ASHA American Speech-Language-Hearing Association

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Clinical Practice Guidelines

American Speech-Language-Hearing Association Clinical Practice Guideline: Cognitive Rehabilitation for the Management of Cognitive Dysfunction Associated With Acquired Brain Injury

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ABSTRACT

Background: Cognitive-communication impairments following acquired brain injury (ABI) can have devastating effects on a person's ability to participate in community, social, vocational, and academic preinjury roles and responsibilities. Guidelines for evidence-based practices are needed to assist speech-language pathologists (SLPs) and other rehabilitation specialists in the delivery of cognitive rehabilitation for the adult population.
Purpose: The American Speech-Language-Hearing Association, in conjunction with a multidisciplinary panel of subject matter experts, developed this guideline to identify best practice recommendations for the delivery of cognitive rehabilitation to adults with cognitive dysfunction associated with ABI.
Method: A multidisciplinary panel identified 19 critical questions to be addressed in the guideline. Literature published between 1980 and 2020 was identified based on a set of a priori inclusion/exclusion criteria, and main findings were pooled and organized into summary of findings tables. Following the principles of the Grading of Recommendations Assessment, Development and Evaluation Evidence to Decision Framework, the panel drafted recommendations, when appropriate, based on the findings, overall quality of the evidence, balance of benefits and harms, patient preferences, resource implications, and the feasibility and acceptability of cognitive rehabilitation.
Recommendations: This guideline includes one overarching evidence-based recommendation that addresses the management of cognitive dysfunction following ABI and 11 subsequent recommendations focusing on cognitive rehabilitation treatment approaches, methods, and manner of delivery. In addition, this guideline includes an overarching consensus-based recommendation and seven additional consensus recommendations highlighting the role of the SLP in the screening, assessment, and treatment of adults with cognitive dysfunction associated with ABI. Future research considerations are also discussed.

Correspondence to Tobi Frymark: tfrymark@asha.org. ***Disclosure:*** *Jessica Brown is a co-investigator on a R-15 grant for Strategies to Accommodate Reading (STAR) and received payment as a guest lecturer for Traumatic Brain Injury Conference (2020). Timothy J. Wolf is a paid consultant with OTs for the city of Oslo, Norway, regarding assessments and interventions related to functional cognition, and a Courage Kenny Rehabilitation Institute paid consultant on a military-funded research project related to developing a functional cognitive assessment for service members; is a paid guest lecturer on neurorehabilitation and cognition for Braintree Rehabilitation Hospital and Nevada Occupational Therapy Association; and receives royalties from American Occupational Therapy Association Press for two textbooks currently in print related to stroke rehab and functional cognition. Tobi Frymark and Rebecca Bowen are employed by the American Speech-Language-Hearing Association. The other authors have declared that no competing financial or nonfinancial interests existed at the time of publication.*

The American Speech-Language-Hearing Association (ASHA), in conjunction with a multidisciplinary panel of subject matter experts, has developed evidence-based clinical practice recommendations for the management of cognitive dysfunction associated with acquired brain injury (ABI) based on a systematic review and meta-analysis of 112 studies published between 1980 and 2020. Given the current state of the evidence, implementation considerations, and the balance of benefits and harms, ASHA recommends the following when treating adults with cognitive dysfunction following ABI (see Table 1).

Introduction

This evidence-based clinical practice guideline is an official statement of ASHA, providing recommendations for the provision of cognitive rehabilitation for adults with nondegenerative ABIs including diagnoses such as traumatic brain injury (TBI), stroke, and tumors. Clinicians must determine the applicability of the guideline and its recommendations based on expertise, knowledge, and the unique circumstances and preferences of the individual patient and their caregivers.

Table 1. Executive summary recommendations.

Evidence-based recommendations	**Adults with cognitive dysfunction associated with acquired brain injury (ABI) should receive holistic, integrated cognitive rehabilitation that is clinician directed, person centered, and evidence based (recommendation, low certainty).**
Evidence-based recommendations include:	❖ Restorative treatment approaches to reduce impairment and improve function. ❖ Compensatory treatment approaches to manage cognitive impairments and limitations and improve function and self-awareness of injury. ❖ Domain-specific treatment approaches targeting impaired attention, memory, executive function, and/or social communication skills. ❖ Comprehensive interventions using a combination of treatment approaches for the management of generalized cognitive dysfunction. ❖ Activities delivered using decontextualized and contextualized treatments. Emphasis should be placed on contextualized treatments targeting cognitive-communication skills in the functional context in which the individual lives, works, and/or studies to maximize applicability of treatment and encourage generalization and carryover. ❖ Consideration of demographic and other factors that may contribute to a patient's response to intervention. ❖ Cognitive rehabilitation initiated as early as possible for optimal outcomes. ❖ Treatment initiated and extended beyond the acute phase of recovery based on progress, trajectory of functional improvement, and individualized (attainable/meaningful) goals. ❖ Group treatment as an adjunct to individual treatment or as the primary service delivery model when appropriate to offer peer support and facilitate practice of learned skills and generalization. ❖ Computer-based treatment programs when part of a clinician-directed, comprehensive cognitive rehabilitation plan. ❖ Services delivered by telepractice (virtual modality) when feasible and appropriate to meet the needs of the individual.
Consensus-based practice recommendations	**Speech-language pathologists (SLPs) play a central role in the screening, assessment, and treatment of adults with cognitive dysfunction associated with ABI (consensus recommendation).**
Consensus-based recommendations include:	❖ Care coordination as part of an integrated and holistic approach to cognitive rehabilitation and collaboration with an interdisciplinary team or referral to appropriate professionals with training and expertise in adults with ABI. The interdisciplinary team should include SLPs when cognitive-communication skills are affected following ABI. ❖ Successful treatment planning and rehabilitation of cognitive dysfunction in adults with ABI with a timely, symptom-focused assessment of cognitive-communication skills by an SLP. The comprehensive assessment should include a variety of objective, subjective, and ecologically valid measures appropriate for detecting functionally significant impairments in the ABI population. ❖ Tools such as the Goal Attainment Scale to assist in the development of individualized, meaningful, time-limited, and measurable treatment goals. Use of patient-reported outcome measures to facilitate tracking of perceived functional progress and patient satisfaction. ❖ Cognitive rehabilitation with consideration of the patient's views, cultural and linguistic background, premorbid lifestyle, and the activity limitation and participation restriction components within the WHO International Classification of Functioning, Disability and Health framework. ❖ A plan of care developed in concert with the patient and their family with shared decision making and identification of personally relevant goals targeting cognitive-communication skills that impact day-to-day function. ❖ A therapeutic alliance based on trust. A therapeutic alliance is paramount to the success of rehabilitation and ensures realistic treatment expectations. ❖ Dynamic assessment and monitoring of functional performance to determine response to treatment. Cognitive rehabilitation by an SLP should allow for modifications based on the individual needs, progress, and goals of the patient, which can change over the course of ABI recovery.

Note. WHO = World Health Organization.

In line with current best practices in guideline development, ASHA based its guideline methodology on the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach (Guyatt et al., 2008). The guideline was developed by a multidisciplinary panel made up of subject matter experts involved in the delivery of services to adults with ABI and methodologists from ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP; see Table 2). Each panel member submitted a written disclosure statement prior to initiating the guideline development work. No conflicts of interest impeded participation on the guideline committee.

Guideline recommendations were formulated based on a comprehensive systematic review of the research and the overall quality and estimated effects of the evidence. These findings and considerations of the balance of benefits and harms of cognitive rehabilitation; patient/caregiver values and preferences; and the feasibility, acceptability, and resource implications were carefully considered by the panel to determine recommendations.

Prior to publication, this guideline underwent widespread and select peer review. All peer reviewer comments were reviewed and addressed by authors, and the document was modified as needed. To ensure up-to-date clinical information is provided to speech-language pathologists (SLPs), other health care professionals, and interested stakeholders, this guideline will be reviewed and updated at 5-yearly intervals or earlier if needed in response to new evidence.

Purpose and Scope

This guideline was developed to address the rehabilitation needs of adults with cognitive dysfunction associated with ABI. It aims to highlight the management options for cognitive rehabilitation supported by scientific evidence to help SLPs, other clinicians, patients, and patient advocates make evidence-informed treatment decisions and improve patient care. Although SLPs may be involved in many aspects of care for individuals with ABI (e.g., diagnosis, assessment, treatment, and education/counseling), the focus of this guideline was to describe and evaluate the effectiveness of evidence-based cognitive and communicative treatment practices implemented by SLPs across the rehabilitation spectrum (e.g., acute care to community reentry and reintegration) and make recommendations, where applicable, to improve the quality of care. Such a guideline is beneficial given the high level of SLP involvement in clinical care of this population and the varying levels of confidence and knowledge that SLPs report when working with individuals with ABI (O'Brien, 2020; Riedeman & Turkstra, 2018). Subsequent changes in clinical education (Morrow et al., 2021) and provision of practice guidelines based on empirical evidence are important components in the advancement for the SLP-related care of individuals following ABI.

Intended Audience

Although ABIs can occur at any time during the life span, this guideline is intended for SLPs working with adult populations. Other audiences include patients and their families or caregivers, other rehabilitation specialists, payers, and policy makers.

Population

The Brain Injury Association of America (BIAA) defines ABI as an injury to the brain occurring after birth that is not hereditary, congenital, degenerative, or induced

Table 2. Guideline development team.

Panel	Name	Discipline	Organization
Guideline Development Panel members	Jessica Brown, PhD, CCC-SLP	Speech-language pathology	The University of Arizona
	Darryl Kaelin, MD	Physical medicine & rehabilitation	University of Louisville
	Erin Mattingly, MA, CCC-SLP, CBIS	Speech-language pathology	Loyal Source Government Services
	Catherine Mello, BA, CBIS	Patient advocate	Brain Injury Association of Maryland
	E. Sam Miller, MEd, CRC	Vocational rehabilitation	Maryland State Department of Education
	Gina Mitchell, MA, CCC-SLP	Speech-language pathology	Mayo Clinic
	Linda M. Picon, MCD, CCC-SLP	Speech-language pathology	U.S. Department of Veterans Affairs
	Brigid Waldron-Perrine, PhD, ABPP-ABCN	Neuropsychology	University of Michigan/Michigan Medicine
	Timothy J. Wolf, OTD, PhD, OTR/L, FAOTA	Occupational therapy	University of Missouri
N-CEP staff	Rebecca Bowen, MA, CCC-SLP	Methodologist	American Speech-Language-Hearing Association
	Tobi Frymark, MA, CCC-SLP	Methodologist	American Speech-Language-Hearing Association
	Beverly Wang, MLIS	Information manager	American Speech-Language-Hearing Association

Note. N-CEP = National Center for Evidence-Based Practice in Communication Disorders.

Table 3. Common causes of traumatic and nontraumatic brain injuries.

Traumatic brain injuries	Nontraumatic brain injuries
Motor vehicle accident	Stroke
Sports or recreation injury	Tumors
Assault	Infection (e.g., meningitis, encephalopathy)
Falls	Neurotoxic exposure (e.g., carbon monoxide, lead)
Gunshot wound	Hypoxia or anoxia (e.g., drowning, choking)
Blast injury	Overdose
	Seizure
	Metabolic disorders

by birth trauma (BIAA, n.d.). The term "ABI" encompasses, but is not limited to, etiologies such as TBI, as well as non-TBIs such as stroke, brain tumor resections, and anoxic/hypoxic events (see Table 3).

TBIs are defined as either a penetrating/open injury (e.g., a gunshot wound directly to the head) resulting from external forces to the skull/brain or a nonpenetrating/closed injury (e.g., a blow to the head) resulting from external forces to the skull/brain (American Psychiatric Association, 2013). This can also include nondirect impact injuries because of the brain undergoing an accelerating/decelerating movement (e.g., trauma generated from a blast or explosion or as a result of whiplash). Although TBI can be focal (confined to one area of the brain), closed injury is typically diffuse (occurs in more than one area). The main mechanism of injury responsible for diffuse damage stems from a rapid accelerating–decelerating blow to the head, which can lead to shearing, bleeding, bruising, or swelling of the brain. Secondary damage, including neurotransmitter release, free-radical generation, calcium-mediated damage, gene activation, mitochondrial dysfunction, and inflammatory responses, can develop hours or days postinjury (Maas et al., 2008).

According to the Centers for Disease Control and Prevention (CDC, 2015), TBI is classified as mild, moderate, or severe in nature. Although there is no standard classification system for TBI, most systems use loss of consciousness; altered consciousness; post-traumatic amnesia; neuroimaging; and the Glasgow Coma Scale (GCS) to stratify injuries into mild, moderate, and severe. The latter, the GCS, is a tool used to evaluate a person's level of consciousness by assessing motor responsiveness, verbal performance, and eye opening (Teasdale & Jennett, 1974). Severity and initial GCS score are often used as predictors of TBI recovery (Baum et al., 2016). Table 4 highlights the two most common severity classification systems from the BIAA (2021) and the Department of Veterans Affairs/Department of Defense (VA/DoD, 2021).

Mild TBIs (mTBIs) account for up to 80% of all TBIs (Skandsen et al., 2019). Although most mTBIs result in full recovery within weeks of injury occurrence in adult populations (Alexander, 1995; Iverson, 2005), a subset of individuals will experience persistent symptoms at 3 months (approximately 30%; Rabinowitz & Levin, 2014) or greater than 1 year (approximately 10%–15%; Theadom et al., 2016) post mTBI. Of note, symptoms reported following mTBI beyond the acute phase often do not correlate with objective cognitive measures (Stulemeijer et al., 2007) but can have a significant impact on function and quality of life. Other factors such as negative expectations of recovery or symptom misattribution may impact the trajectory of individuals sustaining mTBI (Niesten et al., 2020; Rohling et al., 2012).

Table 4. Traumatic brain injury severity classification.

Severity	Criteria	VA/DoD	BIAA
Mild	Imaging	Normal	Normal
	Loss of consciousness	0–30 min	Brief, if any
	Post-traumatic amnesia	0–24 hr	—
	Alteration in consciousness/mental state	A moment–24 hr	—
	Other signs and symptoms	—	Lethargy, memory loss, vomiting, and dizziness
Moderate	Imaging	Normal or abnormal	Signs of injury on neuroimaging
	Loss of consciousness	> 30 min and < 24 hr	Up to 24 hr
	Post-traumatic amnesia	> 24 hr and < 7 days	—
	Alteration in consciousness/mental state	> 24 hr, severity determined by other criteria	—
	Other signs and symptoms	—	Signs of brain trauma, contusions, or bleeding
Severe	Imaging	Normal or abnormal	Signs of injury on neuroimaging
	Loss of consciousness	> 24 hr	> 24 hr (coma)
	Post-traumatic amnesia	> 7 days	—
	Alteration in consciousness/mental state	> 7 days, severity based on other criteria	—
	Other signs and symptoms	—	No sleep/wake cycle during loss of consciousness

Note. VA/DoD = Department of Veterans Affairs/Department of Defense; BIAA = Brain Injury Association of America.

Moderate and severe TBIs make up approximately 25% of all TBIs (National Center for Injury Prevention and Control, 2003). Although these types of injuries are less common, they are associated with a higher level of morbidity, lasting cognitive impairment, and significant or even permanent activity limitations (Colantonio et al., 2004; Dikmen et al., 2003).

Nontraumatic ABIs reflect a wide variety of etiologies resulting from internal forces or changes to brain structure and function. Nontraumatic etiologies of ABI commonly result from lack of oxygen, infectious diseases, and exposure to toxins (see Table 2). Thus, damage can be either focal or diffuse in nature, depending on presented etiology; however, many common causes of nontraumatic ABI (e.g., stroke) result in focal damage to specific regions of the brain.

The location and the size of the portion of the brain deprived of oxygen during a stroke determine the level of severity. Strokes are typically classified first as ischemic or hemorrhagic and then as minor, moderate, moderate–severe, or severe. Ischemic strokes are the most common and result from a blockage of oxygen-rich blood flow through an artery. Hemorrhagic strokes are less common and occur when an artery leaks blood or ruptures (CDC, 2020).

The National Institutes of Health Stroke Scale (NIHSS) is commonly used to measure stroke severity (Lyden, 2017). On a 3- or 4-point ordinal scale, it examines level of consciousness, orientation, response to commands, gaze, visual fields, facial movement, arm and leg motor function, limb ataxia, sensory loss, language, articulation, and inattention to stratify stroke severity (see Table 5). Both baseline stroke severity and change in severity within the first 24 hr after stroke are often used as predictors of patient outcome (Wouters et al., 2018).

According to the American Heart Association (2019), 10% of those who sustain a stroke will recover almost completely and 25% will recover with minor impairments. However, over 50% experience moderate-to-severe impairments requiring specialty care.

Economic and Societal Cost of ABI

ABI is a serious public health problem in the United States. Each year, over 2.5 million Americans experience ABI—that is, approximately 1.7 million people sustain a TBI and approximately 795,000 Americans have a stroke (CDC, 2015; Faul et al., 2010; Go et al., 2013). Additionally, according to the National Center for Injury Prevention and Control (2003), an estimated cumulative 5.3 million individuals are living with a TBI-related disability in the United States. This represents a prevalence of approximately 2% of the U.S. population (CDC, 2015). Other data suggest the prevalence of U.S. TBI-related disability after hospitalization to be 3.2 million (Zaloshnja et al., 2008) and estimate that approximately 775,000 older adults live with long-term disability associated with TBI (Zaloshnja et al., 2008). Like TBI, stroke is a leading cause of disability in the United States (Virani et al., 2020). Stroke prevalence is roughly 3% of the adult population, with the incidence rapidly increasing with age (Roger et al., 2011). Approximately 75% of strokes occur in adults aged 65 years or older, and the risk doubles every 10 years after 55 years of age (Virani et al., 2020).

Table 5. National Institutes of Health Stroke Scale score.

Stroke severity	Score
No stroke symptoms	0
Minor stroke	1–4
Moderate stroke	5–15
Moderate-to-severe stroke	16–20
Severe stroke	21–42

Direct and indirect medical costs of TBI are approximately $76.5 billion annually, with nearly 90% of the total medical costs related to fatal TBIs and those TBIs requiring hospitalization (Coronado et al., 2012; Finkelstein et al., 2006). Other cost analysis data estimate the annual direct cost burden of TBI (e.g., hospitalization) to be $302 million and indirect cost burden (e.g., lost productivity) to be $2.8 billion (Humphreys et al., 2013; Runge, 1993; Schulman et al., 2002). The estimated annual cost relative to care of individuals with stroke is approximately $34 billion (Virani et al., 2020). These costs are expected to reach $1.1 trillion by 2035, with direct medical costs of $748 billion and indirect costs of $368 billion (Benjamin et al., 2018).

ABI and Cognition

A hallmark feature of all ABIs is cognitive dysfunction, which may include impairments in basic and complex processing of visual and auditory information, attention, memory, executive functioning, and communication (CDC, 2015; Rabinowitz & Levin, 2014). Impairments may be present immediately following injury and may persist beyond the acute phase of recovery (Selassie et al., 2008; Sun et al., 2014), resulting in long-term effects on an individual's ability to independently complete basic (e.g., bathing, dressing, feeding) and instrumental (e.g., money management, medication management) activities of daily living and participate in preinjury roles and responsibilities (e.g., interacting and participating in social exchanges, return to vocational or academic environments; Hofgren et al., 2010). Cognitive impairments following brain injury can impact communication functioning (termed *cognitive-communication disorder*) and may substantially influence an individual's relationship with family and friends, resulting in caregiver distress, depression, and deterioration of family functioning (Anderson et al., 2002; Katz et al., 2015; Kreutzer et al., 2009; Ponsford & Schönberger, 2010). Incidence rates of cognitive-communication disorders in individuals with ABI have been reported to be as high as 75%–100% (Côté et al., 2007; Ferré et al., 2011; Halper et al., 1991; Hinckley, 2014). Table 6 provides

Table 6. Signs and symptoms of difficulties within cognitive domains.

Cognitive domain	Potential impairment	Functional impact
Attention	• Difficulty in shifting attention between tasks • Difficulty with selective attention • Impaired sustained attention (e.g., for task completion) • Reduced attention span	• Difficulty holding a conversation or focusing on one conversation when many people are talking • Difficulty reading or following a television program
Memory and learning	• Impaired short-term memory • Deficits in working memory • Difficulty with prospective memory • Difficulty retrieving information from memory	• Difficulty following instructions • Difficulty remembering to perform a planned task such as taking medication
Orientation	• Deficits in orientation to self, situation, location, and/or time	• May become confused or agitated
Executive functioning	• Difficulty with decision making • Impaired cognitive flexibility • Impaired judgment • Poor initiation and self-monitoring skills • Poor reasoning and problem solving • Difficulty with planning and organization • Difficulty with goal setting	• Unable to perform tasks that require multiple steps such as dressing, shopping, or cooking • Difficulty planning, scheduling, and keeping track of important appointments
Metacognition	• Reduced deficit awareness • Lack of insight	• Poor judgment regarding what is safe vs. unsafe behavior • Inability to follow rules • Inability to live independently
Social communication	• Difficulty following rules of communication • Tendency to be tangential/verbose or inhibiting inappropriate language or behavior • Difficulty using or interpreting nonverbal communication effectively (e.g., tone of voice, facial expression, body language) • Impaired social cognition skills (e.g., difficulty regulating emotion, expressing emotion, and perceiving emotion of others; inability to take the perspective of others and to modify language accordingly)	• Inability to establish and maintain relationships, hold a job • Difficulty understanding and adhering to social norms and boundaries

examples of cognitive impairments across a variety of domains, as well as the potential functional impact of such impairments on successful return to work, daily living, and independence in adults following ABI.

Cognitive Rehabilitation and the Role of the SLP

The Brain Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine defines cognitive rehabilitation as a "systematic, functionally oriented service of therapeutic activities that is based on assessment and understanding of the person's brain-behavioral deficits" (Harley et al., 1992, p. 63). Cognitive rehabilitation may be viewed as an umbrella term for a variety of intervention techniques that addresses impairments in one or more cognitive domains with the overarching goal to enhance successful daily functioning and independence and reduce impairment by (a) reinforcing, strengthening, or reestablishing previously learned patterns of behavior (e.g., restoration); (b) establishing new patterns of cognitive activity (e.g., neuroplasticity); or (c) compensating for impaired neurological systems.

Cognitive rehabilitation is shown to be most effective when administered using a coordinated, patient-centered interprofessional team approach with the patient and their family included as active members of the rehabilitation team (Cicerone et al., 2019; Joint Committee on Interprofessional Relations Between the American Psychological Association and the American Speech-Language-Hearing Association, 2007). This approach encourages collaboration and joint decision making based on the unique values, preferences, and cultural traditions of the patient (Institute of Medicine, 2001; Kramer et al., 2014). It also fosters patient autonomy and choice in goal setting, allowing for a more customized plan of care targeting meaningful activities (Kramer et al., 2014).

In addition to patients and families, team members will include representatives from medical, mental health, and the various rehabilitation disciplines that support recovery from ABI. When cognitive-communication skills are affected following ABI, SLPs are integral to this interdisciplinary team. SLPs are well suited for involvement in neurorehabilitation efforts given their in-depth training in cognitive and communicative impairments across care settings and populations. Evidence exists documenting the role and expertise of SLPs in assessing and enhancing care of adult populations following all ABI severities (Ackley & Brown, 2020; Gilmore et al., 2019; Henderson et al., 2019; MacDonald & Wiseman-Hakes, 2010; Togher et al., 2014) and the practical implementation of SLP services to support cognitive, communicative, and swallowing impairments following injury (ASHA, 2003; Coreno & Ciccia, 2020; Hardin & Kelly, 2019; Wertheimer et al., 2008).

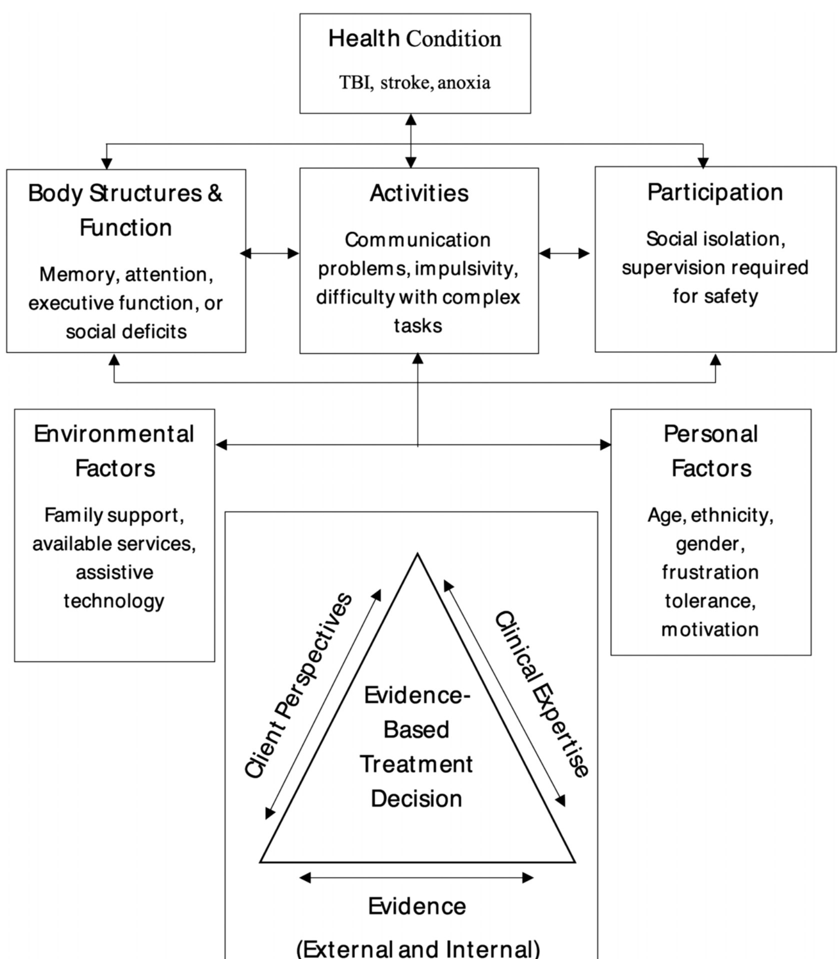
Evidence-Based Treatment Decisions in Cognitive Rehabilitation

Prior to initiating treatment, SLPs should engage patients in holistic and comprehensive assessments consistent with the World Health Organization's (WHO's) International Classification of Functioning, Disability and Health (ICF; WHO, 2001). In this manner, evaluation will focus on functioning at impairment, activity, and participation levels through procurement of data sources such as patient-reported measures; standardized, objective assessment; and performance on functional, real-world tasks (ASHA, 2004b). Following such an evaluation, implementation of treatment is recommended based on the principles of evidence-based practice (EBP) with development of goals that are functional and relevant and crafted with the clinician's expert input, as well as input from the patient and their family (ASHA, 2004a; Sackett et al., 2000).

Use of the ICF and EBP models prior to treatment implementation may serve to foster patient-centered care, enhance patient motivation and buy-in, increase treatment fidelity, improve functional outcomes, and maintain treatment gains (Bilbao et al., 2003; Melin, 2018). It is only then that distinct treatment planning and decision making can occur. Figure 1 illustrates the importance of using the ICF as a framework to help inform collaborative evidence-based treatment decisions for adults with cognitive dysfunction following ABI.

When making informed evidence-based treatment decisions to support individuals with cognitive dysfunction associated with ABI, SLPs must consider aspects including, but not limited to, the target of treatment, potential or anticipated treatment aims and outcomes, evidence behind treatment approaches or methods, and specific

Figure 1. Cognitive rehabilitation using the International Classification of Functioning, Disability and Health and evidence-based practice framework. TBI = traumatic brain injury.



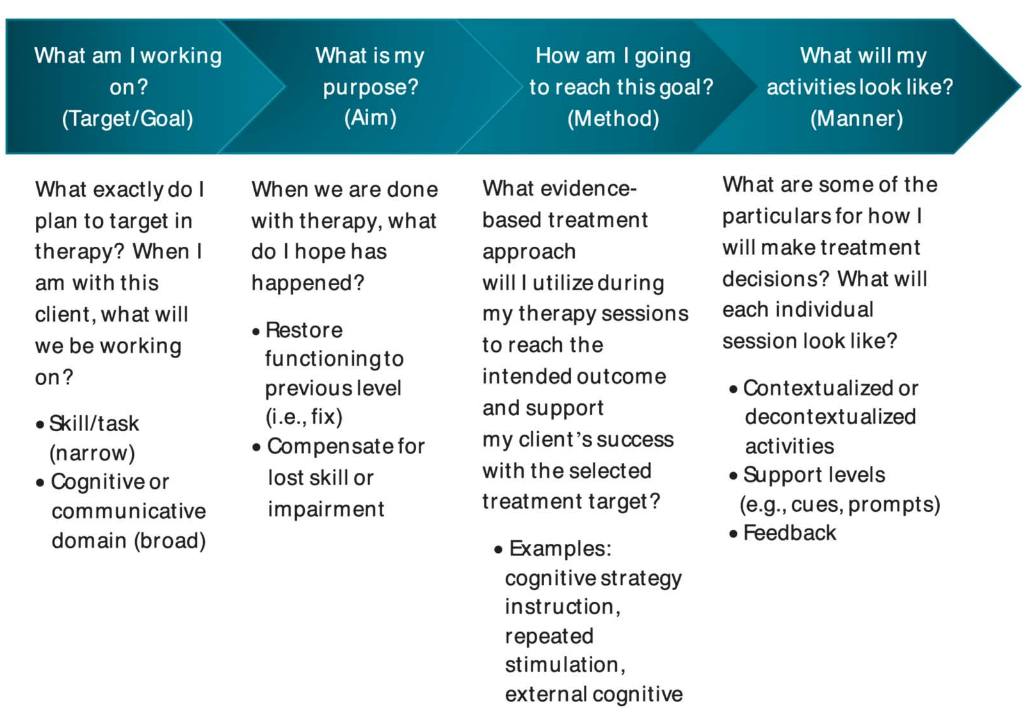
contextual decisions within treatment sessions and activities. Figure 2, along with the information below, provides a visual depiction and overview of the potential SLP treatment decisions impacting the care of adults with cognitive dysfunction post ABI.

Clinicians must first determine the type of "treatment target" for intended focus prior to commencing therapy. SLPs may select and choose to work on an overall cognitive domain (e.g., selective attention across settings and contexts) or a specific skill/task impacted by that cognitive domain (e.g., selectively attending to conversation in noisy group environments). Selection of an overall domain as a treatment target may be advantageous when addressing impairments at a broader functional level. As such, treatment activities can focus on a variety of skills and tasks allowing for inherent generalization of learned behaviors or strategies across contexts (Sohlberg & Turkstra, 2011). Selection of a domain as a treatment target may result in slower treatment gains potentially decreasing client buy-in and impacting observable treatment gains to justify intervention. Selection of a skill or task targets a specific activity or situation to increase performance (e.g., vocational, household, or leisure tasks). Targeting a skill or task may offer a higher level of personalization and relevance to the individual and potentially improve quality of life in a relatively short manner; however, generalization to untrained tasks or skills may be limited (Sohlberg & Turkstra, 2011).

Following target identification, SLPs should consider and determine the potential or "anticipated outcome or aim of treatment." That is, subsequent decisions will support the chosen target through either restoration of lost functioning or compensation of deficits. Restorative approaches may serve to ameliorate symptoms within a skill/task or across an entire domain focusing on the impairment level of functioning. Direct, restorative treatments for individuals with cognitive dysfunction associated with ABI may be well suited for those who meet the following requirements: (a) consistent assessment results, (b) client-reported concerns match assessment results, (c) presence of sufficient residual neural resources, (d) client readiness to change, and (e) intact self-awareness (Serino et al., 2007). Restorative approaches may pair well with treatments targeting specific skills/tasks to improve performance in a small subset of areas. Conversely, the use of compensatory strategies or techniques is designed to alleviate the activity or participation challenges that emerge following impairments post ABI. These vary in purpose and level of sophistication and can range from memory aids to metacognitive training for self-monitoring. Such interventions are not intended to restore underlying cognitive symptoms but rather support everyday function through reduction of negative effects of impairment.

Selection of a maximally effective and appropriate evidence-based therapeutic technique serves to reach the intended treatment target and foster the anticipated outcome

Figure 2. Considerations for cognitive rehabilitation across the continuum of speech-language pathology treatment planning.



or aim of treatment. For adults with cognitive or communicative impairments following ABI, "treatment approaches or methods" may include components such as, but not limited to, repeated stimulation, cognitive strategy instruction, external cognitive aids, and assistive technology use. Effectiveness of a particular method may depend on a variety of patient-related factors. Therefore, evidence to support only one method in isolation is limited. Instead, researchers and clinicians alike utilize a multicomponent approach to treatment, which incorporates a variety of treatment methods to reach a client's goals.

