subscales showed significant improvement from baseline to 4 wk follow-up. No significant differences were observed for the quantity, quality, external relation, social style, or subject style subscores. 2. For PPIC, only the aesthetics subscale was significantly improved (p=0.039) comparing post-intervention to pre-intervention. 3. No significant differences for LCQ were observed when comparing baseline to 4 wk follow-up or pre- to post-intervention. During the intervention, participants identified between three and six goals each. There was a significant increase in GAS goal T-scores after the intervention (p=0.012).

Discussion

Finch et al. (2017) conducted a pre-post study to examine the effect of a metacognitive, goal-based intervention aimed at improving and maintaining social communication skills for individuals with TBI. Participants completed two (individual and group) 1-hour sessions that addressed communication deficits by using a metacognitive strategy intervention and goal-based therapy. Results from this study indicated that goal-driven and metacognitive strategy-based interventions may help individuals with TBI achieve social communication goals.

Conclusions

There is level 4 evidence suggesting that a goal-driven, metacognitive strategy intervention may be beneficial in assisting individuals with TBI to achieve social communication goals (Finch et al., 2017).

KEY POINTS

- Metacognitive strategy instruction may assist individuals with TBI to achieve their social communication goals.

Cognitive Pragmatic Treatment

Cognitive Pragmatic Treatment (CPT) is a rehabilitation program based on cognitive pragmatic theory that aims to assist individuals with TBI to reintegrate into their social environment by addressing aspects of communication competence such as executive function and theory of mind (Gabbatore et al., 2015). Theory of mind refers to the ability to understand the interlocutor's perspective and intentions when communicating with others, while cognitive pragmatics theory contends that a stereotyped pattern of interaction, or behavioral game, is essential in communication to help interpretation of the dialogue and comprehension of meaning (Bosco et al., 2012). Cognitive pragmatic theory addresses inferential ability, which is the gap that sometimes occurs between what an individual says and what they intend to communicate (Gabbatore et al., 2015).

The CPT program has been used to treat individuals with schizophrenia, autism and TBI, and it focuses on inferential abilities such as social and contextual appropriateness and the ability to use a variety of expressive means to communicate with others (e.g., tone of voice, rhythm, facial expressions)(Gabbatore et al., 2022).

TABLE 10 | Cognitive Pragmatic Treatment for Social Communication Post TBI

Author, Year Country Study Design Sample Size	Methods	Outcome
Parola et al. (2019) Italy Pre-Post N=10	**Population:** TBI; Mean Age=41.4±12.2 yr; Gender: Male=10, Female=0; Mean Time Post Injury=129.1±97.1mo; Mean GCS=4.7±1.9. **Intervention:** Cognitive Pragmatic Treatment (CPT) that encompasses different communicative skills such as how to structure a discourse. CPT was run by 2 psychologists in groups of 5, 1.5hr/session, 2x/wk for 3mo. Assessments conducted at T0 (3mo before treatment), T1 (1wk before treatment), T2 (1wk after treatment) and T3 (3mo post treatment). **Outcome Measures:** Neuropsychological Tests: Naming task of the Aachener Aphasie test, Attentional Matrices, Disyllabic Word Repetition test, Corsi's Block-Tapping test, Deferred Recall test, Tower of London test, Modified Card Sorting test, Trail Making task, Raven's Colored Progressive Matrices, Sally & Ann task, Strange Stories task. Narrative Abilities: Picture narrative description tasks. Assessment of communicative pragmatic abilities: Assessment Battery for Communication.	1. No significant differences were found between T1 and T2 for any of the neuropsychological tests ($p>0.05$). 2. From T1 to T2, participants produced significantly higher percentage of lexical information units after treatment ($p<0.05$), an indicator of improvement in the quality of their informational skills. 3. A main effect of treatment on the Assessment Battery for Communication was found; participants made significant improvements post treatment (T2 and T3) compared to before (T0 and T1; $p<0.001$).
Bosco et al. (2018) Italy Pre-post N=19	**Population:** *Severe TBI:* Mean age=38.5yr; Gender: Male=16, Female=3; Mean time post-injury=99.4 months; GCS<8. **Intervention:** Groups of 5-6 participants met twice a week for 12 weeks for a total of 24	1. There was a significant difference in scores on the ABaCO between pretreatment and posttreatment scores ($p<0.001$). There were no significant differences between the two initial

	Cognitive Pragmatic Treatment (CPT) sessions. Participants were assessed at four time points, 3-months pre-treatment, immediately before treatment, immediately following treatment, and 3-months post-treatment. **Outcomes:** Assessment Battery for Communication (ABaCo), Communications Activities of Daily Living (CADL), Aachener Aphasie test, Attentional Matrices, Trail Making test, Verbal Span, Corsi's Block-Tapping test, immediate and deferred recall test, Tower of London test, Modified Card Sorting test, Raven Colored Progressive Matrices, Sally & Ann, Strange Stories.	time points or the two posttreatment timepoints. 2. Similar results were seen for the CADL, with individuals showing a significant improvement in their functional communication skills following treatment (p=0.024). 3. Between immediate pre-treatment scores and immediate posttreatment scores significant differences were only seen on the Verbal Span (p=0.045), and the Modified Card Sorting test (p=0.004).
Gabbatore et al. (2015) Italy Pre-Post $N_{Initial}$=20 N_{Final}=15	**Population:** TBI; Mean Age=36.7 yr; Gender: Male=10, Female=5; Mean Time Post Injury=76.13 mo; Mean GSC=4.5. **Intervention:** Participants received a control procedure with non-communication activities for 3 mo. This was followed by a 3-mo cognitive pragmatic training (CPT) program (2 sessions/wk) consisting of 5-participants groups focused on improving pragmatic abilities, self-awareness, and executive function. **Outcome Measure:** Assessment Battery for Communication (ABaCo-comprehension, production, linguistic, extralinguistic, paralinguistic, and context), Attentive Matrices, Trail Making test, Verbal Span, Spatial Span, Immediate and Deferred Recall test, Tower of London test, Wisconsin Card Sorting test (WCST), Coloured Progressive Matrices Raven, Aachener Aphasie test-denomination scale (AAT), Sally and Ann Task, Strange Stories Task.	1. No significant improvements in ABaCo (production and comprehension) were observed during the nonspecific control period. 2. Participants showed significant improvements from pre-training to post-training for ABaCo comprehension (p<0.001), production (p<0.001), linguistic (p=0.005), extralinguistic (p=0.008), paralinguistic (p=0.02), and context (p=0.01). 3. At 3 mo follow-up post-treatment, AbaCo scores did not show significant differences from post-treatment. 4. From pre-training to post-training, no significant differences were observed for Verbal Span, Spatial Span, Attentive Matrices test, Trial Making test, Tower of London test, Raven's Colored Progressive Matrices, AAT, Sally and Ann task, or the Strange Stories task. Improvements were observed for the Immediate and Deferred Recall task (p=0.01) and Wisconsin Card Sorting test (p=0.003).

Discussion

Gabbatore et al. (2015) evaluated the effectiveness of CPT, a rehabilitation program aimed at improving all aspects of communicative-pragmatic abilities, specifically inferential ability. No improvements in comprehension were found from baseline to pre-training (p=0.41); however, significant improvements were demonstrated at post-training and follow-up. Post-treatment results indicated improvements in comprehension and production tasks, particularly in linguistics and extra linguistics abilities, such as hand gestures and body movements to convey meaning during an interaction. After the intervention, participants showed better confidence when using tone of voice and gaze to communicate their emotions. Additionally, higher levels of social appropriateness and sensitivity to social context were observed (Gabbatore et al., 2015).

Two other studies examined the effectiveness of the CPT program in improving communication abilities (Bosco et al., 2018; Parola et al., 2019). In both studies, improvements on measures of communication,

communication in daily activities, pragmatic abilities, and verbal span were observed. Although these studies demonstrated significant improvements in social and functional communication, there was no control group to determine the effects of this therapy compared to no or alternative therapies. Further evidence is needed to determine the benefits of CPT for individuals with TBI.

Conclusions

There is level 4 evidence that the Cognitive Pragmatic Treatment may improve communicative-pragmatic abilities in individuals with TBI; however, randomized controlled trials are needed to determine the effectiveness of this intervention (Bosco et al., 2018; Gabbatore et al., 2015; Parola et al., 2019).

KEY POINTS

- Cognitive Pragmatic Treatment may improve communicative-pragmatic abilities in individuals with TBI; however, further research is needed.

Training Communication Partners

Training of communication partners has become a central component of communication interventions with many populations (Togher et al., 2014). Following an ABI, individuals may have difficulty engaging in meaningful conversation with others. Communication deficits affect not only the individual with ABI, but also their families and care partners; therefore, when individuals and partners share responsibility in the communication process, the individual with ABI may regain acceptance from family members, friends, and their communities (Wiseman-Hakes et al., 2020).

According to Togher (2013), communication partners of individuals with ABI have a special role to facilitate communication flow by displaying collaborative intent (e.g., 'we are doing this together'), providing cognitive support (e.g., 'what can help make this easier?'), offering emotional support (e.g., 'I'm with you, it's OK'), showing a positive question style (e.g., 'I'm interested in what you have to say'), and taking turns collaboratively (e.g., 'I'm interested in sharing conversation'). Communication partners may benefit from training and learning communication strategies to support the individual with brain injury, while maintaining their role as peers, family members and friends (Togher, 2013).

