JRRD Guest Editorial

Cognitive-communication rehabilitation for combat-related mild traumatic brain injury

INTRODUCTION

Over 2 million servicemembers (SMs) have served in two theaters of operation in Iraq (Operation Iraqi Freedom [OIF]), which ended in December 2011, and Afghanistan (Operation Enduring Freedom [OEF]). Improvements in body armor and advances in medical care have resulted in the highest survival rate of wounded military personnel compared with any previous conflict in U.S. history [1]. Traumatic brain injury (TBI) is among the most common injuries and has been called the "signature injury" of the Global War on Terror [2–3]. Data based on self-reports indicate that approximately 15 to 22 percent of SMs deployed in OIF/OEF may have sustained mild TBI (mTBI) as a result of exposure to improvised explosive devices [4–7]. The true incidence of mTBI among SMs remains largely unknown, because many SMs either do not seek immediate medical care or receive a diagnosis long after the injury, when the details of the event are more difficult to establish [8].

Studies with non-combat-related mTBI populations suggest that initial symptoms generally resolve within weeks or months following the injury. However, these findings cannot be assumed to generalize to combat veterans who typically sustain repeated injuries in the context of chronic stress and life-threatening situations in the battlefield environment [9]. Effective interventions are needed for the growing number of wounded SMs returning from combat with persistent symptoms and functional limitations associated with mTBI and its comorbidities [8].

In May 2007, the U.S. Army Medical Department and the Office of the Army Surgeon General established the Proponency Office for Rehabilitation and Reintegration (PR&R) to advance best practices, policy, and research related to the care of injured SMs. One of PR&R's initiatives was to support the development of evidence-informed clinical management guidance (CMG) for physical therapists (PTs), occupational therapists (OTs), and speech-language pathologists (SLPs) working with wounded SMs with concussion and/or mTBI.

This guest editorial provides a synopsis of the SLP CMG for cognitive-communication interventions for SMs and veterans with a history of concussion and/or mTBI. The terms concussion and mTBI are used interchangeably in this and other Department of Veterans Affairs (VA) and Department of Defense (DOD) clinical practice guidelines [10]. We offer recommendations for clinical decision-making based on existing evidence and consensus of a working group of SLPs providing services to wounded SMs in VA medical

centers, military treatment facilities, and academic settings.

DEVELOPMENT OF SPEECH-LANGUAGE PATHOLOGIST CLINICAL MANAGEMENT GUIDANCE

mTBI can negatively affect an individual's cognitive-communication functioning, including difficulties with concentration and memory [11–13]; problems participating in social communication; disorganized verbal expression; dysfluent speech; word-retrieval problems; and difficulties with planning, problem solving, judgment, and decision making (**Table**) [14–17].

SLPs play a major role in the evaluation and management of cognitive-communication disorders following TBI [18]. The SLP CMG is intended to address cognitive-communication rehabilitation for SMs and veterans who (1) are ≥18 years old, (2) have a history of concussion and/or mTBI, and (3) are ≥3 months postinjury with persistent cognitive-communication symptoms. It does not address (1) interventions for moderate or severe TBI managed in an inpatient setting or (2) concussion and/or mTBI in the acute phase (<3 months postinjury). The *VA/DOD Clinical Practice Guideline: Management of Concussion/Mild Traumatic Brain Injury (mTBI)* recommends that, between 7 days and 3 months postinjury, concussion and/or mTBI symptoms be addressed through education and by setting expectations for full resolution of the symptoms [10].

Evidence-based practice is an integration of (1) best available current evidence; (2) clinical expertise; (3) clinical judgment; and (4) patient and family preferences and values with the goal of providing high-quality services reflecting the interests, needs, and choices of the individuals served [18–19]. References in the CMG were shaped by the consensus conference on cognitive rehabilitation conducted by the Defense Centers of Excellence (DCoE) for Psychological Health and Traumatic Brain Injury and the Defense and Veterans Brain Injury Center (DVBIC) [8] and the *VA/DOD Clinical Practice Guideline: Management of Concussion/Mild Traumatic Brain Injury (mTBI)* [10]. The literature review included research on moderate and severe TBI, since studies specific to the mTBI population are sparse. Likewise, research on concussion and/or mTBI incurred in civilian settings (e.g., sports injuries or motor vehicle crashes [MVCs]) was included in the review because literature on combat-related concussion and/or mTBI is still emerging. Despite differences between mTBI and moderate to severe TBI, as well as between concussion and/or mTBI sustained in combat versus civilian life, crossover of effectiveness of intervention strategies is reasonably expected. Recommendations in the SLP CMG also evolved through a consensus process for areas where research does not exist, is not sufficient, or is not of high quality. It is important to appreciate that insufficient evidence for the efficacy of cognitive-communication intervention with the mTBI population should not be interpreted as evidence for the lack of efficacy of such treatments [20–21].

A panel of experts reviewed the SLP CMG document, including (1) three SLPs with distinguished research careers, clinical expertise, and publications as subject matter experts in cognitive-communication rehabilitation for individuals with TBI (Diane R. Paul, PhD; McKay M. Sohlberg, PhD; and Lyn S. Turkstra, PhD); (2) a physiatrist/audiologist/researcher who serves as chair of an academic program in communication sciences and disorders and a consultant to the DVBIC (Henry L. Lew, MD, PhD); and (3) a U.S. Army S3 Operations Officer who earned advanced degrees at the Command and General Staff College and the School of Advanced Military Studies after completing cognitive-communication rehabilitation and treatment for polytrauma injuries sustained during his deployment in Iraq (MAJ Beau Hendricks).