Finally, SLPs working within a rehabilitation team must develop clinical services and engage clients in individually tailored therapy sessions and activities to reach intended goals. These distinct decisions regarding the "manner" of care provision may substantially impact client performance within and across treatment sessions. Within a given treatment session, clinicians are tasked with creating scenarios that incorporate contextualized and decontextualized activities. Contextualized activities are those that are provided in the context of the real-life situation in which the individual exhibits difficulties, and decontextualized activities are those that target a specific cognitive impairment (Institute of Medicine, 2011). An example of a contextualized treatment includes going to a restaurant, ordering from a menu, and paying for a meal. Contextualized activities also include practicing customized activities of daily living in a virtual environment through information and computer technology (i.e., virtual reality). Decontextualized activities are usually clinic-based activities that are not normally encountered in everyday life such as computer-based attention programs. Additionally, clinicians must scaffold for and alter prompts and cues as appropriate during activities, provide varying types and amounts of feedback based on client performance, and incorporate "treatment supplements" such as patient education or environmental modifications. These decisions contribute highly to skilled service provision and should be altered to each individual patient's unique needs, status, and treatment goals to improve functional independence, communication, and daily activity completion.

Method

Based on the aforementioned treatment models and the need for further support when making informed clinical decisions, ASHA, in conjunction with a multidisciplinary panel of subject matter experts, developed a guideline for the delivery of cognitive rehabilitation to adults with cognitive dysfunction associated with ABI. As part of the guideline development process, a comprehensive systematic review of the evidence was conducted. Although the review protocol was not preregistered on a publicly available site such as PROSPERO, all aspects of the review (e.g., development of clinical questions, inclusion/exclusion criteria, data extraction, and quality appraisals) were established a priori using guidance from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist (Moher et al., 2009). The process, outlined below, was strictly followed to guard against potential bias.

Clinical Questions

Prior to initiating the systematic review, the panel generated a list of a priori questions and outcomes for inclusion in the guideline using the GRADE method described elsewhere (Guyatt et al., 2011). Briefly, the panel first brainstormed all possible questions and then individually rated each question for relative importance. Only those questions deemed to be critical for clinical decision making were included in the guideline. This same a priori process was used to identify critical outcomes of interest. Once the questions and outcomes were established, the panel identified definitions for cognitive interventions and generated a list of commonly used outcome measures within each outcome domain. The list of measures was provided merely as examples and not considered exhaustive.

Given that the intended audience of this guideline includes payers as well as clinicians and consumers, the panel identified questions pertaining to both the efficacy of cognitive rehabilitation and the comparative effectiveness of one form of cognitive rehabilitation to another. Addressing the efficacy questions may help guide payer policy, lend support to advocacy efforts, and build patient and family member confidence in treatment. Addressing the comparative effectiveness questions may assist clinicians to determine which treatment is best, at what time, for which patients.

A total of 19 questions were vetted by the panel to form the basis of this guideline (see Table 7 for the full list of questions and outcomes). One overarching question examined the efficacy of any form of cognitive rehabilitation compared to a no-treatment condition, seven questions examined different aspects of cognitive rehabilitation (e.g., restorative, compensatory, contextualized), and 10 questions directly compared cognitive rehabilitation treatments and service delivery models (e.g., restorative vs. compensatory, early vs. late). Last, we sought to examine the modifiable and nonmodifiable variables that were predictive of success in cognitive rehabilitation. The findings from this question may help clinicians determine what factors may contribute to a patient's response to intervention or function as a barrier to engagement and progression in rehabilitation.

Selection Criteria

Prior to initiating the search, predetermined inclusion/exclusion criteria were established. Studies were selected for inclusion into the review and subsequent guideline if they

Table 7. Guideline clinical questions and outcomes.

Question
1. Should cognitive rehabilitation vs. no cognitive rehabilitation be used for adults with cognitive dysfunction associated with ABI?
2. Should restorative cognitive treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
3. Should compensatory cognitive treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
4. Should compensatory vs. restorative cognitive treatment be used for adults with cognitive dysfunction associated with ABI?
5. Should attention treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
6. What is the comparative effectiveness of attention treatments for adults with cognitive dysfunction associated with ABI?
7. Should memory treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
8. What is the comparative effectiveness of memory treatments for adults with cognitive dysfunction associated with ABI?
9. Should executive function treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
10. What is the comparative effectiveness of executive function treatments for adults with cognitive dysfunction associated with ABI?
11. Should social communication treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
12. What is the comparative effectiveness of social communication treatments for adults with cognitive dysfunction associated with ABI?
13. Should contextualized cognitive treatment vs. no treatment be used for adults with cognitive dysfunction associated with ABI?
14. Should contextualized cognitive treatment vs. decontextualized cognitive treatment be used for adults with cognitive dysfunction associated with ABI?
15. Should early cognitive rehabilitation vs. delayed cognitive rehabilitation be used for adults with cognitive dysfunction associated with ABI?
16. Should remotely delivered cognitive rehabilitation vs. in-person cognitive rehabilitation be used for adults with cognitive dysfunction associated with ABI?
17. Should clinician-directed cognitive rehabilitation vs. non–clinician-directed cognitive rehabilitation be used for adults with cognitive dysfunction associated with ABI?
18. Should cognitive rehabilitation vs. no cognitive rehabilitation be used in maintaining improvement for adults with cognitive dysfunction associated with ABI?
19. What demographic/patient characteristic variables (modifiable and nonmodifiable) influence cognitive rehabilitation outcomes for adults with ABI-related cognitive dysfunction?
Outcome
Improved impairment-based outcomes
Improved functional outcomes
Improved quality of life (e.g., self-report, quality-of-life measures)
Decreased need for cognitive-based supervision/independent living
Decreased caregiver burden
Return to work/school
Treatment satisfaction
Improved self-awareness into impact of injury
Increased knowledge/education regarding injury/course of recovery
Maintained improvement
Excluded questions
Should process-oriented treatment vs. no treatment be used for adults with ABI-related cognitive dysfunction?
Should group treatment vs. no treatment be used for adults with ABI-related cognitive dysfunction?
Excluded outcomes
None

Note. Maintained improvement time points = 1, 3, 6, and 12 months posttreatment. ABI = acquired brain injury.

- were published in English from 1980 onward (note that a cursory search of the published literature showed that the majority of research was published after 2000, so the publication year limit was set for 1980 to maximize study yield);
- reported original data;
- included adult participants aged 18 years or older with an ABI or included mixed populations with the majority of participants (≥ 80%) aged 18 years or older with a diagnosis of ABI;
- utilized a randomized controlled trial (RCT) or controlled trial with a no-treatment control or comparator of interest for all efficacy and comparative effectiveness questions or utilized a cohort study design for the predictive factor question (note that for the efficacy questions, the no-treatment condition included participants receiving no intervention, deferred intervention [i.e., those on a waitlist for treatment], or education only or general exercises in which the clinician was not directly involved in intervention instruction and feedback [e.g., brain games in which clinician only provided setup and proctoring]);
- examined a cognitive treatment, strategy, or intervention that could be used by an SLP to address one or more cognitive processes such as attention, memory, executive functioning, or social communication (note that holistic treatments were included if the primary focus of the treatment was cognitive remediation); and

- provided data on an outcome measure of interest with documented psychometric properties or included data from a dichotomous outcome measure (i.e., return to work and treatment satisfaction).

Studies were excluded if they

- were published before 1980 or did not include usable data for inclusion in our meta-analysis;
- were observational, uncontrolled, or single-case design;
- included individuals with neurodegenerative disorders or nonstable or ongoing brain events (e.g., uncontrolled seizure disorder), psychiatric disorders, or speech and language disorders (e.g., aphasia);
- included mixed participant age ranges or mixed diagnoses if greater than 80% were not adults with ABI;
- did not report on measures with reported psychometric properties, used a validated measure that was modified by the investigators, or used a measure as a trained task during the intervention;
- examined pharmacological interventions, cognitive behavioral interventions, treatments targeting coma stimulation, neurofeedback, self-directed computer-based "brain games," or treatments targeting speech, language, voice, or fluency as the primary intervention under investigation (note that self-directed computer-based programs in which the clinician was not directly involved in treatment could be used as comparator); or
- examined a form of cognitive rehabilitation but did not compare it to a control or a different form of cognitive rehabilitation (e.g., pharmacological treatment, cognitive behavioral treatment).

Search Method

A systematic search of 16 scholarly databases and clinical trial registries was conducted from December 5, 2019, to December 12, 2019. The search strategies were developed by N-CEP's information manager using the clinical questions and key words related to ABI, cognitive rehabilitation, cognitive intervention, and speech-language pathology treatment. Key words were provided by the reviewers and expert panel members. The search strategies included controlled vocabulary, free-text searches with synonyms, Boolean logic, and truncation symbols as appropriate. All search protocols were peer-reviewed by another information specialist using the Peer Review of Electronic Search Strategies checklist (McGowan et al., 2016).

Additional searches were run between March 2020 and September 2020 for gray literature, clinical trials, and recently published protocols. All articles accepted for extraction were loaded into Rayyan (Ouzzani et al., 2016), a systematic review software, and any author who appeared 5 times or more, irrespective of order in the author list, was then searched in Google Scholar for additional publications. Rayyan was also used to find journals that included five or more accepted studies. These journals were hand-searched for articles published in the past 5 years (2015–2020). The reference lists of all accepted studies and review articles were scanned for additional studies (i.e., snowballing). Finally, any accepted study was searched in Google Scholar for additional relevant publications (i.e., forward searching). The full search strategy and list of sources and rationale are available as Supplemental Materials S1 and S2. All citations were managed in EndNote X8 (Clarivate Analytics, 2021), deduplicated and then loaded into Covidence systematic review software for sifting and extraction (Veritis Health Innovation, n.d.; http://www.covidence.org).

Publication Screening

Two N-CEP reviewers independently screened the titles and abstracts of all potentially relevant articles identified by the systematic search. The same two reviewers independently assessed the full text of the selected abstracts to determine if they met the inclusion criteria. Reviewer agreement for full-text sifting and article inclusion was considered substantial (Landis & Koch, 1977). Kappa reliability (κ) was .84 and .80, respectively.

Blinded title, abstract, and full-text sifting was managed using Covidence systematic review software (Veritis Health Innovation, n.d.; http://www.covidence.org), with reviewers making a binary judgment of eligibility (i.e., eligible vs. ineligible) based on the preset criteria. All disagreements with publication selection and inclusion were documented and resolved through discussion until consensus was reached.

Quality Assessment

The same two masked reviewers assessed each study and the relevant outcomes from those studies using Cochrane's risk of bias tool across the following six domains: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, incomplete outcome data, and selective outcome reporting (Higgins et al., 2011). Each domain was rated as low, high, or unclear risk of bias. To determine risk of bias for incomplete outcome data, we used the What Works Clearinghouse (WWC) standards (U.S. Department of Education, n.d.). To be considered low risk of bias, a study had to meet WWC's optimistic threshold using a combination of overall attrition and differential attrition between groups.

To assess the methodological quality of predictive factor studies, we used a modified version of the Quality in Prognosis Studies (QUIPS) tool (Hayden et al., 2013). Using the same blinded procedures noted above, we assessed potential sources of bias across six domains: study participation, study attrition, prognostic factors measurement, outcome measurement, study confounders, and statistical analysis and reporting. Each domain was rated as high, moderate, or low risk of bias.

Kappa coefficients were calculated to determine the level of interrater agreement for each quality indicator based on Landis and Koch (1977) parameters. Reviewer agreement ranged from .91 (substantial agreement) to .51 (moderate agreement) on the Cochrane risk of bias quality indicators and from 1.0 (perfect agreement) to .57 (moderate agreement) on the QUIPS quality indicators. All inconsistencies between reviewers were documented and resolved by discussion.

Data Extraction and Management

One reviewer extracted data from the full text of included studies using a predesigned data extraction form. Prior to use, the data extraction form was vetted by the panel and pilot-tested on a subset of articles. No changes to the form were made during the review. Data extracted included participant characteristics such as number of participants, age, gender, diagnosis/ABI type, severity, and time postonset as well as intervention characteristics such as treatment type and dosage and outcome(s) of interest. When appropriate, we combined data from multiarm studies into a single group using Cochrane formulas (Higgins & Green, 2011) to prevent double counting of participants or arbitrarily excluding pertinent data (Higgins et al., 2021).

Each study was assigned to one or more clinical questions addressing the efficacy of cognitive rehabilitation or comparative effectiveness of different cognitive treatment or service delivery approaches. Efficacy studies were defined as any experimental treatment compared to a no-treatment condition (i.e., no intervention; deferred treatment; or a passive control that did not involve direct clinician interaction, instruction, engagement, or monitoring/feedback). Examples of passive controls included, but were not limited to, brain health information without instruction on cognitive strategies or commercially available brain game programs without clinician instruction and feedback. Comparative effectiveness studies included any domain-specific cognitive treatment compared to a different cognitive treatment within the same domain (e.g., Memory Treatment A vs. Memory Treatment B), a comparison of the same cognitive treatment with an additional ingredient or a comparison of the same cognitive treatment using different service delivery models (e.g., in-person vs. remote). Studies comparing experimental treatment to education that included cognitive strategy instruction as part of education or studies using comparators in which the examiner provided instruction or was actively engaged were considered comparative effectiveness. All data extraction elements and clinical question(s) for each study were checked for accuracy by a second reviewer and a subset of panel members.

Study Outcome Management

Upon completion of the search, potential outcome measures were identified from the included studies and categorized into corresponding domains (e.g., impairment, function, and quality of life). Prior to data extraction and analysis, the complete list of outcome measures was reviewed by a subset of panel members to ensure proper coding. Based on the panel's knowledge of the literature, we anticipated a great deal of multiplicity within studies. That is, studies often reported more than one outcome measure within a single domain or used multiple measures of the same outcome. To deal with potential effect size multiplicity within studies, a two-step approach was employed before inclusion in the analyses (López-López et al., 2018). First, we attempted to reduce multiplicity based on a set of decision rules. Within an outcome domain, we prioritized total scores over subtest scores for a single assessment measure. That is, if a study reported both a total score and its corresponding subtests for an individual assessment measure, we included the total score in our meta-analysis. Similarly, we prioritized self-assessed measures over proxy or caregiver-reported measures if a study reported both. Next, we calculated an average effect size from studies in which multiplicity issues remained. A full list of outcome measures included in the review can be found in Supplemental Materials S3 and S4.

Last, if data were missing or not reported in a usable format for the analysis (i.e., end point means and standard deviations), we attempted to contact the corresponding author to obtain relevant data. Since author e-mail addresses were not typically provided in studies prior to 2000, author correspondence was limited to the past 20 years. Additionally, in instances where a clinical trial was registered, the lead investigator was contacted to determine if study results would be published in time for completion of the systematic review. In both cases, data were included in the meta-analytic results if provided by authors. If we were unable to obtain the data from the author and the information was presented in a graphical format, numerical values were extracted from images using WebPlotDigitizer, Version 4.3 (Rohatgi, 2020; https://automeris.io/WebPlotDigitizer/). The WebPlotDigitizer software was chosen based on high levels of intercoder agreement (Drevon et al., 2017).

When possible, data were also imputed from other formats such as medians and ranges, mean quotients, mean *t* scores, standard error of the mean, 95% confidence interval (CI) to estimated means, and/or standard deviation values using the methods described by Follmann et al. (1992), Hozo et al. (2005), and Wan et al. (2014). An overall summary of these methods is described by Wiebe et al. (2006).

Data Synthesis and Analysis

The Cochrane Review Manager 5.3 meta-analysis software was used for all analyses (Cochrane Collaboration, 2014). When necessary, data were converted to reflect the direction of results (i.e., for some outcome measures, lower frequency of occurrence = better performance; for others, higher frequency of occurrence = better performance). Apart from return to work and treatment satisfaction, which were dichotomous outcomes and reported as a relative risk (RR), all outcomes were continuous with the effect size and corresponding 95% CI reported as a standardized mean difference (SMD). Pooled effects were calculated using a random-effects model for clinical questions and outcomes with multiple studies or using a fixed-effects model for clinical questions and outcomes with only one study. Effect sizes were classified as small (0.2), medium (0.5), and large (0.8) based on Cohen's standard (Cohen, 1988) and considered statistically significant if the 95% CI did not cross the null value (i.e., 0).

The certainty of evidence for each effect was classified as high, moderate, low, or very low to reflect a rating of confidence in the point estimates of the effect. Certainty of evidence was determined based on the assessment of risk of bias (e.g., limitations in different aspects of trial design, conduct, and/or reporting), inconsistency (e.g., unexplained variations or differences in effects across studies), indirectness (e.g., the extent to which the population, intervention, and/or outcome measures were different than those of interest), imprecision (e.g., studies that included few patients or few events and consequently had a wide CI around the effect), and publication bias (e.g., an over- or underestimation of the effect due to the suspected failure to publish results of studies based on the direction of their findings). As part of the GRADE process, the body of the evidence for each outcome was downgraded if judged to have serious (i.e., downgraded one level) or very serious (i.e., downgraded two levels) limitations (Guyatt et al., 2008). Two reviewers independently determined the certainty of evidence for each outcome, and all designations of serious or very serious limitations were discussed and agreed upon by consensus.

Main findings were pooled by clinical question and outcome into evidence tables (see Appendix A, Tables A1–A12) supported by forest plots and risk of bias summaries (see Supplemental Material S5, Figures S1–S20). In addition to the main findings, further analyses were completed, when possible, to investigate differences in outcomes based on select participant (i.e., traumatic and nontraumatic ABI type, time postonset) and intervention (i.e., group and computer-based treatments, specific treatment methods) characteristics. All potential analyses were predefined by the panel prior to the initiation of the search.

Literature Search

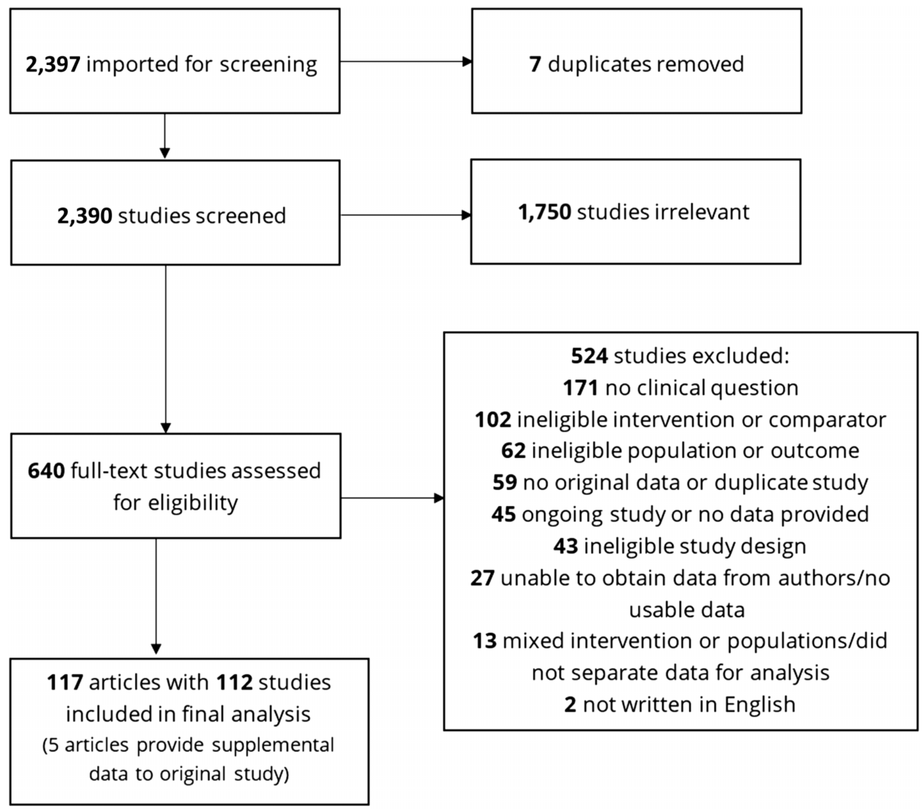
A total of 181,221 articles were pulled into EndNote. After deduplication, 106,085 articles were sifted in an initial pass by the information specialist. A total of 2,397 potentially relevant articles were imported into Covidence for further consideration by the reviewers. One hundred seventeen articles with 112 studies met the final inclusion criteria after title, abstract, and full-text sifting by two blinded N-CEP reviewers (see Figure 3).

Figure 4 highlights the number of studies examining the effect of cognitive rehabilitation compared to no treatment (i.e., efficacy studies) or to a different treatment or service delivery model (i.e., comparative effectiveness studies). Seventy efficacy studies met the inclusion criteria, the majority of which had a primary aim to restore cognitive function (36/70 studies) or compensate for a cognitive deficit (30/70 studies). Eight studies used a combined restorative and compensatory treatment approach. A handful of studies also examined a specific cognitive domain targeted in treatment (e.g., memory, attention) to a no-treatment condition, whereas other studies examined the manner (i.e., contextualized or decontextualized) in which treatment was delivered (see Appendix B, Tables B1–B3 for participant and intervention characteristics of efficacy studies).

To help clinicians make an informed decision about different treatment options, 37 studies also allowed for a direct comparison of cognitive rehabilitation by specific domains, treatment approaches, and service delivery models. Five studies examined the effects of a restorative versus compensatory treatment, eight studies examined the effects of a contextualized versus decontextualized treatment, and 30 studies directly compared two different cognitive treatments within the same domain. Twelve studies compared memory treatments, three studies compared attention treatments, 10 studies compared executive function treatments, and five studies compared social communication treatments (see Appendix B, Table B4 for participant and intervention characteristics of comparative effectiveness studies).

Last, to understand the comparative utility of different service delivery options, we sought to examine the impact of treatment characteristics related to timing, setting, and provider. To examine these effects, included studies had to hold the intervention (i.e., cognitive rehabilitation) constant and only manipulate the service delivery model. Two studies compared early versus delayed cognitive rehabilitation, and three studies compared remote versus in-person delivery of cognitive rehabilitation. A final analysis investigated the factors predictive of treatment

Figure 3. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

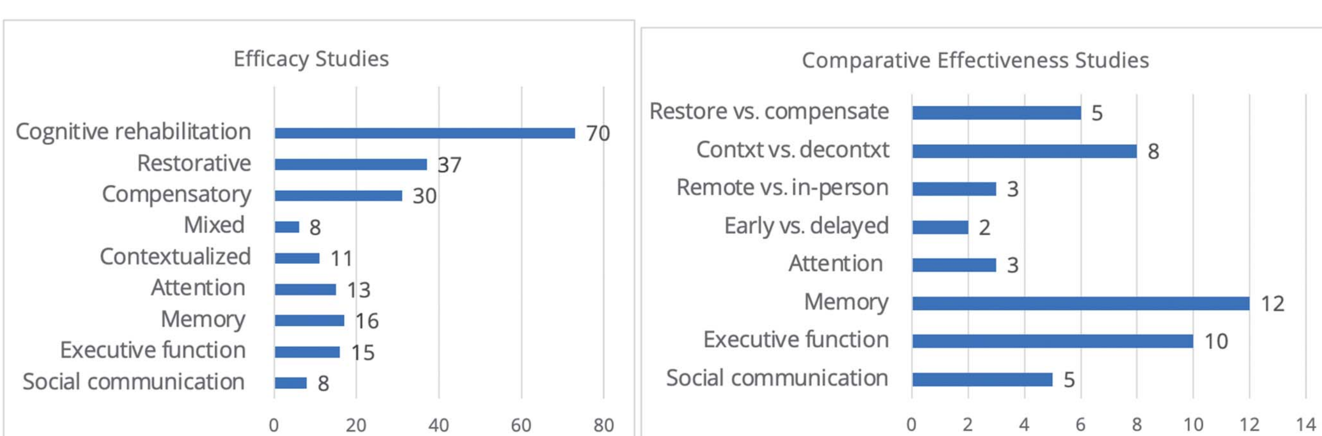


success. Table 8 highlights the included studies by efficacy, comparative effectiveness, and predictive factors.

Development of Recommendations

The GRADE Evidence to Decision framework was used to facilitate panel discussion during the recommendation development process (Guyatt et al., 2008). For each clinical question, the panel received a corresponding evidence table, which included information about the number of studies, study designs, judgments on risk of bias, imprecision, inconsistency, indirectness, magnitude of effect, and level of certainty. The panel also received additional information on key factors pertinent to decision making (e.g.,

Figure 4. Number of studies by treatment aim, target, and manner of delivery.



Note: Number of studies does not total 102 as many studies fell into more than one category. Contxt = contextualized treatment; decontxt = decontextualized treatment.

Table 8. Included studies.

Study	Efficacy studies	Comparative studies	Predictive factor studies
Aben et al. (2014)	x		
Akerlund et al. (2013)	x		
Barker-Collo et al. (2009)	x		
Behn et al. (2019)	x		
Bertens et al. (2015)		x	
Bertens et al. (2016)[a]		x	
Björkdahl et al. (2013)[a]	x		
Bornhofen & McDonald (2008a)	x		
Bornhofen & McDonald (2008b)	x	x	
Bourgeois et al. (2007)		x	
Cantor et al. (2014)	x		
Caplain et al. (2019)	x		
Caracuel et al. (2012)		x	
Carter et al. (1988)	x		
Cheng & Man (2006)	x		
Cho et al. (2015)	x		
Chopra et al. (2016)	x		
Cicerone et al. (1996)			x
Cooper et al. (2017)	x		
Cuberos-Urbano et al. (2018)		x	
Dahlberg et al. (2007)	x		
das Nair et al. (2019)	x		
das Nair & Lincoln (2012)	x		
De Joode et al. (2013)		x	
De Luca et al. (2019)		x	
DeGutis & Van Vleet (2010)	x		
Doorhein & De Haan (1998)	x		
Emmanouel et al. (2020)		x	
Engelberts et al. (2002)	x	x	
Faria et al. (2016)		x	
Fasotti et al. (2000)		x	
Ferreira et al. (2011)	x	x	
Gamito et al. (2017)	x		
García-Molina et al. (2015)[b]			x
Gehring et al. (2009)	x		
Goverover et al. (2007)	x		
Gray et al. (1992)	x		
Hajek et al. (1993)	x		
Harrison-Felix et al. (2018)		x	
Hasanzadeh Pashang et al. (2021)	x		
High et al. (2006)		x	
Hildebrandt et al. (2006)		x	
Hildebrandt et al. (2011)		x	
Hu et al. (2003)[b]	x		
Janak et al. (2017)			x
Jiang et al. (2016)	x		
Kaschel et al. (2002)		x	
Kersey et al. (2019)[a]	x		
Kim et al. (2014)	x		
Lannin et al. (2014)		x	
Lawson et al. (2020)		x	
Leininger et al. (2014)			x
Lesniak et al. (2018)	x	x	
Levine et al. (2011)	x		
Lewis & Horn (2013)			x
Lin et al. (2014)	x		
Llorens et al. (2016)		x	
Maier et al. (2020)	x		
Malec (2001)			x
Man et al. (2013)	x	x	
Man et al. (2006)	x	x	
McDonald et al. (2008)	x		
McDonald et al. (2013)	x		
McEwen et al. (2015)[a]	x		
L. A. Miller & Radford (2014)	x		
Miotto et al. (2009)	x		

(*table continues*)

Table 8. *(Continued).*

Study	Efficacy studies	Comparative studies	Predictive factor studies
Mlinarič Lešnik et al. (2015)			x
Moriarty et al. (2016)	x		
Neumann et al. (2015)	x	x	
Novakovic-Agopian et al. (2018)	x		
O'Connor et al. (2016)	x		
O'Neil-Pirozzi et al. (2010)	x		
Ownsworth & McFarland (2004)			x
Ownsworth et al. (2008)	x	x	
Park & Lee (2019)	x		
Peers et al. (2020)	x		
Potvin et al. (2011)	x		
Poulin et al. (2017)		x	
Powell et al. (2012)		x	
Prigatano & Wong (1999)			x
Prokopenko et al. (2019)	x		
Radice-Neumann et al. (2009)		x	
Richter et al. (2015)		x	
Richter et al. (2018)		x	
Rietdijk et al. (2020)		x	
Rogan (2018)	x		
Sander et al. (2002)			x
Schmitter-Edgecombe et al. (1995)	x		
Scott et al. (2016)			x
Shum et al. (2011)	x	x	
Skidmore et al. (2015)	x		
Skidmore et al. (2017)		x	
Smania et al. (2013)			x
Spikman et al. (2010)		x	
Storzbach et al. (2017)	x		
Strangman et al. (2012)			x
Tam & Man (2004)	x		
Thickpenny-Davis & Barker-Collo (2007)	x		
Thompson et al. (2016)	x		
Togher et al. (2013)	x	x	
Tornås et al. (2016)	x		
Tornås et al. (2019)[a]	x		
Twamley et al. (2015)	x		
Vanderploeg et al. (2008)		x	
van de Ven et al. (2017)	x		
Van Vleet et al. (2014)	x		
Vas et al. (2016)	x		
Vas et al. (2011)	x		
Veisi-Pirkoohi et al. (2020)	x		
Westerberg et al. (2007)	x		
Winkens et al. (2009)	x		
Withiel et al. (2019)	x		
Wolf et al. (2016)	x		
Wolf et al. (2021)		x	
Yoo et al. (2015)	x		
Zucchella et al. (2013)	x		
Zucchella et al. (2014)	x		

[a]Provide supplemental data to original study. [b]Abstract only; study not written in English.

the values and preferences of cognitive rehabilitation to consumers; desirable and undesirable anticipated effects of treatment; resource implications associated with treatment, acceptability, feasibility, and/or barriers to treatment delivery) based on the GRADE Evidence to Decision framework (Alonso-Coello et al., 2016). Preliminary judgments for each of the key factors and overall certainty of the evidence were discussed during group phone calls, and recommendations were drafted when applicable. Each panel member privately voted on each draft recommendation with consent or dissent documented by N-CEP. Final recommendations were agreed upon by all panel members.

Recommendations and Supporting Evidence

The following evidence-based recommendations for cognitive rehabilitation are based on the balance between desirable and undesirable effects, the acceptability of treatment to consumers, implementation facilitators/barriers, equity implications, and the confidence in the quality of the evidence. The evidence tables, which summarize the quality of the evidence and the magnitude of effect for each outcome, serve as the basis when discussing the overall body of supporting evidence. For brevity and clinical utility, the recommendations and supporting evidence are grouped by different aspects of treatment (e.g., target, aim, method, manner; see Figure 2), with the final recommendations incorporating the findings of multiple clinical questions to provide all audiences with succinct, actionable guidance.

Evidence-Based Recommendation:

ASHA recommends adults with cognitive dysfunction associated with ABI receive cognitive rehabilitation that is clinician directed, person centered, and evidence based (Recommendation; Low Certainty of Evidence).

The panel found that cognitive rehabilitation was effective at reducing symptoms of cognitive dysfunction and was integral to meaningful, functional patient outcomes. As such, the panel recommends adults with cognitive dysfunction associated with ABI receive cognitive rehabilitation. Cognitive rehabilitation should be clinician directed and patient centered, with joint decision making in line with an individual's cultural values and goals and priorities. Our recommendation for cognitive rehabilitation is based on small-to-medium treatment effects and its value to patients and families. Given the societal and economic impact of ABI and the vulnerability of the population, any improvement from cognitive rehabilitation was considered meaningful. Additionally, no adverse effects of treatment were reported in our findings and other systematic reviews (Institute of Medicine, 2011; Kumar et al., 2017). Following essential, often lifesaving medical care, adults with ABI may have persistent symptoms preventing return to preinjury levels of functioning. In conjunction with other medical care and rehabilitative care, cognitive rehabilitation serves as a bridge between an individual's current impaired state and a productive, fulfilling life. The individual and societal benefits of this bridge to productivity and role resumption cannot be understated.

Cognitive Rehabilitation Summary of the Evidence

A cumulative total of 3,072 participants reported in 70 studies examined the efficacy of cognitive rehabilitation to a no-treatment condition (see Appendix B, Tables B1–B3). One study by das Nair et al. (2019) provided follow-up data only. Treatment approaches, service delivery models, and dosages varied across studies. Most efficacy studies utilized repeated stimulation, hierarchical training, cognitive strategy instruction, and/or external cognitive aids as the primary cognitive rehabilitation approach with approximately one third of the studies utilizing a combination of approaches.

Most participants were male with a mean age between 23.0 and 73.4 years, when reported. Twenty-nine studies included participants with nontraumatic ABI primarily due to a cerebrovascular accident. Four studies included participants with nontraumatic ABIs from seizure disorders or brain tumors. The remaining studies included participants with TBIs (25 studies) or included mixed ABI populations (13 studies). Time postinjury ranged from acute (up to 3 months, 11 studies), subacute (3–12 months, 12 studies), and chronic (≥ 12 months, 41 studies). Eleven studies included participants at both the subacute and chronic stages of recovery. Approximately one third of the studies reported ABI severity using a variety of methods such as the NIHSS (Lyden, 2017), the GCS (Teasdale & Jennett, 1974), or the VA/DoD TBI severity classification system (VA/DoD, 2021). Of the 1,300 participants with ABI severity reported, 37% were considered mild; 25%, mild–moderate or moderate; and 38%, moderate–severe or severe. Limited information could be gleaned about severity of cognitive-communication impairment due to the wide variety of measures reported at baseline by authors.