TABLE 11 | Strategies for Training Communication Partners of individuals with ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Service Providers in the Community		

Behn et al. (2012) Australia RCT PEDro=6 N=15	**Population:** Caregivers=10, TBI=5. *TBI*: Mean Age=29.2 yr; Gender: Male=3, Female=2; Mean Time Post Injury=6.8 yr. **Treatment:** Caregivers were randomly assigned to a program on how to facilitate better conversations with individuals who had a TBI. The treatment group (n=5) participated in in a range of collaboration and elaboration conversational strategies (17 hr across 8 wk). Collaborative strategies were designed to encourage those with a TBI to participate more actively in conversations. The control group (n=5) was not trained. **Outcome Measure:** Adapted Measure of Support in conversation (MSC), Adapted Measure of Participation in Conversation, La Trobe Communication Questionnaire, Modified Burden Scale.	1. The trained group improved significantly on the MSC-acknowledging competence ($p<0.001$) and MSC-revealing competence ($p=0.002$). 2. Study results found paid caregivers were able to benefit from training; all participants were able to improve their communication skills with those who had sustained a TBI. Trained caregivers also found they experienced greater levels of burden and described negative aspects of caring more often than those who were not in the paid group.
Togher et al. (2004) Australia RCT Crossover PEDro=5 N=40	**Population:** Police Officers=20, TBI=20**.** *TBI*: Gender: Male=20, Female=0; Mean Age=36.75 yr; Mean Time Post Injury=8.8 yr. **Treatment:** participants were randomly assigned to interact with trained (treatment; n=10) or untrained (control; n=10) male police officers. Trained officers were provided with a 6 wk program targeting communication strategies using videos, theory, and transcripts **Outcome Measure:** Analyzed transcripts, Communication effectiveness.	1. Partner training resulted in more efficient and focused interactions, and fewer episodes of unrelated utterances by the people with ABI. 2. 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.
Joint Training for Individuals and their Communication Partners		
Rietdijk et al. (2020a) Australia RCT PEDro=7 Cohort N=51	**Population:** Moderate to Severe TBI. *Telehealth Group (N= 19):* Mean Age= 42yr; Gender: Male=17, Female=2; Mean Time Post Injury= 53mo. *In person Group (N= 17):* Mean Age= 54yr; Gender: Male=13, Female=4; Mean Time Post Injury= 12mo. *Control Group (N= 15)*: Mean Age=36yr; Gender: Male=13, Female=2; Mean Time Post Injury= 91mo. **Intervention:** Participants allocated to the following groups: (1) In-person TBIconneCT at home, (2) telehealth TBIconneCT via Skype and (3) historical control group. Both intervention arms had 10 sessions (1.5hr each) delivered by a speech-language pathologist and focused on activities related to social communication skills (clinical modeling, feedback, rehearsal, and role-play). **Outcome Measures:** La Trobe Communication Questionnaire (LCQ).	1. There were no significant between group differences found pre and post treatment on the LCQ total scores when comparing training groups (in-person and telehealth) to controls, or in-person to telehealth groups. 2. There were no significant between group differences found from post-treatment to follow-up on the LCQ total scores when comparing training groups (in-person and telehealth) to controls, or in-person to telehealth groups. 3. Better outcomes for the telehealth group were observed, when compared to the in-person group.
Rietdijk et al. (2020b) Australia RCT PEDro=7	**Population:** Moderate to Severe TBI. *Telehealth Group (N= 19):* Mean Age= 42yr; Gender: Male=17, Female=2; Mean Time Post Injury= 53mo. *In person Group (N= 17):* Mean Age= 54yr; Gender: Male=13, Female=4; Mean Time	1. There was a significant difference between the training groups (In-person and Telehealth) compared to the control group on the MSC Reveal Competence ($p=0.04$); those in the

N=51	Post Injury= 12mo. *Control Group (N= 15)*: Mean Age=36yr; Gender: Male=13, Female=2; Mean Time Post Injury= 91mo. **Intervention:** Participants allocated to the following groups: (1) In-person TBIconneCT at home, (2) telehealth TBIconneCT via Skype and (3) historical control group. Both intervention arms had 10 sessions (1.5hr each) delivered by a speech-language pathologist and focused on activities related to social communication skills (clinical modeling, feedback, rehearsal, and role-play). **Outcome Measures:** Conversation samples (purposeful and casual conversations): Adapted Measure of Support in Conversation (MSC) and Adapted Measure of Participation in Conversation (MPC).	trained groups improved whereas controls declined. 2. There was also a significant difference between training groups and controls on MPC Interaction, MPC Transaction, and MSC Acknowledge competence subscales ($p<0.05$) from pre- to post-treatment for casual conversations and MPC transaction in purposeful conversation; training groups improved, and controls declined. 3. There was a significant between group difference between training groups for MPC Transaction, favoring the in-person group for purposeful conversations.
Behn et al., (2019a) UK PCT $N_{Initial}=21$, $N_{Final}=21$	**Population:** TBI=13; *Treatment Group (n=11):* Mean Age=43.55±14.39yr; Gender: Male=6, Female=5; Mean Time Post Injury=12.27±12.54yr; Severity: Mild=0, Moderate=1, Severe=7. *Control Group (n=10):* Mean Age=48.30±14.91yr; Gender: Male=5 Female=5; Mean Time Post Injury=11.60±13.52yr; Severity: Mild=0, Moderate=0, Severe=5. **Intervention:** Individuals with TBI and their communication partners were allocated to a treatment or waitlist control group. The treatment group attended a project-based group session for ten 2h sessions over 6wk. Participants worked on projects aimed at helping others, improving communication skills and quality of life. Outcome measures were assessed at baseline, 1-2wk before the commencement of treatment, 1-2wk post treatment and 6-8wk post-treatment at follow-up. **Outcome Measures:** Adapted Measure of Participation in Conversation (MPC), Satisfaction With Life Scale (SWLS), Adapted Measure of Support in Conversation (MSC), Conversation Impression Scales (Appropriate, Effortful, Interesting, Rewarding), La Trobe Communication Questionnaire (LCQ), Goal Attainment Scaling (GAS), Quality of Life in Brain Injury (QOLIBRI).	1. Conversational interaction significantly improved in the treatment group compared to the waitlist group (MPC-Interaction, $p=0.04$). 2. The communication skills of communication partners significantly improved in the treatment group (MSC, $p=0.02$). 3. GAS and conversation effort significantly improved in the treatment group (GAS, $p<0.0011$; Effortful Conversation Impression Scale, $p=0.03$). 4. No other outcome measures significantly improved in the treatment group compared to controls ($p>0.05$).
Behn et al., (2019b) UK Pre-Post $N_{Initial}=21$, $N_{Final}=21$	**Population:** TBI=13; Mean Age=45±14.47yr; Gender: Male=12, Female=9; Mean Time Post Injury=11.95±12.69yr; Severity: Mild=0, Moderate=1, Severe=12. **Intervention:** Individuals participated in a group treatment program focused on enhancing social and cognitive skills. Group	1. All participants were able to set goals with their communication partners within one session. 2. One participant was unable to recall their goals independently post-treatment. 3. For the remaining participants, goal recall improved as treatment progressed. Initially,

	interventions were facilitated by a speech and language therapist and consisted of ten 2h sessions over a 6wk period for a total of 20h. Participants were taught techniques to improve their conversational skills, as well as methods to set and achieve social communication goals. Outcome measures for participants and their communication partners were assessed at baseline, post-treatment, and follow-up (6-8wk later). **Outcome Measures:** Goal setting and recall, Goal achievement (Goal Attainment Scaling (GAS)).	38% of participants were able to recall their goal correctly, compared to 95% in the final treatment session; however, no statistical analyses were conducted. 4. Goal achievement significantly improved from pre-treatment to post-treatment as rated by the participant ($p<0.001$) and their communication partner ($p<0.001$). This improvement was maintained at follow-up. 5. Participants and communication partners agreed on GAS ratings, as no significant differences were observed between groups at any time point ($p>0.05$).
Togher et al. (2016) Australia PCT $N_{Initial}=44$ $N_{Final}=38$	**Population:** TBI; Gender: Male=26, Female=18. *Control (n=15)*: Mean Age=38.1 yr; Mean Time Post Injury=9.7 yr. *JOINT (n=14)*: Mean Age=30.3 yr; Mean Time Post Injury=8yr; *TBI SOLO (n=15)*: Mean Age=39.7 yr; Mean Time Post Injury=8.1 yr. **Treatment:** Participants were allocated to one of three groups: 1) control group, no training; 2) the JOINT group, attended all sessions together with their communication partner; or 3) the TBI SOLO group, attended sessions without their communication partner. The training was 2.5 hr/wk of group sessions and 1 hr/wk of individual sessions for 10 wk. Outcomes were assessed before and after treatment, and at 6 mo follow-up. **Outcome Measure:** La Trobe Communication Questionnaire (LCQ) - Self Report and Significant Other Report.	1. Post treatment, communication partners in JOINT reported greater overall improvements compared to TBI SOLO ($p=0.05$) and control ($p<0.001$). 2. Post treatment, individuals with TBI and their partners reported more positive change on LCQ in JOINT ($p<0.001$ for both) and TBI SOLO ($p=.01$; $p=0.004$) compared to controls, with only a significant difference on LCQ significant others reports between JOINT and TBI SOLO conditions ($p=0.002$). 3. At follow-up, individuals with TBI reported increase in positive change in communication skills in JOINT ($p=0.01$) and TBI SOLO ($p=0.03$) compared to controls, with no significant difference between JOINT and TBI SOLO. 4. At follow-up, more change was reported in communication partners in JOINT than TBI SOLO ($p=0.01$) and controls ($p<0.001$).
Sim et al. (2013) Australia PCT $N_{Initial}=29$ $N_{Final}=27$	**Population:** TBI; Gender: Male=24, Female=5. *JOINT Group (n=14)*: Mean Age=30.29 yr; Mean Time Post Injury=8.04 yr *Control Group (n=15)*: Mean Age=38.07 yr; Mean Time Post Injury=9.71 yr. **Intervention:** Participants and their everyday communication partners (ECPs) were allocated into either the JOINT training that received social communication training or a waitlist control group. The training was 2.5 hr/wk of group sessions and 1 hr/wk of individual sessions for 10 wk **Outcome Measure:** Exchange Structure Analysis (ESA), Productivity analysis, Information giving moves (K1), Information requesting or receiving moves (K2), Dynamic Moves (DM), Per Minute Speaking Time (PMST).	1. Those ECPs in the JOINT group, compared to controls, changed their use of questions more often ($p=0.04$) and their DM (information tracking/negotiation; $p=0.07$). 2. Participates with TBI in the JOINT group made greater improvements in PMST than controls ($p=0.03$). 3. No significant between group changes were identified for ECPS in K1 and K2. 4. No significant between group differences were determined for those with TBI in DM, K1, or K2.
Togher et al. (2013) Australia PCT $N_{Initial}=44$	**Population:** TBI; Gender: Male=38, Female=6. *Control (n=15):* Mean Age=38.1 yr; Mean Time Post Injury=9.7 yr. *JOINT (n=14):* Mean Age=30.3 yr; Mean Time Post Injury=8 yr. *TBI*	1. On the MPC, the JOINT group had greater improvements than the control group for both casual conversations (CC) and purposeful conversations (PC) on the Interaction scale (CC:

N_{Final}=38	*SOLO (n=15):* Mean Age=39.7 yr; Mean Time Post Injury=8.1 yr. **Intervention:** Participants were allocated to one of three groups: 1) control group, no training; 2) the JOINT group, attended all sessions together with their communication partner; or 3) the TBI SOLO group, attended sessions without their communication partner. The training was 2.5 hr/wk of group sessions and 1 hr/wk of individual sessions for 10 wk. Training included role-play, listening to audio-recordings, practice interactions, and conversation strategies. Outcomes were assessed before and after treatment, and at 6 mo follow-up. **Outcome Measure:** Adapted Measure of Participation in Conversation (MPC), Adapted Measure of Support in Conversation (MSC).	p=0.01, PC: p=0.03) and on the Transaction scale (CC: p=0.003, PC: p=0.008). 2. The JOINT group made greater gains compared to the TBI SOLO group for Transaction scores in both conditions (CC: p=0.02, PC: p=0.01), and the Interaction scale for PC (p=0.03). 3. There were no significant differences between the TBI SOLO group and the control group on the MPC. 4. There were no significant between group differences on the MSC. 5. At 6mo follow-up, there were no significant changes on outcome measures.

Discussion

Studies examining communication partner training either focused on training individuals and their communication partners jointly (n=7), or independently (n=2). Two RTC studies trained service providers in the community who may interact with individuals with brain injury. Togher et al. (2004) examined the benefits of training police officers regarding how to effectively communicate with post ABI individuals. Police officers were trained to respond to individuals with ABI, while the remaining officers who volunteered did not participate in the training. Overall, it was noted that trained officers significantly reduced the number of inquiries required to gain the necessary information from their callers (Togher et al., 2004). Behn et al. (2012) found that group training enabled paid caregivers to interact more easily with the individual with TBI, compared to a control group. Benefits were more evident when strategies were used to encourage dialogue. The training in this study consisted of several didactic and performance-based approaches such as modeling, role-playing, feedback, and rehearsal (Behn et al., 2012).

When training communication partners, having both the individual with ABI and their communication partner participate in training together is the most efficient way to improve their interactions. Two studies by Togher et al. (2013; 2016) found that individuals who completed social communication training together with their communication partners, made significantly greater gains in participation and overall communication compared to individuals with TBI who attended alone or those who received no training. In a similar study, Sim et al. (2013) found that providing training to communication partners resulted in a modification of their communication styles, which in turn allowed for the individual with TBI to improve their communication. The results of this study highlighted the benefits of monitoring the two-way interaction using discourse analysis to ensure that information is given, received, and negotiated in an effective and appropriate way (Sim et al., 2013).

Two RCT studies investigated the effects of social communication skills training delivered in-person versus via telehealth. Trained individuals with TBI and their communication partners showed significant improvements in conversation, when compared to controls. When comparing outcomes of in-person versus telehealth groups, one study found medium to large effect sizes favoring the telehealth group when compared to the in-person group (Rietdijk et al., 2020a), while the other study found negligible to small effect sizes when comparing in-person to telehealth rehabilitation (Rietdijk et al., 2020b).

Similarly, two studies examined the effects of a group social communication intervention for individuals with TBI and their communication partners on improving social communication skills (Behn et al., 2019a, 2019b). In the first study (2019a), participants attended a group-based treatment where they worked collaboratively to achieve a project that benefited others. The authors concluded that project-based treatment is feasible and may have an impact on communication skills and quality of life in individuals with ABI. In the second (2019b) study, individuals with ABI and their communication partners participated in a group treatment used a goal targeted strategy to identify and structure communication goals. Significant improvements on the goal attainment scale (GAS) were observed, as rated by both participants and their communication partners. No significant differences were observed in ratings between participants and their partners.

In a systematic review, Wiseman-Hakes et al. (2020) found that communication partner training interventions have the potential to improve activity and participation in individuals with TBI by offering opportunities for supported communication, interaction, and meaningful social connections. The authors also found that a collaborative and contextualized training approach may be more effective. In addition, communication partner training may be beneficial for a variety of communication partners, including spouses, partners, parents, and nonfamily members. Service providers, such as health care providers, paid caregivers, police officers, shop keepers and retail personnel can benefit from this type of training (Wiseman-Hakes et al., 2020). In another systematic review, Behn et al. (2021) found that partner communication training interventions may be difficult to compare given the use of several different outcome measures, as well as the variability in length and intensity of interventions. The authors suggested that more research is needed to determine the effectiveness of this training, including assessing larger samples, and establishing a clearer consensus of the most appropriate outcome measures (Behn et al., 2021).

Conclusions

There is level 1b evidence to support the effectiveness of interventions that focus on training communication partners in the community, compared to no training, for improving interactions between responders and those with an ABI (Behn et al., 2012; Togher et al., 2004).

There is level 1b evidence that providing training to both the communication partner and the individual with a TBI together is more effective than only training the individual with TBI alone or no training at all (Behn et al., 2019a, 2019b; Rietdijk et al., 2020a, 2020b; Sim et al., 2013; Togher et al., 2013; Togher et al., 2016).

KEY POINTS

- Providing communication training to individuals in the community who interact with people with TBI is effective and encourages two-way dialogue.
- Providing training to the communication partner and the individual with TBI together is more effective than training the individual with TBI alone.

Emotion Recognition

Individuals with brain injury may experience difficulties using social cues to infer meaning and intentions in an interaction, as well as difficulties related to the recognition of facial expressions and emotional prosody, understanding sarcasm, humour and irony, as well as the mental state of others (Evans & Evans, 2019). For individuals with ABI, interacting with others can be a challenge when their ability to identify nonverbal expressions of emotion is limited; in particular, perception of negative emotions (e.g., anger, sadness, fear) is more often affected than perception of positive ones, (e.g., happiness) (Bird & Parente, 2014). The ability to recognize facial affect is often impaired in individuals with TBI, performing more poorly than control groups in face perception tasks, such as recognizing, matching and labelling facial expressions (Babbage et al., 2011).

TABLE 12 | Effectiveness of Emotion Recognition Interventions post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Westerhof-Evers et al. (2017) Netherlands RCT PEDro=7 $N_{Initial}$=61 N_{Final}=56	**Population:** TBI; Mean Age=43.2 yr; Gender: Male=83, Female=17; Severity: Moderate to severe. **Intervention:** Participants were randomly assigned to receive Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo, n=30) protocol or Cogniplus (n=29) training. The TScEmo protocol is aimed at enhancing emotion perception, perspective taking, theory of mind, goal-directed social behaviour through 20 individual treatment sessions offered 1-2x/wk by neuropsychologists. Cogniplus is an individually administered computerized attention training aimed at improving general cognition. Outcomes were assessed baseline (T0), post-intervention (T1), and 3-5 mo follow-up (T2). **Outcome Measure:** The Awareness of Social Inferences Test (TASIT-short), Sixty faces test (FEEST), Cartoon test, Faux Pas test (FP), Wechsler Adult Intelligence Scale (WAIS-III digit span), Trail Making Test (TMT A and B/A), Test of Everyday Attention Lottery (TEA	1. For the primary outcome of TASIT-short, there was no significant improvements over time in either group or no significant differences between groups. 2. Significant Time x Group interactions from T0 to T1 were observed for FEEST (p=0.01), CT (p=0.02), RRL (p<0.01), and TGA (p<0.01). No significant interactions from T0 to T1 were observed for FP, DEX-Soc-self, DEX-Soc-proxy, BAFQ-SM-self, BAFQ-SM-proxy, BAFQ-Emp-self, BAFQ-Emp-proxy, QOLIBRI satisfaction, QOLIBRI burden, RQS-self, RQS-life partner, WAIS-III digit span, TMT A, TMT B/A, or TEA lottery. 3. Significant Time x Group interactions from T0 to T2 were observed for FEEST (p<0.01), CT (p=0.02), BAFQ-Emp-proxy (p=0.02), RRL (p<0.01), QOLIBRI burden (p=0.04), RQS-life partner (p=0.02), and TGA (p<0.01). No