TRAUMATIC BRAIN INJURY

Mild Traumatic Brain Injury

TBI refers to a traumatically induced structural injury and/or physiological disruption of brain function as a result of an external force and is indicated by new onset or worsening of at least one of the following clinical signs immediately following the event

Table.
Cognitive changes in mild traumatic brain injury (mTBI) and potential effects on function and communication [15–17].

Cognitive Domain	Changes Caused by mTBI	Effects on Function and Communication
Attention*	Lapses in sustained attention. Highly distractible. Decreased concentration. Poor performance on competing tasks or stimuli.	Difficulty responding appropriately to incoming information. Difficulty learning new information. Difficulty filtering out irrelevant stimuli. Difficulty conversing in situations with distractions, background noise, and multiple participants. Difficulty managing the demands of high-level activity. Difficulty sustaining attention when reading complex and/or lengthy material. Difficulty shifting attention as needed. Difficulty maintaining or changing topics in conversation. Tangential discourse. Social avoidance to compensate for sense of overstimulation.
Speed of Processing	Slowness in processing information.	Delayed responses. Difficulty making decisions. Difficulty comprehending rapid rate of speech. Difficulty staying on topic. Long pauses within discourse.
Memory	Impaired memory. Problems with new learning.	Difficulty recalling instructions or messages. Difficulty learning new information. Difficulty remembering names of individuals, appointments, directions, and/or location of personal effects (e.g., keys, cellular telephones, identification cards, head gear). Difficulty recalling details when reading complex and/or lengthy material. Difficulty maintaining topic or remembering purpose of conversation. Repetition of ideas, statements, questions, conversations, or stories. Failure to use compensatory strategies to improve performance on everyday tasks.
	Disorganized thoughts and actions. Ineffective planning. Reduced initiation. Decreased insight. Ineffective reasoning, judgment, and problem solving. Decreased mental flexibility. Difficulties self-monitoring performance and assessing personal strengths and needs. Impulsivity and disinhibition.	Lack of coherence in discourse. Lack of organization in planning daily activities. Difficulty implementing plans and actions. Difficulty initiating conversations. Problems recognizing and repairing conversational breakdowns. Inability to determine the needs of communication partners. Difficulty making inferences or drawing conclusions. Difficulty assuming another person's perspective. Difficulty interpreting the behavior of others. Difficulty evaluating validity of information. Verbose; lack of conciseness in verbal expression. Decreased comprehension of abstract language, humor, and/or indirect requests. Difficulty meeting timelines. Difficulty formulating realistic goals. Difficulty recognizing complexity of tasks and need for simplification. Difficulty anticipating consequences of actions. Inappropriate comments.

*Because attention is the foundation of other cognitive processes, problems in attention are likely to result in or compound impairment in other processes, including memory and executive functions.

[10]: (1) any period of loss of consciousness (LOC) or a decreased level of consciousness, (2) any loss of memory of events immediately before or after the injury, (3) any alteration of consciousness (AOC) or alteration in mental state at the time of the injury (confusion, disorientation, slowed thinking, etc.), (4) neurological deficits (weakness, loss of balance, change in vision, praxis, paresis, sensory loss, aphasia, etc.) that may or may not be transient, and (5) intracranial lesion. External forces may include any of the following: (1) head being struck by an object or the head striking an object; (2) brain undergoing an

acceleration or deceleration movement without direct external trauma to the head; (3) foreign body penetrating the brain; and (4) forces generated from events such as a blast, explosion, or other forces yet to be defined.

TBI severity is divided into mild, moderate, and severe categories based on the length of LOC, AOC, and/or posttraumatic amnesia (PTA) (DOD/VA consensus-based classification of closed TBI severity). Concussion and/or mTBI is characterized as meeting one or more of the following criteria [8]: (1) LOC for 0 to 30 minutes, (2) AOC for a moment up to 24 hours, and (3) PTA for less than 24 hours. A Glasgow Coma Scale score of 13 to 15 is also used as a criterion [22]. In mTBI, there is often an absence of structural injury that can be reliably detected with conventional clinical neuroimaging.

Concussion and/or mTBI may result when injury triggers a pathologic neurochemical cascade but is insufficient to produce widespread neuronal dysfunction or the axonal disruption that characterizes more severe TBIs [23]. Headache is the most commonly reported symptom in concussion and/or mTBI, with dizziness also frequently reported. Immediate symptoms, such as nausea, vomiting, and drowsiness, are typically short-lived. Other possible symptoms include decreased concentration, slowed information processing speed, fatigue, and irritability [10].

The overwhelming majority of people who sustain concussion and/or mTBI recover fully in a matter of days to a couple of months [24]. A small minority of people, estimated at approximately 5 [25] to 15 [8,20] percent, continue to exhibit physical, cognitive, and behavioral symptoms for longer than 3 to 6 months postinjury. These symptoms are known as postconcussive symptoms (PCSs). If continuing for longer than 12 months, the term persistent PCSs can apply. When distant from the time of the injury, PCSs tend to be nonspecific and the etiology is not always clear. It is important to note that mTBI is not the only predictor of PCSs. Multiple factors, including demographic, psychiatric, and social support variables and mTBI comorbidities and their interactions, all contribute to ongoing PCSs in persons with mTBI [26].

In contrast with civilian settings, recovery from combat-related concussion and/or mTBI is complicated by at least four factors: (1) physically and emotionally traumatic circumstances in which injuries are sustained [10], (2) potentially repetitive and cumulative nature of concussions sustained over a tour (or multiple tours) of combat duty [10], (3) high incidence of comorbid mental health conditions [5–6], and (4) difficulty in following typical recommendations for postconcussion care (e.g., rest) in a deployment setting.