Pooled analysis of included efficacy studies revealed that cognitive rehabilitation had a small statistically significant effect on four of eight critical outcomes (see Appendix A, Table A1). One outcome, decreased need for cognitive-based supervision, did not include any studies. Overall effects of cognitive rehabilitation revealed an SMD of 0.25 (95% CI [0.14, 0.37], low certainty, 46 studies) for decreased impairment, an SMD of 0.38 (95% CI [0.22, 0.54], low certainty, 46 studies) for improved function, an SMD of 0.24 (95% CI [0.07, 0.40], moderate certainty, 12 studies) for increased self-awareness, and an RR of 1.17 (95% CI [1.03, 1.33], low certainty, three studies) for return to work. These effects were maintained or improved for all outcomes at one or more time points (e.g., 1, 3, 6, and 12 months posttreatment). Two of the three remaining outcomes—decreased caregiver burden (one study, 63 participants) and treatment satisfaction (one study, 20 participants)—also favored cognitive rehabilitation; however, these effects did not reach significance. The remaining outcome, improved quality of life, had negligible effects (13 studies, 867 participants).

An additional analysis revealed that the effects of cognitive rehabilitation were somewhat larger for individuals in the acute phase of recovery for decreasing impairment (SMD = 0.48, 95% CI [0.10, 0.86]) and for improving function (SMD = 0.52, 95% CI [0.05, 1.00]). These same findings were seen for individuals with nontraumatic ABIs. Effect sizes were 0.48 (95% CI [0.23, 0.73]) and 0.55 (95% CI [0.22, 0.87]) for impairment and functional outcomes, respectively.

Evidence-Based Recommendation:

Restorative and compensatory treatments are viable options for cognitive rehabilitation. Clinicians should tailor interventions to the needs of the individual and consider cognitive severity and stage of recovery when making treatment decisions.

The panel recommends that adults with cognitive dysfunction associated with ABI receive cognitive rehabilitation to address the intended treatment aim and individual needs of the patient. Although previous literature suggests that cognitive rehabilitation post ABI has two distinct phases with treatment often starting with a restorative approach to strengthen impaired skills through repetitive exercises of neuronal circuits and then moving to a compensatory approach when it is thought that neural functions can no longer be recovered (Koehler et al., 2011), our findings support a more recent notion that both restorative and compensatory treatments are efficacious and beneficial at acute and postacute phases of recovery. Participants receiving restorative and compensatory cognitive treatments did significantly better on several critical outcomes compared to a no-treatment condition at various stages of recovery. In addition, a head-to-head comparison of these two treatment approaches revealed equivocal results. Taken together, these findings suggest that restorative treatments are beneficial to reduce impairment and improve function, and compensatory treatments are beneficial to manage cognitive impairments and activity limitations while improving function and self-awareness. Therefore, SLPs should consider the desired outcome (i.e., restore function toward the previous level, compensate for a lost skill or impairment or both) at varying stages of recovery and for various levels of impairment severity to determine whether concurrent or sequential application of restorative and compensatory treatments would be of most benefit.

Restorative and Compensatory Treatments Summary of the Evidence

Thirty-six studies with 1,406 participants examined the effects of restorative treatments to a no-treatment condition (see Appendix B, Table B1). These included participants at the acute phase of recovery (0–3 months postinjury, eight studies), participants at the subacute phase of recovery (3–12 months postinjury, seven studies), and participants at the chronic phase of recovery (> 12 months postinjury, 18 studies). Three additional studies included participants with a time postonset ranging from a subacute to chronic phase of recovery. Most studies included participants with non-TBIs (18 studies). The remaining studies included participants with TBI (12 studies) or mixed ABIs (six studies).

Combined results across studies revealed that restorative treatments had small statistically significant effects on three of six critical outcomes (see Appendix A, Table A2). Pooled effects were 0.34 (95% CI [0.09, 0.59], low certainty, 22 studies) on decreased impairment and 0.21 (95% CI [0.06, 0.35], moderate certainty, 21 studies) on improved function, including return to work (RR = 1.17, 95% CI [1.03, 1.34], moderate certainty, one study). Restorative treatments also had a small nonsignificant effect on improved self-awareness/impact into injury (SMD = 0.26, 95% CI [−0.06, 0.59], low certainty, six studies) and treatment satisfaction (SMD = 0.43, 95% CI [−0.46, 1.32], very low certainty, one study) with the latter outcome including only 20 participants. Negligible effects were found for quality of life. No studies reported data on caregiver burden, need for cognitive-based supervision, or increased knowledge/education regarding injury/course of recovery. Limited information could be gleaned regarding maintenance of effects due to a small number of studies and participants reporting follow-up data.

Most studies examined restorative treatments that used repetitive stimulation exercises (seven studies), a hierarchical training approach with a gradual progression of tasks ranging from simple to complex based on performance (15 studies), or combined repeated stimulation and hierarchical training (six studies). Although restorative treatments favored interventions for proximal impairment and functional outcomes, those incorporating hierarchical training (SMD = 0.48, 95% CI [0.13, 0.83]) or hierarchical training plus repeated stimulation (SMD = 0.43, 95% CI [−0.01, 0.87]) had the strongest effects on decreased impairment. However, the latter did not reach significance. This same finding was seen for improving functional outcomes with an effect size of 0.20 (95% CI [−0.04, 0.44]) for hierarchical training and an effect size of 0.53 (95% CI [−0.27, 1.34]) for hierarchical training plus repeated stimulation. However, these findings did not reach significance. The remaining studies utilized a mixed restorative treatment approach with too much heterogeneity across studies for additional analyses.

Twenty-nine studies investigated the efficacy of compensatory treatments (see Appendix B, Table B2). Of these, a cumulative total of 1,200 participants included posttest data. One study (das Nair et al., 2019) reported follow-up data only for inclusion in the meta-analysis. Five studies included participants at the acute (0–3 months post ABI) or subacute (3–12 months post ABI) phase of recovery, and 22 studies included participants at the chronic (> 12 months post ABI) phase of recovery. The remaining two studies had participants who were at least 6 months postinjury or had participants ranging from subacute to chronic ABI. Most studies included participants with TBI (12 studies). Ten studies included participants with nontraumatic ABIs, and seven studies included mixed ABI populations.

Findings revealed that compensatory treatment had a small statistically significant effect on two of seven critical outcomes (see Appendix A, Table A3). No studies reported data on decreased need for cognitive-based supervision or treatment satisfaction. Pooled effects were 0.39 (95% CI [0.16, 0.61], moderate certainty, 23 studies) for improved function and 0.25 (95% CI [0.04, 0.47], low certainty, six studies) for increased self-awareness into impact of injury. These effects were maintained or improved at 3- and 6-month follow-up. Although limited by the small number of studies and participants, findings also favored compensatory treatment for decreasing caregiver burden (SMD = 0.31, 95% CI [−0.19, 0.81], very low certainty, one study) and return to work (RR = 1.10, 95% CI [0.67, 1.80], very low certainty, two studies); however, the effects were not significant with a small number of participants included. Negligible effects were found for decreased impairment (SMD = 0.16, 95% CI [0.02, 0.31], moderate certainty, 21 studies).

The primary compensatory method used within all studies was cognitive strategy instruction, an instructional approach that, when applied, teaches a range of explicit internal thought processes and techniques to monitor and improve functional performance. These included, but were not limited to, chunking, association, cognitive mapping, strategic memory and reasoning training, and metacognitive strategy training (18 studies). Few studies also reported the use of hierarchical training (two studies), repeated stimulation (one study), or cognitive aids (six studies), in conjunction with cognitive strategy instruction. The remaining studies examined three or more combined treatment approaches (e.g., cognitive strategy instruction, cognitive aid environmental modification, repeated stimulation). Some studies specified that education was a component of treatment. Although other studies did not report this information, education may have been included as a standard component of cognitive rehabilitation. Additional analyses revealed that cognitive strategy instruction had the strongest effects on functional outcomes (SMD = 0.58, 95% CI [0.27, 0.89]). Given the heterogeneous nature of the compensatory methods used in conjunction with cognitive strategy instruction, further analysis could not be completed.

Last, five studies with 180 participants with chronic or subacute ABI directly compared the effects of a restorative treatment to a compensatory treatment (see Appendix B, Table B4). Interventions targeted specific cognitive domains (e.g., memory, attention, executive function) and employed a variety of treatment approaches and formats. Restorative treatments included repeated stimulation and hierarchical training delivered via the computer or during individual or group task-specific activities. Compensatory treatments primarily included cognitive strategy instruction (e.g., metacognitive strategy training) and/or paired cognitive strategy instruction with the use of an external cognitive aid.

All studies provided data on at least one functional outcome. Some studies also provided data on measures of impairment, quality of life, self-awareness, and caregiver burden. No data were provided on the remaining four critical outcomes of return to work, treatment satisfaction, decreased need for cognitive-based supervision, and increased knowledge/education regarding injury/course of recovery. Across all studies and reported outcomes, equivocal effects were found when comparing restorative and compensatory treatments (see Appendix A, Table A4). Four studies also reported follow-up data on impairment and functional outcomes at 1 and 6 months posttreatment. Small effects favoring restorative treatment were only found for impairment-based outcomes at 1-month follow-up; however, effects were not significant with only 47 participants from two included studies. Although limited by the number of studies, no differences were found by ABI type or ABI time postinjury.

Evidence-Based Recommendation:

Effective management of cognitive-communication impairments may include domain-specific treatment approaches targeting impaired memory, attention, executive function, and/or social communication skills and include one or more treatment approaches for the management of generalized cognitive dysfunction.

Prior to initiating any form of cognitive rehabilitation, SLPs must also determine the intended target of treatment. This target can be a broad function (e.g., attend a college class), one or more overarching domains (e.g., attention, memory), or a narrow task or skill impacted by the impaired domain (e.g., taking notes). Although our review found that treatments focused on specific cognitive processes of attention, memory, executive function, and social communication had positive effects on many critical outcomes, the evidence did not support one treatment approach or intervention over another. Therefore, SLPs may choose to adopt an integrated approach to cognitive rehabilitation using one or more treatment methods (e.g., cognitive strategy instruction, repetition stimulation, cognitive aids) based on the individual's needs and preferences. Additionally, given the interconnectedness of cognitive, social, behavioral, and emotional functioning, emphasis should be placed on a holistic treatment approach supported by a multidisciplinary team.

Domain-Specific Treatments Summary of the Evidence

Attention

Thirteen studies with 538 participants examined the efficacy of attention treatments compared to a no-treatment condition, the majority of which included participants with chronic (eight studies) or nontraumatic (10 studies) ABIs. Additionally, most treatments targeted multiple aspects of attention (e.g., sustained, selective, divided, and alternating attention) using restorative approaches such as repeated stimulation with graded exercises (nine studies). Other studies utilized a restorative or compensatory approach designed to strengthen a specific aspect of attention (e.g., dual-task performance, inattention). No studies targeted a specific skill or task to improve attention. Additionally, most studies (11/13) utilized computer-based interventions skillfully adjusted by clinicians according to an individual's performance and needs. One study (Barker-Collo et al., 2009) utilized attention process training (APT), a clinician-directed and manipulated attention training program; two studies (DeGutis & Van Vleet, 2010; Van Vleet et al., 2014) utilized tonic and phasic alertness training, a tonic and alertness training program specifically designed to treat spatial neglect; and nine studies utilized various computer-based programs that were reportedly set up, monitored, and adjusted or altered by a clinician based on individual performance (see Appendix B, Tables B1–B3).

Studies reported data on four critical outcomes (decreased impairment, 10 studies; improved function, four studies; improved quality of life, three studies; and return to work, one study). No studies included data on the remaining five outcomes. Pooled effects favored interventions for decreased impairment (SMD = 0.21, 95% CI [−0.02, 0.44], very low certainty) and return to work (RR = 1.17, 95% CI [1.03, 1.34], moderate certainty), with the latter reaching significance. Minimal effects were found for improved function, quality of life, and maintenance of effects with a limited number of studies and participants included (see Appendix A, Table A5).

Additional analyses revealed that restorative attention treatments had a small effect on impairment-based outcomes in studies examining adults with non-TBIs (SMD = 0.30, 95% CI [−0.08, 0.67]) and those with chronic non-TBIs (SMD = 0.48, 95% CI [0.09, 0.87]), with the latter reaching statistical significance. Engelberts et al. (2002) was the only study to include participants with controlled focal seizures; the remaining participants suffered strokes. No additional analyses could be completed for efficacy studies due to the small number of studies and participants.

Only three studies with 71 participants with chronic nontraumatic ABIs allowed for a direct comparison of attention treatments on measures of impairment, function, quality of life, self-awareness, and treatment satisfaction (see Appendix B, Table B4). The first study (Ferreira et al., 2011) examined two different compensatory attention treatments using cognitive strategy instruction (i.e., mental imagery vs. visual scanning); the second study (Engelberts et al., 2002) compared a restorative computer-based attention treatment to a compensatory attention treatment using cognitive strategy instruction; and the third study (Llorens et al., 2016) examined two different restorative attention treatments, one using a virtual reality–based system to complete cognitive exercises with hierarchical training and the other using a battery of attention exercises with repeated stimulation. Except for treatment satisfaction, which revealed that participants favored the virtual reality–based hierarchical treatment over the repeated stimulation approach (SMD = 0.85, 95% CI [0.02, 1.67]), no other differential effects reached significance for these studies.

Memory

Sixteen studies with 625 participants included post-test data on four critical outcomes to examine the efficacy of a memory treatment to a no-treatment condition. No studies included data on the remaining five critical outcomes of caregiver burden, decreased need for cognitive-based supervision, return to work, treatment satisfaction, or increased knowledge/education regarding impact of injury (see Appendix A, Table A6 and Appendix B, Tables B1–B3). An additional study by das Nair et al. (2019) included follow-up data only.

Pooled analysis of studies revealed statistically significant effects for decreased impairment (SMD = 0.27, 95% CI [0.10, 0.45], moderate certainty, 13 studies), improved function (SMD = 0.32, 95% CI [0.03, 0.62], moderate certainty, 13 studies), and increased self-awareness into impact of injury (SMD = 0.34, 95% CI [0.05, 0.63], low certainty, two studies). Only one study by Aben et al. (2014) included data on quality of life with no significant benefits reported (SMD = −0.07, 95% CI [−0.40, 0.25], low certainty). Although limited by the number of studies, these effects were maintained or improved at 1, 3, and 6 months post-treatment for self-awareness and function, with the latter reaching significance.

One study by Thompson et al. (2016) included participants with temporal lobe epilepsy. The remaining studies included participants with subacute or chronic ABI because of a TBI or cerebrovascular accident. All studies were provided in a decontextualized manner, with the primary aim to restore memory function in four studies and to compensate for memory impairment in 11 studies. All restorative memory treatments utilized a computer-based hierarchical training approach in which the clinician set up, monitored, and adjusted treatment as appropriate. All compensatory treatments utilized cognitive strategy instruction in isolation or in combination with other compensatory techniques (e.g., external cognitive aid). One study by das Nair and Lincoln (2012) included two treatment arms compared to a no-treatment control, one using a restorative repeated stimulation approach and the other using a compensatory cognitive aid with repeated stimulation; however, the authors did not provide data to allow for separate analyses.

Additional analyses revealed that restorative memory treatments had medium significant effects for decreased impairment (SMD = 0.51, 95% CI [0.06, 0.97], three studies). Conversely, small-to-medium significant effects for improved function came from compensatory memory treatments. Overall, the pooled effect from nine studies on functional measures was 0.37 (95% CI [0.02, 0.73]), with the two studies that utilized cognitive strategy instruction as the primary treatment approach reporting the strongest effects (SMD = 0.60, 95% CI [0.01, 1.20]).

An additional 12 studies with 391 participants allowed for the direct comparison of one memory treatment to another (see Appendix B, Table B4). All but two studies included mixed ABI populations. The remaining two studies by Bourgeois et al. (2007) and Hildebrandt et al. (2011) included participants with traumatic or nontraumatic ABIs, respectively. Additionally, three studies included participants in the acute phase of recovery (0–3 months postinjury), three studies had participants in the subacute phase (3–12 months postinjury), and six studies included participants ranging from a subacute (> 3 months post, one study) to chronic (12+ months post, five studies) phase. Only one study by Shum et al. (2011) provided information about TBI severity.

Most studies compared the impact of two different memory treatments on decreased impairment and/or improved function. Only one study provided data on quality of life, self-awareness, or treatment satisfaction. No outcomes were reported for return to work, caregiver burden, decreased cognitive-based supervision, or increased knowledge/impact of injury.

Given the heterogeneous nature of interventions examined, limited information could be gleaned regarding the effects of a particular memory treatment over another. For example, two studies by Richter et al. (2015, 2018) examined a restorative treatment approach using a computer-based hierarchical training program combined with repetitive stimulation treatment compared to a group memory treatment using repetitive stimulation alone. Although the results favored hierarchical training plus repeated stimulation with a small effect for decreased impairment (SMD = 0.32, 95% CI [−0.15, 0.78]) and a negligible effect for improved function (SMD = 0.10, 95% CI [−0.55, 0.75]), the findings were not significant.

Only one study (Emmanouel et al., 2020) found a large nonsignificant effect favoring a compensatory memory treatment (i.e., working memory strategy training), with an added ingredient of goal management training versus working memory strategy training alone on decreased impairment (SMD = 1.52, 95% CI [−0.52, 3.55]). Although the study only included 18 participants and both working memory strategy training approaches differed in structure, formation of training instruction, and goals, the findings, although not significant, warrant further investigation of the benefit to goal management training as an additional component to memory treatment.

The remaining studies examined memory treatments using different cognitive aids or service delivery formats. Although some studies showed that participants receiving a particular memory treatment improved on many critical outcomes, the benefits were not significant and often came from a small number of studies and participants, with effects having wide CIs. For example, small-to-medium effects were found in favor of cognitive strategy instruction paired with an electronic memory aid compared to cognitive strategy instruction paired with a nonelectronic memory aid for decreased impairment (SMD = 0.43, 95% CI [−0.29, 1.16]), improved function (SMD = 0.31, 95% CI [−0.06, 0.69]), and improved quality of life (SMD = 0.67, 95% CI [−0.11, 1.44]) and compared to an electronic memory aid plus repeated stimulation for treatment satisfaction (RR = 1.01, 95% CI [0.82, 1.23]). This same pattern was seen for a single study (Lesniak et al., 2018) comparing a compensatory memory treatment using cognitive strategy instruction in an individual versus a group format and another study (Bourgeois et al., 2007) comparing a compensatory to a restorative memory treatment; both provided via a telehealth service delivery model. Small nonsignificant effects were found in favor of the individual over group compensatory treatment for decreased impairment (SMD = 0.38, 95% CI [−0.23, 0.98]) and improved function (SMD = 0.22, 95% CI [−0.38, 0.82]), and small nonsignificant effects were found in favor of compensatory over restorative treatment when delivered remotely for improved function (SMD = 0.28, 95% CI [−0.37, 0.93]). The remaining four studies compared a variety of combined restorative and compensatory memory treatments to various compensatory approaches with equivocal results on proximal outcomes.

Executive Functions

Fifteen studies with 604 participants contributed data to two of five critical outcomes, with results favoring executive function treatment compared to a no-treatment condition (see Appendix B, Tables B1–B3). Small statistically significant effects were found for improved function (SMD = 0.46, 95% CI [0.23, 0.69], moderate certainty, 14 studies) and improved quality of life (SMD = 0.32, 95% CI [0.02, 0.62], moderate certainty, three studies). Other critical outcomes with results favoring executive function intervention included treatment satisfaction (SMD = 0.43, 95% CI [−0.46, 1.32], very low certainty, one study) and increased self-awareness into impact of injury (SMD = 0.20, 95% CI [−0.06, 0.46], low certainty, eight studies); however, findings did not reach significance (see Appendix A, Table A7). No data were included for caregiver burden, return to work, decreased cognitive-based supervision, or increased knowledge/education regarding impact of injury. Although the remaining outcome, decreased impairment, revealed trivial effects posttreatment (SMD = 0.05, 95% CI [−0.35, 0.45], very low certainty, nine studies), medium-to-large statistically significant effects were found at 3 and 6 months posttreatment (five studies). Although limited by the number of studies and participants included, maintenance of effects was also seen for functional outcomes, quality of life, and self-awareness into impact of injury at one or more time points.

Additional analyses revealed that most studies included participants with both traumatic and nontraumatic ABIs in the subacute or chronic phase of recovery. Only three studies included participants with acute stroke (Skidmore et al., 2015; Wolf et al., 2016) or acute TBI (Cheng & Man, 2006). Executive function treatments were also primarily compensatory. Of the 10 studies examining compensatory executive function treatments, two utilized a top-down hierarchical strategy-based approach to improve cognitive control (i.e., Strategic Memory Advanced Reasoning Training), seven taught goal management or metacognitive strategies during activities of daily living, and one utilized a time pressure management strategy training approach. Of the five studies that examined restorative executive function treatments, three primarily utilized repeated stimulation and education in an awareness retraining program, and two studies incorporated hierarchical training with and without the additional use of cognitive aids and cognitive strategy instruction. Seven studies provided executive function treatment in a contextualized or quasicontextualized manner. Studies reporting functional outcomes had the largest significant effects when the executive function treatment was compensatory (SMD = 0.74, 95% CI [0.43, 1.05], eight studies) and when activities were provided in a contextualized manner (SMD = 0.87, 95% CI [0.52, 1.23]). Medium significant effects were also seen for increased self-awareness when executive function treatments were contextualized (SMD = 0.56, 95% CI [0.00, 1.12], four studies) regardless of treatment aim (i.e., restorative, compensatory).

Ten studies with 313 participants directly compared one executive function treatment approach to another (e.g., hierarchical training vs. repeated stimulation), compared the effects of an added ingredient to executive function treatment (e.g., cognitive strategy instruction plus repetitive stimulation vs. repetitive stimulation alone), or compared different treatment formats (e.g., individual vs. group). Only two studies included participants with an acute ABI. The remaining participants had subacute or chronic ABIs (see Appendix B, Table B4). All 10 studies included posttest data on functional outcomes. Some studies also examined the comparative effects of executive function treatment on decreased impairment (six studies), increased self-awareness into impact of injury (two studies), and improved quality of life (four studies). No data were reported on the other five critical outcomes.

Overall, no significant benefit was found for one executive function treatment over another at posttreatment or follow-up. Specifically, the two studies that directly compared an executive function treatment using a virtual reality–based hierarchical training approach to repetitive stimulation exercises (Man et al., 2013) and a metacognitive occupation-based strategy training approach to computer-based repetitive stimulation exercises (Poulin et al., 2017) reported no differential effects across outcomes. This same finding was seen for the three studies examining the added benefit of including repeated stimulation when teaching a cognitive strategy instruction approach. Equivocal results were seen on posttreatment measures of impairment, function, quality of life, and self-awareness into impact of injury. Only one study by Shum et al. (2011) examined the added benefit of cognitive strategy instruction to a self-awareness training program on decreased impairment. Despite having only 23 participants, a large significant effect was found when the self-awareness training using repeated stimulation and education included the added ingredient of cognitive strategy instruction (SMD = 1.00, 95% CI [0.12, 1.88]). However, there was no difference between self-awareness training with and without cognitive strategy instruction on functional outcomes.

Finally, two studies allowed for the comparison of executive function treatments using different service delivery models. Man et al. (2006) investigated the effects of a computer-based versus individual analogic treatment using a hierarchical training approach. Both treatments had equivocal results for decreased impairment. Ownsworth et al. (2008) examined the differential effects of individual, group, and combined individual plus group metacognitive strategy training programs for adults with cognitive dysfunction following ABI. Overall, these findings indicated that individual treatment had a small effect on improved function and that group treatment had a small effect on improved quality of life, both of which were not significant. The combined treatment approach also contributed to gains in functional outcomes and treatment satisfaction at 3-month follow-up.

Social Communication

To date, few RCTs (eight studies) have examined the impact of social communication treatments on adults with cognitive dysfunction following ABI (see Appendix B, Tables B1–B3). A cumulative total of 302 participants examined the efficacy of social communication treatments compared to a no-treatment condition on four of the nine critical outcomes (decreased impairment, improved function, improved self-awareness into impact of injury, and improved quality of life). Most studies (seven of eight) were restorative in nature and included emotional perception treatments and social skills training programs. Except for a study by Behn et al. (2019), all restorative treatments included activities provided in a decontextualized manner. Behn et al. was the only study to include contextualized activities during a project-based social communication treatment. Additionally, one study by Togher et al. (2013)

specifically examined the effects of social communication training with (i.e., "JOINT") and without (i.e., "SOLO") the addition of communication partner training. The JOINT treatment with communication partner training had a restorative and compensatory focus, and the SOLO treatment without social communication training was restorative in nature. The remaining study by Neumann et al. (2015) had a compensatory focus, which taught participants facial and contextual strategies during a computer-based emotional recognition training program.

Overall, the combined results from 184 participants suggest that social communication treatment had a statistically significant benefit for improving function (SMD = 0.41, 95% CI [0.11, 0.72], low certainty, seven studies). No intervention effects were found on the remaining three critical outcomes with reported data or maintenance of effects; however, the findings were limited by the number of studies and participants included for these outcomes (see Appendix A, Table A8). Only one study with 71 participants measured impairment-based outcomes, two studies with 119 participants measured quality of life, and one study with 26 participants measured self-awareness into impact of injury. No studies examined return to work, treatment satisfaction, decreased cognitive-based supervision, or increased knowledge/education regarding injury/course of recovery.

Additional analyses revealed all studies included participants who were at least 12 months postinjury, and most studies included participants with social communication deficits because of a severe or moderate-to-severe ABI, when reported (see Appendix B, Tables B1–B3). There was a statistically significant benefit of decontextualized social communication treatments on functional outcomes (SMD = 0.44, 95% CI [0.11, 0.72]). The one study that utilized a contextualized social communication treatment also had a small nonsignificant effect in favor of intervention. However, the study only included 21 participants with the CI crossing the null value (SMD = 0.23, 95% CI [−0.63, 1.09]). The study by Togher et al. (2013) allowed for a separate analysis of a restorative social communication treatment (SOLO) and a mixed restorative and compensatory treatment (JOINT) that included communication partner training to a no-treatment control. Although limited by the inclusion of only 27 participants, the findings suggest that a mixed JOINT treatment approach with communication partner training had a large significant effect compared to no treatment (SMD = 0.78, 95% CI [0.12, 1.43]). No further information could be gleaned about the effect of different social communication treatment approaches (e.g., hierarchical training, repeated stimulation) due to the limited number of studies and participants.

Only five studies with 227 participants with TBI allowed for a direct comparison of different social communication treatments, four of which provided data on functional outcomes (see Appendix B, Table B4). One study provided data on measures of impairment, quality of life, and self-awareness. Study authors did not report any information on the remaining five critical outcomes. Studies compared different social communication treatment approaches (e.g., emotional perceptual treatment with self-instruction training, emotional perceptual treatment with errorless learning drills), the same approach using different decontextualized and contextualized activities (e.g., computer-based emotional perceptual training with facial cues vs. contextual strategy training, interactive vs. noninteractive group social communication treatment), and the benefits of an added ingredient to a social communication treatment (e.g., JOINT social communication partner training plus individual social communication treatment vs. SOLO individual social communication treatment).

Although small-to-medium effects ranging from an SMD of 0.21 to 0.53 were found in favor of computer-based emotional recognition with contextual strategies, JOINT communication partner training plus individual social communication treatment and group noninteractive social communication training on measures of impairment and function, all CIs crossed the null value, indicating the effects were not significant. Additionally, equivocal results were found for the one study reporting self-awareness and quality-of-life outcomes. Therefore, overall findings from limited studies suggest that no one social communication treatment was found to be superior to another.

Evidence-Based Recommendation:

Cognitive rehabilitation can include activities using decontextualized and contextualized treatments. Emphasis should be placed on contextualized treatments to maximize function and self-awareness.

In addition to selecting the most appropriate cognitive rehabilitation treatment for adults with cognitive dysfunction post ABI, SLPs must also consider the preferred service delivery model, the manner in which treatment is provided (e.g., contextualized), and any additional factors that may contribute to a positive treatment response (e.g., cultural and linguistic factors, mechanism of injury, family support). Based on the findings from our review, the panel considered cognitive rehabilitation to be practical for delivery in a clinical setting and in a more contextualized community setting. Moreover, although decontextualized treatments had beneficial effects, the strongest effects came from contextualized treatments at both posttreatment and follow-up on proximal outcomes, including self-awareness of injury, which is thought to be a critical construct in successful rehabilitation (Korpershoek et al., 2011). Additionally, contextualized activities are thought to be more patient centered, resulting in increased participation in treatment, stronger patient–provider relationships, and increased satisfaction (K. L. Miller, 2016; Stewart et al., 2013). As such, functional therapeutic interventions in the context of meaningful real-life activity are integral to maximizing function and increasing self-awareness of injury and decreasing impairment.

Contextualized and Decontextualized Treatments Summary of the Evidence

Eleven studies with 423 participants met the inclusion criteria and investigated the effect of contextualized cognitive rehabilitation compared to a no-treatment condition (see Appendix B, Tables B1 and B2). Four studies aimed to restore cognitive function, and seven studies aimed to compensate for cognitive deficits when integrating contextualized activities. Participants were evenly split by ABI type and were primarily from TBI or stroke. Participants ranged from the acute phase (four studies), subacute phase (one study), or chronic phase (three studies) of ABI recovery. Three additional studies included subacute and chronic participants. Treatment methods included goal management training during functional tasks; in-home patient and family cognitive treatment targeting use of compensatory strategies; environmental modifications and education; skill-based cognitive training during functional group or individual activities; and training cognitive skills in virtual, quasicontextual environments.

Pooled findings from these RCTs revealed small-to-medium statistically significant effects showing the benefits of contextualized treatments on improved function (SMD = 0.48, 95% CI [0.19, 0.77], moderate certainty, 10 studies) and increased self-awareness (SMD = 0.56, 95% CI [0.00, 1.12], four studies). Posttreatment effects did not reach significance for decreased impairment (SMD = 0.47, 95% CI [−0.11, 1.05], four studies). However, maintenance of effects was statistically significant for impairment-based outcomes at 3 and 6 months posttreatment. Although limited by the number of studies reporting follow-up data (three studies), effect sizes ranged from 0.84 to 1.64 (see Appendix A, Table A9).

Further analyses from five studies (195 participants) revealed that functional outcomes had the strongest effects when contextualized treatments focused on compensating for cognitive impairments using a cognitive strategy instruction approach in isolation or in conjunction with external cognitive aids (SMD = 0.58, 95% CI [0.18, 0.98]). Conversely, impairment-based outcomes had the strongest effects when the aim of the contextualized treatments was to restore cognitive function using a hierarchical training approach (SMD = 1.65, 95% CI [0.61, 2.70]), although this finding is only from one study with 20 participants with acute ABI. Additionally, although the largest posttreatment effects came from studies that included participants with acute ABI, the findings from those studies did not reach significance. SMDs for improved function were based on three studies with 77 participants (SMD = 0.69, 95% CI [−0.02, 1.40]).

Eight studies examined the comparative effectiveness of contextualized versus decontextualized treatments on five critical outcomes. Except for impairment-based outcomes, in which a small significant effect favored contextualized treatments (SMD = 0.40, 95% CI [0.14, 0.65], low certainty, six studies), no differences were found in the manner in which treatment was delivered. Seven studies provided data on functional outcomes, four studies provided data on quality of life, one study provided data on caregiver burden, and three studies provided data on self-awareness into impact of injury (see Appendix A, Table A10). No studies directly compared contextualized versus decontextualized treatment on the remaining critical outcomes of return to work, treatment satisfaction, decreased need for cognitive-based supervision, and increased knowledge/education regarding injury/course of recovery. Most studies included participants with traumatic or mixed traumatic and nontraumatic ABIs (six studies) or those at the postacute phase of recovery (seven studies).

Evidence-Based Recommendation:
Cognitive rehabilitation should be initiated as early as possible. Treatment should be initiated and extended beyond the acute phase of recovery based on progress, trajectory of functional improvement, and individualized (attainable/meaningful) goals.

Our findings, along with previous systematic reviews, also suggest that timing, dosage, provider, and format of treatment play a critical role in the functional recovery of adults with cognitive dysfunction post ABI. Specifically, early and more intensive neurorehabilitation approaches have a beneficial effect on the recovery process of adults with ABI, including decreased length of hospital stay and duration of coma (Königs et al., 2018; Turner-Stokes et al., 2015). Whereas no information could be gleaned regarding the dosage of cognitive rehabilitation due to the wide dosage ranges in the included studies (e.g., from 20- to 150-min sessions ranging from 2 to 12 weeks), our findings, although limited, corroborate the potential benefits of early initiation of cognitive rehabilitation.

Timing and Dosage of Treatment Summary of the Evidence

Two RCTs examining a total of 185 participants found that early cognitive rehabilitation had a positive statistically significant effect on functional outcomes (e.g., self-reported cognitive difficulties in social interactions, community integration) at posttreatment (compared to delayed onset of comparable treatment; SMD = 0.48, 95% CI [0.17, 0.8], very low certainty, two studies). These findings were maintained at 12-month follow-up (SMD = 0.44, 95% CI [0.11, 0.77], very low certainty, one study). One of the two RCTs also examined the effect of cognitive rehabilitation timing on distal outcomes. Although the results did not reach significance, treatment favored early cognitive rehabilitation for return to work (RR = 1.28, 95% CI [0.92, 1.78]). These findings suggest that timing of cognitive rehabilitation is important to the functional recovery process of the ABI population. No additional information could be gleaned about dosage of treatment (see Appendix A, Table A11 and Appendix B, Table B4).