Author, Year Country Study Design Sample Size	Methods	Outcome
	lottery), Dysexecutive Questionnaire-Social scales (DEX-Soc-self, DEX-Soc-proxy), Brock's Adaptive Functioning Questionnaire-Social monitoring scale (BAFQ-SM-self, BAFQ-SM-proxy), BAFQ empathy scale (BAFQ-Emp-self, BAFQ-Emp-proxy), Role Resumption List (RRL), Quality of Life after Brain Injury (QOLIBRI satisfaction, QOLIBRI burden), Treatment Goal Attainment (TGA), Relationship Quality Scale (RQS-self, RQS-life partner).	significant interactions from T0 to T2 were observed for FP, DEX-Soc-self, DEX-Soc-proxy, BAFQ-SM-self, BAFQ-SM-proxy, BAFQ-Emp-self, QOLIBRI satisfaction, RQS-self, WAIS-III digit span, TMT A, TMT B/A, or TEA lottery.
Neumann et al. (2015) USA RCT PEDro=9 $N_{Initial}$=71 N_{Final}=60	**Population:** TBI; *Faces (n=24)*: Mean Age=41 yr; Gender: Male=23, Female=1; Mean Time Post Injury=10.5yr; Mean GCS=6.9; *Stories (n=23)*: Mean Age=41.5 yr; Gender: Male=18, Female=5; Mean Time Post Injury=10.9 yr; Mean GCS=4.4; *Control (n=24)*: Mean Age=39.5 yr; Gender: Male=16, Female=8; Mean Time Post Injury=9.8yr; Mean GCS=5.3. **Intervention:** Participants randomly assigned to one of three interventions for 1 hr sessions 3 days/wk for 3 wk. Faces intervention taught individuals to recognize emotions in facial expressions, whereas stories intervention taught individuals to recognize emotion within stories. Control group underwent cognitive training. Participants assessed at pre-treatment and post-treatment within 4 days, at 3 mo and 6 mo. **Outcome Measure:** Diagnostic Assessment of Nonverbal Accuracy 2-Adult Faces (DANVA 2-AF), Emotional Inference from Stories Test (EIST), Interpersonal Reactivity Index (IRI), Neuropsychiatric Inventory (NPI) Irritability and Aggression domain.	1. According to DANVA 2-AF, participants trained in the face's intervention had a significant improvement across all follow-up time points compared to controls (p=0.031). 2. No significant improvement for the story's intervention on DANVA 2-AF compared to controls (p=0.239). 3. No significant improvement on EIST for the story's intervention (p=0.167) and faces (p=0.349) compared to controls. 4. Across all post-treatment assessments, there was a main effect of time as performance decreased for the story's intervention on EIST compared to controls (p=0.001). 5. NPI irritability and aggression and IRI empathy were not significant for faces or story interventions compared to controls.
McDonald et al. (2013) Australia RCT PEDro=6 N=20	**Population:** Severe TBI=16, CVA=3, Other=1; Mean Age=45.62 yr; Gender: Male=15, Female=5; Mean Time Post Injury=9.41 yr. **Intervention:** Participants were assigned to either a treatment group (n=10) or a control group (n=10). Participants receiving treatment attended 2hr/wk treatment sessions for 3 wk. Sessions consisted of a therapist and two participants. The program was tailored to focus on prosodic cues that may be seen in expressions of emotions. **Outcome Measure:** Awareness of Social Interference Test Form B-Part 1 (audio presentation), Prosodic Emotion Labelling Task, Communication Questionnaires.	1. No significant treatment effects were found for the TASIT B, while accuracy on the prosody task (p=0.074) and rating of intensity of emotions (p=0.076) approached significance. 2. The treatment group showed a significant change on the self-report communication questionnaire (p=0.013).
Radice-Neumann et al. (2009) USA RCT PEDro=5 N_{intial}=21	**Population:** TBI=19, ABI=2; Mean Age=43 yr; Gender: Male=12, Female=8; Mean Time Post Injury=12 yr; Mean GCS=4.08. **Intervention:** Participants were randomly assigned to receive either the facial affect recognition (FAR; n=10) training or the stories of emotional inference training (SEI; n=9). In the FAR training, individuals practiced	1. The FAR group improved on the DANVA2-AF over time (p<0.001), with changes being seen from pre-post (p<0.001) but not post to follow-up (p=0.244). 2. The SEI group also improved on the DANVA2-AF (p=0.006). The change occurred between the two pre-tests (p=0.004).

Author, Year Country Study Design Sample Size	Methods	Outcome
N_{final}=19	identifying and discriminating emotions from facial expressions and focused on processing their internal emotions. SEI involved reading stories and answering questions. Sessions were 1:1 for 1 hr, 3 x/wk for 2-3 wk. **Outcome Measure:** Levels of Emotional Awareness Scale (LEAS), Diagnostic Assessment of Nonverbal Affect – adult faces/adult paralanguage (DANVA2-AF and DANVA2-AP), Brock Adaptive Functioning Questionnaire (BAFQ).	3. No significant changes were found for either group on the DANVA2-AP or the ability to infer emotions on video. 4. Both groups improved on their ability to infer emotions from contextual situations (LEAS; both p=0.019). 5. On the BAFQ, caregivers, indicated those in the FAR group showed improvement in the behaviour of participants (p=0.042); out of 4 emotional behaviours, only aggression changed significantly (p=0.047); SEI did not improve in perceived behaviour.

Discussion

Westerhof-Evers et al. (2017) assigned participants to an experimental compensatory strategy intervention (T-ScEmo) aimed at enhancing emotion perception, or a computerized cognitive function training (Cogniplus) control condition. The experimental intervention included training in emotion recognition, theory of mind and social behavioural skills. The authors found that the T-ScEmo group showed significant improvements on facial affect recognition, with effects lasting up to 5 months post treatment. Additionally, participants in the experimental group showed improvements in proxy-rated empathic behavior (Westerhof-Evers et al., 2017).

Radice-Neumann et al. (2009) randomly assigned participants to an intervention on emotion processing from faces ('Facial affect recognition' - FAR), and an intervention on emotion processing from written context ('Stories of emotional inference' - SEI). The authors found that training focused on emotional processing (either by face affect recognition or by emotional inference training) can be effective when introduced to a group of individuals who had sustained an ABI. Participants in the FAR group showed improvements in emotion recognition, while participants in the SEI group did not; however, qualitative feedback from participants and their caregivers indicated that those in the SEI group felt more comfortable talking about their emotions and dealing with emotions in difficult situations (Radice-Neumann et al., 2009). In a later study by Neumann et al. (2015) participants were randomized to two similar interventions to enhance emotion processing, 'faces' and 'stories'. The authors found that participants who received the Facial Intervention showed a significant improvement in facial affect recognition, when compared to the Stories intervention and the control group. Participants in the Facial intervention showed improved ability to recognize emotions from facial expressions, as well as a decreased level of aggression; however, improvements in other psychosocial behaviours, such as empathy, were not observed (Neumann et al., 2015).

In terms of perceiving emotions in voice, independently from facial expression, McDonald et al. (2013) examined the effectiveness of an intervention to improve the ability to recognize emotional prosody in individuals with ABI. This short treatment consisted of mostly games designed to focus on prosodic cues but found no change related to communication competence. No significant treatment effects were found; however, participants in the treatment group self-reported that their ability to comprehend daily conversations had improved after the intervention (McDonald et al., 2013).

Conclusions

There is level 1b evidence that the Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo), when compared to Cogniplus, is effective for improving facial affect recognition in individuals with ABI (Westerhof-Evers et al., 2017).

There is level 1b evidence that facial affect recognition training and emotional inference training may improve emotion recognition in individuals with ABI (Neumann et al., 2015; Radice-Neumann et al., 2009).

There is level 1b evidence that a short intervention designed to improve the ability to recognize emotional prosody may not be effective in individuals with ABI (McDonald et al., 2013).

There is level 4 evidence that a Cognitive Pragmatic Treatment (CPT) program is effective in improving communicative-pragmatic abilities in individuals with ABI, particularly use of voice tone and gaze to communicate emotions (Gabbatore et al., 2015).

KEY POINTS

- The Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo) is effective for improving facial affect recognition in individuals with an ABI.
- Facial affect recognition and emotional interference training may improve emotion recognition post ABI.
- A short intervention designed to improve emotional prosody may not be effective post ABI.
- Cognitive Pragmatic Treatment (CPT) program is effective in improving communicative-pragmatic abilities such as voice tone and gaze to communicate emotions.

Alternative and Augmentative Communication

Following severe ABI, individuals present with significant communication challenges that interfere with daily communication needs. Whereas those who sustain a mild or moderate ABI may be more readily able to communicate using natural speech with minor difficulties, those with severe ABI may not be able to meet communication needs through speech alone and may benefit from an augmentative or

alternative communication (AAC) strategy (M. S. Bourgeois et al., 2001; Burke et al., 2004; de Joode et al., 2012; Fager et al., 2006; Johannsen-Horbach et al., 1985). While many individuals eventually recover their speech abilities post ABI, some individuals may remain unable to speak for extended periods of time; therefore, assessments and AAC interventions may be a continual process to ensure that the individual's level of function is matched appropriately with new systems as needed (Fager et al., 2006).

ACC comprises a group of components that improve communication, including low-tech options such as writing and photos, as well as high-tech options such as speech-generating devices and mobile apps (Dietz et al., 2020). Clinicians working with AAC, or Assistive/Enabling Technology are well acquainted with the recent explosion of technology options available. High-tech AAC methods integrate both hardware and software to support the communication needs of the individual through smart devices and dedicated AAC devices that offer a wide variety of features, such as speech generation (Elsahar et al., 2019).

While there is a great deal of discussion around the importance of AAC, there is limited literature supporting the effectiveness of the strategies currently available for ABI populations. Further research is required to understand how these communication approaches or alternatives work to benefit individuals with an ABI and their care partners.

Text-to-Speech Technology

Synthetic voice, or synthesized speech uses computer-generated text-to-speech can extract speech and sound components from words and then combine them to form a synthetic voice that sounds natural, facilitating message flexibility and allowing for greater accuracy of what the individual is trying to convey (JL Flaubert, 2017). Text-to-speech technology (TTS) has been used to assist individuals with aphasia to obtain access to digital texts, such as emails, newspapers, newsletters and articles (Hux et al., 2020)

TABLE 13 | Effectiveness of Text-to-Speech Technology post ABI

Author, Year Country Study Design Sample Size	Methods	Outcome
Harvey et al. (2013) USA Pre-Post N=9	**Population:** Severe TBI=9; Mean Age=35.78 yr; Gender: Male=8, Female=1; Mean Time Post Injury=10.89 yr. **Intervention:** Participants read 24 passages in two different scenarios, once without any training and once after receiving 6 sessions of computerized text-to-speech training. **Outcome Measure:** Reading rate, comprehension accuracy.	1. Reading rates were significantly faster after receiving training (p=0.036). 2. No significant difference between text-to-speech and no text-to-speech conditions were noted for comprehension accuracy (p=0.950).