Blast-Related Traumatic Brain Injury

Primary blast most often damages air-filled organs, such as the lungs, colon, and ears, or those filled with fluid, such as the eyes [27]. The effect of high-force blast waves on the brain is more uncertain. The Institute of Medicine weighed on the side of accepting "biologic plausibility" of blast-induced neurotrauma and concluded that rigorous human studies are needed to examine the consequences of these injuries, their recovery trajectory, and factors that determine their outcome [28]. In contrast with injury from the primary blast, secondary and tertiary blast injuries are mechanical injuries and would therefore likely be physiologically similar to TBIs sustained from falls or MVCs.

The potential neuropsychological implications of exposure to blast are still uncertain. The existing TBI literature was created almost exclusively from data on individuals who sustained TBI from blunt-force trauma. Preliminary studies seem to indicate that neuropsychological consequences of blast-related TBI are not very different from those of non-blast-related TBI. Sayer et al. found that the mechanism of injury did not predict outcomes, such as changes in motor or cognitive functioning, as measured by the Functional Independence Measure [3]. More pointedly, Belanger et al. suggested that cognitive sequelae following TBI are determined by severity of injury rather than the mechanism of injury [29]. Overall, current literature does not provide strong evidence that blast is categorically different from other mechanisms of TBI, at least with regard to cognitive sequelae [8].

Comorbidities of Concussion and/or Mild Traumatic Brain Injury—The Military Experience

The same combat exposure that causes concussion and/or mTBI may also result in other comorbidities such as posttraumatic stress disorder (PTSD), headache, pain, amputation, acute stress reactions, auditory and visual dysfunction, sleep disorders, exacerbations of pre-existing conditions, and substance use [5,30–31]. In fact, the presence of comorbidities has been found to be a significant predictor of physical, cognitive, and emotional symptoms postdeployment, including those associated with concussion and/or mTBI [5,26]. Caution should be exercised when attributing cognitive-communication difficulties to a specific etiology since comorbidities may further challenge cognitive abilities.

In addition to comorbid conditions, returning SMs and veterans presenting to military or VA healthcare facilities often have numerous psychosocial and financial stressors. Readjustment from a "battlemind" state to a civilian mind-set and environment is neither instantaneous nor easy for SMs returning home [32]. It is reasonable to assume that the overall recovery process is more complicated and prolonged for OIF/OEF veterans with concussion and/or mTBI and comorbid conditions than in veterans without these conditions or in civilians [26].

COGNITIVE-COMMUNICATION REHABILITATION FOR SERVICEMEMBERS AND VETERANS

Overview

Although the majority of individuals who sustain mTBI recover completely [24], some may develop chronic neuropsychological problems and functional disability and require intervention [8,33]. During intervention for cognitive-communication symptoms, it is important to emphasize expectancy of recovery by providing education regarding positive outcomes in mTBI, highlighting skills and abilities shown by the person with mTBI, and engaging in risk communication whereby the language used in delivering treatment creates the expectation for recovery (e.g., avoiding terms such as brain damage, impairment, and postconcussion syndrome in favor of concussion, difficulties, and PCSs). A meta-analysis of educationally oriented treatments designed to facilitate positive expectation of recovery found this methodology to be effective in reducing the long-term complaints of people with mTBI [34].

The nature of treatment for concussion and mTBI symptoms depends on the time postinjury when the patient enters clinical care. In the acute phase of uncomplicated mTBI (<3 months), treatment typically includes education, counseling, and a period of rest and observation. Education regarding fatigue, irritability, and mood lability that may occur during recovery has been shown to facilitate improvement and lessen the likelihood that the patient develops persistent PCSs [35]. While education and support seem to benefit patients with respect to somatic and psychological complaints [36], a recent review of trials incorporating educational and supportive treatment for mTBI identified a proportion of patients who demonstrated intractable disability [37].

Persistent mTBI symptoms, including cognitive and emotional sequelae, can result in significant functional disability [8,20]. Symptomatic interventions for cognitive-communication difficulties related to PCSs (≥3 months postinjury) can be effective in lessening the functional effect of the disability. Increasing evidence exists that functional improvements may continue for years postinjury and that SMs and veterans can be effectively supported through active treatment [38]. Additionally, interventions to reduce the level of functional disability caused by cognitive-communication symptoms should be considered irrespective of whether the etiology of the symptoms can be teased out among presenting comorbidities (i.e., concussion vs pain vs PTSD) [39]. Refer to **Appendix 1** (available online only) for a general schema of SLP interventions for concussion and/or mTBI.

Interdisciplinary Team Approach

Care for SMs and veterans with mTBI and cognitive-communication deficits is complex and may require the intervention of multiple medical, mental health, social work, and rehabilitation specialists. An interdisciplinary team (IDT) reduces the risk of

missing potential complicating factors that may negatively influence rehabilitation outcomes [40–41]. Team membership is based on the individual SM or veteran's needs and may include medical and rehabilitation professionals such as physician (e.g., physiatrist, neurologist), nurse, social worker, neuropsychologist, rehabilitation psychologist, SLP, audiologist, OT, PT, and vocational counselor. Clinicians from different disciplines have complementary roles in developing common goals and treatment strategies with the patients they serve and reinforce the use of these strategies in their own practice. A patient-centered treatment plan should incorporate results of the comprehensive assessments from each discipline with treatment goals formulated in collaboration with the SM or veteran and his or her family [42]. SLPs are one of several rehabilitation disciplines that contribute to defining the nature of the cognitive deficits resulting from TBI, adding unique skills to the interdisciplinary management of the functional consequences of those deficits.

ASSESSMENT OF COGNITIVE-COMMUNICATION DISORDERS IN TARGET POPULATION

Screenings are used to identify individuals with potential cognitive-communication symptoms, while the comprehensive assessment helps determine the nature of the problem, establish the clinical indications for rehabilitation, and develop a treatment plan. To the extent possible, the cognitive-communication screening and evaluation should be incorporated into a comprehensive assessment process conducted by an IDT.

