Treating Executive Function Impairments in Adults with Traumatic Brain Injury

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Abstract

Traumatic brain injury (TBI) can result in damage that may affect areas of the brain responsible for the regulation of executive functions. Executive function impairments affect an individual's ability to problem-solve using a set of higher order cognitive functions that include planning and organization, reasoning, judgment, concept formation, mental flexibility, inhibition and impulse control, and social adaptive functioning. This study will 1) establish the treatment options available for executive function impairments in adults, 2) examine the evidence-base for treating these impairments, and 3) determine how certified Speech-Language Pathologists make decisions on treating executive function impairments in adults.

Introduction

Evidence-based practice is a relatively new concept, not only to the profession of speech-language pathology but to the medical/health field in general as an expansion to the notion of efficacy studies. It was during the 1990s that evidence-based practice became a popular method for clinical decision making. This method advocates the use of evidence as the rationale for patient care. (Reilly, Douglas, & Oates, 2004)

As evidence-based practice has become acceptable in the medical field, speech-language pathology has begun to adopt it as well. The discipline of speech-language pathology has numerous specialty areas that have embraced evidence-based practice, one of which is treatment of traumatic brain injury.

Traumatic brain injury (TBI) can result in a range of impairments from mild to profound. The resulting impairment is largely a function of the amount and location of the damage. This damage will often affect areas of the brain responsible for the regulation of executive functioning. Executive functions are a set of higher-order cognitive abilities that are required to initiate, generate, select, plan and monitor goal-directed behavior during the completion of a purposeful task or novel behavior (Murray & Clark, 2006, Bennet, Ong, & Ponsford 2005a, 2005b). Evidence-based practice for traumatic brain injured patients with executive function impairments may include "judgment, reasoning, concept formation, and abstraction; intonation and fluency; planning and organizing; set maintenance and mental flexibility; and disinhibition and impulse control" (Pelham & Lovell, 2005, p.164). Executive functions are important to virtually all aspects of life and impairment to one or multiple areas can have a significant effect on an individual's quality of life. Treating impaired executive functions is thus imperative to improving quality of life.

The treatment for TBI involves a network of professionals that may include a neurologist, a physiotherapist, an occupational therapist, and a speech-language pathologist (SLP). The SLP is often responsible for the treatment of impaired executive functions and must make clinical judgements regarding how they will provide treatment for these impairments. It is hypothesized that 1) certified SLPs with less than five years of experience and SLPs with no experience treating executive function impairments in adults with TBI will rely on evidence-based practice studies to determine how they will treat these clients. 2) Certified SLPs with five years or more of clinical experience in settings that include this type of patient are expected to rely more on experience rather than evidence-based practice to make their decisions regarding treatment of executive function impairments in adults with TBI.

In order to establish that clinical years of experience and clinical setting impact the decision-making process for treating executive function impairments in adults with TBI, this study will examine three principles. These include 1) to determine what therapy approaches are available to treat executive functioning in adults with TBI; 2) examine the evidence-based practice studies on treating executive functions in adults with TBI; 3) determine how certified SLPs make clinical decisions regarding treatment of executive function impairments in adults with TBI and how they treat these impairments. The first two purposes will be explored by a literature review, while a survey will be used to meet the third purpose.

The literature review will focus on four aspects. 1) It will present a description of TBI including incidence, prevalence, risk factors, and pathophysiology. 2) It will provide a description of the different types of executive functions and how they may be impaired in adults with TBI. 3) It will examine evidence-based practice in the discipline of speech-language pathology. 4) Finally, therapy approaches along with relevant evidence-based practice studies for executive functioning impairments in adults with TBI will be reviewed.

Methodology will involve comparing data obtained from the literature review with a survey that was sent to certified speech-language pathologists. The survey will establish the role of clinical years of experience and settings in treating executive functions in adults with TBI.

Literature Review

Traumatic Brain Injury

The term traumatic brain injury (TBI) denotes the result of an abrupt external force on the head (Brookshire, 2003). While degenerative disease, stroke or other vascular problem, infection, or tumor may cause acquired brain injury their sequelae are separate and distinct from the sequelae that follow a TBI. Table 1 provides a definition of TBI from The Centers for Disease Control and Prevention (1999).