Evidence-Based Recommendation:

Use computer-based treatment programs when part of a clinician-directed, comprehensive cognitive rehabilitation plan.

Our findings also revealed that cognitive rehabilitation that is delivered by a clinician trained in cognitive rehabilitation theory and practice had beneficial effects on several critical outcomes, including return to work and increased self-awareness into impact of injury. Additionally, computer-based and virtual reality treatment programs, when part of a clinician-directed, comprehensive cognitive rehabilitation plan, help decrease impairment and improve function resulting from ABI (Cooper et al., 2017; De Luca et al., 2019; Kumar et al., 2017). Although we were unable to directly examine the impact of the provider on patient outcomes, previous research supports the role of the clinician–patient therapeutic alliance in brain injury rehabilitation (Bishop et al., 2019; Hall et al., 2010; Lustig et al., 2003; Peiris et al., 2012). Evidence suggests that successful cognitive rehabilitation depends on a strong therapeutic alliance between the clinician and the patient and enhances patient understanding about prognosis and treatment outcomes (Muehlschlegel et al., 2015; Stacey et al., 2011; Stagg et al., 2019). Additional research by Vanderploeg et al. (2018) highlights the importance of clinician involvement in cognitive rehabilitation, with the authors reporting that self-directed computer treatment was negatively associated with cognitive and neurobehavioral improvement. This is the first study to report a possible adverse effect of non–clinician-directed cognitive treatment.

Provider Summary of the Evidence

No studies were found examining clinician-directed versus non–clinician-directed cognitive rehabilitation where treatment was held constant. However, one study (Cooper et al., 2017) compared a commercially available self-administered computer-based treatment (i.e., brain games) to a clinician-directed treatment that included APT or APT plus psychoeducation for individuals with mTBI. To our knowledge, this is the only study that directly examined self-administered (i.e., no provider) to clinician-directed computer-based treatment with findings revealing that the therapist-directed treatment arms "had superior outcomes compared with treatment arms without therapist-directed rehabilitation, both at the end of treatment and at 12 weeks of posttreatment follow-up" on functional outcomes (Cooper et al., 2017, p. E11).

Evidence-Based Recommendation:

Consider group treatment to offer opportunities of peer interaction and generalization.

Different treatment formats were also found to have beneficial effects for the ABI population. For example, cognitive rehabilitation delivered in a group format may be as effective and, in some cases, more effective for certain subgroups of adults with cognitive dysfunction following ABI. Group treatment offers the opportunity to practice learned skills developed during individual treatment, provides opportunities for peer interaction, and allows for a greater sense of support (Bertisch et al., 2011).

Findings also suggest that manualized interventions offer a feasible and structured delivery format for cognitive rehabilitation that can focus on a single domain (e.g., Barker-Collo et al., 2009) or multiple domains simultaneously (e.g., Storzbach et al., 2017; Twamley et al., 2015). Manualized interventions can be adapted to individual and group settings and may include restorative and compensatory interventions to meet individualized functional needs. Associated with improved impairment, functional, and return-to-work outcomes, manualized cognitive rehabilitation formats can provide clinicians with time-limited, step-by-step, evidence-based delivery of interventions for education, goal setting, planning, and symptom management, among others (e.g., see the SCORE [Study of Cognitive Rehabilitation Effectiveness] study manual; Defense and Veterans Brain Injury Center, 2015).

Group Treatment Summary of the Evidence

A secondary analysis of 20 studies allowed for the examination of group cognitive rehabilitation compared to a no-treatment control on four of the nine critical outcomes. Small-to-medium statistically significant effects favoring group treatment were found for decreased impairment (SMD = 0.20, 95% CI [0.02, 0.38], 14 studies), increased function (SMD = 0.49, 95% CI [0.26, 0.73], 16 studies), and increased self-awareness of impact into injury (SMD = 0.21, 95% CI [0.01, 0.40], six studies).

Improved function and self-awareness into impact of injury had the strongest effects when group treatment had a compensatory focus or when group treatment targeted a specific cognitive domain or when provided in a contextualized manner. Effect sizes for group compensatory treatments on improved function and self-awareness were 0.57 (95% CI [0.24, 0.90], 10 studies) and 0.28 (95% CI [0.05, 0.51], five studies), respectively. Domain-specific group memory treatments had an SMD of 0.73 (95% CI [0.34, 1.15], four studies) on improved function and an SMD of 0.34 (95% CI [0.05, 0.63], two studies) on improved self-awareness into impact of injury, executive function group treatments had an SMD of 0.67 (95% CI [0.32, 1.10], five studies) on improved function, and group-based contextualized treatment had an SMD of 1.01 (95% CI [0.33, 1.69], two studies) on self-awareness into impact of injury; however, the latter outcome had a limited number of participants (< 50). As reported earlier, only one study by Ownsworth et al. (2008) directly compared an individual to group metacognitive strategy instruction treatment with no difference between service delivery formats.

Evidence-Based Recommendation:
Consider telehealth to expand access to cognitive rehabilitation.

Recent evidence also suggests that telerehabilitation, also known as *telehealth* or *remote therapy*, can improve health care accessibility, especially for those who may have limited access to care due to cognitive and physical impairments (Weidner & Lowman, 2020). It also allows individuals who live in rural areas access to providers with specialized training and expertise (Schmeler et al., 2009). Our findings, albeit limited by the number of studies and participants included, confirm that telepractice is a promising service delivery method for the ABI population. Current evidence revealed that cognitive treatment delivered remotely to adults with cognitive dysfunction following ABI had equivocal results compared to in-person treatment. Remote delivery was also acceptable to individuals with reported advantages of convenience, anonymity, and comfort with receiving support in the home (Coleman et al., 2015; Ownsworth et al., 2018).

Telerehabilitation Summary of the Evidence

Three studies with 128 participants compared remote versus in-person cognitive rehabilitation, each providing treatment in different cognitive domains. Lawson et al. (2020) investigated the delivery of remote and in-person compensatory memory treatment to participants with nontraumatic ABIs, Rietdijk et al. (2020) examined the delivery of remote and in-person restorative social communication skills training program to participants with moderate-to-severe TBIs, and Man et al. (2006) compared an online interactive computer-based analogic training to a conventional in-person training to participants with mixed ABIs. For the latter, the author stated that the content of treatment was identical (e.g., training problem-solving skills with basic to functional skill development) and that both arms had clinician involvement (see Appendix B, Table B4).

All studies included participants in the postacute phase of recovery, with two studies including those with chronic ABI (> 12 months post). Although limited by the number of studies and participants, no differences were found between remote and in-person treatment on decreased impairment (SMD = 0.00, 95% CI [−0.53, 0.53], one study) and improved function (SMD = −0.14, 95% CI [−0.49, 0.21], three studies) posttreatment. No other critical outcomes were reported by authors (see Appendix A, Table A12).

Three additional studies that did not provide data for inclusion in our meta-analysis offer additional support for telerehabilitation. A study by Riegler et al. (2013) found that there was no significant difference ($p = .55$) between a remotely delivered problem-solving treatment and an in-person treatment, and a study by Bergquist et al. (2009) found no significant difference ($p > .05$) in memory performance between remote and in-person memory treatment. Additionally, Bergquist et al. (2014) found that most participants (> 87%) were satisfied with the remote Internet-based memory treatment and that greater satisfaction was positively correlated with decreased mood ($r = -.59$, $p = .03$) and greater employment rates ($r = .63$, $p = .02$).

Evidence-Based Recommendation:
Cognitive rehabilitation should consider demographic and other factors that may contribute to a patient's response to intervention.

Predictive factors can influence trajectories of recovery from ABI and are extremely heterogeneous, due in part to varied direct mechanisms of injury and direct neurological sequelae from the brain injury as well as to underlying human characteristics and past experiences that will inevitably shape the recovery trajectory. Understanding the influence of such prognostic factors is imperative to maximizing rehabilitation outcomes and establishing realistic expectations in clinical care paradigms. To date, little research has focused on predictive person-specific factors that influence cognitive rehabilitation outcomes. There is some known influence of contextual factors, including therapeutic engagement and motivation, and comorbid factors, including psychiatric or learning disability history on general outcomes post ABI, but few studies have explored the impact of these factors specifically on the cognitive rehabilitation process and specific functional cognitive outcomes. Although not included in our review, a recent study by Belanger et al. (2020) found that perceived self-efficacy at the beginning of cognitive treatment was associated with therapeutic engagement for treatment responders. These findings suggest that increasing the patient's level of self-efficacy may be an important factor in mediating treatment success. Similarly, the INCOG guidelines support the findings that performance can also be influenced by preinjury and postinjury factors (e.g., prior history of substance abuse, level of education, employment history, concomitant psychiatric conditions, vision or hearing deficits) and recommend personal factors be considered when determining an individual's communication competence and need for treatment (Togher et al., 2014).

It is imperative that SLPs be aware of factors that may potentially moderate a patient's response to intervention or function as a barrier to engagement and progression in rehabilitation. Furthermore, it is important that practitioners of cognitive rehabilitation be aware of patient characteristics or demographics that can help the clinician navigate the episode of care. Knowledge of the patient's preexisting tendencies, strengths, and weaknesses and general level of functioning can help establish relevant and attainable goals. Knowledge of moderators of intervention effectiveness can also help clinicians make choices among different cognitive treatments, some of which may have known effectiveness for persons with specific backgrounds or characteristics.

Predictive Factors Summary of the Evidence

As part of our guideline, we undertook a systematic review and qualitative analysis of cohort studies to identify patient characteristics and demographic variables, both modifiable (characteristics that are responsive to treatment; exercise participation is an example) and nonmodifiable (static characteristics such as education, intelligence, and work history), that may influence cognitive rehabilitation outcomes for adults with ABI-related cognitive dysfunction. For each study, data were extracted on the predictive factors considered (e.g., patient factors, comorbidities, contextual factors), the outcomes used to measure cognitive rehabilitation success (e.g., decreased impairment, improved function, return to work), and the significant findings reported (see Appendix C, Table C1). The methodological quality of each study was also assessed using a modified version of the QUIPS tool (see Appendix C, Table C2). The wide variety and/or inadequate descriptions of the interventions used in many of these studies prevented a more formal meta-analytic assessment of which factors had the most predictive value for different cognitive treatments.

Overall findings from 13 cohort studies revealed that most studies examined predictive factors related to the patient's characteristics such as age, gender, and education level (eight of 13 studies); ABI clinical characteristics such as time postonset and severity of injury (nine of 13 studies); and baseline neuropsychological performance (seven of 13 studies) on response to treatment. Few studies also examined the impact of comorbidities (e.g., psychiatric history, depression; four of 13 studies) and contextual factors (e.g., marital status, family functioning; three of 13 studies) on cognitive rehabilitation success. Most outcomes were analyzed in terms of functional improvement (e.g., participation, return to work, independent living) and, to a lesser extent, by decreased impairment, improved self-awareness, and quality of life. No studies examined predictive factors associated with decreased caregiver burden, treatment satisfaction, or increased knowledge/education regarding injury/course of recovery.

Patient Factors

Eight studies examined the impact of one or more patient characteristics on response to treatment, with age as the sole predictor with significant findings (see Appendix C, Table C1). One study (García-Molina et al., 2015) also found that younger subjects were more likely to improve on impairment-based outcomes, and another study (Smania et al., 2013) found that younger age was a useful predictor for return to home. Other patient variables (i.e., sex, education, and handedness) were not associated with decreased impairment or improved function.

Comorbidities

Four studies examined the role of coexisting comorbidities (e.g., tracheostomy at admission, depression) and previous mental health conditions (e.g., history of psychiatric problems) on cognitive rehabilitation outcomes, of which two had significant findings. One study (Janak et al., 2017) found that adults with post-traumatic stress disorder were less likely to make progress on impairment-based measures, and the other study (Scott et al., 2016) revealed the presence of depression and history of psychiatric problems were negative predictors of treatment success on functional measures (see Appendix C, Table C1).

Contextual Factors

In addition to patient characteristics and comorbid conditions, contextual factors related to family and social support were also examined to determine their contribution to cognitive and functional recovery post ABI. Four studies examined different contextual factors, which included marital status, family functioning, location of treatment, and compensation-seeking behavior. Of these, two studies (García-Molina et al., 2015; Smania et al., 2013) found that family functioning and location of treatment were significantly associated with positive response to treatment. One study (Sander et al., 2002) also found that individuals with healthy family functioning made significantly more progress posttreatment on functional and return-to-work measures than those with unhealthy family functioning. Another study (García-Molina et al., 2015) found that treatment provided in the home was positively associated with decreased impairment in memory, attention, and executive functioning. Marital status, military status (e.g., deployment, rank), and disability status (litigation/compensation seeking) were examined in one study, each with no significant impact on examined cognitive rehabilitation outcomes (see Appendix C, Table C1).

Clinical Factors

Most studies (nine of 13 studies) examined clinical characteristics related to the patient's ABI such as time postinjury, severity, ABI type, and mechanism of injury (see Appendix C, Table C1). Not surprisingly, time postonset was a significant predictor of treatment success. One study (Lewis & Horn, 2013) found that individuals who were within 6 months of injury had better functional outcomes than those who were further postonset, and another study (Malec, 2001) found that subjects whose injury occurred within the last year showed increased gains in independent living compared to those whose injury occurred 2–10 years and 10 years or more ago. In addition to time postonset, two of four studies (García-Molina et al., 2015; Smania et al., 2013) found that adults with TBI performed better than those with other etiologies (e.g., stroke, anoxia) on functional measures, return to work, and discharge disposition, and one study (García-Molina et al., 2015) found that adults with TBI performed better on impairment-based measures.

Few studies also examined other clinical factors such as ABI severity, GCS score, ABI mechanism of injury, previous history of ABI, postconcussive symptoms, and findings on diffuse tensor imaging. Of these, only the latter two factors were significant predictors of treatment success. One study (Cicerone et al., 1996) found that those who were unable to return to work reported significantly more postconcussive symptoms than those who were able, and another study (Strangman et al., 2012) found that higher fractional anisotropy served as a negative predictor of treatment success on impairment-based and functional measures.

Neuropsychological Factors

Finally, neuropsychological factors were analyzed to determine whether pretreatment cognitive performance was predictive of cognitive rehabilitation success. Although the measures used across studies varied widely, baseline performance on the Mayo-Portland Adaptability Inventory, the Barrow Neurological Institute Screen for Higher Cerebral Functions Visual Spatial subtest, the Tinkertoy Test, and the Independent Living Scales Health and Safety subtest had significant findings on decreased need for cognitive-based supervision and community-based employment, improved function/goal attainment, and increased self-awareness, respectively (see Appendix C, Table C1). Additionally, one study (Ownsworth & McFarland, 2004) found that individuals who deny or minimize their ABI symptoms were less likely to improve strategy behavior and psychosocial functioning.

Consensus-Based Practice Recommendations

Finally, there are several recommendations that were not specifically addressed through our systematic review of the evidence, but our panel of subject matter experts agreed that these recommendations warranted mention in the guideline. The following recommendations were informed by evidence, panel expertise, and consensus and highlight the role of the SLP in the screening, assessment, and treatment of adults with cognitive dysfunction associated with ABI.

- Care coordination is part of an integrated and holistic approach to cognitive rehabilitation and should include collaboration with an interdisciplinary team or referral to appropriate professionals with training and expertise in adults with ABI. The interdisciplinary team should include SLPs when cognitive-communication skills are affected following ABI.
- Successful treatment planning and rehabilitation for adults with cognitive dysfunction associated with ABI requires a timely, symptom-focused assessment of cognitive-communication skills by an SLP (ASHA, 2005; MacDonald, 2017). A comprehensive assessment by an SLP should include a variety of objective, subjective, and ecologically valid measures appropriate for detecting functionally significant impairments in the ABI population (Coelho et al., 2005; Turkstra et al., 2005).
- Tools such as the Goal Attainment Scale can assist in the development of individualized, meaningful, time-limited, and measurable treatment goals. Use of patient-reported outcome measures can align cognitive rehabilitation with each patient's individual goals and facilitate tracking of perceived functional progress and patient satisfaction.
- Cognitive rehabilitation should consider the patient's views, cultural and linguistic background, and premorbid lifestyle and address the activity limitation and participation restriction components within the WHO-ICF (WHO, 2001).
- A treatment plan should be developed in concert with the patient and their family and strive toward shared decision making and identify personally relevant goals that will target cognitive-communication skills impacting day-to-day function.
- Establishment of a therapeutic alliance should be based on trust. As stated above, the therapeutic alliance is paramount to the success of rehabilitation and ensures realistic treatment expectations (Bishop

et al., 2019; Hall et al., 2010; Lustig et al., 2003; Peiris et al., 2012; Stagg et al., 2019).

- Dynamic assessment and monitoring of functional performance are critical to determine response to treatment. Cognitive rehabilitation delivered by an SLP should allow for modifications in treatment focus, approach, and delivery based on the individual needs, progress, and goals of each patient, which can change over the course of ABI recovery.

Limitations and Future Research

There are some limitations related to the body of evidence, which should be carefully considered. First, the certainty of evidence was primarily low due to the limited number of high-quality RCTs identified. Overall, there were methodological concerns with the evidence base, particularly regarding randomization and lack of blinding, two constructs that are often challenging to implement in behavioral intervention research. This is primarily due to inherent concerns about withholding treatment from research participants in need of rehabilitation and the inability to keep participants and clinicians in the dark regarding the allocation of treatment. When participants, who may or may not be blinded, complete patient-reported outcomes, assessor blinding can subsequently be compromised. Additionally, many authors provided too few details leading to unclear risk of bias when rating quality indicators such as selective outcome reporting and participant and personnel blinding. These limitations, coupled with wide CIs around many of the pooled effects and the small number of participants across many clinical questions and outcomes, contributed to the overall low certainty of effect.

Second, there were issues around heterogeneity of the patient population, treatment approaches, and outcomes used. Given that ABI is a broad category including patients with various mechanisms of injury and a wide variety of physical, cognitive, behavioral, and social impairments, no two patients are exactly alike. Similarly, the term cognitive rehabilitation is quite broad and includes many types of interventions varying in target, purpose, method, and manner, with most studies incorporating multiple treatment approaches or providing limited information about the treatment provided. Treatment dosage also varied widely. Session length ranged from 30 to 120 min, with the frequency ranging from 1 to 5 times per week over a 2- to 24-week period. The heterogeneous nature of ABI, paired with the variety of severity classification systems used and the wide range of treatments and dosages, made it difficult to compare patients and interventions with much granularity.

In addition, researchers used a wide variety of outcome measures across studies. Although outcome measures without reported psychometric data were eliminated, over 100 remained, making it difficult to compare intervention efficacy results. It was also not surprising that most measures included were impairment based given the scarcity of validated functional cognitive measures. Ideally, functional measures may more accurately reflect the activity and participation limitations of adults with cognitive dysfunction. Moreover, research on this population can prove difficult due to potential confounders, which include spontaneous recovery, symptom misattribution, holistic and integrated treatment approaches, patient factors, and the presence of comorbidities that can affect both proximal and distal outcomes. Individuals experiencing ABI are often survivors of significant life disruption. The simple fact that these individuals could be adjusting to the loss of independence and function can make distal outcomes such as quality of life challenging to measure accurately and to interpret meaningfully. Improved outcome measurements for self-awareness, quality of life, and so forth, are needed to accurately capture the impact of treatment without the potential artifact of a patient's feelings of loss.

Finally, we encountered many studies that reported multiple effect sizes within a critical outcome, which may have impacted the meta-analytical results. For example, primary authors often used multiple measures for the same outcome (e.g., used two different quality-of-life scales), reported total and subtest scores for the same measure (e.g., reported a quality-of-life total score and corresponding subscales), or measured more than one cognitive domain within the same outcome for each patient (e.g., used standardized measures for attention, memory, and global cognition). Because of the need to account for these multiplicity issues and distill multiple measures within a domain down to a single effect size value for inclusion in our meta-analysis, a "washing out" of effect size may have occurred. That is, the score achieved through averaging was often lowered by the process. The inclusion of multiple measures also limited our ability to determine a single threshold for clinical significance for the effects of each outcome. This was primarily due to measurement-specific properties and sensitivity to change and/or measures with unique or unestablished minimal clinically important difference values. Additionally, many studies did not report data for all valid outcome measures in a usable format (i.e., end point means and standard deviations) or in a format that could be imputed or transformed. That is, a study may have included 10 impairment-based measures, but only two measures could be included in the meta-analysis because insufficient data were reported. These reporting limitations in conjunction with our efforts to reduce multiplicity (e.g., use patient-reported measures over caregiver-reported measures) may have introduced selection bias and influenced our results. These methodological and reporting limitations should be considered when conducting future research for these types of interventions and with this heterogeneous population.

Specifically, more well-designed research from high-quality RCTs using adequate randomization, blinding, and active or placebo controls is needed to minimize bias, grow the evidence base, and demonstrate the efficacy of different treatment options and supports for this diverse population. Future research should examine the effects of different cognitive rehabilitation interventions for adults with varying severity levels of ABI and cognitive impairment to determine which approach works best for whom and under what circumstances. Additionally, it is important for investigators to adequately describe the target, aim, method, and manner in which treatment is being delivered as well as use and document comparable outcome measures to better evaluate the immediate and long-term benefits of cognitive rehabilitation. Use of outcome measures that do not adequately reflect communication abilities and real-world performance can lead to underreporting of cognitive-communication problems and underreferral for treatment when needed (MacDonald & Johnson, 2005). Future research should include use of a common set of cognitive-communication outcome measures and include proximal and distal outcomes for improved function, increased self-awareness, and improved quality of life. Other factors (e.g., presence of comorbid or previous health conditions, medication use, injury parameters, cultural and linguistic variables, therapeutic alliance, shared decision making) that may influence response to cognitive rehabilitation should also be explored. Future research should also examine barriers within the health care system that potentially limit access to care for certain racial and ethnic groups. Examination of these cognitive rehabilitation factors and barriers is imperative for informing best practices for adults with cognitive dysfunction associated with ABI.

Summary

ASHA, in conjunction with a multidisciplinary panel of subject matter experts, has developed evidence-based clinical practice recommendations for cognitive rehabilitation in adults with cognitive dysfunction associated with ABI. This clinical practice guideline is based on a systematic review of 112 studies published in 117 articles between 1980 and 2020 and has several implications for SLPs working with this population. Although no single approach to cognitive rehabilitation will be effective for every individual with ABI, many are recommended when treating adults with cognitive dysfunction associated with ABI. SLPs should consider the diverse toolkit of evidence-based treatments and service delivery options based on the individual needs of the patient over the course of their recovery and based on available resources.

Due to the heterogeneity of the ABI population and included interventions as well as the methodology used, small-to-medium effect sizes and low certainty of evidence were expected and in keeping with other reviews on this topic. The decision to make a recommendation incorporated evidence and considerations for the negative impact of the problem, the balance of desirable and undesirable effects, the acceptability of treatment to consumers, implementation facilitators/barriers, equity implications, and the confidence in the quality of the evidence. Although our methodology differs from previous guidelines, our recommendations provide additional support for the provision and reimbursement of cognitive rehabilitation for adults with cognitive dysfunction associated with ABI. For additional guidance in implementing this guideline, fact sheets on tools and resources for clinicians, consumers, and payers are provided as Supplemental Materials S6–S8.

Author Contributions

Guideline Development Panel: Conceptualization (Lead), Formal analysis (Supporting), Writing – original draft (Supporting), Writing – review & editing (Supporting). **Tobi Frymark:** Formal analysis (Lead), Methodology (Lead), Project administration (Lead), Writing – original draft (Lead), Writing – review & editing (Supporting). **Rebecca Bowen:** Formal analysis (Lead), Methodology (Lead), Project administration (Supporting), Writing – original draft (Supporting), Writing – review & editing (Supporting).

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References

References marked with an asterisk indicate studies included in the meta-analysis.

*Aben, L., Heijenbrok-Kal, M. H., Ponds, R. W., Busschbach, J. J., & Ribbers, G. M. (2014). Long-lasting effects of a new memory self-efficacy training for stroke patients: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 28*(3), 199–206. https://doi.org/10.1177/1545968313478487

Ackley, K., & Brown, J. (2020). Speech-language pathologists' practices for addressing cognitive deficits in college students with traumatic brain injury. *American Journal of Speech-Language Pathology, 29*(4), 2226–2241. https://doi.org/10.1044/2020_AJSLP-20-00079

*__Akerlund, E., Esbjornsson, E., Sunnerhagen, K. S., & Bjorkdahl, A.__ (2013). Can computerized working memory training improve impaired working memory, cognition, and psychological health? *Brain Injury, 27*(13–14), 1649–1657. https://doi.org/10.3109/02699052.2013.830195

Alexander, M. P. (1995). Mild traumatic brain injury: Pathophysiology, natural history, and clinical management. *Neurology, 45*(7), 1253–1260. https://doi.org/10.1212/wnl.45.7.1253

Alonso-Coello, P., Schünemann, H. J., Moberg, J., Brignardello-Petersen, R., Akl, E. A., Davoli, M., Treweek, S., Mustafa, R. A., Rada, G., Rosenbaum, S., Morelli, A., Guyatt, G. H., Oxman, A. D., & the GRADE Working Group. (2016). GRADE Evidence to Decision (EtD) frameworks: A systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *BMJ, 353,* i2016. https://doi.org/10.1136/bmj.i2016

American Heart Association. (2019). *Rehab therapy after a stroke*. https://www.stroke.org/en/life-after-stroke/stroke-rehab/rehab-therapy-after-a-stroke

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

American Speech-Language-Hearing Association. (2003). *Evaluating and treating communication and cognitive disorders: Approaches to referral and collaboration for speech-language pathology and clinical neuropsychology* [Technical report]. https://www.asha.org/policy/tr2003-00137/

American Speech-Language-Hearing Association. (2004a). *Evidence-based practice in communication disorders: An introduction* [Technical report]. https://www.asha.org/policy/tr2004-00001/

American Speech-Language-Hearing Association. (2004b). *Preferred practice patterns for the profession of speech-language pathology* [Preferred practice patterns]. https://www.asha.org/policy/pp2004-00191/

American Speech-Language-Hearing Association. (2005). *Roles of speech-language pathologists in the identification, diagnosis, and treatment of individuals within cognitive communication disorders* [Position statement]. http://www.asha.org/policy

Anderson, M. I., Parmenter, T. R., & Mok, M. (2002). The relationship between neurobehavioural problems of severe traumatic brain injury (TBI), family functioning and the psychological well-being of the spouse/caregiver: Path model analysis. *Brain Injury, 16*(9), 743–757. https://doi.org/10.1080/02699050210128906

*__Barker-Collo, S. L., Feigin, V. L., Lawes, C. M. M., Parag, V., Senior, H., & Rodgers, A.__ (2009). Reducing attention deficits after stroke using attention process training: A randomized controlled trial. *Stroke, 40*(10), 3293–3298. https://doi.org/10.1161/STROKEAHA.109.558239

Baum, J., Entezami, P., Shah, K., & Medhkour, A. (2016). Predictors of outcomes in traumatic brain injury. *World Neurosurgery, 90,* 525–529. https://doi.org/10.1016/j.wneu.2015.12.012

*__Behn, N., Marshall, J., Togher, L., & Cruice, M.__ (2019). Feasibility and initial efficacy of project-based treatment for people with ABI. *International Journal of Language & Communication Disorders, 54*(3), 465–478. https://doi.org/10.1111/1460-6984.12452

Belanger, H. G., Vanderploeg, R. D., Curtiss, G., Armistead-Jehle, P., Kennedy, J. E., Tate, D. F., Eapen, B. C., Bowles, A. O., & Cooper, D. B. (2020). Self-efficacy predicts response to cognitive rehabilitation in military service members with post-concussive symptoms. *Neuropsychological Rehabilitation, 30*(6), 1190–1203. https://doi.org/10.1080/09602011.2019.1575245

Benjamin, E. J., Virani, S. S., Callaway, C. W., Chamberlain, A. M., Chang, A. R., Cheng, S., Chiuve, S. E., Cushman, M., Delling, F. N., Deo, R., de Ferranti, S. D., Ferguson, J. F., Fornage, M., Gillespie, C., Isasi, C. R., Jiménez, M. C., Jordan, L. C., Judd, S. E., Lackland, D., … American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. (2018). Heart disease and stroke statistics—2018 update: A report from the American Heart Association. *Circulation, 137*(12), e67–e492. https://doi.org/10.1161/CIR.0000000000000558

Bergquist, T., Gehl, C., Mandrekar, J., Lepore, S., Hanna, S., Osten, A., & Beaulieu, W. (2009). The effect of Internet-based cognitive rehabilitation in persons with memory impairments after severe traumatic brain injury. *Brain Injury, 23*(10), 790–799. https://doi.org/10.1080/02699050903196688

Bergquist, T., Yutsis, M., & Sullan, M. (2014). Satisfaction with cognitive rehabilitation delivered via the Internet in persons with acquired brain injury. *International Journal of Telerehabilitation, 6*(2), 39–50. https://doi.org/10.5195/ijt.2014.6142

*__Bertens, D., Kessels, R. P. C., Boelen, D. H. E., & Fasotti, L.__ (2016). Transfer effects of errorless goal management training on cognitive function and quality of life in brain-injured persons. *NeuroRehabilitation, 38*(1), 79–84. https://doi.org/10.3233/NRE-151298

*__Bertens, D., Kessels, R. P. C., Fiorenzato, E., Boelen, D. H. E., & Fasotti, L.__ (2015). Do old errors always lead to new truths? A randomized controlled trial of errorless goal management training in brain-injured patients. *Journal of International Neuropsychological Society, 21*(8), 639–649. https://doi.org/10.1017/S1355617715000764

Bertisch, H., Rath, J., Langenbahn, D., Sherr, R. L., & Diller, L. (2011). Group treatment in acquired brain injury rehabilitation. *The Journal for Specialists in Group Work, 36*(4), 264–277. https://doi.org/10.1080/01933922.2011.613901

Bilbao, A., Kennedy, C., Chatterji, S., Ustün, B., Barquero, J. L., & Barth, J. T. (2003). The ICF: Applications of the WHO model of functioning, disability, and health to brain injury rehabilitation. *NeuroRehabilitation, 18*(3), 239–250. https://doi.org/10.3233/NRE-2003-18308

Bishop, M., Kayes, N., & McPherson, K. (2019). Understanding the therapeutic alliance in stroke rehabilitation. *Disability and Rehabilitation, 43*(8), 1074–1083. https://doi.org/10.1080/09638288.2019.1651909

*__Björkdahl, A., Åkerlundd, E., Svensson, S., & Esbjörnsson, E.__ (2013). A randomized study of computerized working memory training and effects on functioning in everyday life for patients with brain injury. *Brain Injury, 27*(13–14), 1658–1665. https://doi.org/10.3109/02699052.2013.830196

*__Bornhofen, C., & McDonald, S.__ (2008a). Comparing strategies for treating emotion perception deficits in traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 23*(2), 103–115. https://doi.org/10.1097/01.HTR.0000314529.22777.43

*__Bornhofen, C., & McDonald, S.__ (2008b). Treating deficits in emotion perception following traumatic brain injury. *Neuropsychological Rehabilitation, 18*(1), 22–44. https://doi.org/10.1080/09602010601061213

*__Bourgeois, M. S., Lenius, K., Turkstra, L., & Camp, C.__ (2007). The effects of cognitive teletherapy on reported everyday memory behaviours of persons with chronic traumatic brain injury. *Brain Injury, 21*(12), 1245–1257. https://doi.org/10.1080/02699050701727452