A cognitive-communication screening may be conducted to identify individuals who require further assessment. It typically consists of a written and/or verbal intake questionnaire and informal interaction and conversation with the SM or veteran. Information gleaned from screening includes (1) cognitive-communication symptoms and concerns; (2) history of the injury event, including mechanism of injury, duration and severity of AOC, immediate symptoms, symptom course, and prior treatment; (3) premorbid intellectual functioning, level of education, previous speech-language diagnosis or services received, and other neuropsychological, psychiatric, or social factors that may affect current function; and (4) identification of healthcare concerns that may be contributing to cognitive-communication symptoms and may warrant referral for further evaluation or management. Screening may result in recommendations for rescreening, comprehensive cognitive-communication assessment, or referral for other services.

The comprehensive evaluation provides the basis for determining the nature, severity, and characteristics of cognitive-communication disorder and is a prerequisite to designing and implementing an effective treatment program with baseline and pretreatment measures, functional goals, and required supports. The cognitive-communication evaluation should be based on (1) thorough history; (2) patient, family, and/or command (when appropriate) reports of symptoms and the effect of symptoms on function; and (3) problem-focused, hypothesis-based, ecologically valid assessments that may include standardized instruments and nonstandardized tools to assess language, attention, memory, processing speed, executive functions, and social communication. The number of assessment tools designed specifically for cognitive-communication impairments resulting from TBI is limited [43]. Refer to **Appendix 2** (available online only) for assessment instruments to consider.

Assessment of the cognitive-communication challenges of SMs and veterans with concussion and/or mTBI should also address issues central to real-life situations; different family roles; social and community participation; and return to Active Duty, work, or school [44]. For the veteran population, challenges may be related to community reintegration after discharge from the military and adjustment to disability. For the Active Duty military population, real-life demands include performing military occupational specialties (MOSs) and carrying out missions with potential emotional, physical, and environmental stressors.

It is important that information regarding cognitive-communication skills is gathered from individualized tasks that test the upper limits of the

patient's resources. Cognitive-communication problems may be difficult to capture in the clinical setting because individuals with concussion tend to perform adequately under structured conditions. Measures of complex speed of processing (e.g., conceptual or semantic processing), along with measures of working memory and attention, show the most potential for being sensitive to cognitive dysfunction after mTBI [45–46].

Persistent cognitive-communication symptoms are probably multifactorial with regard to etiology. Therefore, test results should be cross-referenced with findings from other rehabilitation team members (e.g., neuropsychologist, OT, audiologist, vision specialist) and should take into consideration factors such as pain or sleep disturbance. Referral to mental health providers may be indicated when posttraumatic stress, anxiety, or other psychological health concerns may be affecting performance.

Treatment of Cognitive-Communication Deficits in Target Population

Overview

Cognitive rehabilitation is a systematic, functionally oriented treatment program that is based on an understanding of a patient's brain-behavioral deficits [47] and is grounded in scientific evidence, including theoretical foundations of cognition, communication, brain-behavior relationships, neuroplasticity, learning theories, behavioral modification, and counseling. Neuroplasticity is believed to be the mechanism by which the intact brain encodes experience and learns new behavior and by which the damaged brain relearns lost behavior in response to environmental demands and rehabilitation. Understanding the nature of neuroplasticity can improve rehabilitation strategies to optimize functional outcomes [48]. Instructional practices that enhance neuroplasticity include providing intensive, repetitive practice of functional targets with careful consideration of salience, potential for generalization, and personal factors [49].

A paradigm shift has occurred in cognitive-communication therapy from repetitive decontextualized drills in the clinic to training compensatory and metacognitive strategies that can be directly applied in naturalistic situations to address functional recovery goals. Rehabilitation of cognitive processes and functional skills training should be combined to facilitate application of compensatory strategies to real-life situations [15,49]. Treatment should be embedded in meaningful contexts and individualized to fulfill the unique needs of each SM and veteran and to ensure generalizability from controlled situations in therapy to natural environments and daily routines [50].

In preparation for return to Active Duty or work, treatment must consider and include personal and contextual factors that can enhance or hinder job performance. Contextual factors include the physical, social, and attitudinal surroundings in which SMs and veterans function (e.g., work space, perceptions and expectations of the unit or place of employment, command climate). Personal factors include features of the individual that are not part of a health condition or functional state (e.g., coping styles, social background, education, past and current experiences) [51]. Clinicians should be systematic in their treatment planning and mindful that every SM and veteran learns differently and requires individually tailored instructions or strategies [52]. Methods involved in selecting instructional targets and presenting and reinforcing target information can facilitate learning and directly influence learner outcomes. Therapy should include direct instruction combined with strategy instruction and errorless learning techniques [53].

A review of the cognitive rehabilitation literature yields substantial evidence to support interventions for attention, memory, executive function, and social communication skills [54]. Specific interventions may be directed at (1) reinforcing, strengthening, or reestablishing previously learned patterns of behavior; (2) establishing new patterns of behavior through compensatory mechanisms; and (3) facilitating adaptation to cognitive disability to improve overall functioning and quality of life [47].

Therapeutic Alliance

Cognitive-communication rehabilitation is a dynamic process that involves a collaborative relationship between clinician and patient. The challenges in mTBI management, including the difficulties of determining

the etiology for the symptoms or most effective treatment, reinforce the need to build strong alliances based on trust and credibility among the clinician, the SM or veteran, and his or her family. The patient's concerns and experiences should be validated by allowing adequate time for building the clinician-patient alliance and applying an effective risk communication approach [10].