Table 1: Traumatic brain injury defined

Traumatic brain injury is defined as either:

1. The occurrence of injury to the head that is documented in a medical record, with one or more of the following conditions attributed to head injury rising from blunt or penetrating trauma or from acceleration-deceleration forces:
   a. Observed or self-reported partial or complete loss of consciousness including obtundation, stupor, or coma
   b. Amnesia for events immediately preceding injury, the injury event itself, or for events subsequent to the injury.
   c. Skull fracture
   d. Objective neurological abnormalities including motor function, sensory function, reflexes, speech, or seizures immediately following the head injury.
   e. Objective neuropsychological abnormalities including disorders of mental status (disorientation, agitation, confusion), and changes in cognition, behavior, or personality.
   f. Diagnosed intracranial lesion including traumatic intracranial hematomas or hemorrhage (epidural, subdural, subarachnoid, or intracerebral), cerebral contusions or lacerations, or penetrating cerebral injuries (e.g. gunshot wounds).
2. The occurrence of death resulting from trauma, with head injury listed on the death certificate, autopsy report, or medical examiner's report in the sequence of conditions that resulted death.

From Centers for Disease Control and Prevention (CDC). (1999) Traumatic Brain Injury in the United States: A Report to Congress.

The following section will examine 1) the incidence, prevalence and risk factors of TBI in the adult population, 2) the pathophsyiology of TBIs, and finally 3) the consequences of TBI.

Incidence and Prevalence

According to a study conducted by the CDC (1999), an estimated 1.5 million Americans incur a TBI every year. As a result of these injuries 230,000 people are hospitalized and survive, 50,000 people die, and between 80,000 and 90,000 develop long-term disabilities. It has been estimated (Brookshire, 2003) that the true incidence of TBI is likely between 100 and 250 per 100,000 people each year in the United States. The world-wide mortality rate for brain injuries varies from 14 to 30 per 100,000 population per year (Kraus & McArthur, 1999). The National Institute of Health (1998) estimated that the prevalence rate for individuals living with the consequences of TBI range from 2.5 million to 6.5 million.

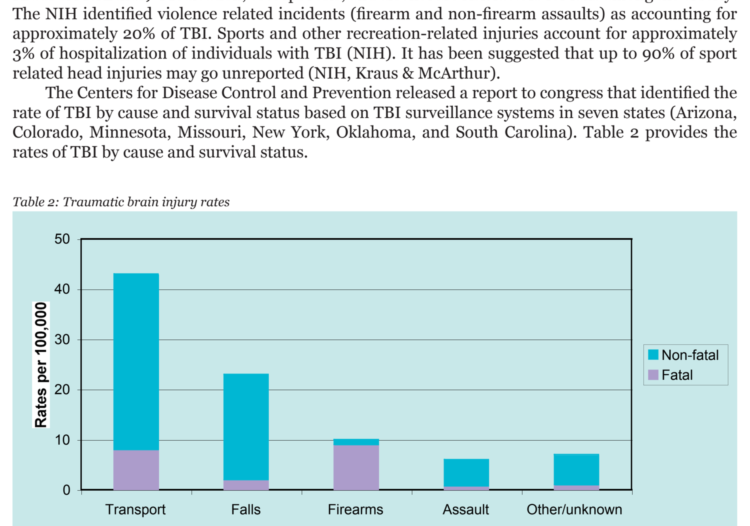
Risk Factors and Causes

The highest incidence for TBI by age is for individuals between 15-24 years old (NIH, 1998, Kraus & McArthur, 1999) and for individuals over 75 years (NIH, CDC,1999), with males being twice as likely as females to sustain a TBI (NHI, Brookshire, 2003, Kraus & McArthur, CDC). Substance abuse has been identified as contributing to between 40 and 60% of the patients admitted to the hospital following a TBI (Brookshire, Kraus & McArthur). The National Institute of Health (1998) reported that alcohol is involved in half of all TBIs either in the individual with the injury or in the individual causing the injury.

Transport related accidents involving motor vehicles, bicycles and pedestrians account for over half of all TBIs (NIH) and account for a majority of injuries in young adults (Brookshire, 2003). Falls are the most frequent cause for TBI in the elderly and young children (NIH, 1998, Brookshire, Kraus & McArthur). Medication, osteoporosis, and alcohol are risk factors for falls among the elderly. The NIH identified violence related incidents (firearm and non-firearm assaults) as accounting for approximately 20% of TBI. Sports and other recreation-related injuries account for approximately 3% of hospitalization of individuals with TBI (NIH). It has been suggested that up to 90% of sport related head injuries may go unreported (NIH, Kraus & McArthur).