Discussion

Harvey et al. (2013) examined comprehension, rate and perceptions and reading preferences of individuals with severe TBI. Participants completed six sessions of computerized text-to-speech (TTS) training. Results showed a significant improvement in reading rates during the TTS conditions compared to the no text-to-speech conditions; however, the use of TTS did not affect reading comprehension. The authors found that participants in the TTS condition read faster than those in the non-TTS condition These findings suggest that text-to-speech technology is a useful tool in improving reading rates among individuals with a TBI. In addition, participants reported perceived benefits related to the use of TTS in visual scanning, pronouncing unfamiliar words and sustaining attention (Harvey et al., 2013).

Conclusions

There is level 4 evidence that text-to-speech technology improves reading rate post TBI but not reading comprehension (Harvey et al., 2013).

KEY POINTS

- Text-to-speech technology improves reading rate, but not reading comprehension in individuals with severe TBI.

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 included semantic topic, geographic place, and first letter of alphabet. While participants 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.

Non-Electronic Communication Board

Assistive devices for AAC range in their properties and capabilities. Non-electronic communication boards, along with electronic counterparts, can aid individuals post ABI with messages and symbols depicted on the display. However, the number of messages they can display are limited, and they do not have the capacity for speech output (Iacono et al., 2011). This option would be ideal for people with complex communication needs, as they are easy to access, less expensive, and generally easier to use by individuals with ABI, their care partners and clinicians.

Eye-Gaze Communication Board

Gaze-based communication boards use computers controlled by the individual's eyes. This device replaces keyboard and mouse with eye gaze for those who have physical impairments that prevents the use of upper limb motor function (Borgestig et al., 2016). By using their eyes, individuals can control the computer and gain access to communication and activities, including playing games, music, and perform a range of activities that they would not otherwise be physically able to do (Borgestig et al., 2016). The limitation of this technology is that it is not as cost effective as other AAC devices, and novice users may experience fatigue quickly, as there is a substantial learning curve with the type of specific eye movements needed to operate the communication board (it does not mimic natural/intuitive eye movements required for daily activities) (Borgestig et al., 2016).

Bliss Symbols

Bliss symbols or boards have been available and utilized for several years. The use of these symbols has been found to be very effective with those who have been diagnosed with aphasia or Broca's aphasia (Rajaram et al., 2012). However, there is little in the literature specifically pertaining to individuals with an ABI.

Pictograms

Pictograms allow individuals to express their thoughts, emotions, wants and needs with pictures, as there is not a verbal explanation of all words. Pictogram-based ACC has been used for over 30 years and has been shown to help learn new linguistic skills (Pahisa-Solé & Herrera-Joancomartí, 2017).

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 SC & F, 1999). The selection of symbols should be appropriate to the individual's communicative needs. Picture/symbol software is also available for computers, iPads, and iPhones.

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 SC & F, 1999). A lexical communication board is another type of AAC that uses common words such as nouns, pronouns, verbs, and adjectives to improve sentence formation in individuals with ABI; however, this is not supported by academic sources and therefore requires further research.

Memory Aids

The use of memory aids as an AAC tool has been studied extensively in individuals with dementia and Alzheimer's, however their use in individuals with an ABI are not well documented. There are several different aids that can be used to compensate for memory loss and decline of cognitive and linguistic skills. Memory books are amongst the most popular and capitalize on procedural memory skills (page turning and reading aloud), they also promote transfer of information and increase social closeness. Memory aids help compensate for memory loss by helping to access stored information and memories, therefore they can be an extremely effective tool that are easily accessible and straightforward to use from the individual's perspective (M. Bourgeois et al., 2001). Please see Module 18 "Rehabilitation of Learning and Memory Deficits".

Sign Language

All the above AAC treatments are "aided" forms of communication, meaning they require external support by way of auxiliary materials (communication board, printed words, etc.) (Sigafoos & Drasgow, 2001). In contrast, natural gestures and sign language are forms of "unaided" AAC (Sigafoos & Drasgow, 2001). American Sign Language is the most commonly used; however, there are other systems including Pidgin Signed English (PSE) and Signed Exact English (SEE). The advantages of sign language include that it does not require materials or devices, and it can be easier to teach than speech (Sigafoos & Drasgow, 2001). There is no literature to support use of sign language in a ABI population specifically, therefore more research in this field is required to make conclusions about its efficacy as a potential therapy.

KEY POINTS

- Augmentative and alternative communication interventions designed to assist with organization, access, and efficiency of communication may be beneficial for individuals with severe ABI.

CONCLUSION

Individuals with brain injury often present with cognitive-communication and social cognition deficits. Impairments related to theory of mind (e.g., indirect communication, sarcasm) emotion recognition (e.g., facial/vocal affect recognition), and self-awareness, may negatively impact the way individuals with brain injury interact with others and their daily functioning (McDonald & Genova, 2021). Impairments related to pragmatic communication are also frequent in persons with ABI, hindering the individual's ability to follow rules of social interaction and self-monitoring capacity during when communicating with others (Dahlberg et al., 2006).

Difficulties with communication post ABI can potentially have a devastating effect the individual, affecting their ability to maintain meaningful relationships, as well as causing isolation, loneliness and decreased life satisfaction (Paice et al., 2020). Cognitive-communication impairments, should not be treated in isolation, and the individual's context and their everyday communication needs must be taken into consideration (Togher et al., 2014). In addition, recognizing the role of communication partners such as family members, friends, and professional caregivers, is critical when implementing interventions to remediate cognitive-communication in populations with ABI (Behn et al., 2021).

REFERENCES

Alashram, A. R., Annino, G., Padua, E., Romagnoli, C., & Mercuri, N. B. (2019, Aug). Cognitive rehabilitation post traumatic brain injury: A systematic review for emerging use of virtual reality technology. *J Clin Neurosci, 66*, 209-219. https://doi.org/10.1016/j.jocn.2019.04.026

Babbage, D. R., Yim, J., Zupan, B., Neumann, D., Tomita, M. R., & Willer, B. (2011). Meta-Analysis of Facial Affect Recognition Difficulties After Traumatic Brain Injury. *Neuropsychology, 25*(3), 277-285.

Barreca, S., Velikonja, D., Brown, L., Williams, L., Davis, L., & Sigouin, C. S. (2003). Evaluation of the effectiveness of two clinical training procedures to elicit yes/no responses from patients with a severe acquired brain injury: a randomized single-subject design. *Brain Injury, 17*(12), 1065-1075.

Behn, N., Francis, J., Togher, L., Hatch, E., Moss, B., & Hilari, K. (2021). Description and Effectiveness of Communication Partner Training in TBI: A Systematic Review. *The Journal of Head Trauma Rehabilitation, 36*(1), 56-71.

Behn, N., Marshall, J., Togher, L., & Cruice, M. (2019a, May). Feasibility and initial efficacy of project-based treatment for people with ABI. *Int J Lang Commun Disord, 54*(3), 465-478. https://doi.org/10.1111/1460-6984.12452

Behn, N., Marshall, J., Togher, L., & Cruice, M. (2019b, Sep). Setting and achieving individualized social communication goals for people with acquired brain injury (ABI) within a group treatment. *Int J Lang Commun Disord, 54*(5), 828-840. https://doi.org/10.1111/1460-6984.12488

Behn, N., Togher, L., Power, E., & Heard, R. (2012). Evaluating communication training for paid carers of people with traumatic brain injury. *Brain Inj, 26*(13-14), 1702-1715. https://doi.org/10.3109/02699052.2012.722258

Bhatnagar SC, & F, S. (1999). *Communicating with nonverbal patients in India: Inexpensive augmentative communication devices*. http://www.dinf.ne.jp/doc/english/asia/resource/apdrj/z13jo0400/z13jo0405.html

Bird, J., & Parente, R. (2014). Recognition of nonverbal communication of emotion after traumatic brain injury. *NeuroRehabilitation, 34*(1), 39-43.

Bond, F., & Godfrey, H. P. (1997, May). Conversation with traumatically brain-injured individuals: a controlled study of behavioural changes and their impact. *Brain Inj, 11*(5), 319-329. http://www.ingentaconnect.com/content/apl/tbin/1997/00000011/00000005/art00002?token=00521af6de2090228441333c4a2f7a7a6a763b49415d486b3c704f6d6222346b626876305021e044b6

Borgestig, M., Sandqvist, J., Parsons, R., Falkmer, T., & Hemmingsson, H. (2016). Eye gaze performance for children with severe physical impairments using gaze-based assistive technology: a longitudinal study. *Assistive technology, 28*(2), 93. http://uwo.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwrV1NT8JAEJ0oXryIosbvzIWehLRsK-3JEIV4MTEGPXhptnQpJAZKbY3wD_zXznZ3FYkHDh6a9LCZpJv5eLOd9xaAtZp2YyUnOIJAnMNdh-r1kJFTR9wOYtbmUXRFAGRVM8nMtOv9fPuz05PXSz1lr82P2fxaBa9djioyz9KR3fKtsW6uVHgGbBO2WqzN5F0H9-6LydmMYJMizWkLK8KhZbHpVeHTUHb0-LWRcjKNrFikvMhHqo9dEnT8_-_YhR2NWLGjXGwPNsSkBvVldWLsK2kCtPDxl_B3DaoP2g_Mmn0YdecCE74QmP6QFpBe0BDLUR4OI5VskdEiY0DyOcdZychDOa2flEYasgzHSC2ATFbvAvPvfwUHcNnr9m_uGmqPw1QJa4RS6vp2_NwJp1lCTxFSd0V48RAqk-lEHAE6gYgpOxOo4p47cJnPvSHnXhR5LBi4vnsM9bVMnqy57hS2CSDpI5czqORZIc5LEHJR-s8XSArsqg

Bosco, F. M., Bono, A., & Bara, B. G. (2012). Recognition and repair of communicative failures: The interaction between Theory of Mind and cognitive complexity in schizophrenic patients. *Journal of Communication Disorders, 45*(3), 181-197.