The therapeutic working alliance refers to the partnership between clinician and patient in their efforts to achieve change through the therapy process. The alliance is built on agreement on the goals of therapy, agreement on tasks to achieve these goals, and the development of a personal bond between the clinician and the SM or veteran. A strong therapeutic working alliance can positively influence outcomes in postacute TBI rehabilitation [55–58].

A patient-centered approach that integrates goal-directed counseling for eliciting behavior change can promote positive health outcomes and improved quality of life for patients and their families. Aspects of a supportive counseling approach include [10] (1) caring and empathy (e.g., perceived sincerity, ability to listen, viewing issues from the perspectives of others), (2) competence and expertise (e.g., perceived intelligence, training, experience, professional attainment, knowledge), (3) dedication and commitment (e.g., perceived altruism, involvement, diligence in pursuit of health goals), and (4) honesty and openness (e.g., perceived truthfulness, candidness, fairness, objectivity).

Process

Cognitive rehabilitation helps patients with concussion and/or mTBI develop awareness of factors that contribute to their performance problems and learn strategies to optimize execution of everyday activities. Treatment strategies include [59]—

- Educating patients regarding where and when breakdowns or inefficiencies occur.
- Identifying barriers and supports and developing compensatory strategies to improve performance.
- Promoting generalization of strategies and skills to compensate for cognitive inefficiencies across varied contexts of daily activities to achieve the highest level of participation in daily living and optimal quality of life.

Cognitive-communication rehabilitation domains include attention, speed of information processing, memory, comprehension, social communication, reasoning, problem solving, judgment, initiation, planning, and self-monitoring. Treatment should address the unique needs of SMs and veterans with reference to returning to Active Duty or work; balancing military and family relationships; readjusting to civilian life; and considering risk for posttraumatic stress and other comorbidities, including pain, headache, irritability, sleep disturbances, and poor anger management [60]. Comprehensive-holistic rehabilitation programs provide individual- and group-based treatment of cognitive, emotional, and interpersonal skills within an integrated therapeutic environment to remediate impairment and promote meaningful and satisfactory quality of life, even in the presence of existing limitations [50]. The goals, strategies, scope, intensity, duration, and interval of rehabilitation should be based on diagnosis, prognosis, individual functional needs of the SM or veteran, and reasonable expectations of continued progress with treatment [61].

Treatment for Impairment in Cognitive Domains

Attention and Speed of Processing

While cognitive dysfunction tends to be partial, even in the acute recovery period [62], one of the most frequent complaints is slowed thinking and difficulty concentrating [63]. Attentional impairments are common after mTBI and are seen particularly with novel and timed tasks. Difficulties are due in part to slowed information processing speed associated with diffuse axonal injury [64] and problems with controlling and allocating attentional resources resulting from injury to the dorsolateral aspects of the frontal lobes. Common functional complaints related to attention problems include—

- Difficulty completing tasks, reading lengthy material, or following the plotline of a movie (may indicate problems with sustained attention).
- Distractibility or poor concentration when other activities are occurring in the immediate environment (may be related to impaired selective attention).

- Decreased ability to shift from task to task or to multitask (may indicate impaired alternating attention).

Problems with attention are likely to affect other cognitive processes, including memory and executive functions [65–66]. Conversely, it has been shown that treatments that focus on strategies for optimal allocation of limited attentional resources [17,67] can result in improvements on neuropsychological measures (Continuous Performance Test, Paced Auditory Serial Addition Test) and on self-report measures of functional performance [65]. Education and strategy training to help the patient identify, anticipate, and modify situations that are likely to result in cognitive overload and compromise goal-oriented behaviors include minimizing distractions, allowing ample time to complete tasks, taking breaks, and reducing simultaneous demands.

Slowing of information processing capacity has been shown to affect various cognitive and communication processes such as encoding information, verbal comprehension, and adaptive responding to novel situations [68]. Functionally, individuals may report experiencing problems with a wide range of daily tasks, such as processing information over the telephone; processing verbal or written instructions at work or at school; learning and integrating new information; effectively participating in conversations; and "reading" other people's feelings, opinions, and intentions. These problems may become more prominent when tasks require more mental control and are less automatic. People who have sustained mTBI often report that their thinking is less automatic and that it requires more effort to respond appropriately [63]. As such, cognitive fatigue may occur at a lower threshold of mental effort than it did prior to the injury and may trigger symptoms such as headaches or irritability that, in turn, may further tax the speed and capacity of the information processing system.

Early intervention that focuses on education and coping strategies for processing speed problems contributes to reducing anxiety, functional limitations, and severity and duration of symptoms [65,69–70]. Treatment for SMs and veterans should focus on the development of compensatory strategies specific to limitations and situations, environmental modifications, and coping mechanisms for managing changes in processing speed [26]. Education aims at helping the individual identify, anticipate, and modify situations likely to result in cognitive overload. Strategies include seeking preferential seating, choosing face-to-face interactions, preparing for situations ahead of time, and having tasks demonstrated when possible. A variety of cognitive assistive technologies (e.g., digital recorder, smartpen) are available to facilitate fast-paced activities such as taking notes in a classroom.

In addition to the underlying cognitive functions that affect processing speed, careful consideration must be given to other contributing factors to cognitive slowing, such as stress, sleep deprivation, PTSD and other mental health conditions [29], and pain [71]. Reading and writing skills, preinjury psychosocial and educational factors, and integrity of vision and hearing systems must also be considered. Collaborative evaluation and treatment with audiologists, vision specialists, psychologists, neuropsychologists, and vocational rehabilitation specialists may be needed.