Brain Injury Association of America. (n.d.). *Brain Injury Association USA home page*. http://www.biausa.org
Brain Injury Association of America. (2021). *About brain injury—Injury severity*. https://www.biausa.org/brain-injury/about-brain-injury/basics/injury-severity
*__Cantor, J., Ashman, T., Dams-O'Connor, K., Dijkers, M. P., Gordon, W., Spielman, L., Tsaousides, T., Allen, H., Nguyen, M., & Oswald, J.__ (2014). Evaluation of the Short-Term Executive Plus plus intervention for executive dysfunction after traumatic brain injury: A randomized controlled trial with minimization. *Archives of Physical Medicine and Rehabilitation, 95*(1), 1–9.e3. https://doi.org/10.1016/j.apmr.2013.08.005
*__Caplain, S., Chenuc, G., Blancho, S., Marque, S., & Aghakhani, N.__ (2019). Efficacy of psychoeducation and cognitive rehabilitation after mild traumatic brain injury for preventing post-concussional syndrome in individuals with high risk of poor prognosis: A randomized clinical trial. *Frontiers in Neurology, 10,* 929. https://doi.org/10.3389/fneur.2019.00929
*__Caracuel, A., Cuberos-Urbano, G., Santiago-Ramajo, S., Vilar-Lopez, R., Coin-Megias, M. A., Verdejo-Garcia, A., & Perez-Garcia, M.__ (2012). Effectiveness of holistic neuropsychological rehabilitation for Spanish population with acquired brain injury measured using Rasch analysis. *NeuroRehabilitation, 30*(1), 43–53. https://doi.org/10.3233/NRE-2011-0726
*__Carter, L. T., Oliveira, D. O., Duponte, J., & Lynch, S. V.__ (1988). The relationship of cognitive skills performance to activities of daily living in stroke patients. *The American Journal of Occupational Therapy, 42*(7), 449–455. https://doi.org/10.5014/ajot.42.7.449
Centers for Disease Control and Prevention. (2015). *Report to Congress on traumatic brain injury in the United States: Epidemiology and rehabilitation*. National Center for Injury Prevention and Control, Division of Unintentional Injury Prevention. https://www.cdc.gov/traumaticbraininjury/pdf/TBI_Report_to_Congress_Epi_and_Rehab-a.pdf
Centers for Disease Control and Prevention. (2020). *About stroke*. https://www.cdc.gov/stroke/types_of_stroke.htm
*__Cheng, S. K. W., & Man, D. W. K.__ (2006). Management of impaired self-awareness in persons with traumatic brain injury. *Brain Injury, 20*(6), 621–628. https://doi.org/10.1080/02699050600677196
*__Cho, H.-Y., Kim, K.-T., & Jung, J.-H.__ (2015). Effects of computer-assisted cognitive rehabilitation on brain wave, memory, and attention of stroke patients: A randomized control trial. *Journal of Physical Therapy Science, 27*(4), 1029–1032. https://doi.org/10.1589/jpts.27.1029
*__Chopra, S., Kumaran, S., Pandey, R., Sinha, S., Kumar, A., Kaur, H., & Nehra, A.__ (2016). Visual memory activation changes post cognitive rehabilitation after traumatic brain injury: A controlled trial. *Brain Injury, 30*(5–6), 565–656. https://doi.org/10.3109/02699052.2016.1162060
Cicerone, K. D., Goldin, Y., Ganci, K., Rosenbaum, A., Wethe, J. V., Langenbahn, D. M., Malec, J. F., Bergquist, T. F., Kingsley, K., Nagele, D., Trexler, L., Fraas, M., Bogdanova, Y., & Harley, J. P. (2019). Evidence-based cognitive rehabilitation: Systematic review of the literature from 2009 through 2014. *Archives of Physical Medicine and Rehabilitation, 100*(8), 1515–1533. https://doi.org/10.1016/j.apmr.2019.02.011
*__Cicerone, K. D., Smith, L. C., Ellmo, W., Mangel, H. R., Nelson, P., Chase, R. F., & Kalmar, K.__ (1996). Neuropsychological rehabilitation of mild traumatic brain injury. *Brain Injury, 10*(4), 277–286. https://doi.org/10.1080/026990596124458
Clarivate Analytics. (2021). *EndNote X8*. https://endnote.com/
Cochrane Collaboration. (2014). *Review Manager (RevMan)* Version 5.3 [Computer program]. The Nordic Cochrane Centre.
Coelho, C., Ylvisaker, M., & Turkstra, L. S. (2005). Nonstandardized assessment approaches for individuals with traumatic brain injuries. *Seminars in Speech and Language, 26*(4), 223–241. https://doi.org/10.1055/s-2005-922102
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Routledge Academic.
Colantonio, A., Ratcliff, G., Chase, S., Kelsey, S., Escobar, M., & Vernich, L. (2004). Long term outcomes after moderate to severe traumatic brain injury. *Disability and Rehabilitation, 26*(5), 253–261. https://doi.org/10.1080/09638280310001639722
Coleman, J. J., Frymark, T., Franceschini, N. M., & Theodoros, D. G. (2015). Assessment and treatment of cognition and communication skills in adults with acquired brain injury via telepractice: A systematic review. *American Journal of Speech-Language Pathology, 24*(2), 295–315. https://doi.org/10.1044/2015_AJSLP-14-0028
*__Cooper, D. B., Bowles, A. O., Kennedy, J. E., Curtiss, G., French, L. M., Tate, D. F., & Vanderploeg, R. D.__ (2017). Cognitive rehabilitation for military service members with mild traumatic brain injury: A randomized clinical trial. *The Journal of Head Trauma Rehabilitation, 32*(3), E1–E15. https://doi.org/10.1097/htr.0000000000000254
Coreno, A., & Ciccia, A. H. (2020). Supporting students with TBI: A clinically focused tutorial for speech-language pathologists. *Seminars in Speech and Language, 41*(2), 161–169. https://doi.org/10.1055/s-0040-1701684
Coronado, V. G., McGuire, L. C., Sarmiento, K., Bell, J., Lionbarger, M. R., Jones, C. D., Geller, A. I., Khoury, N., & Xu, L. (2012). Trends in traumatic brain injury in the U.S. and the public health response: 1995–2009. *Journal of Safety Research, 43*(4), 299–307. https://doi.org/10.1016/j.jsr.2012.08.011
Côté, H., Payer, M., Giroux, F., & Joanette, Y. (2007). Towards a description of clinical communication impairment profiles following right-hemisphere damage. *Aphasiology, 21*(6–8), 739–749. https://doi.org/10.1080/02687030701192331
*__Cuberos-Urbano, G., Caracuel, A., Valls-Serrano, C., Garcia-Mochon, L., Gracey, F., & Verdejo-Garcia, A.__ (2018). A pilot investigation of the potential for incorporating lifelog technology into executive function rehabilitation for enhanced transfer of self-regulation skills to everyday life. *Neuropsychological Rehabilitation, 28*(4), 589–601. https://doi.org/10.1080/09602011.2016.1187630
*__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. *Archives of Physical Medicine and Rehabilitation, 88*(12), 1561–1573. https://doi.org/10.1016/j.apmr.2007.07.033
*__das Nair, R., Bradshaw, L. E., Carpenter, H., Clarke, S., Day, F., Drummond, A., Fitzsimmons, D., Harris, S., Montgomery, A. A., Newby, G., Sackley, C., & Lincoln, N. B.__ (2019). A group memory rehabilitation programme for people with traumatic brain injuries: The ReMemBrIn RCT. *Health Technology Assessment, 23*(16), 1–194. https://doi.org/10.3310/hta23160
*__das Nair, R., & Lincoln, N. B.__ (2012). Evaluation of rehabilitation of memory in neurological disabilities (ReMiND): A randomized controlled trial. *Clinical Rehabilitation, 26*(10), 894–903. https://doi.org/10.1177/0269215511435424
*__De Joode, E. A., Van Heugten, C. M., Verhey, F. R., & Van Boxtel, M. P.__ (2013). Effectiveness of an electronic cognitive aid in patients with acquired brain injury: A multicentre

randomised parallel-group study. *Neuropsychological Rehabilitation, 23*(1), 133–156. https://doi.org/10.1080/09602011.2012.726632

*De Luca, R., Maggio, M. G., Maresca, G., Latella, D., Cannavò, A., Sciarrone, F., Lo Voi, E., Accorinti, M., Bramanti, P., & Calabrò, R. S.** (2019). Improving cognitive function after traumatic brain injury: A clinical trial on the potential use of the semi-immersive virtual reality. *Behavioral Neurology, 2019,* 9268179. https://doi.org/10.1155/2019/9268179

Defense and Veterans Brain Injury Center. (2015). *SCORE study manuals*. https://health.mil/Military-Health-Topics/Centers-of-Excellence/Traumatic-Brain-Injury-Center-of-Excellence/Provider-Resources/SCORE-Study-Manuals

*DeGutis, J. M., & Van Vleet, T. M.** (2010). Tonic and phasic alertness training: A novel behavioral therapy to improve spatial and non-spatial attention in patients with hemispatial neglect. *Frontiers in Human Neuroscience, 4,* 60. https://doi.org/10.3389/fnhum.2010.00060

Department of Veterans Affairs/Department of Defense. (2021). *VA/DoD clinical practice guideline for the management and rehabilitation of post-acute mild traumatic brain injury*. https://www.healthquality.va.gov/guidelines/Rehab/mtbi/

Dikmen, S. S., Machamer, J. E., Powell, J. M., & Temkin, N. R. (2003). Outcome 3 to 5 years after moderate to severe traumatic brain injury. *Archives of Physical Medicine and Rehabilitation, 84*(10), 1449–1457. https://doi.org/10.1016/s0003-9993(03)00287-9

*Doorhein, K., & De Haan, E. H. F.** (1998). Cognitive training for memory deficits in stroke patients. *Neuropsychological Rehabilitation, 8*(4), 393–400. https://doi.org/10.1080/713755579

Drevon, D., Fursa, S. R., & Malcolm, A. L. (2017). Intercoder reliability and validity of WebPlotDigitizer in extracting graphed data. *Behavior Modification, 41*(2), 323–339. https://doi.org/10.1177/0145445516673998

*Emmanouel, A., Kontrafouri, E., Nikolaos, P., Kessels, R. P. C., & Fasotti, L.** (2020). Incorporation of a working memory strategy in GMT to facilitate serial-order behaviour in brain-injured patients. *Neuropsychological Rehabilitation, 30*(5), 888–914. https://doi.org/10.1080/09602011.2018.1517369

*Engelberts, N. H. J., Klein, M., Adèr, H. J., Heimans, J. J., Kasteleijn-Nolst Trenité, D. G. A., & van der Ploeg, H. M.** (2002). The effectiveness of cognitive rehabilitation for attention deficits in focal seizures: A randomized controlled study. *Epilepsia, 43*(6), 587–595. https://doi.org/10.1046/j.1528-1157.2002.29401.x

*Faria, A. L., Andrade, A., Soares, L., & Badia, S. B. I.** (2016). Benefits of virtual reality based cognitive rehabilitation through simulated activities of daily living: A randomized controlled trial with stroke patients. *Journal of NeuroEngineering and Rehabilitation, 13*(1), 96. https://doi.org/10.1186/s12984-016-0204-z

*Fasotti, L., Kovacs, F., Eling, P. A. T. M., & Brouwer, W. H.** (2000). Time pressure management as a compensatory strategy training after closed head injury. *Neuropsychological Rehabilitation, 10*(1), 47–65. https://doi.org/10.1080/096020100389291

Faul, M., Xu, L., Wald, M. M., & Coronado, V. G. (2010). *Traumatic brain injury in the United States: Emergency department visits, hospitalizations, and deaths, 2002–2006*. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

Ferré, P., Ska, B., Lajoie, C., Bleau, A., & Joanette, Y. (2011). Clinical focus on prosodic, discursive, and pragmatic treatment for right hemisphere damaged adults: What's right? *Rehabilitation Research and Practice, 2011,* 131820. https://doi.org/10.1155/2011/131820

*Ferreira, H. P., Leite Lopes, M. A., Luiz, R. R., Cardoso, L., & André, C.** (2011). Is visual scanning better than mental practice in hemispatial neglect? Results from a pilot study. *Topics in Stroke Rehabilitation, 18*(2), 155–161. https://doi.org/10.1310/tsr1802-155

Finkelstein, E. A., Corso, P. S., & Miller, T. R. (2006). *Incidence and economic burden of injuries in the United States*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195179484.001.0001

Follmann, D., Elliott, P., Suh, I., & Cutler, J. (1992). Variance imputation for overviews of clinical trials with continuous response. *Journal of Clinical Epidemiology, 45*(7), 769–773. https://doi.org/10.1016/0895-4356(92)90054-q

*Gamito, P., Oliveira, J., Coelho, C., Morais, D., Lopes, P., Pacheco, J., Brito, R., Soares, F., Santos, N., & Barata, A. F.** (2017). Cognitive training on stroke patients via virtual reality–based serious games. *Disability and Rehabilitation, 39*(4), 385–388. https://doi.org/10.3109/09638288.2014.934925

*García-Molina, A., López-Blázquez, R., García-Rudolph, A., Sánchez-Carrión, R., Enseñat-Cantallops, A., Tormos, J. M., & Roig-Rovira, T.** (2015). Rehabilitación cognitiva en daño cerebral adquirido: Variables que median en la respuesta al tratamiento [Cognitive rehabilitation in acquired brain damage: Variables that mediate the response to treatment]. *Rehabilitación, 49*(3), 144–149. https://doi.org/10.1016/j.rh.2015.02.002

*Gehring, K., Sitskoorn, M. M., Gundy, C. M., Sikkes, S. A., Klein, M., Postma, T. J., van den Bent, M. J., Beute, G. N., Enting, R. H., Kappelle, A. C., Boogerd, W., Veninga, T., Twijnstra, A., Boerman, D. H., Taphoorn, M. J., & Aaronson, N. K.** (2009). Cognitive rehabilitation in patients with gliomas: A randomized, controlled trial. *Journal of Clinical Oncology, 27*(22), 3712–3722. https://doi.org/10.1200/jco.2008.20.5765

Gilmore, N., Ross, K., & Kiran, S. (2019). The intensive cognitive-communication rehabilitation program for young adults with acquired brain injury. *American Journal of Speech-Language Pathology, 28*(1S), 341–358. https://doi.org/10.1044/2018_AJSLP-17-0153

Go, A. S., Mozaffarian, D., Roger, V. L., Benjamin, E. J., Berry, J. D., Borden, W. B., Bravata, D. M., Dai, S., Ford, E. S., Fox, C. S., Franco, S., Fullerton, H. J., Gillespie, C., Hailpern, S. M., Heit, J. A., Howard, V. J., Huffman, M. D., Kissela, B. M., Kittner, S. J., … American Heart Association Statistics Committee and Stroke Statistics Subcommittee. (2013). Heart disease and stroke statistics—2013 update: A report from the American Heart Association. *Circulation, 127*(1), e6–e245. https://doi.org/10.1161/CIR.0b013e31828124ad

*Goverover, Y., Johnston, M. V., Toglia, J., & Deluca, J.** (2007). Treatment to improve self-awareness in persons with acquired brain injury. *Brain Injury, 21*(9), 913–923. https://doi.org/10.1080/02699050701553205

*Gray, J. M., Robertson, I., Pentland, B., & Anderson, S.** (1992). Microcomputer-based attentional retraining after brain damage: A randomised group controlled trial. *Neuropsychological Rehabilitation, 2*(2), 97–115. https://doi.org/10.1080/09602019208401399

Guyatt, G. H., Oxman, A. D., Kunz, R., Atkins, D., Brozek, J., Vist, G., Alderson, P., Glasziou, P., Falck-Ytter, Y., & Schünemann, H. J. (2011). GRADE guidelines: 2. Framing the question and deciding on important outcomes. *Journal of Clinical Epidemiology, 64*(4), 395–400. https://doi.org/10.1016/j.jclinepi.2010.09.012

Guyatt, G. H., Oxman, A. D., Vist, G. E., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., Schünemann, H. J., & GRADE Working Group. (2008). GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ, 336*(7650), 924–926. https://doi.org/10.1136/bmj.39489.470347.AD

*Hajek, V. E., Kates, M. H., Donnelly, R., & McGree, S.** (1993). The effect of visuo-spatial training in patients with right hemisphere stroke. *Canadian Journal of Rehabilitation, 6*(3), 175–186.

Hall, A. M., Ferreira, P. H., Maher, C. G., Latimer, J., & Ferreira, M. L. (2010). The influence of the therapist–patient relationship on treatment outcome in physical rehabilitation: A systematic review. *Physical Therapy, 90*(8), 1099–1110. https://doi.org/10.2522/ptj.20090245

Halper, A. S., Cherney, L., & Miller, T. R. (1991). *Clinical management of communication problems in adults with traumatic brain injury*. Aspen.

Hardin, K. Y., & Kelly, J. P. (2019). The role of speech-language pathology in an interdisciplinary care model for persistent symptomatology of mild traumatic brain injury. *Seminars in Speech and Language, 40*(1), 65–78. https://doi.org/10.1055/s-0038-1676452

Harley, J. P., Allen, C., Braciszewski, T. L., Cicerone, K. D., Dahlberg, C., Evans, S., Foto, M., Gordon, W., Harrington, D., Levin, W., Malec, J. F., Millis, S., Morris, J., Muir, C., Richert, J., Salazar, E., Schiavone, D., & Smigelski, J. (1992). Guidelines for cognitive rehabilitation. *NeuroRehabilitation, 2*(3), 62–67. https://doi.org/10.3233/NRE-1992-2310

*Harrison-Felix, C., Newman, J. K., Hawley, L., Morey, C., Ketchum, J. M., Walker, W. C., Bell, K. R., Millis, S. R., Braden, C., Malec, J., Hammond, F. M., Eagye, C. B., & Howe, L.** (2018). Social competence treatment after traumatic brain injury: A multicenter, randomized controlled trial of interactive group treatment versus noninteractive treatment. *Archives of Physical Medicine and Rehabilitation, 99*(11), 2131–2142. https://doi.org/10.1016/j.apmr.2018.05.030

*Hasanzadeh Pashang, S., Zare, H., Alipour, A., & Sharif-Alhoseini, M.** (2021). The effectiveness of cognitive rehabilitation in improving visual and auditory attention in ischemic stroke patients. *Acta Neurologica Belgica, 121*(8), 915–920. https://doi.org/10.1007/s13760-020-01288-4

Hayden, J. A., van der Windt, D. A., Cartwright, J. L., Côté, P., & Bombardier, C. (2013). Assessing bias in studies of prognostic factors. *Annals of Internal Medicine, 158*(4), 280–286. https://doi.org/10.7326/0003-4819-158-4-201302190-00009

Henderson, D., Jensen, M., Drucker, J., & Lutz, A. (2019). Rehabilitation of speech, language, and swallowing disorders in clients with acquired brain injury. In J. Elbaum (Ed.), *Acquired brain injury: An integrative neuro-rehabilitation approach* (pp. 201–226). Springer. https://doi.org/10.1007/978-3-030-16613-7_9

Higgins, J. P. T., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., Savovic, J., Schulz, K. F., Weeks, L., Sterne, J. A., Cochrane Bias Methods Group, & Cochrane Statistical Methods Group. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ, 343,* d5928. https://doi.org/10.1136/bmj.d5928

Higgins, J. P. T., & Green, S. (2011). *Cochrane handbook for systematic reviews of interventions* (Version 5.1.0) (updated March 2011). The Cochrane Collaboration. https://www.handbook.cochrane.org

Higgins, J. P. T., Li, T., & Deeks, J. J. (2021). Choosing effect measures and computing estimates of effect. In J. Higgins, J. Thomas, J. Chandler, M. Cumpston, T. Li, M. J. Page, & V. A. Welch (Eds.), *Cochrane handbook for systematic reviews of interventions* (Version 6.2) (updated February 2021). Cochrane. http:/www.training.cochrane.org/handbook

*High, W. M., Roebuck-Spencer, T., Sander, A. M., Struchen, M. A., & Sherer, M.** (2006). Early versus later admission to post-acute rehabilitation: Impact on functional outcome after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation, 87*(3), 334–342. https://doi.org/10.1016/j.apmr.2005.11.028

*Hildebrandt, H., Bussmann-Mork, B., & Schwendemann, G.** (2006). Group therapy for memory impaired patients: A partial remediation is possible. *Journal of Neurology, 253*(4), 512–519. https://doi.org/10.1007/s00415-006-0013-6

*Hildebrandt, H., Gehrmann, A., Modden, C., & Eling, P.** (2011). Enhancing memory performance after organic brain disease relies on retrieval processes rather than encoding or consolidation. *Journal of Clinical and Experimental Neuropsychology, 33*(2), 257–270. https://doi.org/10.1080/13803395.2010.511471

Hinckley, J. J. (2014). A case for the implementation of cognitive-communication screenings in acute stroke. *American Journal of Speech-Language Pathology, 23*(1), 4–14. https://doi.org/10.1044/1058-0360(2013/11-0064)

Hofgren, C., Esbjörnsson, E., & Sunnerhagen, K. S. (2010). Return to work after acquired brain injury: Facilitators and hindrances observed in a sub-acute rehabilitation setting. *Work, 36*(4), 431–439. https://doi.org/10.3233/WOR-2010-1039

Hozo, S. P., Djulbegovic, B., & Hozo, I. (2005). Estimating the mean and variance from the median, range, and the size of a sample. *BMC Medical Research Methodology, 5*(1), 13. https://doi.org/10.1186/1471-2288-5-13

*Hu, X., Zuo, Z., Zhu, H., Wan, G., & Li, J.** (2003). The single blind procedure research of cognitive rehabilitation interventions on cognitive deficits in patients with stroke. *Chinese Journal of Clinical Rehabilitation, 7*(10), 1521–1523.

Humphreys, I., Wood, R. L., Phillips, C. J., & Macey, S. (2013). The costs of traumatic brain injury: A literature review. *Clinicoeconomics Outcomes Research, 5,* 281–287. https://doi.org/10.2147/CEOR.S44625

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century*. National Academies Press.

Institute of Medicine. (2011). *Cognitive rehabilitation therapy for traumatic brain injury: Evaluating the evidence*. National Academies Press. https://doi.org/10.17226/13220

Iverson, G. L. (2005). Outcome from mild traumatic brain injury. *Current Opinion in Psychiatry, 18*(3), 301–317. https://doi.org/10.1097/01.yco.0000165601.29047.ae

*Janak, J., Cooper, D. B., Bowles, A. O., Alamgir, A. H., Cooper, S. P., Gabriel, K. P., Pérez, A., & Orman, J. A.** (2017). Completion of multidisciplinary treatment for persistent postconcussive symptoms is associated with reduced symptom burden. *The Journal of Head Trauma Rehabilitation, 32*(1), 1–15. https://doi.org/10.1097/HTR.0000000000000202

*Jiang, C., Yang, S., Tao, J., Huang, J., Li, Y., Ye, H., Chen, S., Hong, W., & Chen, L.** (2016). Clinical efficacy of acupuncture treatment in combination with RehaCom cognitive training for improving cognitive function in stroke: A 2 × 2 factorial design randomized controlled trial. *Journal of the American Medical Directors Association, 17*(12), 1114–1122. https://doi.org/10.1016/j.jamda.2016.07.021

Joint Committee on Interprofessional Relations Between the American Psychological Association and the American Speech-Language-Hearing Association. (2007). *Structure and function of an interdisciplinary team for persons with acquired brain injury*. https://www.asha.org/policy/gl2007-00288/

*Kaschel, R., Della Sala, S., Cantagallo, A., Fahlböck, A., Laaksonen, R., & Kazen, M.** (2002). Imagery mnemonics for the rehabilitation of memory: A randomised group controlled trial. *Neuropsychological Rehabilitation, 12*(2), 127–153. https://doi.org/10.1080/09602010143000211

Katz, D. I., Cohen, S. I., & Alexander, M. P. (2015). Mild traumatic brain injury. *Handbook of Clinical Neurology, 127,* 131–156. https://doi.org/10.1016/B978-0-444-52892-6.00009-X

*__Kersey, J., Juengst, S. B., & Skidmore, E.__ (2019). Effect of strategy training on self-awareness of deficits after stroke. *The American Journal of Occupational Therapy, 73*(3), 7303345020p1–7303345020p7. https://doi.org/10.5014/ajot.2019.031450

*__Kim, G. Y., Han, M. R., & Lee, H. G.__ (2014). Effect of dual-task rehabilitative training on cognitive and motor function of stroke patients. *Journal of Physical Therapy Science, 26*(1), 1–6. https://doi.org/10.1589/jpts.26.1

Koehler, R., Wilhelm, E., & Shoulson, I. (2011). *Cognitive rehabilitation therapy for traumatic brain injury: Evaluating the evidence*. National Academies Press.

Korpershoek, C., van der Bijl, J., & Hafsteinsdóttir, T. B. (2011). Self-efficacy and its influence on recovery of patients with stroke: A systematic review. *Journal of Advanced Nursing, 67*(9), 1876–1894. https://doi.org/10.1111/j.1365-2648.2011.05659.x

Königs, M., Beurskens, E. A., Snoep, L., Scherder, E. J., & Oosterlaan, J. (2018). Effects of timing and intensity of neurorehabilitation on functional outcome after traumatic brain injury: A systematic review and meta-analysis. *Archives of Physical Medicine and Rehabilitation, 99*(6), 1149–1159.e1. https://doi.org/10.1016/j.apmr.2018.01.013

Kramer, M. H. H., Bauer, W., Dicker, D., Durusu-Tanriover, M., Ferreira, F., Rigby, S. P., Roux, X., Schumm-Draeger, P. M., Weidanz, F., van Hulsteijn, J. H., & the European Federation of Internal Medicine Working Group on Professional Issues. (2014). The changing face of internal medicine: Patient centred care. *European Journal of Internal Medicine, 25*(2), 125–127. https://doi.org/10.1016/j.ejim.2013.11.013

Kreutzer, J. S., Rapport, L. J., Marwitz, J. H., Harrison-Felix, C., Hart, T., Glenn, M., & Hammond, F. (2009). Caregivers' well-being after traumatic brain injury: A multicenter prospective investigation. *Archives of Physical Medicine and Rehabilitation, 90*(6), 939–946. https://doi.org/10.1016/j.apmr.2009.01.010

Kumar, K. S., Samuelkamaleshkumar, S., Viswanathan, A., & Macaden, A. (2017). Cognitive rehabilitation for adults with traumatic brain injury to improve occupational outcomes. *Cochrane Database of Systematic Reviews, 6*(6), CD007935. https://doi.org/10.1002/14651858.CD007935.pub2

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159–174. https://doi.org/10.2307/2529310

*__Lannin, N., Carr, B., Allaous, J., Mackenzie, B., Falcon, A., & Tate, R.__ (2014). A randomized controlled trial of the effectiveness of handheld computers for improving everyday memory functioning in patients with memory impairments after acquired brain injury. *Clinical Rehabilitation, 28*(5), 470–481. https://doi.org/10.1177/0269215513512216

*__Lawson, D. W., Stolwyk, R. J., Ponsford, J. L., McKenzie, D. P., Downing, M. G., & Wong, D.__ (2020). Telehealth delivery of memory rehabilitation following stroke. *Journal of International Neuropsychological Society, 26*(1), 58–71. https://doi.org/10.1017/s1355617719000651

*__Leininger, S., Strong, C. A., & Donders, J.__ (2014). Predictors of outcome after treatment of mild traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 29*(2), 109–116. https://doi.org/10.1097/HTR.0b013e3182860506

*__Lesniak, M. M., Mazurkiewicz, P., Iwanski, S., Szutkowska-Hoser, J., & Seniow, J.__ (2018). Effects of group versus individual therapy for patients with memory disorder after an acquired brain injury: A randomized, controlled study. *Journal of Clinical and Experimental Neuropsychology, 40*(9), 853–864. https://doi.org/10.1080/13803395.2018.1441379

*__Levine, B., Schweizer, T. A., O'Connor, C., Turner, G., Gillingham, S., Stuss, D. T., Manly, T., & Robertson, I. H.__ (2011). Rehabilitation of executive functioning in patients with frontal lobe brain damage with goal management training. *Frontiers in Human Neuroscience, 5,* 9. https://doi.org/10.3389/fnhum.2011.00009

*__Lewis, F. D., & Horn, G. J.__ (2013). Traumatic brain injury: Analysis of functional deficits and posthospital rehabilitation outcomes. *Journal of Special Operations Medicine, 13*(3), 56–61. https://doi.org/10.55460/ATYP-5WSB

*__Lin, Z. C., Tao, J., Gao, Y. L., Yin, D. Z., Chen, A. Z., & Chen, L. D.__ (2014). Analysis of central mechanism of cognitive training on cognitive impairment after stroke: Resting-state functional magnetic resonance imaging study. *The Journal of International Medical Research, 42*(3), 659–668. https://doi.org/10.1177/0300060513505809

*__Llorens, R., Navarro, M. D., Noé, E., & Alcañiz, M.__ (2016). *Competition improves attention and motivation after stroke* [Paper presentation]. Proceedings of the 11th International Conference on Disability, Virtual Reality and Associated Technologies, Los Angeles, CA, United States.

López-López, J. A., Page, M. J., Lipsey, M. W., & Higgins, J. P. T. (2018). Dealing with effect size multiplicity in systematic reviews and meta-analyses. *Research Synthesis Methods, 9*(3), 336–351. https://doi.org/10.1002/jrsm.1310

Lustig, D., Strauser, D., Weems, G., Donnell, C., & Smith, L. (2003). Traumatic brain injury and rehabilitation outcomes: Does the working alliance make a difference? *Journal of Applied Rehabilitation Counseling, 34*(4), 30–37. https://doi.org/10.1891/0047-2220.34.4.30

Lyden, P. (2017). Using the National Institutes of Health Stroke Scale. *Stroke, 48*(2), 513–519. https://doi.org/10.1161/STROKEAHA.116.015434

Maas, A. I., Stocchetti, N., & Bullock, R. (2008). Moderate and severe traumatic brain injury in adults. *The Lancet Neurology, 7*(8), 728–741. https://doi.org/10.1016/S1474-4422(08)70164-9

MacDonald, S. (2017). Introducing the model of cognitive-communication competence: A model to guide evidence-based communication interventions after brain injury. *Brain Injury, 31*(13–14), 1760–1780. https://doi.org/10.1080/02699052.2017.1379613

MacDonald, S., & Johnson, C. J. (2005). Assessment of subtle cognitive-communication deficits following acquired brain injury: A normative study of the Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES). *Brain Injury, 19*(11), 895–902. https://doi.org/10.1080/02699050400004294

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. https://doi.org/10.3109/02699050903518118

*__Maier, M., Ballester, B. R., Leiva Bañuelos, N., Duarte Oller, E., & Verschure, P.__ (2020). Adaptive conjunctive cognitive training (ACCT) in virtual reality for chronic stroke patients: A randomized controlled pilot trial. *Journal of NeuroEngineering and Rehabilitation, 17*(1), Article 42. https://doi.org/10.1186/s12984-020-0652-3

*__Malec, J. F.__ (2001). Impact of comprehensive day treatment on societal participation for persons with acquired brain injury. *Archives of Physical Medicine and Rehabilitation, 82*(7), 885–895. https://doi.org/10.1053/apmr.2001.23895

*Man, D. W., Poon, W. S., & Lam, C. (2013). The effectiveness of artificial intelligent 3-D virtual reality vocational problem-solving training in enhancing employment opportunities for people with traumatic brain injury. *Brain Injury, 27*(9), 1016–1025. https://doi.org/10.3109/02699052.2013.794969

*Man, D. W., Soong, W. Y., Tam, S. F., & Hui-Chan, C. W. (2006). A randomized clinical trial study on the effectiveness of a tele-analogy-based problem-solving programme for people with acquired brain injury (ABI). *NeuroRehabilitation, 21*(3), 205–217. https://doi.org/10.3233/NRE-2006-21303

*McDonald, S., Tate, R., Togher, L., Bornhofen, C., Long, E., Gertler, P., & Bowen, R. (2008). Social skills treatment for people with severe, chronic acquired brain injuries: A multicenter trial. *Archives of Physical Medicine and Rehabilitation, 89*(9), 1648–1659. https://doi.org/10.1016/j.apmr.2008.02.029

*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. *Neuropsychological Rehabilitation, 23*(2), 267–286. https://doi.org/10.1080/09602011.2012.751340

McEwen, S., Polatajko, H., Baum, C., Rios, J., Cirone, D., Doherty, M., & Wolf, T. (2015). Combined cognitive-strategy and task-specific training improve transfer to untrained activities in subacute stroke: An exploratory randomized controlled trial. *Neurorehabilitation and Neural Repair, 29*(6), 526–536. https://doi.org/10.1177/1545968314558602

McGowan, J., Sampson, M., Salzwedel, D. M., Cogo, E., Foerster, V., & Lefebvre, C. (2016). PRESS peer review of electronic search strategies: 2015 guideline statement. *Journal of Clinical Epidemiology, 75,* 40–46. https://doi.org/10.1016/j.jclinepi.2016.01.021

Melin, J. (2018). Patient participation in physical medicine and rehabilitation: A concept analysis. *International Physical Medicine & Rehabilitation Journal, 3*(1), 36–42. https://doi.org/10.15406/ipmrj.2018.03.00071

Miller, K. L. (2016). Patient centered care: A path to better health outcomes through engagement and activation. *NeuroRehabilitation, 39*(4), 465–470. https://doi.org/10.3233/NRE-161378

*Miller, L. A., & Radford, K. (2014). Testing the effectiveness of group-based memory rehabilitation in chronic stroke patients. *Neuropsychological Rehabilitation, 24*(5), 721–737. https://doi.org/10.1080/09602011.2014.894479

*Miotto, E. C., Evans, J. J., de Lucia, M. C., & Scaff, M. (2009). Rehabilitation of executive dysfunction: A controlled trial of an attention and problem-solving treatment group. *Neuropsychological Rehabilitation, 19*(4), 517–540. https://doi.org/10.1080/09602010802332108

*Mlinarič Lešnik, V., Starovasnik Žagavec, B., & Goljar, N. (2015). *The effect of computer-based attention training on divided attention regarding to age of patients after stroke* [Paper presentation]. International Congress on Vascular Dementia, Ljubljana, Slovenia. MEDIMOND.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA statement. *Journal of Clinical Epidemiology, 62*(10), P1006–P1012. https://doi.org/10.1016/j.jclinepi.2009.06.005

*Moriarty, H., Winter, L., Robinson, K., Piersol, C. V., Vause-Earland, T., Iacovone, D. B., Newhart, B., True, G., Fishman, D., Hodgson, N., & Gitlin, L. N. (2016). A randomized controlled trial to evaluate the Veterans' In-home Program program for military veterans with traumatic brain injury and their families: Report on impact for family members. *PM&R, 8*(6), 495–509. https://doi.org/10.1016/j.pmrj.2015.10.008