Bosco, F. M., Parola, A., Angeleri, R., Galetto, V., Zettin, M., & Gabbatore, I. (2018, Nov 2018

2019-01-15). Improvement of communication skills after traumatic brain injury: The efficacy of the cognitive pragmatic treatment program using the communicative activities of daily living. *Archives of Clinical Neuropsychology, 33*(7), 875-888. https://doi.org/http://dx.doi.org/10.1093/arclin/acy041

Bourgeois, M., Dijkstra, K., Burgio, L., & Allen-Burge, R. (2001). Memory aids as an augmentative and alternative communication strategy for nursing home residents with dementia. *Augmentative and Alternative Communication, 17*(3), 196-210. https://doi.org/10.1080/aac.17.3.196.210

Bourgeois, M. S., Dijkstra, K., Burgio, L., & Allen-Burge, R. (2001). Memory aids as an augmentative and alternative communication strategy for nursing home residents with dementia. *AAC: Augmentative and Alternative Communication, 17*(3), 196-210. http://www.scopus.com/inward/record.url?eid=2-s2.0-0035447395&partnerID=40&md5=804dcbfef37f37c631ad8483378ee9ad

Braden, C., Hawley, L., Newman, J., Morey, C., Gerber, D., & Harrison-Felix, C. (2010). Social communication skills group treatment: a feasibility study for persons with traumatic brain injury and comorbid conditions. *Brain Inj, 24*(11), 1298-1310. https://doi.org/10.3109/02699052.2010.506859

Brassel, S., Power, E., Campbell, A., Brunner, M., & Togher, L. (2021). Recommendations for the Design and Implementation of Virtual Reality for Acquired Brain Injury Rehabilitation: Systematic Review. *Journal of Medical Internet Research, 23*(7), e26344-e26344.

Brownell, H., Lundgren, K., Cayer-Meade, C., Milione, J., Katz, D. I., & Kearns, K. (2013, 2014-09-08). Treatment of metaphor interpretation deficits subsequent to traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 28*(6), 446-452. https://doi.org/http://dx.doi.org/10.1097/HTR.0b013e31825b5e85

Burke, R., Beukelman, D. R., & Hux, K. (2004, May). Accuracy, efficiency and preferences of survivors of traumatic brain injury when using three organization strategies to retrieve words. *Brain Inj, 18*(5), 497-507. https://doi.org/10.1080/02699050310001645784

Campbell, M. (2000). *Rehabilitation for traumatic brain injury: physical therapy practice in context* (2 ed.). Churchill Livingstone

Ciuffreda, K. J., Han, Y., Kapoor, N., & Ficarra, A. P. (2006). Oculomotor rehabilitation for reading in acquired brain injury. *NeuroRehabilitation, 21*(1), 9-21.

Coelho, C. A., DeRuyter, F., & Stein, M. (1996, Oct). Treatment efficacy: cognitive-communicative disorders resulting from traumatic brain injury in adults. *J Speech Hear Res, 39*(5), S5-17.

College of Audiologists and Speech Language Pathologists of Ontario. (2002). *Preferred practice guideline for cognitive-communication disorders*. http://www.caslpo.com/Portals/0/ppg/ppg_ccd.pdf

Copley, A., Smith, K., Savill, K., & Finch, E. (2015). Does metacognitive strategy instruction improve impaired receptive cognitive-communication skills following acquired brain injury? *Brain Inj, 29*(11), 1309-1316. https://doi.org/10.3109/02699052.2015.1043343

Dahlberg, C., Hawley, L., Morey, C., Newman, J., Cusick, C. P., & Harrison-Felix, C. (2006). Social communication skills in persons with postacute traumatic brain injury: Three perspectives. *Brain Injury, 20*(4), 425-435.

Dahlberg, C. A., Cusick, C. P., Hawley, L. A., Newman, J. K., Morey, C. E., Harrison-Felix, C. L., & Whiteneck, G. G. (2007). Treatment Efficacy of Social Communication Skills Training After Traumatic Brain Injury: A Randomized Treatment and Deferred Treatment Controlled Trial. *Arch Phys Med Rehabil, 88*(12), 1561-1573. http://www.scopus.com/inward/record.url?eid=2-s2.0-36348945113&partnerID=40&md5=2b45d9a093a5124259fe394fca72c3d7

http://ac.els-cdn.com/S0003999307014876/1-s2.0-S0003999307014876-main.pdf?_tid=8f3aabcc-a0b0-11e3-bb65-00000aacb35d&acdnat=1393616773_e22cbdf6d4146953d0a67002efac14ce

de Joode, E., Proot, I., Slegers, K., van Heugten, C., Verhey, F., & van Boxtel, M. (2012). The use of standard calendar software by individuals with acquired brain injury and cognitive complaints: a mixed methods study. *Disability and Rehabilitation: Assistive Technology, 7*(5), 389-398. https://doi.org/10.3109/17483107.2011.644623

Dietz, A., Wallace, S. E., & Weissling, K. (2020). Revisiting the Role of Augmentative and Alternative Communication in Aphasia Rehabilitation. *American Journal of Speech-Language Pathology, 29*(2), 909-913.

Douglas, J. M., Knox, L., De Maio, C., Bridge, H., Drummond, M., & Whiteoak, J. (2019, Jan). Effectiveness of Communication-specific Coping Intervention for adults with traumatic brain injury: preliminary results. *Neuropsychol Rehabil, 29*(1), 73-91. https://doi.org/10.1080/09602011.2016.1259114

Elsahar, Y., Hu, S., Bouazza-Marouf, K., Kerr, D., & Mansor, A. (2019). Augmentative and Alternative Communication (AAC) Advances: A Review of Configurations for Individuals with a Speech Disability. *Sensors (Basel, Switzerland), 19*(8), 1911.

Evans, K. J., & Evans, D. L. (2019). Interpretation of non-verbal cues by people with and without TBI: understanding relationship intentions. *International journal of language & communication disorders, 54*(3), 377-389.

Fager, S., Hux, K., Beukelman, D. R., & Karantounis, R. (2006, Mar). Augmentative and alternative communication use and acceptance by adults with traumatic brain injury. *Augment Altern Commun, 22*(1), 37-47. https://doi.org/10.1080/07434610500243990

Finch, E., Cornwell, P., Copley, A., Doig, E., & Fleming, J. (2017). Remediation of social communication impairments following traumatic brain injury using metacognitive strategy intervention: a pilot study. *Brain Inj, 31*(13-14), 1830-1839. https://doi.org/10.1080/02699052.2017.1346284

[Record #1 is using a reference type undefined in this output style.]

Gabbatore, I., Longobardi, C., & Bosco, F. M. (2022). Improvement of Communicative-pragmatic Ability in Adolescents with Autism Spectrum Disorder: The Adapted Version of the Cognitive Pragmatic Treatment. *Lanaugage Learning and Development, 18*(1), 62-80.

Gabbatore, I., Sacco, K., Angeleri, R., Zettin, M., Bara, B. G., & Bosco, F. M. (2015, Sep 2015 - Oct

Sep 2015 - Oct 2015

2017-09-25). Cognitive Pragmatic Treatment: A rehabilitative program for traumatic brain injury individuals. *The Journal of Head Trauma Rehabilitation, 30*(5), E14-E28. https://doi.org/http://dx.doi.org/10.1097/HTR.0000000000000087

Harvey, J., Hux, K., Scott, N., & Snell, J. (2013). Text-to-speech technology effects on reading rate and comprehension by adults with traumatic brain injury. *Brain Inj, 27*(12), 1388-1394. https://doi.org/10.3109/02699052.2013.823649

Hux, K., Brown, J. A., Wallace, S., Knollman-Porter, K., Saylor, A., & Lapp, E. (2020). Effect of Text-to-Speech Rate on Reading Comprehension by Adults With Aphasia. *American Journal of Speech-Language Pathology, 29*(1), 168-184.

Iacono, T., Lyon, K., & West, D. (2011). Non-electronic communication aids for people with complex communication needs. *International Journal of Speech-Language Pathology, 13*(5), 399-410. https://doi.org/10.3109/17549507.2011.482162

JL Flaubert, C. S., AM Jette. (2017). *The Promise of Assistive Technology to Enhance Activity and Work Participation.* National Academies of Sciences.

Johannsen-Horbach, H., Cegla, B., Mager, U., Schempp, B., & Wallesch, C. W. (1985). Treatment of chronic global aphasia with a nonverbal communication system. *Brain and Language, 24*(1), 74-82. http://www.scopus.com/inward/record.url?eid=2-s2.0-0021917242&partnerID=40&md5=7461c96e4ce0deaa7b0f2eab33b68ed9

Jorgensen, M., & Togher, L. (2009). Narrative after traumatic brain injury: A comparison of monologic and jointly-produced discourse. *Brain Injury, 23*(9), 727-740.

Keegan, L. C., Murdock, M., Suger, C., & Togher, L. (2020, Mar 24). Improving natural social interaction: Group rehabilitation after Traumatic Brain Injury. *Neuropsychol Rehabil, 30*(8), 1497-1522. https://doi.org/10.1080/09602011.2019.1591464

Kennedy, M. R., & Coelho, C. (2005). Self-Regulation after Traumatic Brain Injury: A Framework for Intervention of Memory and Problem Solving. *Seminars in Speech and Language, 26*(4), 242-255.