Strength of recommendation—attention training has been the subject of well-designed research, and numerous studies have confirmed its benefit [8]. Recent evidence-based reviews recommend treatment of attention using direct and metacognitive training to promote development of compensatory strategies and foster generalization to real-world tasks during post-acute recovery from mild or moderate TBI. Repeated use of computer-based tasks without intervention by a clinician is not recommended [54].

Memory

Individuals identified with attention problems frequently also exhibit difficulties on memory tasks [72]. Memory deficits are a common consequence of mTBI. SMs and veterans with concussion and/or mTBI frequently report forgetting appointments, directions, instructions, and names of individuals and losing or misplacing items such as keys, cellular telephones, and identification badges and cards.

Short-term memory allows people to hold a limited amount of information for a brief period of time. The average person can hold approximately five to seven items in short-term memory in the absence of distractions or interruption [17,49]. Working memory is similar to short-term memory and allows people to hold information in conscious thought and manipulate that information for storage or retrieval (e.g., planning, organizing, sequencing). Working memory provides the mental work space for complex activities such as learning, reasoning, comprehension, and metacognition (i.e., thinking about one's own thinking and making adjustments in the process). Long-term memory allows people to hold information in a virtually permanent store (i.e., minutes to years after initial exposure) and has an unlimited capacity [17,49]. Long-term memory is a more durable system and is typically intact after mTBI; however, problems with short-term memory affect the ability to hold on to the information long enough to prepare it for storage into long-term memory [49].

Compensatory techniques and strategies to improve memory should be selected to accommodate the individual needs of the SM or veteran. The goal of intervention is to decrease demand on impaired memory processes and improve function in everyday activities [49]. Sufficient training opportunities should be provided during therapy sessions and incorporated in a variety of functional situations and environments for successful generalization. Repetitive memory drills (e.g., memorizing word lists, faces, or designs without explicit strategy training) have been shown to have little or no efficacy [8].

Internal memory strategies such as mnemonics, visual imagery, and repetition may be used to encode information and improve retrieval. Evidence exists that use of imagery may be helpful by teaching patients to elaborate and expand on information to be recalled [73]. However, use of intrinsic memory techniques may actually require more cognitive effort to retain items [52]. External memory aids include daily planners, calendars, notebooks, environmental anchors (designated areas at home or work to keep specific items or lists), and electronic devices. Use of external aids in combination with strategy training can lead to improvements that extend into patients' everyday function [8].

Instructional practices that have been experimentally validated and promote learning for individuals with memory impairments include (1) clearly delineating intervention targets with use of task analyses when training multistep procedures, (2) limiting errors when teaching or reteaching information and procedures, (3) providing sufficient practice, (4) distributing practice within sessions and across sessions, (5) using stimulus variation or multiple exemplars, (6) using strategies to promote more effortful processing (e.g., verbal elaboration, imagery), and (7) selecting and training ecologically valid targets [52].

During the acquisition phase of training, SMs and veterans should not be overloaded with multiple target strategies. For each new strategy introduced, multiple practice sessions should be provided with a high number of repetitions of practice trials. Stimuli and contexts should be as similar to the target task as possible. Distributed practice should be incorporated by gradually lengthening time between probes for new memory strategies. After initial acquisition, target memory strategies should be practiced with distractors similar to those found in the SM or veteran's real-life situation. The clinician should help the patient develop metacognitive strategies by encouraging self-monitoring and reflection about task performance using memory strategies. Data should be collected to determine the response to intervention and whether memory strategies are consistently used in real-life situations over time [49].

Strength of recommendation—training in the use of memory compensation strategies as applied to real-life tasks is supported by empirical evidence [47,54,74]. Based on guidance from the DCoE/DVBIC consensus conference, "efficacy has been demonstrated for memory training techniques derived from cognitive neuroscience" [8, p. 245], particularly for patients with mTBI and mild memory impairment. Repetitive memory drills without the teaching of compensatory strategies have little or no efficacy [8].

Executive Functions

Executive functions refer to the set of skills necessary to complete complex, goal-oriented activities

successfully [75]. Cicerone et al. define executive functions as "cognitive processes that determine goal-directed and purposeful behavior and are super-ordinate in the orderly execution of daily life functions. These processes include the ability to: (1) establish goals; (2) initiate behavior; (3) anticipate consequences of actions; (4) plan and organize behaviors according to spatial, temporal, topical, or logical sequences; and (5) monitor and adapt behavior to fit a particular task or context" [47, p. 1605].

Executive function disorders following mTBI are heterogeneous and result in different profiles of strengths and weaknesses [76]. Deficits in executive functions should be addressed in cognitive-communication therapy since they are likely to affect functional activities and participation in everyday life events. Intervention in this domain often focuses on two skills commonly impaired after TBI: metacognition (self-monitoring and control of one's own cognitive functions) and problem solving.

A systematic review of studies indicated that step-by-step metacognitive strategy instruction with young to middle-aged adults with TBI improved problem-solving skills, planning, and organization for personally relevant activities or problem situations [76]. Step-by-step intervention procedures can include (1) acknowledging and/or formulating goals related to the everyday needs of the SM or veteran, (2) determining how to initiate the goals, (3) self-monitoring and self-recording performance, (4) choosing and revising strategies based on goals and performance, (5) reformulating decisions or plans based on self-assessment, and (6) reviewing what was successful and unsuccessful [75–76]. Remediation of executive functions should initially include external strategies and explicit instruction and feedback but gradually shift to the internalization of self-regulation strategies through self-instruction and self-monitoring [74–75].

Strength of recommendation—Training in the use of problem solving and organization strategies as applied to real-life tasks is supported by empirical evidence [47,54,73]. According to guidance provided by members of the DCoE/DVBIC consensus conference, "a robust literature supports the use of metacognitive strategy training as an intervention for executive function impairments due to TBI" [8, p. 246].