The Centers for Disease Control and Prevention released a report to congress that identified the rate of TBI by cause and survival status based on TBI surveillance systems in seven states (Arizona, Colorado, Minnesota, Missouri, New York, Oklahoma, and South Carolina). Table 2 provides the rates of TBI by cause and survival status.

Table 2: Traumatic brain injury rates



From Centers for Disease Control and Prevention (CDC). (1999) Traumatic Brain Injury in the United States: A Report to Congress.

Pathophysiology

Traumatic brain injuries may be separated into two distinct categories: penetrating brain injuries and non-penetrating brain injuries (Brookshire, 2003). If the skull and meninges remain intact, the injury is considered to be non-penetrating, or a closed head trauma (Murray & Clark, 2006). Non-penetrating head injuries may be further subdivided into acceleration injuries and non-acceleration injuries. Acceleration injuries occur when the unrestrained head is struck by a moving object or if the moving head strikes a fixed object. This type of injury will result in damage to the brain where it hits the skull (coup injury) and injury to the surface of the brain on the opposite side from the initial blow due to deceleration compression (contre-coup injury). "Diffuse axonal shearing has been identified as the major form of both focal and diffuse primary damage following closed head injury..." (Murray & Clark, p. 73) and is thought to be associated with loss of consciousness. Non-acceleration injuries occur when a moving object collides with the restrained head and result in less severe TBI than acceleration injuries.

Penetrating brain injuries, also known as open-head injuries occur "If the skull is fractured or perforated and the meninges are torn or lacerated" (Brookshire, p.384). Missiles such as bullets, stones, and other projectiles; blunt instruments such as clubs and baseball bats, and falls may cause penetrating brain injury. Velocity will determine the amount and nature of the brain damage from missiles. High velocity missile wounds are nearly always fatal (Brookshire). Individuals who survive penetrating head injuries are almost always left with physical, cognitive, and linguistic deficits. These consequences will be examined in further detail.

Consequences

A traumatic brain injury has the ability to impact an individual's vocational and career ambitions with the potential to significantly bear on social and family relationships (CDC, 1999). The Brain Injury Association of America (2005) reported that 40% of individuals hospitalized with a TBI had a minimum of one unmet need for support services one year post injury.

Next the economical and financial, neurological, behavioral, social, and cognitive consequence of TBI will be explored.

Economical and Financial

The Centers for Disease Control and Prevention (1999) reported that in 1985 the economic burden from TBI in the United States was roughly $37.8 billion. This estimate includes $4.5 billion for direct medical care, $20.6 billion in related work-loss and disability, and $12.7 billion in lost income as a result of premature death. The Brain Injury Association of America (2005) reported that for 1995 the total of direct and indirect costs (including loss of productivity) of TBI in the United States was $56.3 billion. Kraus & McArthur (1999) reported that the average lifetime costs for an individual with head injury across severity levels was approximately $85,000. Table 3 provides a summary of estimated costs per person by severity of TBI.

Table 3: Estimated costs per person by severity of TBI

	Severe	Moderate	Mild
Acute care	$578,750	$280,400	$500 - $15,800
Annual medical care	$32,250 - $84,950	$6,700 - $23,340	$1,000 - $2,500
Extrapolated average lifetime cost	$3,157,150	$941,280	$85,150

Adapted from Kraus & McArthur, 1999, p.16

Neurological

Sensory, motor, and autonomic functions may be affected as a consequence of a TBI (NIH, 1998). These consequences may result in "movement disorders, seizures, headaches, ambient visual deficits, and sleep disorders" (NIH, p.6).

Behavioral

Behavioral and emotional changes are common consequences of TBI (Tate, 1999). Traumatic brain injury may result in behavioral deficits such as "decreased ability to initiate responses, aggression, learning difficulties, altered sexual functioning, impulsivity, and social disinhibition...mood disorders, personality changes, altered emotional control, depression, and anxiety..." (NIH, p.6-7).

Social

The increased risk of suicide, divorce, chronic unemployment, economic strain, and substance abuse are all associated with TBI (NIH). These social consequences are significant for the individual that sustains the injury as well as for their family members and caregivers.