Kennedy, M. R. T., Coelho, C., Turkstra, L., Ylvisaker, M., Moore Sohlberg, M., Yorkston, K., Chiou, H. H., & Kan, P. F. (2008). Intervention for executive functions after traumatic brain injury: A systematic review, meta-analysis and clinical recommendations. *Neuropsychological Rehabilitation, 18*(3), 257-299. http://www.scopus.com/inward/record.url?eid=2-s2.0-45749127806&partnerID=40&md5=c14bafd7dcae4a98d1c6b3b862ee2d8e

http://www.tandfonline.com/doi/abs/10.1080/09602010701748644?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed

Kilov, A. M., Togher, L., & Grant, S. (2009). Problem solving with friends: Discourse participation and performance of individuals with and without traumatic brain injury. *Aphasiology, 23*(5), 584-605.

http://www.scopus.com/inward/record.url?eid=2-s2.0-68049084625&partnerID=40&md5=c7711292cff320d574938b0401540b3d

Llorens, R., Navarro, M. D., Alcaniz, M., & Noe, E. (2012). Therapeutic effectiveness of a virtual reality game in self-awareness after acquired brain injury. *Stud Health Technol Inform, 181*, 297-301.

MacDonald, S., & Wiseman-Hakes, C. (2010). Knowledge translation in ABI rehabilitation: A model for consolidating and applying the evidence for cognitive-communication interventions. *Brain Injury, 24*(3), 486-508. http://www.scopus.com/inward/record.url?eid=2-s2.0-77649095665&partnerID=40&md5=a162b8ff61640fba6b753ec1d079b562

http://informahealthcare.com/doi/pdfplus/10.3109/02699050903518118

McDonald, S., & Genova, H. (2021). The effect of severe traumatic brain injury on social cognition, emotion regulation, and mood. In K. M. Heilman & N. S.E (Eds.), *Handbook of clinical neurology* (Vol. 183, pp. 235-260).

McDonald, S., Togher, L., Tate, R., Randall, R., English, T., & Gowland, A. (2013). A randomised controlled trial evaluating a brief intervention for deficits in recognising emotional prosody following severe ABI [Article]. *Neuropsychological Rehabilitation, 23*(2), 267-286. https://doi.org/10.1080/09602011.2012.751340

10.1080/17549500902969477; Heilman, K.M., Bowers, D., Speedie, L.J., Coslett, H.B., Comprehension of affective and nonaffective prosody (1984) Neurology, 34, pp. 917-921; Hornak, J., Bramham, J., Rolls, E., Morris, R., O'Doherty, J., Bullock, P., Polkey, C.E., Changes in emotion after circumscribed surgical lesions of the orbitofrontal and cingulate cortices (2003) Brain: A Journal of Neurology, 126, pp. 1691-1712; Hornak, J., Rolls, E., Wade, D., Face and voice expression identification in patients with emotional and behavioural changes following ventral frontal lobe damage (1996) Neuropsychologia, 34, pp. 247-261; Knox, L., Douglas, J., Long-term ability to interpret facial expression after traumatic brain injury and its relation to social integration (2009) Brain and Cognition, 69, pp. 442-449; Leon, S.A., Rosenbek, J.C., Crucian, G.P., Hieber, B., Holiway, B., Rodriguez, A.D., Gonzalez-Rothi, L., Active treatments for aprosodia secondary to right hemisphere stroke (2005) Journal of Rehabilitation Research and Development, 42, pp. 93-101; Ley, P., (1972) Quantitative Aspects of Psychological Assessment: An Introduction, , London: Duckworth & Co. Ltd; Lovibond, P.F., Lovibond, S.H., (1995) The Depression, Anxiety and Stress Scale (DASS), , Psychology Foundation of Australia, Inc; McDonald, S., Flanagan, S., Martin, I., Saunders, C., The ecological validity of TASIT: A test of social perception (2004) Neuropsychological Rehabilitation, 14, pp. 285-302; McDonald, S., Flanagan, S., Rollins, J., (2011) The Awareness of Social Inference Test (Revised), , Sydney, Australia: Pearson Assessment; McDonald, S., Pearce, S., Clinical insights into pragmatic theory: Frontal lobe deficits and sarcasm (1996) Brain and Language, 53, pp. 81-104; McDonald, S., Saunders, J.C., Differential impairment in recognition of emotion across different media in people with severe traumatic brain injury (2005) Journal of the International Neuropsychological Society, 11, pp. 392-399; McDonald, S., Tate, R.L., Togher, L., Bornhofen, C., Long, E., Gertler, P., Bowen, R., Social skills treatment for people with severe, chronic

acquired brain injuries: A multicenter trial (2008) Archives of Physical Medicine and Rehabilitation, 89, pp. 1648-1659. , doi: 10.1016/j.apmr.2008.02.029; Milders, M., Fuchs, S., Crawford, J.R., Neuropsychological impairments and changes in emotional and social behaviour following severe traumatic brain injury (2003) Journal of Clinical & Experimental Neuropsychology, 25, pp. 157-172; Milders, M., Ietswaart, M., Crawford, J.R., Currie, D., Social behavior following traumatic brain injury and its association with emotion recognition, understanding of intentions, and cognitive flexibility (2008) Journal of the International Neuropsychological Society, 14, pp. 318-326; Pell, M.D., Cerebral mechanisms for understanding emotional prosody in speech (2006) Brain and Language, 96, pp. 221-234; Pell, M.D., Baum, S.R., Unilateral brain damage, prosodic comprehension deficits, and the acoustic cues to prosody (1997) Brain and Language, 57, pp. 195-214; Pell, M.D., Paulmann, S., Dara, C., Alasseri, A., Kotz, S.A., Factors in the recognition of vocally expressed emotions: A comparison of four languages (2009) Journal of Phonetics, 37, pp. 417-435; Radice-Neumann, D.P., Zupan, B.P., Tomita, M.P., Willer, B.P., Training emotional processing in persons with brain injury (2009) Journal of Head Trauma Rehabilitation Focus on Clinical Research and Practice, Part, 24, pp. 313-323; Reitan, R.M., (1992) Trail Making Test, , Tucson, AZ: Reitan Neuropsychological Laboratories; Robertson, I.H., Murre, J.M.J., Rehabilitation of brain damage: Brain plasticity and principles of guided recovery (1999) Psychological Bulletin, 125, pp. 544-575; Rosenbek, J.C., Crucian, G.P., Leon, S.A., Hieber, B., Rodriguez, A.D., Holiway, B., Gonzalez-Rothi, L., Novel treatments for expressive aprosodia: A phase i investigation of cognitive linguistic and imitative interventions (2004) Journal of the International Neuropsychological Society, 10, pp. 786-793. , doi:10.1017/S135561770410502X; Ross, E.D., Monnot, M., Neurology of affective prosody and its functional-anatomic organization in the right hemisphere (2008) Brain and Language, 104, pp. 51-74; Ruff, R.M., Light, R.H., Parker, S.B., Levin, H.S., Benton Controlled Oral Word Association Test: Reliability and updated norms (1996) Archives of Clinical Neuropsychology, 11, pp. 329-338; Spell, L.A., Frank, E., Recognition of nonverbal communication of affect following traumatic brain injury (2000) Journal of Nonverbal Behavior, 24, pp. 285-300; Stringer, A.Y., Treatment of motor aprosodia with pitch biofeedback and expression modelling (1996) Brain Injury, 10, pp. 583-590. , doi:10.1080/026990596124151; Temkin, N., Heaton, R.K., Grant, I., Dikmen, S.S., Detecting significant change in neuropsychological test performance: A comparison of four models (1999) Journal of the International Neuropsychological Society, 5, pp. 357-369; Watts, A.J., Douglas, J.M., Interpreting facial expression and communication competence following severe traumatic brain injury (2006) Aphasiology, 20, pp. 707-722; Wechsler, D., (1997) Wechsler Adult Intelligence Scale - Third Edition (WAIS-III), , San Antonio, TX: The Psychological Corporation; Wechsler, D., (1997) Wechsler Memory Scale - Third Edition (WMS-III), , San Antonio, TX: The Psychological Corporation; Wechsler, D., (2001) The Wechsler Test of Adult Reading (WTAR), , San Antonio, TX: The Psychological Corporation; Wilson, B.A., Baddeley, A., Evans, J., Shiel, A., Errorless learning in the rehabilitation of memory impaired people (1994) Neuropsychological Rehabilitation, 4, pp. 307-326; Ylvisaker, M., Hanks, R., Johnson-Greene, D., Perspectives on rehabilitation of individuals with cognitive impairment after brain injury: Rationale for reconsideration of theoretical paradigms (2002) Journal of Head Trauma Rehabilitation, 17, pp. 191-209; Ylvisaker, M., Jacobs, H.E., Feeney, T., Positive supports for people who experience behavioral and cognitive disability after brain injury: A review (2003) Journal of Head Trauma Rehabilitation, 18, pp. 7-32

Morrow, E. L., Hereford, A. P., Covington, N. V., & Duff, M. C. (2020). Traumatic brain injury in the acute care setting: assessment and management practices of speechlanguage pathologists. *Brain Injury, 34*(1), 1590-1609.

Neumann, D., Babbage, D. R., Zupan, B., & Willer, B. (2015, 2016-08-22). A randomized controlled trial of emotion recognition training after traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 30*(3), E12-E23. https://doi.org/http://dx.doi.org/10.1097/HTR.0000000000000054

Norman, R. S., Mueller, K. D., Huerta, P., Shah, M. N., Turkstra, L. S., & Power, E. (2022). Discourse Performance in Adults With Mild Traumatic Brain Injury, Orthopedic Injuries, and Moderate to Severe Traumatic Brain Injury, and Healthy Controls. *American Journal of Speech-Language Pathology, 31*(1), 67-83.