Cognitive Assistive Devices

Assistive technologies can provide viable treatment options that facilitate return to everyday functions. The effectiveness of assistive technology, including cognitive aids for improving the daily function and independence of persons with cognitive impairments, is well documented in the scientific literature [17,47,53,74,77–79]. Assistive devices discussed in the early TBI literature included low-technology or no-technology tools such as memory notebooks, checklists, and planners or cueing devices such as pagers and alarms for single-task guidance [80–82]. Since then, a number of specialized devices have been designed specifically to address the problems encountered by people with cognitive disabilities. Simultaneously, the use of electronic memory and organization devices designed for the general population (universal design) has grown exponentially. This has resulted in more individuals having familiarity and expertise in the use of these devices. The development of more sophisticated assistive devices that help with the complex array of activities encountered in work and school settings and the advantage of preinjury experience with technology have led to the use of electronic cognitive aids as a practical and functional intervention in cognitive rehabilitation.

The use of cognitive assistive technology is recommended to facilitate compensation for cognitive symptoms, including problems with attention, memory, initiation, planning, organization, and execution, that may be associated with mTBI. An individualized assessment is the first step in determining the need for cognitive assistive technology. Device selection and prescription is a complex process and an integral component of cognitive rehabilitation for mTBI. All SMs and veterans who are prescribed electronic cognitive devices must be involved in a training program that is systematic, goal-oriented, and designed to help them use the device as a cognitive strategy to maximize everyday functioning. Training and use of cognitive aids may take place in the context of direct treatment for confirmed cognitive deficits or as a component of an education-based intervention to support everyday life activities and promote successful return to Active Duty and community reintegration.

The benefit of cognitive devices must be measurable and should show functional improvement in day-to-day functioning, including the ability to achieve desired level of productive life, while using the device.

In working with SMs and veterans with mTBI, the goal of cognitive interventions is to minimize the negative effect of cognitive symptoms on daily living and work settings with an emphasis on return to normal function. Whether the person is a candidate for a direct treatment approach or more indirect services for residual cognitive symptoms, cognitive aids can offer the necessary support to encourage independence and promote positive experiences in the recovery process.

Treatment for Impairment in Cognitive-Communication Domains

Social Communication

Social communication refers to verbal and nonverbal communication skills necessary to be successful in social situations [83]. Impairments in social communication may result from both cognitive and behavioral changes associated with concussion and/or mTBI and comorbid conditions such as PTSD. Persisting irritability and anger may manifest as negative self-talk, verbal abusiveness to others, or physical aggression that can negatively affect social interactions [84]. Postdeployment military personnel may be especially vulnerable to the effects of anger as this is a symptom of battlemind [32], a set of psychological changes that are adaptive in a theater of war but maladaptive when returning to noncombat contexts. Conversely, individuals with mTBI may show high levels of stress and anxiety [85], which have been associated with social phobia and avoidance of social situations [84,86]. Anxiety may be compounded by overstimulation related to significant demands on working memory [65,87] and by comorbid PTSD [88].

Social communication treatment may focus on (1) affective-behavioral impairments, such as anger and anxiety, that result in socially disruptive behavior or social avoidance; (2) maladaptive behaviors arising from cognitive-communication impairments (e.g., diminished attention and memory, impulsivity); and (3) direct training of family and friends (who provide the circle of support) on techniques that facilitate improved communication skills for the SM or veteran with TBI.

When a patient demonstrates unawareness of poor interpersonal skills, reviewing video recordings of social interactions can provide immediate feedback regarding the appropriateness of communication and can facilitate the adoption of positive social communication strategies [89]. Treatment directed at modifying patterns of social communication in the partners of the patient with TBI may also serve to improve the communication skills of the patient [90–91]. Group treatment provides a more natural communication context and should be considered as a strategy to facilitate generalization.

Strength of recommendation—according to guidance provided by members of the DCoE/DVBIC consensus conference, social skills training has shown effectiveness in improving problems in comprehending and responding to nonverbal social cues [8]. Clinical experience with the military population with concussion and/or mTBI has supported the need to address impairments in social communication, particularly in light of comorbidities such as PTSD.

Acquired Stuttering and Other Speech Dysfluencies

SLPs working in the DOD and VA are reporting increasing numbers of referrals for fluency problems in SMs and veterans with suspected blast-related concussion and/or mTBI. Speech dysfluency is typically referred to as stuttering and is characterized by repetition of sounds, syllables, and monosyllabic words; prolongation of sounds; interjections; interruptions of words; silent or audible freezing or blocking; avoidance of difficult words by the use of different phrasing; and excessive physical tension accompanying the production of some words. While stuttering is not a symptom typically associated with concussion and/or mTBI, SLPs need to be mindful of the complex interaction of emotional and neurological consequences of combat injuries and provide appropriate individualized services that address the SM's or veteran's functional needs. Fluency problems may also occur as a result of word-finding difficulties associated with

cognitive impairments of attention and speed of information processing [92].

Adult onset of stuttering may result from neurological changes caused by injury, disease, or medication or in reaction to psychosocial-emotional stressors. Determining the etiology of adult onset stuttering can be challenging, especially when it occurs in the context of emotionally and physically traumatic events such as combat injury. Neurogenic stuttering typically appears following injury or disease to the central nervous system and can occur in isolation or in conjunction with other motor speech and language disorders. Psychogenic stuttering typically begins after a period of stress or after a traumatic event. Sudden onset of stuttering in adults may be related to malingering, but it is more likely a form of psychogenic stuttering, a conversion symptom, or a somatoform disorder. Baumgartner and Duffy suggested that people may be predisposed by personality, social, or cultural bias; early learning; or visceral structure to channel stress into musculoskeletal tension resulting in stuttering behaviors [93]. Speech and laryngeal muscles are known to be susceptible to emotional stress, as seen in muscle tension dysphonia and conversion aphonia [94], stuttering-like behavior, infantile speech, pseudo foreign dialect, and other speech and resonance disorders [95–96].