Morrow, E. L., Turkstra, L. S., & Duff, M. C. (2021). Confidence and training of speech-language pathologists in cognitive-communication disorders: Time to rethink graduate education models. *American Journal of Speech-Language Pathology, 30*(2S), 986–992. https://doi.org/10.1044/2020_AJSLP-20-00073

Muehlschlegel, S., Shutter, L., Col, N., & Goldberg, R. (2015). Decision aids and shared decision-making in neurocritical care: An unmet need in our neuro-ICUs. *Neurocritical Care, 23*(1), 127–130. https://doi.org/10.1007/s12028-014-0097-2

National Center for Injury Prevention and Control. (2003). *Report to Congress on mild traumatic brain injury in the United States: Steps to prevent a serious public health problem*. Centers for Disease Control and Prevention. https://www.cdc.gov/traumaticbraininjury/pdf/mtbireport-a.pdf

*Neumann, D., Babbage, D. R., Zupan, B., & Willer, B. (2015). 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/10.1097/HTR.0000000000000054

Niesten, I., Merckelbach, H., Dandachi-FitzGerald, B., & Jelicic, M. (2020). The iatrogenic power of labeling medically unexplained symptoms: A critical review and meta-analysis of "diagnosis threat" in mild head injury. *Psychology of Consciousness: Theory, Research, and Practice.* Advance online publication. https://doi.org/10.1037/cns0000224

*Novakovic-Agopian, T., Kornblith, E., Abrams, G., Burciaga-Rosales, J., Loya, F., D'Esposito, M., & Chen, A. (2018). Training in goal-oriented attention self-regulation improves executive functioning in veterans with chronic traumatic brain injury. *Journal of Neurotrauma, 35*(23), 2784–2795. https://doi.org/10.1089/neu.2017.5529

O'Brien, K. H. (2020). Overcoming knowledge barriers for inclusion of school-based speech language pathologists in the management of students with mild traumatic brain injury. *Seminars in Speech and Language, 41*(2), 195–208. https://doi.org/10.1055/s-0040-1701687

*O'Connor, M. K., Mueller, L., Kwon, E., Drebing, C. E., O'Connor, A. A., Semiatin, A., Wang, S., & Daley, R. (2016). Enhanced vocational rehabilitation for Veterans with mild traumatic brain injury and mental illness: Pilot study. *Journal of Rehabilitation Research and Development, 53*(3), 307–320. https://doi.org/10.1682/JRRD.2014.10.0231

*O'Neil-Pirozzi, T. M., Strangman, G. E., Goldstein, R., Katz, D. I., Savage, C. R., Kelkar, K. K., Supelana, C., Burke, D., Rauch, S. L., & Glenn, M. B. (2010). A controlled treatment study of internal memory strategies (I-MEMS) following traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 25*(1), 43–51. https://doi.org/10.1097/HTR.0b013e3181bf24b1

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—A web and mobile app for systematic reviews. *Systematic Reviews, 5*(1), 210. https://doi.org/10.1186/s13643-016-0384-4

Ownsworth, T., Arnautovska, U., Beadle, E., Shum, D., & Moyle, W. (2018). Efficacy of telerehabilitation for adults with traumatic brain injury: A systematic review. *The Journal of Head Trauma Rehabilitation, 33*(4), E33–E46. https://doi.org/10.1097/HTR.0000000000000350

*Ownsworth, T., Fleming, J., Shum, D., Kuipers, P., & Strong, J. (2008). Comparison of individual, group, and combined intervention formats in a randomized controlled trial for facilitating goal attainment and improving psychosocial function following acquired brain injury. *Journal of Rehabilitation Medicine, 40*(2), 81–88. https://doi.org/10.2340/16501977-0124

*Ownsworth, T., & McFarland, K. (2004). Investigation of psychological and neuropsychological factors associated with clinical outcome following a group rehabilitation programme. *Neuropsychological Rehabilitation, 14*(5), 535–562. https://doi.org/10.1080/09602010343000538

*Park, M. O., & Lee, S. H. (2019). Effect of a dual-task program with different cognitive tasks applied to stroke patients: A pilot randomized controlled trial. *NeuroRehabilitation, 44*(2), 239–249. https://doi.org/10.3233/nre-182563

*Peers, P. V., Astle, D. E., Duncan, J., Murphy, F. C., Hampshire, A., Das, T., & Manly, T. (2020). Dissociable effects of attention vs. working memory training on cognitive performance and everyday functioning following fronto-parietal strokes. *Neuropsychological Rehabilitation, 30*(6), 1092–1114. https://doi.org/10.1080/09602011.2018.1554534

Peiris, C. L., Taylor, N. F., & Shields, N. (2012). Patients value patient–therapist interactions more than the amount or content of therapy during inpatient rehabilitation: A qualitative study. *Journal of Physiotherapy, 58*(4), 261–268. https://doi.org/10.1016/S1836-9553(12)70128-5

Ponsford, J., & Schönberger, M. (2010). Family functioning and emotional state two and five years after traumatic brain injury. *Journal of International Neuropsychological Society, 16*(2), 306–317. https://doi.org/10.1017/S1355617709991342

*Potvin, M. J., Rouleau, I., Sénéchal, G., & Giguère, J. F. (2011). Prospective memory rehabilitation based on visual imagery techniques. *Neuropsychological Rehabilitation, 21*(6), 899–924. https://doi.org/10.1080/09602011.2011.630882

*Poulin, V., Korner-Bitensky, N., Bherer, L., Lussier, M., & Dawson, D. R. (2017). Comparison of two cognitive interventions for adults experiencing executive dysfunction post-stroke: A pilot study. *Disability and Rehabilitation, 39*(1), 1–13. https://doi.org/10.3109/09638288.2015.1123303

*Powell, L. E., Glang, A., Ettel, D., Todis, B., Sohlberg, M. M., & Albin, R. (2012). Systematic instruction for individuals with acquired brain injury: Results of a randomised controlled trial. *Neuropsychological Rehabilitation, 22*(1), 85–112. https://doi.org/10.1080/09602011.2011.640466

*Prigatano, G., & Wong, J. L. (1999). Cognitive and affective improvement in brain dysfunctional patients who achieve inpatient rehabilitation goals. *Archives of Physical Medicine and Rehabilitation, 80*(1), 77–84. https://doi.org/10.1016/s0003-9993(99)90311-8

*Prokopenko, S. V., Bezdenezhnykh, A. F., Mozheyko, E. Y., & Zubrickaya, E. M. (2019). Effectiveness of computerized cognitive training in patients with poststroke cognitive impairments. *Neuroscience and Behavioral Physiology, 49*(5), 539–543. https://doi.org/10.1007/s11055-019-00767-3

Rabinowitz, A. R., & Levin, H. (2014). Cognitive sequelae of traumatic brain injury. *Psychiatric Clinics of North America, 37*(1), 1–11. https://doi.org/10.1016/j.psc.2013.11.004

*Radice-Neumann, D., Zupan, B., Tomita, M., & Willer, B. (2009). Training emotional processing in persons with brain injury. *The Journal of Head Trauma Rehabilitation, 24*(5), 313–323. https://doi.org/10.1097/HTR.0b013e3181b09160

*Richter, K. M., Modden, C., Eling, P., & Hildebrandt, H. (2015). Working memory training and semantic structuring improves remembering future events, not past events. *Neurorehabilitation and Neural Repair, 29*(1), 33–40. https://doi.org/10.1177/1545968314527352

*Richter, K. M., Modden, C., Eling, P., & Hildebrandt, H. (2018). Improving everyday memory performance after acquired brain injury: An RCT on recollection and working memory training. *Neuropsychology, 32*(5), 586–596. https://doi.org/10.1037/neu0000445

Riedeman, S., & Turkstra, L. (2018). Knowledge, confidence, and practice patterns of speech-language pathologists working with adults with traumatic brain injury. *American Journal of Speech-Language Pathology, 27*(1), 181–191. https://doi.org/10.1044/2017_AJSLP-17-0011

Riegler, L. J., Neils-Strunjas, J., Boyce, S., Wade, S. L., & Scheifele, P. M. (2013). Cognitive intervention results in web-based videophone treatment adherence and improved cognitive scores. *Medical Science Monitor, 19*, 269–275. https://doi.org/10.12659/MSM.883885

*Rietdijk, R., Power, E., Attard, M., Heard, R., & Togher, L. (2020). A clinical trial investigating telehealth and in-person social communication skills training for people with traumatic brain injury: Participant-reported communication outcomes. *The Journal of Head Trauma Rehabilitation, 35*(4), 241–253. https://doi.org/10.1097/htr.0000000000000554

*Rogan, C. (2018). *An examination of the effectiveness of a cognitive group intervention for people with acquired brain injury* [Doctoral dissertation, National University of Ireland, Maynooth] ProQuest Dissertations & Theses Global.

Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Adams, R. J., Berry, J. D., Brown, T. M., Carnethon, M. R., Dai, S., de Simone, G., Ford, E. S., Fox, C. S., Fullerton, H. J., Gillespie, C., Greenlund, K. J., Hailpern, S. M., Heit, J. A., Ho, P. M., Howard, V. J., Kissela, B. M., … American Heart Association Statistics Committee and Stroke Statistics Subcommittee. (2011). Heart disease and stroke statistics—2011 update: A report from the American Heart Association. *Circulation, 123*(4), e18–e209. https://doi.org/10.1161/CIR.0b013e3182009701

Rohatgi, A. (2020). *WebPlotDigitizer* (Version 4.3). https://automeris.io/WebPlotDigitizer

Rohling, M. L., Larrabee, G. J., & Millis, S. R. (2012). The "miserable minority" following mild traumatic brain injury: Who are they and do meta-analyses hide them? *The Clinical Neuropsychologist, 26*(2), 197–213. https://doi.org/10.1080/13854046.2011.647085

Runge, J. W. (1993). The cost of injury. *Emergency Medicine Clinics of North America, 11*(1), 241–253. https://doi.org/10.1016/S0733-8627(20)30669-6

Sackett, D., Strauss, S., Richardson, W., Rosenberg, W., & Haynes, R. B. (2000). *Evidence-based medicine: How to practice and teach EBM* (2nd ed.). Churchill Livingstone.

*Sander, A. M., Caroselli, J. S., High, W. M., Jr., Becker, C., Neese, L., & Scheibel, R. (2002). Relationship of family functioning to progress in a post-acute rehabilitation programme following traumatic brain injury. *Brain Injury, 16*(8), 649–657. https://doi.org/10.1080/02699050210128889

Schmeler, M., Schein, R., McCue, M., & Betz, K. (2009). Telerehabilitation clinical and vocational applications for assistive technology: Research, opportunities, and challenges. *International Journal of Telerehabilitation, 1*(1), 59–72. https://doi.org/10.5195/ijt.2009.6014

*Schmitter-Edgecombe, M., Fahy, J. F., Whelan, J. P., & Long, C. J. (1995). Memory remediation after severe closed head injury: Notebook training versus supportive therapy. *Journal of Consulting and Clinical Psychology, 63*(3), 484–489. https://doi.org/10.1037//0022-006x.63.3.484

Schulman, J., Sacks, J., & Provenzano, G. (2002). State level estimates of the incidence and economic burden of head injuries stemming from non-universal use of bicycle helmets. *Injury Prevention, 8*(1), 47–52. https://doi.org/10.1136/ip.8.1.47

*Scott, K. L., Strong, C. A., Gorter, B., & Donders, J. (2016). Predictors of post-concussion rehabilitation outcomes at three-month follow-up. *The Clinical Neuropsychologist, 30*(1), 66–81. https://doi.org/10.1080/13854046.2015.1127427

Selassie, A. W., Zaloshnja, E., Langlois, J. A., Miller, T. R., Jones, P., & Steiner, C. (2008). Incidence of long-term disability following traumatic brain injury hospitalization, United States, 2003. *The Journal of Head Trauma Rehabilitation, 23*(2), 123–131. https://doi.org/10.1097/01.HTR.0000314531.30401.39

Serino, A., Ciaramelli, E., Santantonio, A. D., Malagù, S., Servadei, F., & Làdavas, E. (2007). A pilot study for rehabilitation of central executive deficits after traumatic brain injury. *Brain Injury, 21*(1), 11–19. https://doi.org/10.1080/02699050601151811

*__Shum, D., Fleming, J., Gill, H., Gullo, M. J., & Strong, J.__ (2011). A randomized controlled trial of prospective memory rehabilitation in adults with traumatic brain injury. *Journal of Rehabilitation Medicine, 43*(3), 216–223. https://doi.org/10.2340/16501977-0647

Skandsen, T., Nilsen, T. L., Einarsen, C., Normann, I., McDonagh, D., Haberg, A. K., & Vik, A. (2019). Incidence of mild traumatic brain injury: A prospective hospital, emergency room and general practitioner–based study. *Frontiers in Neurology, 10,* 638. https://doi.org/10.3389/fneur.2019.00638

*__Skidmore, E. R., Butters, M., Whyte, E., Grattan, E., Shen, J., & Terhorst, L.__ (2017). Guided training relative to direct skill training for individuals with cognitive impairments after stroke: A pilot randomized trial. *Archives of Physical Medicine and Rehabilitation, 98*(4), 673–680. https://doi.org/10.1016/j.apmr.2016.10.004

*__Skidmore, E. R., Dawson, D. R., Butters, M. A., Grattan, E. S., Juengst, S. B., Whyte, E. M., Begley, A., Holm, M. B., & Becker, J. T.__ (2015). Strategy training shows promise for addressing disability in the first 6 months after stroke. *Neurorehabilitation and Neural Repair, 29*(7), 668–676. https://doi.org/10.1177/1545968314562113

*__Smania, N., Avesani, R., Roncari, L., Ianes, P., Girardi, P., Varalta, V., Gambini, M., Fiaschi, A., & Gandolfi, M.__ (2013). Factors predicting functional and cognitive recovery following severe traumatic, anoxic, and cerebrovascular brain damage. *The Journal of Head Trauma Rehabilitation, 28*(2), 131–140. https://doi.org/10.1097/HTR.0b013e31823c0127

Sohlberg, M. M., & Turkstra, L. S. (2011). *Optimizing cognitive rehabilitation: Effective instructional methods*. Guilford Press.

*__Spikman, J. M., Boelen, D. H., Lamberts, K. F., Brouwer, W. H., & Fasotti, L.__ (2010). Effects of a multifaceted treatment program for executive dysfunction after acquired brain injury on indications of executive functioning in daily life. *Journal of International Neuropsychological Society, 16*(1), 118–129. https://doi.org/10.1017/s1355617709991020

Stacey, D., Légaré, F., Lewis, K., Barry, M. J., Bennett, C. L., Eden, K. B., Holmes-Rovner, M., Llewellyn-Thomas, H., Lyddiatt, A., Thomson, R., & Trevena, L. (2011). Decision aids for people facing health treatment or screening decisions. *Cochrane Database of Systematic Reviews, 10,* CD001431. https://doi.org/10.1002/14651858.CD001431.pub5

Stagg, K., Douglas, J., & Iacono, T. (2019). A scoping review of the working alliance in acquired brain injury rehabilitation. *Disability and Rehabilitation, 41*(4), 489–497. https://doi.org/10.1080/09638288.2017.1396366

Stewart, M., Brown, J. B., Weston, W., McWhinney, I. R., McWilliam, C. L., & Freeman, T. (2013). *Patient-centered medicine: Transforming the clinical method* (3rd ed.). CRC Press. https://doi.org/10.1201/b20740

*__Storzbach, D., Twamley, E. W., Roost, M. S., Golshan, S., Williams, R. M., O'Neil, M., Jak, A. J., Turner, A. P., Kowalski, H. M., Pagulayan, K. F., & Huckans, M.__ (2017). Compensatory cognitive training for Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn Veterans with mild traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 32*(1), 16–24. https://doi.org/10.1097/HTR.0000000000000228

*__Strangman, G. E., O'Neil-Perozzi, T. M., Supelana, C., Goldstein, R., Katz, D. I., & Glenn, M. B.__ (2012). Fractional anisotropy helps predicts memory rehabilitation outcome after traumatic brain injury. *NeuroRehabilitation, 31*(3), 295–310. https://doi.org/10.3233/NRE-2012-0797

Stulemeijer, M., Vos, P. E., Bleijenberg, G., & van der Werf, S. P. (2007). Cognitive complaints after mild traumatic brain injury: Things are not always what they seem. *Journal of Psychosomatic Research, 63*(6), 637–645. https://doi.org/10.1016/j.jpsychores.2007.06.023

Sun, J. H., Tan, L., & Yu, J. T. (2014). Post-stroke cognitive impairment: Epidemiology, mechanisms, and management. *Annals of Translational Medicine, 2*(8), 80. https://doi.org/10.3978/j.issn.2305-5839.2014.08.05

*__Tam, S. F., & Man, W. K.__ (2004). Evaluating computer-assisted memory retraining programmes for people with post-head injury amnesia. *Brain Injury, 18*(5), 461–470. https://doi.org/10.1080/02699050310001646099

Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness: A practical scale. *The Lancet, 2*(7872), 81–84. https://doi.org/10.1016/s0140-6736(74)91639-0

Theadom, A., Parag, V., Dowell, T., McPherson, K., Starkey, N., Barker-Collo, S., Jones, K., Ameratunga, S., Feigin, V. L., & BIONIC Research Group. (2016). Persistent problems 1 year after mild traumatic brain injury: A longitudinal population study in New Zealand. *British Journal of General Practice, 66*(642), e16–e23. https://doi.org/10.3399/bjgp16X683161

*__Thickpenny-Davis, K. L., & Barker-Collo, S. L.__ (2007). Evaluation of a structured group format memory rehabilitation program for adults following brain injury. *The Journal of Head Trauma Rehabilitation, 22*(5), 303–313. https://doi.org/10.1097/01.HTR.0000290975.09496.93

*__Thompson, P. J., Conn, H., Baxendale, S. A., Donnachie, E., McGrath, K., Geraldi, C., & Duncan, J. S.__ (2016). Optimizing memory function in temporal lobe epilepsy. *Seizure, 38,* 68–74. https://doi.org/10.1016/j.seizure.2016.04.008

*__Togher, L., McDonald, S., Tate, R., Power, E., & Rietdijk, R.__ (2013). Training communication partners of people with severe traumatic brain injury improves everyday conversations: A multicenter single blind clinical trial. *Journal of Rehabilitation Medicine, 45*(7), 637–645. https://doi.org/10.2340/16501977-1173

Togher, L., Wiseman-Hakes, C., Douglas, J., Stergiou-Kita, M., Ponsford, J., Teasell, R., Bayley, M., Turkstra, L. S., & INCOG Expert Panel. (2014). INCOG recommendations for management of cognition following traumatic brain injury, Part IV: Cognitive communication. *The Journal of Head Trauma Rehabilitation, 29*(4), 353–368. https://doi.org/10.1097/HTR.0000000000000071

*__Tornås, S., Løvstad, M., Solbakk, A. K., Evans, J., Endestad, T., Hol, P. K., Schanke, A. K., & Stubberud, J.__ (2016). Rehabilitation of executive functions in patients with chronic acquired brain injury with goal management training, external cuing, and emotional regulation: A randomized controlled trial. *Journal of the International Neuropsychological Society, 22*(4), 436–452. https://doi.org/10.1017/S1355617715001344

*__Tornås, S., Løvstad, M., Solbakk, A. K., Schanke, A. K., & Stubberud, J.__ (2019). Use it or lose it? A 5-year follow-up study of goal management training in patients with acquired brain injury. *Journal of the International Neuropsychological Society, 25*(10), 1082–1087. https://doi.org/10.1017/s1355617719000626

Turkstra, L. S., Coelho, C., & Ylvisaker, M. (2005). The use of standardized tests for individuals with cognitive-communication disorders. *Seminars in Speech and Language, 26*(4), 215–222. https://doi.org/10.1055/s-2005-922101

Turner-Stokes, L., Pick, A., Nair, A., Disler, P. B., & Wade, D. T. (2015). Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. *Cochrane Database of Systematic Reviews, 2015*(12), CD004170. https://doi.org/10.1002/14651858.CD004170.pub3

*__Twamley, E. W., Thomas, K. R., Gregory, A. M., Jak, A. J., Bondi, M. W., Delis, D. C., & Lohr, J. B.__ (2015). CogSMART compensatory cognitive training for traumatic brain injury: Effects over 1 year. *The Journal of Head Trauma Rehabilitation, 30*(6), 391–401. https://doi.org/10.1097/HTR.0000000000000076

U.S. Department of Education. (n.d.). *What Works Clearinghouse standards handbook* (Version 4.0). https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_standards_handbook_v4.pdf

*__van de Ven, R. M., Murre, J. M. J., Buitenweg, J. I. V., Veltman, D. J., Aaronson, J. A., Nijboer, T. C. W., Kruiper-Doesborgh, S., van Bennekom, C., Ridderinkhof, K. R., & Schmand, B.__ (2017). The influence of computer-based cognitive flexibility training on subjective cognitive well-being after stroke: A multi-center randomized controlled trial. *PLOS ONE, 12*(11), Article e0187582. https://doi.org/10.1371/journal.pone.0187582

*__Van Vleet, T., DeGutis, J., Dabit, S., & Chiu, C.__ (2014). Randomized control trial of computer-based rehabilitation of spatial neglect syndrome: The RESPONSE trial protocol. *BMC Neurology, 14,* Article 25. https://doi.org/10.1186/1471-2377-14-25

Vanderploeg, R. D., Cooper, D. B., Curtiss, G., Kennedy, J. E., Tate, D. F., & Bowles, A. O. (2018). Predicting treatment response to cognitive rehabilitation in military service members with mild traumatic brain injury. *Rehabilitation Psychology, 63*(2), 194–204. https://doi.org/10.1037/rep0000215

*__Vanderploeg, R. D., Schwab, K., Walker, W. C., Fraser, J. A., Sigford, B. J., Date, E. S., Scott, S. G., Curtiss, G., Salazar, A. M., Warden, D. L., & Defense and Veterans Brain Injury Center Study Group.__ (2008). Rehabilitation of traumatic brain injury in active-duty military personnel and veterans: Defense and Veterans Brain Injury Center randomized controlled trial of two rehabilitation approaches. *Archives of Physical Medicine and Rehabilitation, 89*(12), 2227–2238. https://doi.org/10.1016/j.apmr.2008.06.015

*__Vas, A., Chapman, S., Aslan, S., Spence, J., Keebler, M., Rodriguez-Larrain, G., Rodgers, B., Jantz, T., Martinez, D., Rakic, J., & Krawczyk, D.__ (2016). Reasoning training in veteran and civilian traumatic brain injury with persistent mild impairment. *Neuropsychological Rehabilitation, 26*(4), 502–531. https://doi.org/10.1080/09602011.2015.1044013

*__Vas, A., Chapman, S., Cook, L. G., Elliott, A. C., & Keebler, M.__ (2011). Higher-order reasoning training years after traumatic brain injury in adults. *The Journal of Head Trauma Rehabilitation, 26*(3), 224–239. https://doi.org/10.1097/HTR.0b013e318218dd3d

*__Veisi-Pirkoohi, S., Hassani-Abharian, P., Kazemi, R., Vaseghi, S., Zarrindast, M. R., & Nasehi, M.__ (2020). Efficacy of RehaCom cognitive rehabilitation software in activities of daily living, attention, and response control in chronic stroke patients. *Journal of Clinical Neuroscience, 71,* 101–107. https://doi.org/10.1016/j.jocn.2019.08.114

Veritas Health Innovation. (n.d.). *Covidence systematic review software*. https://www.covidence.org/

Virani, S. S., Alonso, A., Benjamin, E. J., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., Chang, A. R., Cheng, S., Delling, F. N., Djousse, L., Elkind, M., Ferguson, J. F., Fornage, M., Khan, S. S., Kissela, B. M., Knutson, K. L., Kwan, T. W., Lackland, D. T., … American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. (2020). Heart disease and stroke statistics—2020 update: A report from the American Heart Association. *Circulation, 141*(9), e139–e596. https://doi.org/10.1161/CIR.0000000000000757

Wan, X., Wang, W., Liu, J., & Tong, T. (2014). Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Medical Research Methodology, 14*(1), 135. https://doi.org/10.1186/1471-2288-14-135

Weidner, K., & Lowman, J. (2020). Telepractice for adult speech-language pathology services: A systematic review. *Perspectives of the ASHA Special Interest Groups, 5*(1), 326–338. https://doi.org/10.1044/2019_PERSP-19-00146

Wertheimer, J. C., Roebuck-Spencer, T. M., Constantinidou, F., Turkstra, L., Pavol, M., & Paul, D. (2008). Collaboration between neuropsychologists and speech-language pathologists in rehabilitation settings. *The Journal of Head Trauma Rehabilitation, 23*(5), 273–285. https://doi.org/10.1097/01.HTR.0000336840.76209.a1

*__Westerberg, H., Jacobaeus, H., Hirvikoski, T., Clevberger, P., Östensson, M. L., Bartfai, A., & Klingberg, T.__ (2007). Computerized working memory training after stroke—A pilot study. *Brain Injury, 21*(1), 21–29. https://doi.org/10.1080/02699050601148726

Wiebe, N., Vandermeer, B., Platt, R. W., Klassen, T. P., Moher, D., & Barrowman, N. J. (2006). A systematic review identifies a lack of standardization in methods for handling missing variance data. *Journal of Clinical Epidemiology, 59*(4), 342–353. https://doi.org/10.1016/j.jclinepi.2005.08.017

*__Winkens, I., Van Heugten, C. M., Wade, D. T., Habets, E. J., & Fasotti, L.__ (2009). Efficacy of time pressure management in stroke patients with slowed information processing: A randomized controlled trial. *Archives of Physical Medicine and Rehabilitation, 90*(10), 1672–1679. https://doi.org/10.1016/j.apmr.2009.04.016

*__Withiel, T. D., Wong, D., Ponsford, J. L., Cadilhac, D. A., New, P., Mihaljcic, T., & Stolwyk, R. J.__ (2019). Comparing memory group training and computerized cognitive training for improving memory function following stroke: A Phase II randomized controlled trial. *Journal of Rehabilitation Medicine, 51*(5), 343–351. https://doi.org/10.2340/16501977-2540

*__Wolf, T. J., Doherty, M., Boone, A., Rios, J., Polatajko, H., Baum, C., & McEwen, S.__ (2021). Cognitive Oriented Strategy Training Augmented Rehabilitation (COSTAR) for ischemic stroke: A pilot exploratory randomized controlled study. *Disability and Rehabilitation, 43*(2), 201–210. https://doi.org/10.1080/09638288.2019.1620877

*__Wolf, T. J., Polatajko, H., Baum, C., Rios, J., Cirone, D., Doherty, M., & McEwen, S.__ (2016). Combined cognitive-strategy and task-specific training affects cognition and upper-extremity function in subacute stroke: An exploratory randomized controlled trial. *The American Journal of Occupational Therapy, 70*(2), 7002290010p1–7002290010p10. https://doi.org/10.5014/ajot.2016.017293

World Health Organization. (2001). *International Classification of Functioning, Disability and Health (ICF)*.

Wouters, A., Nysten, C., Thijs, V., & Lemmens, R. (2018). Prediction of outcome in patients with acute ischemic stroke based on initial severity and improvement in the first 24 h. *Frontiers in Neurology, 9,* 308. https://doi.org/10.3389/fneur.2018.00308

*__Yoo, C., Yong, M. H., Chung, J., & Yang, Y.__ (2015). Effect of computerized cognitive rehabilitation program on cognitive function and activities of living in stroke patients. *Journal of Physical Therapy Science, 27*(8), 2487–2489. https://doi.org/10.1589/jpts.27.2487

Zaloshnja, E., Miller, T. R., Langlois, J. A., & Selassie, A. W. (2008). Prevalence of long-term disability from traumatic brain injury in the civilian population of the United States, 2005. *The Journal of Head Trauma Rehabilitation, 23*(6), 394–400. https://doi.org/10.1097/01.HTR.0000341435.52004.ac

*__Zucchella, C., Capone, A., Codella, V., De Nunzio, A. M., Vecchione, C., Sandrini, G., Pace, A., Pierelli, F., & Bartolo, M.__ (2013). Cognitive rehabilitation for early post-surgery inpatients affected by primary brain tumor: A randomized, controlled trial. *Journal of Neuro-Oncology, 114*(1), 93–100. https://doi.org/10.1007/s11060-013-1153-z

*__Zucchella, C., Capone, A., Codella, V., Vecchione, C., Buccino, G., Sandrini, G., Pierelli, F., & Bartolo, M.__ (2014). Assessing and restoring cognitive functions early after stroke. *Functional Neurology, 29*(4), 255–262. https://doi.org/10.11138/FNeur/2014.29.4.255

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Evidence Tables

Table A1. Cognitive rehabilitation versus no cognitive rehabilitation.

		Certainty assessment					Participants		Effect			
Outcome	*N*	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Cognitive rehab	No cognitive rehab	Relative [95% CI]	Absolute [95% CI]	Certainty	Importance
Decreased impairment	46	Serious[a]	Serious[b]	Not serious	Not serious	None	1,151	983	—	SMD 0.25 *SD* higher [0.14 higher, 0.37 higher]	⊕⊕◯◯ Low	Critical
Improved function	46	Serious[a]	Serious[b]	Not serious	Not serious	None	1,065	876	—	SMD 0.38 *SD* higher [0.22 higher, 0.54 higher]	⊕⊕◯◯ Low	Critical
Improved quality of life	13	Serious[a]	Not serious	Not serious	Not serious	None	431	436	—	SMD 0.16 *SD* higher [0.00 lower, 0.31 higher]	⊕⊕⊕◯ Moderate	Critical
Increased self-awareness into impact of injury	12	Serious[a]	Not serious	Not serious	Not serious	None	301	288	—	SMD 0.24 *SD* higher [0.07 higher, 0.4 higher]	⊕⊕⊕◯ Moderate	Critical
Decreased caregiver burden	1	Very serious[c]	Not serious	Not serious	Serious[d]	None	29	34	—	SMD 0.31 *SD* higher [0.19 lower, 0.81 higher]	⊕◯◯◯ Very low	Critical
Return to work	3	Serious[c]	Not serious	Not serious	Serious[e]	None	52/69 (75.4%)	54/79 (68.4%)	RR 1.17 [1.03, 1.33]	12 more per 100 [2 more, 23 more]	⊕⊕◯◯ Low	Critical
Treatment satisfaction	1	Very serious[c]	Not serious	Not serious	Very serious[d]	None	10	10	—	SMD 0.43 *SD* higher [0.46 lower, 1.32 higher]	⊕◯◯◯ Very low	Critical
Increased knowledge/ education regarding injury/course of recovery	1	Very serious[c]	Not serious	Not serious	Very serious[d]	None	18	12	—	SMD 0.15 *SD* lower [0.88 lower, 0.58 higher]	⊕◯◯◯ Very low	Critical

Note. The following critical outcome included no studies: decreased need for cognitive-based supervision. rehab = rehabilitation; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation; RR = relative risk.

[a]Downgraded due to some concerns regarding study characteristics (e.g., sequence generation, allocation concealment, masking). [b]Downgraded due to $I^2 = 51\%$; $p < .0001$. [c]Downgraded due to significant concerns regarding study characteristics (e.g., sequence generation, allocation concealment, masking). [d]Downgraded due to wide confidence interval and small number of participants. [e]Downgraded due to wide confidence intervals.

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Evidence Tables

Table A2. Restorative cognitive treatment versus no treatment.

	Certainty assessment						Participants		Effect			
Outcome	*N*	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Restorative cognitive treatment	No cognitive treatment	Relative [95% CI]	Absolute [95% CI]	Certainty	Importance
Decreased impairment	22	Serious[a]	Serious[b]	Not serious	Not serious	None	487	396	—	SMD 0.34 *SD* higher [0.09 higher, 0.59 higher]	⊕⊕○○ Low	Critical
Improved function	21	Serious[a]	Not serious	Not serious	Not serious	None	456	349	—	SMD 0.21 *SD* higher [0.06 higher, 0.35 higher]	⊕⊕⊕○ Moderate	Critical
Improved quality of life	7	Serious[a]	Not serious	Not serious	Serious[c]	None	207	193	—	SMD 0.08 *SD* higher [0.2 lower, 0.36 higher]	⊕⊕○○ Low	Critical
Increased self-awareness into impact of injury	6	Serious[a]	Not serious	Not serious	Serious[c]	None	137	123	—	SMD 0.26 *SD* higher [0.06 lower, 0.59 higher]	⊕⊕○○ Low	Critical
Return to work	1	Not serious	Not serious	Not serious	Serious[c]	None	34/34 (100.0%)	39/46 (84.8%)	RR 1.17 [1.03, 1.34]	144 more per 1,000 [25 more, 288 more]	⊕⊕⊕○ Moderate	Critical
Treatment satisfaction	1	Very serious[d]	Not serious	Not serious	Very serious[e]	None	10	10	—	SMD 0.43 *SD* higher [0.46 lower, 1.32 higher]	⊕○○○ Very low	Critical

Note. The following critical outcomes included no studies: decreased caregiver burden, decreased need for cognitive-based supervision, and increased knowledge/education regarding injury/course of recovery. CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation; RR = relative risk.