Pahisa-Solé, J., & Herrera-Joancomartí, J. (2017). Testing an AAC system that transforms pictograms into natural language with persons with cerebral palsy. *Assistive technology : the official journal of RESNA*, 1-9. https://doi.org/10.1080/10400435.2017.1393844

Paice, L., Aleligay, A., & Checklin, M. (2020, Mar 5). A systematic review of interventions for adults with social communication impairments due to an acquired brain injury: Significant other reports. *Int J Speech Lang Pathol*, 1-12. https://doi.org/10.1080/17549507.2019.1701082

Parola, A., Bosco, F. M., Gabbatore, I., Galetto, V., Zettin, M., & Marini, A. (2019, August). The impact of the Cognitive Pragmatic Treatment on the pragmatic and informative skills of individuals with traumatic brain injury (TBI). *Journal of Neurolinguistics, 51*, 53-62. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=emexa&AN=2001443905

https://ocul-uwo.primo.exlibrisgroup.com/openurl/01OCUL_UWO/01OCUL_UWO:UWO_DEFAULT?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rfr_id=info:sid/Ovid:emexa&rft.genre=article&rft_id=info:doi/10.1016%2Fj.jneuroling.2018.12.003&rft_id=info:pmid/&rft.issn=0911-6044&rft.volume=51&rft.issue=&rft.spage=53&rft.pages=53-62&rft.date=2019&rft.jtitle=Journal+of+Neurolinguistics&rft.atitle=The+impact+of+the+Cognitive+Pragmatic+Treatment+on+the+pragmatic+and+informative+skills+of+individuals+with+traumatic+brain+injury+%28TBI%29&rft.aulast=Parola

Pei, Y., & O'Brien, K. H. (2021). Reading Abilities Post Traumatic Brain Injury in Adolescents and Adults: A Systematic Review and Meta-Analysis. *American Journal of Speech-Language Pathology, 30*(2), 789-816.

Radice-Neumann, D., Zupan, B., Tomita, M., & Willer, B. (2009). Training emotional processing in persons with brain injury. *Journal of Head Trauma Rehabilitation, 24*(5), 313-323. http://www.scopus.com/inward/record.url?eid=2-s2.0-70350648724&partnerID=40&md5=c8abe30f7ed258f31dc6eb8a9188dabf

http://graphics.tx.ovid.com/ovftpdfs/FPDDNCIBKBEFML00/fs046/ovft/live/gv023/00001199/00001199-200909000-00002.pdf

Rajaram, P., Alant, E., & Dada, S. (2012). Application of the self-generation effect to the learning of blissymbols by persons presenting with a severe aphasia. *AAC: Augmentative and Alternative Communication, 28*(2), 64-73. http://www.scopus.com/inward/record.url?eid=2-s2.0-84861947737&partnerID=40&md5=d7d99fc2f605c238e9aff8ec1e6e757c

http://informahealthcare.com/doi/abs/10.3109/07434618.2011.653603

Rietdijk, R., Power, E., Attard, M., Heard, R., & Togher, L. (2020a, Jan 28). A Clinical Trial Investigating Telehealth and In-Person Social Communication Skills Training for People With Traumatic Brain Injury: Participant-Reported Communication Outcomes. *J Head Trauma Rehabil*. https://doi.org/10.1097/htr.0000000000000554

Rietdijk, R., Power, E., Attard, M., Heard, R., & Togher, L. (2020b, Feb 26). Improved Conversation Outcomes After Social Communication Skills Training for People With Traumatic Brain Injury and Their Communication Partners: A Clinical Trial Investigating In-Person and Telehealth Delivery. *J Speech Lang Hear Res, 63*(2), 615-632. https://doi.org/10.1044/2019_jslhr-19-00076

Rowley, D. A., Rogish, M., Alexander, T., & Riggs, K. J. (2017). Cognitive correlates of pragmatic language comprehension in adult traumatic brain injury: A systematic review and meta-analyses. *Brain Injury, 31*(12), 1564-1574.

Sackett DL, S. S., Richardson WS, Rosenberg W, Hayes RB. (2000). *Evidence-based medicine: how to practice and teach EBM* (2nd ed. ed.).

Sarno, M. T., Buonaguro, A., & Levita, E. (1986). Characteristics of verbal impairment in closed head injured patients. *Arch Phys Med Rehabil, 67*(6), 400-405. http://www.scopus.com/inward/record.url?eid=2-s2.0-0022454721&partnerID=40&md5=f68cd1ba493f5800c9183140822a6a19

Sigafoos, J., & Drasgow, E. (2001). Conditional Use of Aided and Unaided AAC: A Review and Clinical Case Demonstration. *Focus on Autism and Other Developmental Disabilities, 16*(3), 152-161. https://doi.org/10.1177/108835760101600303

Sim, P., Power, E., & Togher, L. (2013, Jun). Describing conversations between individuals with traumatic brain injury (TBI) and communication partners following communication partner training: Using exchange structure analysis. *Brain Inj, 27*(6), 717-742. https://doi.org/10.3109/02699052.2013.775485

Sisto, S. A., Forrest, G. F., & Glendinning, D. (2002, Winter). Virtual reality applications for motor rehabilitation after stroke. *Top Stroke Rehabil, 8*(4), 11-23. https://doi.org/10.1310/YABD-14KA-159P-MN6F

Solomon, N. P., Makashay, M. J., Kessler, L. S., & Sullivan, K. W. (2004). Speech-Breathing Treatment and LSVT for a Patient With Hypokinetic-Spastic Dysarthria After TBI. *Journal of medical speech-language pathology, 12*(4), 213-219.

Steel, J., & Togher, L. (2019). Social communication assessment after traumatic brain injury: a narrative review of innovations in pragmatic and discourse assessment methods. *Brain Injury, 33*(1), 48-61.

Strauss HM, & RS, P. (1994). Pragmatics and treatment. . In Chapey R (Ed.), *Language Intervention Strategies in Adult Aphasia.* (pp. 246-268). Williams & Wilkins.

Sumowski, J. F., Coyne, J., Cohen, A., & Deluca, J. (2014, Feb). Retrieval practice improves memory in survivors of severe traumatic brain injury. *Arch Phys Med Rehabil, 95*(2), 397-400. https://doi.org/10.1016/j.apmr.2013.10.021

Togher, L. (2013). Training communication partners of people with TBI: Communication really is a two way process. In S. McDonald, L. Togher, & C. Code (Eds.), *Social and communication disorders following traumatic brain injury*. Taylor & Francis Group.

Togher, L., McDonald, S., Code, C., & Grant, S. (2004). Training communication partners of people with traumatic brain injury: A randomised controlled trial. *Aphasiology, 18*(4), 313-335. http://www.scopus.com/inward/record.url?eid=2-s2.0-2442593538&partnerID=40&md5=ad58a8afca933e31749831f74975bf9e

Togher, L., McDonald, S., Tate, R., Power, E., & Rietdijk, R. (2013, Jul). Training communication partners of people with severe traumatic brain injury improves everyday conversations: a multicenter single blind clinical trial. *J Rehabil Med, 45*(7), 637-645. https://doi.org/10.2340/16501977-1173

Togher, L., McDonald, S., Tate, R., Rietdijk, R., & Power, E. (2016). The effectiveness of social communication partner training for adults with severe chronic TBI and their families using a measure of perceived communication ability. *NeuroRehabilitation, 38*(3), 243-255. https://doi.org/10.3233/NRE-151316

Togher, L., Wiseman-Hakes, C., Douglas, J., Stergiou-Kita, M., Ponsford, J., Teasell, R., Bayley, M., & Turkstra, L. S. (2014). INCOG Recommendations for Management of Cognition Following Traumatic Brain Injury, Part IV: Cognitive Communication. *Journal of Head Trauma Rehabilitation, 29*(4), 353-368.

Westerhof-Evers, H. J., Visser-Keizer, A. C., Fasotti, L., Schonherr, M. C., Vink, M., van der Naalt, J., & Spikman, J. M. (2017, Sep/Oct). Effectiveness of a Treatment for Impairments in Social Cognition and Emotion Regulation (T-ScEmo) After Traumatic Brain Injury: A Randomized Controlled Trial. *J Head Trauma Rehabil, 32*(5), 296-307. https://doi.org/10.1097/htr.0000000000000332

Wielaert, S. M., Sage, K., Heijenbrok-Kal, M. H., & Van De Sandt-Koenderman, M. W. M. E. (2016). Candidacy for conversation partner training in aphasia: findings from a Dutch implementation study [Article]. *Aphasiology, 30*(6), 699-718. https://doi.org/10.1080/02687038.2015.1100707

Wiseman-Hakes, C., Ryu, H., Lightfoot, D., Kukreja, G., Colantonio, A., & Matheson, F. I. (2020). Examining the Efficacy of Communication Partner Training for Improving Communication Interactions and Outcomes for Individuals With Traumatic Brain Injury: A Systematic Review. *Archives of Rehabilitation Research and Clinical Translation, 2*(1), Article 100036. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=emexb&AN=2004744759

https://ocul-uwo.primo.exlibrisgroup.com/openurl/01OCUL_UWO/01OCUL_UWO:UWO_DEFAULT?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rfr_id=info:sid/Ovid:emexb&rft.genre=article&rft_id=info:doi/10.1016%2Fj.arrct.2019.100036&rft_id=info:pmid/&rft.issn=2590-1095&rft.volume=2&rft.issue=1&rft.spage=100036&rft.pages=&rft.date=2020&rft.jtitle=Archives+of+Rehabilitation+Research+and+Clinical+Translation&rft.atitle=Examining+the+Efficacy+of+Communication+Partner+Training+for+Improving+Communication+Interactions+and+Outcomes+for+Individuals+With+Traumatic+Brain+Injury%3A+A+Systematic+Review&rft.aulast=Wiseman-Hakes

Wiseman-Hakes, C., Stewart, M. L., Wasserman, R., & Schuller, R. (1998, Dec). Peer group training of pragmatic skills in adolescents with acquired brain injury. *J Head Trauma Rehabil, 13*(6), 23-36.

Yeo, Y. X., Pestell, C. F., Bucks, R. S., Allanson, F., & Weinborn, M. (2021). Metacognitive knowledge and functional outcomes in adults with acquired brain injury: A meta-analysis. *Neuropsychological Rehabilitation, 31*(3), 453-4778.