Stuttering may also be associated with side effects of medications, including neuroleptics or antipsychotic agents. It has been speculated that these drugs interact with neurochemical and neurotransmitter function in the central nervous system, resulting in cognitive and/or extrapyramidal symptoms that interrupt speech fluency [97–102].

SMs and veterans with sudden onset of stuttering following combat-related concussion and/or mTBI should be seen by an SLP for evaluation and treatment. The nature and characteristics of communication dysfluencies require an examination of language, cognition, and motor speech abilities, as well as an astute perceptual assessment and analysis for differential diagnosis and intervention. One of the first aims of an evaluation is to rule out a neurological etiology. An interdisciplinary approach involving neurology, psychiatry, and SLP may be the best option for assessment, especially if an SM or veteran has other neurological symptoms, such as headache, dizziness, or other cognitive-communication problems.

Individuals who are able to decrease their stuttering in trial therapy and whose psychological adjustment is adequate are often good candidates for stuttering therapy. Treatments that have been suggested are similar to those used with developmental stuttering including fluency-shaping with prolonged speech, easy onset, light contact, and easy repetitions; providing education, support, and reassurance; emphasizing adequate respiratory support and optimal vocal resonance with gentle onsets; and following a hierarchy of easy to difficult situations to transfer learned skills outside of therapy [96,103–105].

Treatment of psychogenic stuttering can be successful with limited intervention. However, individuals may not be candidates for treatment or will need extended treatment if they resist the idea that their stuttering is stress-related and if they do not improve with trial therapy. SMs and veterans may benefit from psychotherapy concurrently with stuttering therapy. For individuals taking medications that contributed to the onset of stuttering, prescription adjustments can be effective in eliminating stuttering symptoms [106].

Strength of recommendation—acquired stuttering related to TBI is more common in individuals who have sustained moderate to severe TBIs. An early case description of combat-related acquired stuttering involved an individual diagnosed with combat-psychoneuroses [107]. Other, more recent, case studies have described acquired stuttering in the presence of TBI and PTSD [106,108–111]. Review of existing studies and expert consensus endorses the effectiveness of SLP involvement in cases of adult-onset stuttering.

Discharge from Cognitive-Communication Treatment

Discharge planning begins with the development of the treatment plan and long-term goals following the initial evaluation. It is a documented sequence of tasks and activities designed to achieve, within projected time frames, stated goals that lead to timely and successful transition of the SM or veteran back to his or her commands, into the community, to the VA

system of care, to other providers in local communities, or to civilian facilities with specialized rehabilitation programs or services. Discharge from cognitive-communication rehabilitation should be considered when the SM or veteran no longer requires the facilities, skills, and therapeutic intensity of SLP services to meet the cognitive-communication challenges of his or her social, vocational, and avocational goals. Criteria for discharge are based on the individualized treatment plan for each SM or veteran. There are no established thresholds on standardized testing that can substitute for clinician judgment and SM or veteran goals, perceptions, and preferences.

The clinician should ensure that the following factors are addressed during intervention to facilitate successful discharge: (1) appropriate intervention goals and objectives are specified; (2) sufficient instructional time is provided; (3) current and suitable intervention methods or materials are used; (4) meaningful and functional performance data are collected and analyzed on an ongoing basis to monitor and evaluate progress; (5) appropriate assistive technology or other supports are provided when necessary; (6) a plan is designed and implemented "as needed" to address the needs and concerns of culturally and/or linguistically diverse families; (7) relevant and accurate criteria are used to evaluate intervention outcomes; and (8) health, educational, environmental, or other supports relevant to cognitive-communication interventions are provided.

Treatment is expected to result in deficit reduction and measurably enhanced functioning and participation in life activities. SMs and veterans with persistent mTBI symptoms may require accommodations to facilitate return to Active Duty or the workplace, including (1) gradual work re-entry, (2) flexibility in time and length of the work shift, (3) adjustment of job responsibilities or conditions, or (4) environmental modifications [10]. The restoration of quality of life after TBI is a primary endpoint of recovery and rehabilitation [112]. Follow-up intervention may be indicated for a variety of reasons, including changes in the SM or veteran's environment, availability of new treatment options, or the SM or veteran responding differently to clinical interventions because of maturational or motivational changes or new life transitions. The discharge plan should stipulate a follow-up schedule and long-term goals that are appropriate to the community reintegration needs of the individual SM or veteran.

OUTCOME MEASURES

In an era of emphasis on evidence-based clinical practice, the employment of outcome measures is essential for validating the efficacy of cognitive-communication interventions. The gold standard of outcome measurement is pre- versus postassessment differential in functional status. Other elements to be considered are the moderating variables that may affect outcomes, discharge environment, and consumer satisfaction (including the SM or veteran and also family, employer or command, and referral source) [8]. Functional areas that should be addressed in outcome measurements include (1) job performance (e.g., MOS, work, school); (2) need for job redesignation and/or Active Duty, work, or school restrictions or limitations; (3) differential between preinjury performance and current functional status; (4) performance on simulators (e.g., rifle, flight) and work trials; (5) quality of life; and (6) community participation. It is also important to carefully describe the patients receiving cognitive-communication rehabilitation, including identification of moderating variables, confounds, and comorbidities. Understanding which patients with concussion and/or mTBI respond to cognitive-communication rehabilitation interventions and which do not is the key to advancing best models of intervention for this highly deserving population.

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