[a]Downgraded due to some concerns about study methodological quality. [b]Downgraded for inconsistency due to I^2 = 76%; $p < .00001$. [c]Downgraded due to wide confidence interval and small number of participants. [d]Downgraded due to significant concerns about study methodological quality. [e]Downgraded due to wide confidence intervals.

Evidence Tables

Table A3. Compensatory cognitive treatment versus no treatment.

	Certainty assessment						Participants		Effect			
Outcome	*N*	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Comp cognitive treatment	No cognitive treatment	Relative [95% CI]	Absolute [95% CI]	Certainty	Importance
Decreased impairment	21	Serious[a]	Not serious	Not serious	Not serious	None	481	429	—	SMD 0.16 *SD* higher [0.02 higher, 0.31 higher]	⊕⊕⊕○ Moderate	Critical
Improved function	23	Serious[a]	Not serious	Not serious	Not serious	None	438	387	—	SMD 0.39 *SD* higher [0.16 higher, 0.61 higher]	⊕⊕⊕○ Moderate	Critical
Improved quality of life	7	Serious[a]	Not serious	Not serious	Not serious	None	196	206	—	SMD 0.13 *SD* higher [0.07 lower, 0.32 higher]	⊕⊕⊕○ Moderate	Critical
Increased self-awareness into impact of injury	6	Serious[a]	Not serious	Not serious	Serious[b]	None	164	165	—	SMD 0.25 *SD* higher [0.04 higher, 0.47 higher]	⊕⊕○○ Low	Critical
Decreased caregiver burden	1	Very serious[c]	Not serious	Not serious	Serious[b]	None	29	34	—	SMD 0.31 *SD* higher [0.19 lower, 0.81 higher]	⊕○○○ Very low	Critical
Return to work	2	Serious[a]	Not serious	Not serious	Very serious[d]	None	18/35 (51.4%)	15/33 (45.5%)	RR 1.10 [0.67, 1.80]	45 more per 1,000 [150 fewer, 364 more]	⊕○○○ Very low	Critical
Increased knowledge/education regarding injury/course of recovery	1	Very serious[c]	Not serious	Not serious	Very serious[d]	None	18	12	—	SMD 0.15 *SD* lower [0.88 lower, 0.58 higher]	⊕○○○ Very low	Critical

Note. The following critical outcomes included no studies: decreased need for cognitive-based supervision and treatment satisfaction. Comp = compensatory; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation; RR = relative risk.

[a]Downgraded due to some concerns regarding study characteristics (e.g., sequence generation, allocation, masking). [b]Downgraded due to significant concerns about study methodological quality. [c]Downgraded due to wide confidence interval and small number of participants. [d]Downgraded due to wide confidence intervals.

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Evidence Tables

Table A4. Compensatory versus restorative cognitive treatment.

	Certainty assessment						Participants		Effect			
Outcome	***N***	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Comp cognitive treatment**	**Restore cognitive treatment**	**Relative [95% CI]**	**Absolute [95% CI]**	**Certainty**	**Importance**
Decreased impairment	4	Serious[a]	Not serious	Not serious	Very serious[b]	None	71	71	—	SMD 0.19 *SD* higher [0.15 lower, 0.53 higher]	⊕○○○ Very low	Critical
Improved function	5	Serious[a]	Serious[c]	Not serious	Very serious[b]	None	87	93	—	SMD 0 *SD* [0.5 lower, 0.49 higher]	⊕○○○ Very low	Critical
Improved quality of life	3	Serious[a]	Not serious	Not serious	Very serious[b]	None	60	60	—	SMD 0.16 *SD* higher [0.21 lower, 0.52 higher]	⊕○○○ Very low	Critical
Increased self-awareness into impact of injury	2	Serious[a]	Not serious	Not serious	Very serious[b]	None	43	41	—	SMD 0.03 *SD* higher [0.4 lower, 0.46 higher]	⊕○○○ Very low	Critical
Decreased caregiver burden	1	Serious[a]	Not serious	Not serious	Serious[d]	None	38	37	—	SMD 0.29 *SD* lower [0.76 lower, 0.18 higher]	⊕⊕○○ Low	Critical

Note. The following critical outcomes included no studies: return to work, decreased need for cognitive-based supervision, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. Comp = compensatory; Restore = restorative; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to some concerns about methodological quality. [b]Downgraded due to wide confidence interval. [c]Downgraded due to concerns about heterogeneity; I^2 = 57%. [d]Downgraded due to wide confidence interval and small number of participants.

Evidence Tables

Table A5. Attention treatment versus no treatment.

	Certainty assessment						Participants		Effect			
Outcome	***N***	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Attention treatment**	**No treatment**	**Relative [95% CI]**	**Absolute [95% CI]**	**Certainty**	**Importance**
Decreased impairment	10	Serious[a]	Not serious	Not serious	Not serious	None	207	202	—	SMD 0.21 *SD* higher [0.02 lower, 0.44 higher]	⊕○○○ Very low	Critical
Improved function	4	Serious[a]	Not serious	Not serious	Very serious[b]	None	104	92	—	SMD 0.12 *SD* higher [0.26 lower, 0.50 higher]	⊕○○○ Very low	Critical
Improved quality of life	3	Serious[a]	Not serious	Not serious	Serious[c]	None	134	112	—	SMD 0.15 *SD* higher [0.11 lower, 0.41 higher]	⊕⊕○○ Low	Critical
Return to work	1	Not serious	Not serious	Not serious	Serious[c]	None	34/34 (100.0%)	39/46 (84.8%)	RR 1.17 [1.03, 1.34]	144 more per 1,000 [25 more, 288 more]	⊕⊕⊕○ Moderate	Critical

Note. The following critical outcomes included no studies: improved self-awareness into impact of injury, decreased caregiver burden, decreased need for cognitive-based supervision, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation; RR = relative risk.

[a]Downgraded due to concerns regarding study characteristics (e.g., sequence generation, masking, allocation concealment). [b]Downgraded due to wide confidence interval. [c]Downgraded due to wide confidence interval and small number of participants.

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Evidence Tables

Table A6. Memory treatment versus no treatment.

	Certainty assessment						Participants		Effect			
Outcome	***N***	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Memory treatment**	**No treatment**	**Relative [95% CI]**	**Absolute [95% CI]**	**Certainty**	**Importance**
Decreased impairment	13	Serious[a]	Not serious	Not serious	Not serious	None	279	242	—	SMD 0.27 *SD* higher [0.10 higher, 0.45 higher]	⊕⊕⊕○ Moderate	Critical
Improved function	13	Serious[a]	Not serious	Not serious	Not serious	None	248	199	—	SMD 0.32 *SD* higher [0.03 higher, 0.62 higher]	⊕⊕⊕○ Moderate	Critical
Improved quality of life	1	Not serious	Not serious	Not serious	Very serious[c]	None	72	71	—	SMD 0.07 *SD* lower [0.4 lower, 0.25 higher]	⊕⊕○○ Low	Critical
Increased self-awareness into impact of injury	2	Not serious	Not serious	Not serious	Serious[b]	None	93	90	—	SMD 0.34 *SD* higher [0.05 higher, 0.63 higher]	⊕⊕○○ Low	Critical

Note. The following critical outcomes included no studies: decreased caregiver burden, return to work, decreased need for cognitive-based supervision, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to concerns regarding study characteristics (e.g., sequence generation, masking, allocation concealment). [b]Downgraded due to wide confidence intervals and small number of participants. [c]Downgraded due to wide confidence interval.

Evidence Tables

Table A7. Executive function treatment versus no treatment.

	Certainty assessment						Participants		Effect			
Outcome	*N*	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Executive function treatment	No treatment	Relative [95% CI]	Absolute [95% CI]	Certainty	Importance
Decreased impairment	9	Serious[a]	Serious[b]	Not serious	Very serious[e]	None	245	189	—	SMD 0.05 *SD* higher [0.35 lower, 0.45 higher]	⊕○○○ Very low	Critical
Improved function	14	Serious[a]	Not serious	Not serious	Not serious	None	307	239	—	SMD 0.46 *SD* higher [0.23 higher, 0.69 higher]	⊕⊕⊕○ Moderate	Critical
Improved quality of life	3	Not serious	Not serious	Not serious	Serious[c]	None	82	93	—	SMD 0.32 *SD* higher [0.02 higher, 0.62 higher]	⊕⊕⊕○ Moderate	Critical
Increased self-awareness into impact of injury	8	Serious[a]	Not serious	Not serious	Serious[c]	None	157	161	—	SMD 0.20 *SD* higher [0.06 lower, 0.46 higher]	⊕⊕○○ Low	Critical
Treatment satisfaction	1	Very serious[d]	Not serious	Not serious	Very serious[e]	None	10	10	—	SMD 0.43 *SD* higher [0.46 lower, 1.32 higher]	⊕○○○ Very low	Critical

Note. The following critical outcomes included no studies: decreased caregiver burden, return to work, decreased need for cognitive-based supervision, and increased knowledge/education regarding injury/course of recovery. CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to some concerns about study characteristics (e.g., sequence generation, masking). [b]Downgraded due to high heterogeneity; I^2 = 66%, p < .001. [c]Downgraded due to wide confidence intervals and small number of participants. [d]Downgraded due to significant concerns about study methodological quality. [e]Downgraded due to wide confidence intervals.

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Evidence Tables

Table A8. Social communication treatment versus no treatment.

		Certainty assessment					Participants		Effect			
Outcome	***N***	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Social comm treatment**	**No treatment**	**Relative [95% CI]**	**Absolute [95% CI]**	**Certainty**	**Importance**
Decreased impairment	1	Not serious	Not serious	Not serious	Very serious[a]	None	47	24	—	SMD 0.07 *SD* lower [0.56 lower, 0.42 higher]	⊕⊕○○ Low	Critical
Improved function	7	Serious[b]	Not serious	Not serious	Serious[c]	None	100	84	—	SMD 0.41 *SD* higher [0.11 higher, 0.72 higher]	⊕⊕○○ Low	Critical
Improved quality of life	2	Very serious[d]	Not serious	Not serious	Very serious[a]	None	58	61	—	SMD 0.09 *SD* lower [0.64 lower, 0.46 higher]	⊕○○○ Very low	Critical
Increased self-awareness into impact of injury	1	Serious[b]	Not serious	Not serious	Very serious[a]	None	13	13	—	SMD 0.17 *SD* lower [0.94 lower, 0.6 higher]	⊕○○○ Very low	Critical

Note. The following critical outcomes included no studies: decreased caregiver burden, return to work, decreased need for cognitive-based supervision, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. comm = communication; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to wide confidence intervals. [b]Downgraded due to some concerns about study characteristics (e.g., sequence generation, masking). [c]Downgraded due to wide confidence intervals and small number of participants. [d]Downgraded due to significant concerns about study characteristics (e.g., sequence generation, masking).

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Evidence Tables

Table A9. Contextualized cognitive treatment versus no treatment.

	Certainty assessment						Participants		Effect			
Outcome	***N***	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Contxt treatment**	**No treatment**	**Relative [95% CI]**	**Absolute [95% CI]**	**Certainty**	**Importance**
Decreased impairment	4	Serious[a]	Not serious	Not serious	Serious[b]	None	90	96	—	SMD 0.47 *SD* higher [0.11 lower, 1.05 higher]	⊕⊕○○ Low	Critical
Improved function	10	Serious[a]	Not serious	Not serious	Not serious	None	174	183	—	SMD 0.48 *SD* higher [0.19 higher, 0.77 higher]	⊕⊕⊕○ Moderate	Critical
Improved quality of life	3	Serious[a]	Not serious	Not serious	Very serious[c]	None	80	103	—	SMD 0.08 *SD* higher [0.21 lower, 0.37 higher]	⊕○○○ Very low	Critical
Increased self-awareness into impact of injury	4	Serious[a]	Not serious	Not serious	Serious[b]	None	44	42	—	SMD 0.56 *SD* higher [0, 1.12 higher]	⊕⊕○○ Low	Critical
Decreased caregiver burden	1	Very serious[d]	Not serious	Not serious	Serious[b]	None	29	34	—	SMD 0.31 *SD* higher [0.19 lower, 0.81 higher]	⊕○○○ Very low	Critical
Treatment satisfaction	1	Very serious[d]	Not serious	Not serious	Very serious[c]	None	10	10	—	SMD 0.43 *SD* higher [0.46 lower, 1.32 higher]	⊕○○○ Very low	Critical

Note. The following critical outcomes included no studies: decreased impairment, quality of life, increased self-awareness into impact of injury, decreased caregiver burden, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. Contxt = contextualized; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to some concern about study quality. [b]Downgraded due to wide confidence intervals and low number of participants. [c]Downgraded due to wide confidence intervals. [d]Downgraded due to significant concerns regarding study quality.

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Evidence Tables

Table A10. Contextualized cognitive treatment versus decontextualized cognitive treatment.

	Certainty assessment						Participants		Effect			
Outcome	***N***	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Contxt treatment**	**Decontxt treatment**	**Relative [95% CI]**	**Absolute [95% CI]**	**Certainty**	**Importance**
Decreased impairment	6	Serious[a]	Not serious	Not serious	Serious[b]	None	128	126	—	SMD 0.4 *SD* higher [0.14 higher, 0.65 higher]	⊕⊕○○ Low	Critical
Improved function	7	Serious[a]	Not serious	Not serious	Very serious[c]	None	311	308	—	SMD 0.08 *SD* higher [0.23 lower, 0.39 higher]	⊕○○○ Very low	Critical
Improved quality of life	4	Serious[a]	Not serious	Not serious	Very serious[c]	None	119	108	—	SMD 0.01 *SD* higher [0.26 lower, 0.28 higher]	⊕○○○ Very low	Critical
Increased self-awareness into impact of injury	3	Serious[a]	Not serious	Not serious	Very serious[c]	None	107	102	—	SMD 0.03 *SD* lower [0.3 lower, 0.24 higher]	⊕○○○ Very low	Critical
Decreased caregiver burden	1	Serious[a]	Not serious	Not serious	Serious[b]	None	38	37	—	SMD 0.29 *SD* lower [0.76 lower, 0.18 higher]	⊕⊕○○ Low	Critical

Note. The following critical outcomes included no studies: return to work, decreased cognitive-based supervision, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. Contxt = contextualized; Decontxt = decontextualized; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to some concern about study characteristics (e.g., sequence generation, allocation concealment, blinding). [b]Downgraded due to wide confidence interval and small number of participants. [c]Downgraded due to wide confidence intervals.

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Evidence Tables

Table A11. Early versus delayed cognitive rehabilitation.

	Certainty assessment						Participants		Effect			
Outcome	*N*	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Early cognitive rehab	Delayed cognitive rehab	Relative [95% CI]	Absolute [95% CI]	Certainty	Importance
Improved function	2	Very serious[a]	Not serious	Not serious	Serious[b]	None	123	62	—	SMD 0.48 *SD* higher [0.17 higher, 0.8 higher]	⊕○○○ Very low	Critical
Return to work	1	Very serious[a]	Not serious	Not serious	Serious[b]	None	68/115 (59.1%)	24/52 (46.2%)	RR 1.28 [0.92, 1.78]	129 more per 1,000 [37 fewer, 360 more]	⊕○○○ Very low	Critical
Decreased need for cognitive-based supervision	1	Very serious[a]	Not serious	Not serious	Very serious[c]	None	115	52	—	SMD 0.12 *SD* higher [0.21 lower, 0.44 higher]	⊕○○○ Very low	Critical

Note. The following critical outcomes included no studies: decreased impairment, quality of life, increased self-awareness into impact of injury, decreased caregiver burden, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. rehab = rehabilitation; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation; RR = relative risk.

[a]Downgraded due to significant concerns about study characteristics (e.g., sequence generation, masking). [b]Downgraded due to wide confidence intervals and small number of participants. [c]Downgraded due to wide confidence intervals.

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Evidence Tables

Table A12. Remote versus in-person cognitive rehabilitation.

	Certainty assessment						Participants		Effect			
Outcome	*N*	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Remote cognitive rehab	In-person cognitive rehab	Relative [95% CI]	Absolute [95% CI]	Certainty	Importance
Decreased impairment	1	Not serious	Not serious	Not serious	Very serious[b]	None	25	30	—	SMD 0.00 *SD* lower [0.53 lower, 0.53 higher]	⊕○○○ Very low	Critical
Improved function	3	Serious[a]	Not serious	Not serious	Very serious[b]	None	67	61	—	SMD 0.14 *SD* lower [0.49 lower, 0.21 higher]	⊕⊕○○ Low	Critical

Note. The following critical outcomes included no studies: quality of life, increased self-awareness into impact of injury, decreased caregiver burden, return to work, decreased need for cognitive-based supervision, treatment satisfaction, and increased knowledge/education regarding injury/course of recovery. rehab = rehabilitation; CI = confidence interval; SMD = standardized mean difference; *SD* = standard deviation.

[a]Downgraded due to some concerns about methodological quality. [b]Downgraded due to wide confidence intervals.

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B1. Participant and intervention characteristics for restorative cognitive treatments.

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
Attention	APT + SC	SC	Decontxt	Hierarchical training	60 min 5×/wk. 4 wks.	Computer	IP	38	40	70.2	67.7	61	60	Nontraumatic Acute	—	Barker-Collo et al. (2009)
	Attention training + cognitive rehab	PsyE	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training	60 min 1×/wk. 8 wks. 2×/mo. 24 wks. 14 sess.	Indiv + computer	OP	34	46	38.1	37.4	30	46	Traumatic Acute	Mild	Caplain et al. (2019)
	RehaCom[a]	No Tx	Decontxt	Hierarchical training	30 min 2×/wk. 6 wks.	Computer	IP	12	13	60.0	63.7	58	59	Nontraumatic Subacute	—	Cho et al. (2015)
	TAPAT	WL	Decontxt	1. Hierarchical training 2. Repeated stimulation	30 min 4.5×/wk. 2 wks.	Computer	—	12	12	57.0	66.0	58	67	Nontraumatic Chronic	—	DeGutis & Van Vleet (2010)
	Attention retraining	WL	Decontxt	Hierarchical training	60 min 1×/wk. 6 wks.	Computer	OP	19	8	40.7	36.9	47	63	Nontraumatic Chronic	—	Engelberts et al. (2002)[b]
	Attention training	BG	Decontxt	Repeated stimulation	75 min 2×/wk. 6 wks.	Computer	OP	17	14	26.2	34.1	71	71	Mixed Subacute	15 Sev 16 Mild–mod	Gray et al. (1992)
	Visuospatial training	SC	Decontxt	Repeated stimulation	60 min 2×/wk. 4 wks.	Computer	IP	10	10	66.7	69.6	50	50	Nontraumatic Acute	—	Hajek et al. (1993)
	Dual-task training	ST	Decontxt	Repeated stimulation	30 min 3×/wk. 4 wks.	Group	IP	10	10	58.4	58.2		—	Nontraumatic Chronic	—	Kim et al. (2014)
	Dual-task training	No Tx	Decontxt	Hierarchical training	30 min 3×/wk. 6 wks.	Indiv	IP	15	15	56.3	59.8		—	Traumatic Chronic	—	Park & Lee (2019)
	Selective attention training	No Tx	Decontxt	Repeated stimulation	30–50 min 5×/wk. 4 wks.	Computer	Home	10	10	—	—	60	70	Nontraumatic Chronic	—	Peers et al. (2020)[b]
	TAPAT	WL	Decontxt	1. Hierarchical training 2. Repeated stimulation	—	Computer	Home	24	25	60.5	57.1	67	68	Nontraumatic Chronic	Mild–mod	Van Vleet et al. (2014)

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B1. *(Continued).*

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
Executive function	SWAP	WL	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training 3. Cognitive aid	60 min 45 min 7×/wk. 12 wks.	Indiv + group	OP	49	49	46.7	43.9	29	47	Traumatic Chronic	30 Sev 49 Mod 19 Mild	Cantor et al. (2014)
	Awareness intervention program	No Tx	Contxt (quasi)	1. Repeated stimulation 2. Education	30 min 10×/wk. 4 wks.	Indiv	IP	11	10	54.9	58.1	64	60	Traumatic Acute	—	Cheng & Man (2006)
	Self-awareness retraining	SC	Contxt (quasi)	1. Repeated stimulation 2. Cognitive aid 3. Education	45 min 2.5×/wk. 6 sess.	Indiv	OP	10	10	39.5	39.2	80	80	Mixed Subacute–chronic	Mod–sev	Goverover et al. (2007)
	1. CCR 2. OCR 3. TCR (Analogic training)	No Tx	Decontxt	Hierarchical training	20 sess.	Computer Telehealth FtF	Home OP	83	20	42.7 44.2 44.9	48.6	54 52 60	65	Mixed Chronic	—	Man et al. (2006)[b]
	Self-awareness training	No Tx	Decontxt	1. Repeated stimulation 2. Education	90 min 1×/wk. 8 wks.	Indiv	OP	11	11	23.0	24.0	82	82	Traumatic Subacute	Mod–sev	Shum et al. (2011)[b]
Memory	CogMed + SC	SC	Decontxt	Hierarchical training	30–45 min 5×/wk. 6 wks.	Computer	OP	25	20	45.9	52.9	52	50	Mixed Subacute	—	Akerlund et al. (2013)
	CogMed	No Tx	Decontxt	Hierarchical training	30–50 min 5×/wk. 4 wks.	Computer	Home	10	10	—	—	60	70	Nontraumatic Chronic	—	Peers et al. (2020)[b]
	1. SP 2. IF 3. Contxt content 4. HVP (memory training)	No Tx	Decontxt	Hierarchical training	20–30 min 10 sess.	Computer	OP	24	8	40.4 33.3 32.6 39.8	45.0	67 67 50 50	50	Traumatic — (> 3 mo.)	—	Tam & Man (2004)[b]
	CogMed	No Tx	Decontxt	Hierarchical training	40 min 5×/wk. 5 wks.	Computer	Home	9	9	55.0	44.0	89	44	Nontraumatic Chronic	—	Westerberg et al. (2007)

(*table continues*)

Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B1. *(Continued).*

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
Social comm	Project-based social skills treatment	WL	Contxt	1. Repeated stimulation 2. Cognitive strategy instruction	120 min 10 sess. 6 wks.	Group	OP	11	10	43.6	48.3	55	50	Mixed Chronic	12 Sev 1 Mod 28 —	Behn et al. (2019)
	Emotional perceptual treatment	WL	Decontxt	1. Repeated stimulation 2. Hierarchical training	90 min 2×/wk. 8 wks.	Group	OP	6	6	29.2	43.5	Total 92		Traumatic Chronic	Sev	Bornhofen & McDonald (2008a)
	Emotional perceptual treatment	WL	Decontxt	1. Repeated stimulation 2. Hierarchical training	90 min 2×/wk. 10 wks.	Group	OP	9	5	43.8 35.4	31.2	—		Traumatic Chronic	Sev	Bornhofen & McDonald (2008b)
	Social skills treatment	WL	Decontxt	1. Repeated stimulation 2. Hierarchical training	90 min 1×/wk. 12 wks.	Group	OP	26	26	42.4	39.9	73	96	Traumatic Chronic	Mod–sev	Dahlberg et al. (2007)
	Social skills training	WL	Decontxt	1. Repeated stimulation 2. Cognitive strategy instruction	60 min 180 min 2×/wk. 12 wks.	Indiv + group	OP	18	16	36.3	35.2	72	88	Traumatic Chronic	Sev	McDonald et al. (2008)
	Emotional perceptual training	WL	Decontxt	Repeated stimulation	120 min 3×/wk. 12 wks.	Indiv	OP	10	10	44.6	46.6	60	90	Mixed Chronic	—	McDonald et al. (2013)
	Social comm training (SOLO)	WL	Decontxt	1. Cognitive strategy instruction 2. Repeated stimulation	45–60 min 150 min 1×/wk. 10 wks.	Indiv + group	OP	15	15	39.7	38.1	93	87	Traumatic Chronic	—	Togher et al. (2013)[b]

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B1. *(Continued).*

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
Multiple cognitive domains	Cognitive retraining	No Tx	Decontxt	Hierarchical training	30 min 3×/wk. 3 wks.	Indiv	IP	16	17	70.5	73.4	44	5	Nontraumatic Acute	—	Carter et al. (1988)
	RETRACE	No Tx	Decontxt	Repeated stimulation	6 wks.	Computer	Home	17	17	30.8	32.3		—	Traumatic Acute	Mild–mod	Chopra et al. (2016)
	VR-based cognitive training	WL	Contxt (quasi)	Hierarchical training	60 min 2.5×/wk. 4–6 wks.	Indiv	IP	10	10	Total 55.0		50	90	Nontraumatic Acute	—	Gamito et al. (2017)
	RehaCom	SC	Decontxt	Hierarchical training	5×/wk. 12 wks.	Computer	OP	51	49	62.4	60.5	49	49	Nontraumatic Acute	—	Jiang et al. (2016)
	RehaCom	No Tx	Decontxt	Hierarchical training	60 min 10 wks. 6 sess.	Computer	IP	16	18	62.4	63.2	63	56	Nontraumatic Subacute	—	Lin et al. (2014)
	VR-based adaptive conjunctive cognitive training	BG	Decontxt	Hierarchical training	30 min 7×/wk. 6 wks.	Indiv	OP	19	19	63.6	67.2	58	63	Nontraumatic Chronic	—	Maier et al. (2020)
	Cognitive training	No Tx	Decontxt	Repeated stimulation	60 min 2×/wk. 8 wks.	Computer	OP	5	4	49.0	57.8	60	100	Nontraumatic Subacute	Mild	Prokopenko et al. (2019)
	Cognitive flexibility training	WL	Decontxt	Hierarchical training	30 min 5×/wk. 12 wks.	Computer	Home	38	24	57.0	61.2	63	79	Nontraumatic Chronic	—	van de Ven et al. (2017)
	RehaCom	No Tx	Decontxt	Hierarchical training	45 min 2×/wk. 5 wks.	Computer	Home Telehealth	25	25	52.9	58.8	60	52	Nontraumatic Subacute–chronic	—	Veisi-Pirkoohi et al. (2020)
	RehaCom	SC	Decontxt	Hierarchical training	30 min 5×/wk. 5 wks.	Computer	IP	23	23	53.2	56.3	35	39	Nontraumatic Subacute	—	Yoo et al. (2015)

Note. Em dashes indicate data not reported. Chronicity: acute = 0 to ≤ 3 months post; subacute = 3 to ≤ 12 months post; chronic = ≥ 12 months post. I = intervention; C = control; ABI = acquired brain injury; APT = attention processing training; SC = standard care not otherwise described; wk. = week; wks. = weeks; IP = inpatient; rehab = rehabilitation; PsyE = psychoeducation only; Decontxt = decontextualized; mo. = month(s); sess. = sessions; OP = outpatient; No Tx = no treatment; TAPAT = tonic and phasic alertness training; WL = waitlist; Mod/mod = moderate; SWAP = short-term executive plus treatment; CCR = self-paced computer-assisted analogic training; OCR = online interactive analogic training; TCR = trainer-administered analogic training; Indiv = individual treatment; Sev/sev = severe; Contxt = contextualized; FtF = face-to-face (i.e., in-person); SP = self-paced; IF = immediate feedback; HVP = heightened visual presentation; comm = communication; RETRACE = literacy free cognitive rehabilitation; VR = virtual reality; BG = commercially available brain games; ST = single-task gait training.

[a]Attention module only. [b]Combined group data to examine the efficacy of cognitive rehabilitation.

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B2. Participant and intervention characteristics for compensatory cognitive treatments.

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
Attention	Attention strategy training	WL	Decontxt	Cognitive strategy instruction	60 min 1×/wk. 6 wks.	Indiv	OP	17	8	41.6	36.9	58	63	Nontraumatic Chronic	—	Engelberts et al. (2002)
	1. Visual scanning 2. Mental practice	No Tx	Decontxt	Cognitive strategy instruction	60 min 2×/wk. 5 wks.	Indiv	—	10	5	72.1 72.4	64.2	40 60	60	Nontraumatic Chronic	—	Ferreira et al. (2011)[a]
Executive function	GMT	E	Contxt (quasi)	Cognitive strategy instruction	120 min 7 sess.	Indiv	IP/OP	11	8	49.8	49.3	73	75	Mixed Subacute	—	Levine et al. (2011)
	Metacog strategy training	No Tx	Decontxt	Cognitive strategy instruction	90 min 1×/wk. 10 wks.	Group	OP	10	10	—		—		Mixed Chronic	—	Miotto et al. (2009)
	Goal-oriented attention regulation and metacog strategy training	E	Contxt	Cognitive strategy instruction	60 min 60 min 2×/wk. 5 wks.	Indiv + group	OP	20	13	Total 43.3		Total 88		Traumatic Chronic	7 Sev 7 Mod 19 Mild	Novakovic-Agopian et al. (2018)
	1. Indiv 2. Group 3. Indiv + group (Metacog strategy training)	WL	1. Contxt 2. Decontxt 3. Contxt	Cognitive strategy instruction	60 min 3×/wk. 8 wks.	1. Indiv 2. Group 3. Indiv + group	Home	18	17	Total 43.9		Total 54		Mixed Subacute	—	Ownsworth et al. (2008)[a]
	Metacog strategy training	No Tx	Contxt (quasi)	Cognitive strategy instruction	45 min 5×/wk. 2 wks.	Indiv	IP	15	15	64.9	71.8	60	73	Nontraumatic Acute	Mild–mod	Skidmore et al. (2015)
	GMT	E	Decontxt	Cognitive strategy instruction	120 min 16 wks. 8 sess.	Group	OP	33	37	42.1	43.6	58	51	Mixed Chronic	—	Tornås et al. (2016)
	SMART	E	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training	90 min 2×/wk. 5 wks.	Group	OP	14	14	39.0	47.0	64	50	Traumatic Chronic	—	Vas et al. (2011)

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B2. *(Continued).*

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
	SMART	E	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training	90 min 2×/wk. 5 wks.	Group	OP	31	39	41.0	42.8	55	52	Traumatic Chronic	Mild	Vas et al. (2016)
	TPM	SC	Decontxt	Cognitive strategy instruction	60–120 min 1×/wk. 5–10 wks.	Indiv	IP/OP	20	17	49.5	53.9	45	71	Nontraumatic Chronic	—	Winkens et al. (2009)
	Metacog strategy training	SC	Contxt (quasi)	Cognitive strategy instruction	Up to 10 sessions	Indiv	OP	19	16	57.5	54.4	68	56	Nontraumatic Acute	—	Wolf et al. (2016)
Memory	MSE training	E	Decontxt	1. Cognitive strategy instruction 2. Education	60 min 2×/wk. 4.5 wks.	Group	OP	77	76	58.3	57.9	57	53	Nontraumatic Chronic	—	Aben et al. (2014)
	Memory treatment	No Tx	Decontxt	1. Repeated stimulation 2. Cognitive strategy instruction 3. Cognitive aid	60 min 1×/wk. 10 wks.	Group	OP	171	157	45.8	45.1	42	47	Traumatic Subacute	—	das Nair et al. (2019)[b]
	Memory strategy training	BG	Decontxt	Cognitive strategy instruction	2×/wk. 4 wks.	Indiv	IP	6	6	51.3	51.7	—		Nontraumatic Subacute	—	Doorhein & De Haan (1998)
	1. Indiv 2. Group (memory strategy training)	No Tx	Decontxt	1. Cognitive strategy instruction 2. Cognitive aid 3. Education	60 min 5×/wk. 3 wks.	1. Indiv 2. Group	Home	45	20	39.6 41.3	42.2	74 50	65	Mixed Subacute–chronic	—	Lesniak et al. (2018)[a]
	Memory strategy training	WL	Decontxt	1. Cognitive strategy instruction 2. Cognitive aid 3. Education	120 min 1×/wk. 6 wks.	Group	OP	20	20	53.8	48.2	60	45	Nontraumatic Chronic	—	L. A. Miller & Radford (2014)
	Memory strategy training	No Tx	Decontxt	Cognitive strategy instruction	90 min 2×/wk. 7 wks.	Group	OP	54	40	47.3	47.0	—		Traumatic Chronic	44 Sev 21 Mod 19 Mild 10 —	O'Neil-Pirozzi et al. (2010)

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B2. *(Continued).*

Domain	Treatment characteristics				Service delivery characteristics			Participant characteristics								Study
								N		Age ($\bar{x}$)		%*M*				
	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	
	Memory strategy training	E	Decontxt	Cognitive strategy instruction	90 min 1×/wk. 10 wks.	Computer	Home	10	20	35.0	30.9	70	55	Traumatic Chronic	27 Sev 3 Mod	Potvin et al. (2011)
	Memory strategy training	No Tx	Decontxt	1. Cognitive strategy instruction 2. Education	60 min 1×/wk. 12 wks.	Indiv	OP	4	4	29.9	26.8	—		Traumatic Chronic	Severe	Schmitter-Edgecombe et al. (1995)
	Memory strategy training	No Tx	Decontxt	1. Cognitive strategy 2. Cognitive aid	90 min 1×/wk. 8 wks.	Indiv	OP	11	11	33.0	24.0	73	82	Traumatic Subacute	Mod–severe	Shum et al. (2011)[a]
	Didactic memory training with errorless learning	WL	Decontxt	1. Repeated stimulation 2. Cognitive strategy instruction	60 min 2×/wk. 4 wks.	Group	IP/OP	7	7	35.2	31.4	Total 86		Mixed Chronic	10 Sev 1 Mod 3 —	Thickpenny-Davis & Barker-Collo (2007)
	Memory strategy training	WL	Decontxt	1. Cognitive strategy instruction 2. Cognitive aid 3. Education	12–14 wks.	Indiv	OP/Home	22	19	44.7	42.4	59	58	Nontraumatic Chronic	—	Thompson et al. (2016)
	Everyday memory skills training program	No Tx	Decontxt	1. Cognitive strategy instruction 2. Cognitive aid 3. Education	120 min 1×/wk. 6 wks.	Group	OP	24	19	60.4	60.5	63	78	Nontraumatic Chronic	—	Withiel et al. (2019)
Social comm	Emotional recognition training	BG	Decontxt	Cognitive strategy instruction	60 min 3×/wk. 3 wks.	Computer	OP	47	24	—	39.5	87	67	Traumatic Chronic	2 Mod 69 Sev	Neumann et al. (2015)[a]

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B2. *(Continued).*

Domain	Treatment characteristics				Service delivery characteristics			Participant characteristics								Study
								N		Age ($\bar{x}$)		%*M*		ABI type and chronicity	ABI severity	
	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C			
Multiple cognitive domains	VIP	SC	Contxt	1. Cognitive strategy instruction 2. Cognitive aid 3. Environ mod 4. Education	120 min 5×/wk. 10 wks.	Indiv	Home	40	41	40.3	39.8	38	95	Traumatic Chronic	25 Mod–sev 56 Mild	Moriarty et al. (2016)
	Voc + embedded cognitive training	Voc	Decontxt	Cognitive strategy instruction	60 min 1×/wk. 12 wks.	Indiv	IP/OP	10	8	Total 51		Total 100		Traumatic Chronic	Mild	O'Connor et al. (2016)
	Cog rehab	WL	Decontxt	1. Cognitive strategy instruction 2. Cognitive aid 3. Environ mod 4. Education	180 min 1×/wk. 12 wks.	Group	OP	19	13	43.4	37.2	79	77	Mixed Chronic	24 Sev 4 Mod 4 Mild	Rogan (2018)
	Cognitive training	No Tx	Contxt (quasi)	1. Cognitive strategy instruction 2. Cognitive aid	120 min 2×/wk. 10 wks.	Group	OP	50	69	35.4	34.8	94	96	Traumatic — (> 6 mo.)	Mild	Storzbach et al. (2017)
	CogSMART + supportive employment	No Tx	Decontxt	1. Cognitive strategy instruction 2. Education	60 min 1×/wk. 12 wks.	Computer	OP	25	25	29.7	33.8	96	96	Traumatic Chronic	Mild–mod	Twamley et al. (2015)

Note. Em dashes indicate data not reported. Chronicity: acute = 0 to ≤ 3 months post; subacute = 3 to ≤ 12 months post; chronic = ≥ 12 months post. I = intervention; C = control; ABI = acquired brain injury; WL = waitlist; wk. = week; wks. = weeks; Indiv = individual treatment; OP = outpatient; No Tx = no treatment; E = education only (e.g., brain health workshop); IP = inpatient; Decontxt = decontextualized; Sev/sev = severe; Mod/mod = moderate; Metacog/metacog = metacognitive; GMT = goal management training; sess. = sessions; SMART = Strategic Memory Advanced Reasoning Training; TPM = time pressure management strategy training; SC = standard care not otherwise described; MSE = memory self-efficacy training; BG = commercially available brain games; comm = communication; VIP = Veterans' in-home cognitive rehabilitation program; Environ mod = environmental modification; Voc = vocational rehabilitation; Contxt = contextualized; Cog rehab = cognitive rehabilitation; mo. = months.

[a]Combined group data to examine the efficacy of cognitive rehabilitation. [b]Follow-up data only.

Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B3. Participant and intervention characteristics for mixed restorative/compensatory cognitive treatments.

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
Attention	C-Car + strategy training	WL	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training 3. Cognitive aid	120 min 1×/wk. 6 wks.	Computer + indiv	OP	70	70	42.0	43.8	59	57	Nontraumatic Chronic	—	Gehring et al. (2009)
Memory	Cognitive training	No Tx	Decontxt	1. Repeated stimulation 2. Cognitive aid	90 min 1×/wk. 10 wks.	Indiv + group	OP	6	11	50.3 43.0	54.8	75	78	Nontraumatic Chronic	—	das Nair & Lincoln (2012)[a,b]
Social comm	Social comm training + comm partner training (JOINT)	WL	Decontxt	1. Cognitive strategy instruction 2. Repeated stimulation 3. Education 4. Environ mod	45–60 min 150 min 1×/wk. 10 wks.	Indiv + group	OP	14	15	30.3	38.1	79	87	Traumatic Chronic	—	Togher et al. (2013)[a]
Multiple cognitive domains	Cognitive rehab + APT	BG	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training	120 min 7×/wk. 6 wks.	Indiv + group computer	OP	30	30	33.4	29.9	87	100	Traumatic Subacute	Mild	Cooper et al. (2017)
	Cognitive rehab	SC[c]	Decontxt	1. Cognitive strategy 2. Repeated stimulation 3. Education	60 min 1×/wk. 8 wks.	Group	OP	10	10	53.9	57.7	10	60	Nontraumatic Chronic	—	Hasanzadeh Pashang et al. (2021)
	Self-awareness + memory training	No Tx	Decontxt	1. Cognitive strategy 2. Cognitive aid 3. Repeated stimulation 4. Education	90 min 1×/wk. 8 wks.	Indiv	OP	12	11	23.5	24.0	92	82	Traumatic Subacute	Mod–sev	Shum et al. (2011)[a]

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B3. *(Continued).*

	Treatment characteristics				Service delivery characteristics			Participant characteristics								
								N		Age ($\bar{x}$)		%*M*				
Domain	I	C	Manner	Method	Dosage	Format	Setting	I	C	I	C	I	C	ABI type and chronicity	ABI severity	Study
	Cognitive training + metacog strategy training	SC[c]	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training	60 min 4×/wk. 4 wks.	Computer Individual	IP	25	29	58.7	52.7	56	45	Nontraumatic Acute	—	Zucchella et al. (2013)
	Cognitive training + metacog strategy training	No Tx	Decontxt	1. Cognitive strategy instruction 2. Hierarchical training	60 min 4×/wk. 4 wks.	Computer Individual	IP	42	45	66.6	69.4	55	51	Nontraumatic Subacute	Mild–mod	Zucchella et al. (2014)

Note. Em dashes indicate data not reported. Chronicity: acute = 0 to ≤ 3 months post; subacute = 3 to ≤ 12 months post; chronic = ≥ 12 months post. I = intervention; C = control; ABI = acquired brain injury; C-Car = computer-based attention training; WL = waitlist; wk. = week; wks. = weeks; Indiv = individual treatment; No Tx = no treatment; Decontxt = decontextualized; OP = outpatient; comm = communication; Environ mod = environmental modification; APT = attention processing training; BG = commercially available brain games; rehab = rehabilitation; SC = standard care not otherwise described; Mod/mod = moderate; sev = severe; metacog = metacognitive; IP = inpatient.

[a]Combined group data to examine the efficacy of cognitive rehabilitation. [b]Data from *Cochrane Review*. [c]Standard care did not include cognitive treatment.

Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B4. Participant and intervention characteristics—comparative effectiveness studies.

	Intervention characteristics			Service delivery characteristics		Participant characteristics					
Study	Intervention arms	Method	Manner	Format	Dosage and setting	*N*	Age ($\bar{x}$)	%*M*	ABI type and TPO	ABI severity	Clinical question
Bertens et al. (2015)	GMT with errorless learning	1. Cognitive strategy instruction 2. Repeated stimulation	Contxt (quasi)	Indiv	60 min 2×/wk. 4 wks.	33	49.7	42	Mixed Chronic	—	EF vs. EF
	GMT with trial-and-error learning	Cognitive strategy instruction			OP	34	46.8	59			
Bourgeois et al. (2007)	Functional didactic treatment	1. Cognitive strategy instruction 2. Cognitive aid	Contxt (quasi)	Telehealth	30 min 4–5×/wk. Home	16	40.0	63	Traumatic Chronic	—	C vs. R Mem vs. Mem
	Memory training with spaced retrieval	Repeated stimulation				22	43.0	64			
Bornhofen & McDonald (2008b)	Emotional perceptual training with errorless learning	1. Hierarchical training 2. Repeated stimulation	Decontxt	Group	90 min 2×/wk.	4	43.8	—	Traumatic Chronic	Severe	SC vs. SC
	Emotional perceptual training with self-instruction training	1. Cognitive strategy instruction 2. Repeated stimulation			10 wks. OP	5	35.4				
Caracuel et al. (2012)	Early cognitive rehabilitation	1. Cognitive strategy instruction	Decontxt	Indiv + group	60 min 60 min	8	27.4	88	Traumatic Subacute	Severe	Early vs. Delayed
	Late cognitive rehabilitation	2. Repeated stimulation 3. Environmental modification 4. Education			3×/wk. 24 wks.	10	32.8	60	Traumatic Chronic		
Cuberos-Urbano et al. (2018)	GMT + lifelong SenseCam	Cognitive strategy instruction	Contxt	Indiv	2×/wk. 7 wks.	8	34.1	Total 88	Mixed Chronic	—	EF vs. EF
	GMT	Cognitive strategy instruction			OP	8	37.3				
De Joode et al. (2013)	Electronic memory aid Nonelectronic memory aid	1. Cognitive strategy instruction 2. Cognitive aid	Decontxt	Indiv	30–60 min 0.5–2×/wk. 16 hr	21 13	42.2 39.4	67 77	Mixed Subacute	—	Mem vs. Mem
De Luca et al. (2019)	VR-based cognitive training	Repeated stimulation	Contxt (quasi)	Indiv	60 min 3×/wk.	50	38.7	58	Traumatic Subacute	Mild–mod	Contxt vs. Decontxt
	Cognitive training		Decontxt		8 wks. OP	50	41.1	52			
Emmanouel et al. (2020)	Working memory training + GMT	Cognitive strategy instruction	Decontxt	Indiv	30 min 3–4×/wk.	9	33.6	56	Mixed Chronic	—	Mem vs. Mem
	Working memory training				4 wks. IP	9	36.0	78			
Engelberts et al. (2002)	Compensatory attention training	Cognitive strategy instruction	Decontxt	Indiv Computer	60 min 1×/wk.	17	41.6	58	Nontraumatic Chronic	—	C vs. R Attn vs. Attn
	Attention retraining	Hierarchical training		Indiv	6 wks. OP	19	40.7	47			
Faria et al. (2016)	VR-based cognitive rehabilitation (Reh@City)	Hierarchical training	Contxt (quasi)	Indiv	20 min 2×/wk. 4–6 wks.	9	58.0	44	Nontraumatic Subacute	—	Contxt vs. Decontxt
	General cognitive training	Repeated stimulation	Decontxt		IP	9	53.0	44			

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B4. *(Continued).*

Study	Intervention characteristics: Intervention arms	Method	Manner	Service delivery characteristics: Format	Dosage and setting	Participant characteristics: *N*	Age ($\bar{x}$)	%*M*	ABI type and TPO	ABI severity	Clinical question
Fasotti et al. (2000)	TPM strategy training	Cognitive strategy instruction	Decontxt	Indiv	60 min 3×/wk. 2–3 wks. IP	12	26.2	67	Traumatic Subacute	Severe	EF vs. EF
	General cognitive training (rehearsal + strategy)	1. Cognitive strategy instruction 2. Repeated stimulation			30 min 5×/wk. 3–4 wks. IP	10	30.1	70			
Ferreira et al. (2011)	Visual scanning	Cognitive strategy instruction	Decontxt	Indiv	60 min 2×/wk.	5	72.0	40	Nontraumatic Chronic	—	Attn vs. Attn
	Mental imagery	Cognitive strategy instruction			5 wks. —	5	62.4	60			
Harrison-Felix et al. (2018)	Group interactive social communication treatment	1. Cognitive strategy instruction 2. Repeated stimulation 3. Education	Contxt (quasi)	Group	90 min 1×/wk. 13 wks. IP	90	44.7	68	Traumatic Subacute–chronic	57 Severe 25 Mod 86 Mild 5 —	Contxt vs. Decontxt SC vs. SC
	Group noninteractive social communication treatment	1. Repeated stimulation 2. Education	Decontxt			89	46.4	70			
High et al. (2006)	Early cognitive rehabilitation	1. Cognitive strategy instruction	Contxt (quasi)	Indiv + group	Average 19 wks.	11	31.5	75	Traumatic Acute–subacute	Mod–severe	Early vs. Delayed
	Delayed cognitive rehabilitation	2. Cognitive aids 3. Environmental modification 4. Education				29	27.2	62	Traumatic Chronic		
Hildebrandt et al. (2006)	Memory training	Cognitive strategy instruction	Decontxt	Group	60 min 5×/wk.	22	56.6	68	Mixed Subacute	—	Mem vs. Mem
	Process-oriented + semantic structuring memory training	1. Repeated stimulation 2. Hierarchical training 3. Cognitive strategy instruction		Computer	4 wks. IP	24	63.2	50			
Hildebrandt et al. (2011)	Memory training	Cognitive strategy instruction	Decontxt	Group	—	15	57.9	87	Nontraumatic Acute	—	Mem vs. Mem
	Process-oriented + semantic structuring memory training	1. Repeated stimulation 2. Hierarchical training 3. Cognitive strategy instruction		Computer		12	50.8	75			

(*table continues*)

Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B4. *(Continued).*

Study	Intervention characteristics: Intervention arms	Method	Manner	Service delivery characteristics: Format	Dosage and setting	Participant characteristics: *N*	Age ($\bar{x}$)	%*M*	ABI type and TPO	ABI severity	Clinical question
Kaschel et al. (2002)	Imagery-based memory training	Cognitive strategy instruction	Decontxt	Indiv	30 min 3×/wk. 10 wks. OP	9	41.9	—	Mixed Chronic	—	Mem vs. Mem
	Pragmatic memory training	1. Cognitive strategy instruction 2. Cognitive aids				12	36.6				
Lannin et al. (2014)	Electronic memory aid	1. Cognitive strategy instruction 2. Cognitive aid	Decontxt	Indiv	40 min 9 sessions 9 wks. OP	21	34.8	67	Mixed Chronic	—	Mem vs. Mem
	Nonelectronic memory aid					21	32.5	57			
Lawson et al. (2020)	Remote memory skills training	1. Cognitive strategy instruction 2. Cognitive aid 3. Education	Decontxt	Indiv	60 min 1×/wk. 6 wks. Home/OP	28	53.4	54	Nontraumatic — (≥ 3 months)	—	Remote vs. FtF
	FtF memory skills training					18	62.0	61			
Lesniak et al. (2018)	Indiv memory training	1. Cognitive strategy instruction 2. Cognitive aid 3. Repeated stimulation 4. Education	Decontxt	Indiv	60 min 5×/wk. 3 wks. OP	23	39.6	73	Mixed Subacute–chronic	—	Mem vs. Mem
	Group memory training			Group		22	41.3	50			
Llorens et al. (2016)	VR-based attention retraining exercises	Hierarchical training	Decontxt	Indiv	60 min 3×/wk. 10 wks. OP	12	54.5	50	Nontraumatic Subacute	—	Attn vs. Attn
	Cognitive training	Repeated stimulation				13	54.3	69			
Man et al. (2006)	Online interactive analogic problem-solving training	Hierarchical training	Decontxt	Indiv	20 sessions Home/OP	25	44.2	52	Mixed Chronic	—	Remote vs. FtF EF vs. EF
	FtF analogic problem-solving training					30	44.9	60			
	Computer interactive analogic problem-solving training					28	42.7	54			
Man et al. (2013)	VR-based analogic problem-solving training	Hierarchical training	Contxt (quasi)	Indiv	20–25 min 12 sessions	25	—	—	Traumatic — (postacute)	Mild–mod	Contxt vs. Decontxt EF vs. EF
	Problem-solving exercises	Repeated stimulation	Decontxt			25					
Neumann et al. (2015)	Emotional recognition training (faces)	Cognitive strategy instruction	Decontxt	Computer	60 min 3×/wk. 3 wks. OP	24	41.0	96	Traumatic Chronic	2 Mod 45 Severe	SC vs. SC
	Emotional recognition training (stories)					23	41.5	78			
Ownsworth et al. (2008)	Indiv metacog strategy training	Cognitive strategy instruction	Contxt (quasi)	Indiv	60 min 3×/wk. 8 wks. Home/OP	6	Total 43.9	Total 54	Mixed Subacute	—	Contxt vs. Decontxt EF vs. EF
	Group metacog strategy training	1. Cognitive strategy instruction 2. Education	Decontxt	Group		6					
	Indiv + group metacog strategy training	1. Cognitive strategy instruction 2. Education	Contxt (quasi)	Indiv + group		6					

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B4. *(Continued).*

	Intervention characteristics			Service delivery characteristics		Participant characteristics					
Study	**Intervention arms**	**Method**	**Manner**	**Format**	**Dosage and setting**	***N***	**Age ($\bar{x}$)**	**%*M***	**ABI type and TPO**	**ABI severity**	**Clinical question**
Poulin et al. (2017)	Metacog strategy training	Cognitive strategy instruction	Contxt (quasi)	Indiv	60 min 1×/wk.	5	49.0	60	Nontraumatic Subacute	—	C vs. R Contxt vs. Decontxt
	Executive function training	Repeated stimulation	Decontxt	Computer	8 wks. OP	4	57.8	100			EF vs. EF
Powell et al. (2012)	Electronic memory aid with systematic instruction training	Cognitive strategy instruction	Decontxt	Indiv	45 min 2.5×/wk. 4–6 wks.	15	42.9	60	Mixed Chronic	Mod–severe	Mem vs. Mem
	Electronic memory aid with trial-and-error training	Repeated stimulation			OP	14	41.6	57			
Radice-Neumann et al. (2009)	Emotion processing training (faces)	Cognitive strategy instruction	Decontxt	Computer	2.5×/wk. 6–9 sessions	10	47.0	90	Traumatic Chronic	Severe	SC vs. SC
	Emotion processing training (contextual cues)				OP	9	38.0	33			
Richter et al. (2015)	Working memory training	Hierarchical training Repeated stimulation	Decontxt	Computer	45–60 min 3×/wk.	18	50.0	72	Mixed Acute	—	Mem vs. Mem
	Standard memory training	Repeated stimulation		Group	3 wks. IP	18	50.8	78			
Richter et al. (2018)	Working memory training	Hierarchical training Repeated stimulation	Decontxt	Computer	30 min 3×/wk.	18	50.5	72	Mixed Acute	—	Mem vs. Mem
	Standard memory training	Repeated stimulation		Group	4–6 wks. IP	18	51.2	82			
Rietdijk et al. (2020)	Remote social communication skills training	Repeated stimulation	Decontxt	Indiv	90 min 10 sessions	17	Median 54	76	Traumatic Chronic	Mod–severe	Remote vs. FtF
	FtF social communication skills training					19	Median 42	89			
Shum et al. (2011)	Self-awareness + compensatory memory training	1. Cognitive strategy instruction 2. Cognitive aid 3. Repeated stimulation 4. Education	Decontxt	Indiv	90 min 1×/wk. 8 wks. OP	12	23.5	92	Traumatic Subacute	Mod–severe	C vs. R EF vs. EF Mem vs. Mem
	Compensatory memory training	1. Cognitive strategy instruction 2. Cognitive aid				11	33.0	73			
	Self-awareness training	1. Repeated stimulation 2. Education				11	23.0	82			
Skidmore et al. (2017)	Guided GMT	Cognitive strategy instruction	Contxt (quasi)	Indiv	45 min 5×/wk.	21	65.9	43	Nontraumatic Acute	Moderate	EF vs. EF
	Direct skill training	1. Cognitive strategy instruction 2. Repeated stimulation			— IP	22	66.7	59			

(*table continues*)

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Participant and Intervention Characteristics of Efficacy and Comparative Effectiveness Studies

Table B4. *(Continued).*

Study	Intervention characteristics			Service delivery characteristics		Participant characteristics					Clinical question
	Intervention arms	Method	Manner	Format	Dosage and setting	*N*	Age ($\bar{x}$)	%*M*	ABI type and TPO	ABI severity	
Spikman et al. (2010)	Metacog strategy training	1. Cognitive strategy instruction 2. Education	Contxt (quasi)	Indiv	60 min 2×/wk. 12 wks.	38	41.4	68	Mixed Chronic	—	C vs. R Contxt vs. Decontxt
	Computer-based cognitive training	Repeated stimulation	Decontxt	Computer	OP	37	43.7	65			
Togher et al. (2013)	Social skills + communication partner training (JOINT)	1. Cognitive strategy instruction 2. Repeated stimulation 3. Environmental modification	Decontxt	Indiv + group	45–60 min (indiv) 150 min (group) 1×/wk. 10 wks.	14	30.3	79	Traumatic Chronic	Severe	SC vs. SC
	Social skills training (SOLO)	1. Cognitive strategy instruction 2. Repeated stimulation			OP	15	39.7	93			
Vanderploeg et al. (2008)	Functional experiential treatment	Repeated stimulation	Contxt (quasi)	Group	90–150 min 15×/wk.	180	31.7	94	Traumatic Acute	Mod–severe	Contxt vs. Decontxt
	Cognitive-didactic treatment (trial and error)	Hierarchical training	Decontxt	Computer + indiv	— IP	180	33.2	92			
Wolf et al. (2021)	Metacog strategy training + task-specific training	1. Cognitive strategy instruction 2. Repeated stimulation	Contxt (quasi)	Indiv	45 min 1–2×/wk. 12 sessions	24	61.6	12	Nontraumatic Acute	12 — 9 Mild 23 Mod	EF vs. EF
	Task-specific training	Repeated stimulation			OP	20	58.8	9			

Note. Em dashes indicate data not reported. ABI = acquired brain injury; TPO = time postonset; GMT = goal management training; Contxt = contextualized; Indiv/indiv = individual treatment; wk. = week; wks. = weeks; OP = outpatient; EF vs. EF = comparative effectiveness of executive function treatments; C vs. R = compensatory vs. restorative; Mem vs. Mem = comparative effectiveness of memory treatments; Decontxt = decontextualized; SC vs. SC = comparative effectiveness of social communication treatments; Mod/mod = moderate; IP = inpatient; Attn vs. Attn = comparative effectiveness of attention treatments; VR = virtual reality; TPM = time pressure management; FtF = face-to-face (i.e., in-person); Metacog/metacog = metacognitive.

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Predictive Factor Studies

Table C1. Predictive factors and response to treatment.

Study	Sample	Predictive variables considered: Patient factors	Comorbid factors	Contextual factors	Clinical factors	Neuropsych factors	Outcome variables	Significant predictors
Cicerone et al. (1996) Cognitive rehabilitation based on individual needs	20 subjects $\bar{x}$ 36.8 years 20 mTBI Acute	Age Education	None	None	TPO PCS	Memory, attention, and executive function composite scores	Employment (RTW)	Self-reported PCS and improvement on cognitive measures were significant predictors of response to treatment. - Self-reported symptoms (greater PCS) were negatively associated with return to work. - Greater improvement on memory, attention, and executive function neuropsychological measures was positively associated with return to work.
García-Molina et al. (2015) Remote cognitive treatment NOS	528 subjects Median: 40.4 years 367 males, 121 females 272 TBI, 141 stroke, 115 other Subacute	Age Education Sex	None	Marital status Treatment location	ABI type TPO GCS	None	Memory, attention, and executive function composite scores (impairment)	Age, etiology, and location of treatment were significant predictors of response to treatment. - Younger age was positively associated with decreased impairment in all cognitive domains. TBI was positively associated with decreased impairment in memory and executive function domains. - Treatment provided in the home was positively associated with decreased impairment in all cognitive domains.
Janak et al. (2017) Multidisciplinary cognitive rehabilitation	257 subjects Median: 29.0 years 228 males, 28 females 257 mTBI 158 blast injury, 99 other injury Subacute	Age Sex	PTSD symptoms	Military rank Number of combat deployments	Mechanism of injury Number of previous TBIs	None	NSI (impairment)	Mental health was a significant predictor of response to treatment. - The presence of PTSD symptoms was negatively associated with response to treatment.
Leininger et al. (2014) Cognitive treatment based on individual needs	49 subjects $\bar{x}$ 42.1 years 15 males, 34 females 49 mTBI 24 MVA, 19 falls, 2 assault, 4 other Acute	None	Hx of psychiatric problems	None	Hx of previous concussions	TMT	MPAI-4 (functional)	None

(*table continues*)

Table C1. *(Continued).*

Study	Sample	Predictive variables considered: Patient factors	Comorbid factors	Contextual factors	Clinical factors	Neuropsych factors	Outcome variables	Significant predictors
Lewis & Horn (2013) Restorative cognitive treatment	285 subjects $\bar{x}$ 41.0 years 234 males, 51 females 285 TBI 151 MVA, 66 falls, 26 assault, 42 other Chronic	None	None	None	TPO	None	MPAI-4 (functional)	TPO was a significant predictor of response to treatment. - TPO < 6 months improved significantly more than those with later TPO.
Malec (2001) Comprehensive day treatment	96 subjects $\bar{x}$ 34.2 years 70 males, 26 females 69 TBI, 18 stroke, 9 other 7 mild, 6 moderate, 79 severe, 4 unknown Chronic	Age Education	None	None	ABI type TPO ABI severity	MPAI-22	MPAI-22 (functional) GAS (functional) Independent living/ILS (supervision) Vocational independence/VIS (RTW)	TPO and baseline performance were significant predictors of response to treatment. - TPO < 12 months was a positive predictor of decreased supervision/ independent living, as measured by the ILS, compared to TPO of 2–10 years or > 10 years. - Preadmission MPAI-22 score of < 550 was a positive predictor of decreased supervision and community-based employment.
Mlinarič Lešnik et al. (2015) Computer-based attention training	16 subjects Median: 45.0 years 16 stroke	Age	None	None	None	None	TAP Divided Attention subtest (impairment)	None
Ownsworth & McFarland (2004) Group executive function treatment	28 subjects $\bar{x}$ 36.0 years 19 males, 9 females 22 TBI, 5 stroke, 1 anoxia Chronic	None	None	None	None	Volition (ILS Health & Safety) Purposeful behavior (TTT) Personality-related denial (M-CSDS) Coping-related denial (SEC)	Improved psychosocial functioning/SIP (quality of life) Improved executive function/SRSI (self-awareness)	Baseline executive function skills, level of coping, and personality-related denial were significant predictors of response to treatment. - Baseline ILS score (< 33/40) was predictive of improved self-awareness. - Baseline level of personality denial (lower M-CSDS score) was predictive of improved self-awareness and strategy behavior. - Baseline level of purposeful behavior (< 8/12 on TTT) was predictive of improved strategy behavior and psychosocial functioning. - Level of coping-related denial (> 9/30 on SEC) was predictive improved of psychosocial functioning.

(*table continues*)

Appendix C (p. 3 of 5)

Predictive Factor Studies

Table C1. *(Continued).*

Study	Sample	Predictive variables considered: Patient factors	Comorbid factors	Contextual factors	Clinical factors	Neuropsych factors	Outcome variables	Significant predictors
Prigatano & Wong (1999) Cognitive rehabilitation NOS	95 subjects $\bar{x}$ 61.1 years 57 males, 38 females 58 stroke, 23 TBI, 3 AVM, 9 aneurism, 2 other Chronic	Age Education Handedness Sex	None	None	TPO	BNIS subtests	GAS (functional)	Baseline neuropsychological performance was a significant predictor of response to treatment. - Baseline visual–spatial skills as measured by the BNIS was positively associated with improved function (i.e., goal attainment). - Visual spatial subtest was positively associated with improved function (i.e., goal attainment).
Sander et al. (2002) Cognitive treatment NOS	37 subjects $\bar{x}$ 27.4 years 27 males, 10 females 37 TBI 37 severe Chronic	None	None	Family functioning (FAD)	None	None	DRS (functional) DRS Employability subscale (return to work)	Family functioning was a significant predictor of response to treatment. - Healthy family function as measured by the FAD was a positive predictor of improved function and return to work.
Scott et al. (2016) Postconcussive neurorehabilitation	50 subjects $\bar{x}$ 41.0 years 19 males, 31 females 50 mTBI 31 MVA, 8 falls, 5 assault, 6 other Acute	None	Depression (BDI-II) Hx of psychiatric problems	Comp-seeking	None	TMT-B	MPAI-4 (functional)	Mental health was a significant predictor of response to treatment. - The presence of depression was a negative predictor of improved function as measured by the MPAI-4 Ability subscale at 3 months post. - The presence of a previous psychiatric problem was a negative predictor of improved function as measured by the MPAI-4 Adjustment subtest.
Smania et al. (2013) Cognitive rehabilitation based on individual needs	329 subjects $\bar{x}$ 45.7 years 233 males, 96 females 329 severe ABI 192 TBI, 104 Stroke, 33 Anoxia Acute	Age Sex	4 at admission PEG at admission	None	ABI type TPO GCS Rehab LOS	DRS FIM LCF GOS	Discharge status (functional)	Etiology was a significant predictor of response to treatment. - TBI was positively associated with decreased impairment and discharge to home compared to other etiologies. - Age, etiology, and DRS score were useful predictors of probability of returning home.

(*table continues*)

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Predictive Factor Studies

Table C1. *(Continued).*

		Predictive variables considered						
Study	**Sample**	**Patient factors**	**Comorbid factors**	**Contextual factors**	**Clinical factors**	**Neuropsych factors**	**Outcome variables**	**Significant predictors**
Strangman et al. (2012) Compensatory memory training	37 subjects $\bar{x}$ 45.7 years 26 males, 11 females 37 TBI 24 MVA, 6 blunt force trauma, 5 falls, 2 other Chronic	Age Education	None	None	Diffuse tensor imaging TPO ABI severity	None	HVLT-R (impairment) RBMT (functional)	Diffuse tensor imaging results were a significant predictor of response to treatment. - Higher fractional anisotropy of the parahippocampal white matter was negatively associated with decreased impairment as measured by the HVLT-R. - Higher fractional anisotropy of the anterior corpus callosum, left anterior internal capsule, and right anterior corona radiata were negatively associated with improved function as measured by the RBMT.

Note. Neuropsych = neuropsychological; mTBI = mild traumatic brain injury; TPO = time postonset; PCS = postconcussive symptoms; TBI = traumatic brain injury; ABI = acquired brain injury; GCS = Glasgow Coma Scale; PTSD = post-traumatic stress disorder; NSI = Neurobehavioral Symptom Inventory; Hx = history; MPAI = Mayo-Portland Adaptability Inventory; GAS = Goal Attainment Scale; ILS = Independent Living Scale; TAP = Test of Attentional Performance; TTT = The Tinkertoy Test; M-CSDS = Marlowe–Crowne Social Desirability Scale; SEC = Symptom Expectancy Checklist; SIP = Sickness Impact Profile; SRSI = Self-Regulation Skills Interview; BNIS = Barrow Neurological Institute Screen for Higher Cerebral Functions; FAD = Family Assessment Device; DRS = Disability Rating Scale; BDI-II = Beck Depression Inventory–Second Edition; Comp-seeking = compensation seeking; LCF = Level of Cognitive Functioning Scale; GOS = Glasgow Outcomes Scale; HVLT-R = Hopkins Verbal Learning Test–Revised; RBMT = Rivermead Behavioural Memory Test; RTW = return to work; NOS = not otherwise specified; MVA = motor vehicle accident; TMT = Trail Making Test; VIS = Vocational Independence Scale; AVM = arteriovenous malformations; LOS = length of stay; FIM = Functional Independence Measure.

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Predictive Factor Studies

Table C2. Methodological quality of predictive factor studies.

Study	Design	Adequate description of population	Adequate attrition	Adequate PF measurement	Adequate outcome measures	Confounding factors	Adequate analysis & reporting
Cicerone et al. (1996)	Cohort	?	N/A	+	+	–	?
García-Molina et al. (2015)	Cohort	?	N/A	+	+	?	?
Janak et al. (2017)	Cohort	?	N/A	+	+	?	?
Leininger et al. (2014)	Cohort	+	+	+	+	?	?
Lewis & Horn (2013)	Cohort	?	+	?	+	+	?
Malec (2001)	Cohort	+	+	+	?	?	?
Mlinarič Lešnik et al. (2015)	Cohort	+	+	+	+	?	?
Ownsworth & McFarland (2004)	Cohort	?	+	+	+	?	?
Prigatano & Wong (1999)	Cohort	+	N/A	+	?	?	?
Sander et al. (2002)	Cohort	?	+	+	+	+	?
Scott et al. (2016)	Cohort	?	+	?	+	+	?
Smania et al. (2013)	Cohort	+	+	+	+	+	?
Strangman et al. (2012)	Cohort	+	?	+	+	+	?

Note. N/A = not applicable—retrospective analysis; PF = predictive factor; + = yes; – = no; ? = unknown.