Cognitive Consequences

The cognitive consequences following TBI are complex and changing in severity and presentation over time. These unrelenting deficits include "...memory impairment, difficulties in attention and concentration, language use, visual perception, and executive skills" (NIH, p.7). The cognitive status of an individual following TBI are greater predictors of functional outcome than the resulting physical condition of an individual (Murray & Clark, 2006). According to Brookshire (2003), attention deficits are inherent consequences of TBI. In addition, the Cognitive Rehabilitation Task Force (Cicerone et al., 2000) identified a number of studies that support therapeutic intervention for both memory impairments and attention deficits secondary to TBI. Cognitive abilities, including attention, memory, and executive skills (or executive functions) have an integral role in daily functioning. Executive function impairments have the ability to adversely affect quality of life to a high degree. Executive functions and their impairments will be investigated in the following section.

Executive Functions

Executive functions are a set of higher-order cognitive abilities that are required to initiate, generate, select, plan and monitor goal-directed behavior during the completion of a purposeful task or novel behavior (Murray & Clark, 2006, Bennet, Ong, & Ponsford 2005a, 2005b). McCullagh & Feinstein (2005) describe executive functions as the higher-order capabilities that are regarded as the domain of the frontal lobes and their projections. Currently, there is no single model of executive functioning that can explain the breadth of cognitive abilities that are encompassed in this set of higher-order capabilities (Busch, McBride, Curtiss, & Vanderploeg, 2005). The cognitive abilities that comprise the term "executive functioning" may include: reasoning, judgment, mental flexibility, concept formation, planning, organizing, inhibition, impulse control, social adaptive functioning, attentional control, working memory, set shifting, and generativity (Pelham & Lovell, 2005; McCullagh & Feinstein, 2005 Hart, Whyte, Kim & Vaccaro, 2005).

Murray & Clark (2005) identified planning, organization, inhibition, cognitive flexibility, problem solving, and self monitoring as the executive functions required to perform daily activities. Planning involves strategy development and the sequencing of steps involved in the strategies to realize a goal (Murray& Clark, Ownsworth & Fleming, 2005). Organization is the ability to give structure to or categorize incoming information, as well as structuring responses (Murray& Clark). Inhibition comprises the regulation and repression of automatic, rote, or inappropriate responses (Murray&Clark). Sohlberg & Mateer (1989) identified awareness, impulse control, perseveration, and environmental dependency as the factors encompassed by the term regulation. Cognitive flexibility permits change and adaptation of behaviour in the face of failure (Murray &Clark). Problem solving encompasses identification of a problem, and the generation, selection, and implementation of solutions (Murray & Clark). These skills are required when regular or automatic behavior is inadequate to accomplish a goal (Marshall, Karow, Morelli, Iden, Dixon, 2003). Self-monitoring is the capability to evaluate and alter performance and behavior based on environmental feedback, knowledge of task difficulty, and awareness of personal strengths and limitations (Murray & Clark). Kennedy (2004) included prediction, specifically the prediction of recall information as a key component of self-monitoring.

Impairments of these higher-order cognitive processes are significant considering executive functions "...govern and use subordinate mental activities including attention, memory, language, and perceptual functions in the mediation of real-world problems." (McCullagh & Feinstein 2005, p. 324). Executive impairments are thus capable of exaggerating deficits in other areas. Executive function impairments may affect an individual's ability to effectively engage with others, plan activities, solve problems, and interact with their environment in order to meet their own personal needs (Pelham & Lovell, 2005). Fortin, Godbout, & Braun (2003) argued that executive function deficits specifically in the areas of planning, self-monitoring, decision making, and judgement may be the key factors that result in traumatic brain injury patients with impaired activities of daily living (ADL). Executive function deficits often have more severe consequences on an individual's life than do physical impairments (Kersel, Marsh, Havill, & Sleigh 2001). Knowledge of the extent of the deficits in executive functioning is essential in determining functional outcome after a traumatic brain injury (McCullagh & Feinstein, 2005).

According to Cummings & Trimble (1995) as cited in Pelham & Lovell (2005), executive functions are often impaired when a frontal-subcortical circuit or loop is damaged. Three circuits are identified in which damage often results in executive functioning impairments. Damage to the dorsolateral prefrontal circuit is thought to produce deficits in planning, organization, and working memory (Pelham & Lovell, 2005, McCullagh & Feinstein, 2005). Damage to the lateral orbitofrontal circuit results in disinhibition and antisocial acts (Pelham & Lovell, 2005). Finally, damage to the medial frontal/anterior cingulated circuit will result in diminished motivation, interest and social involvement as well as reduced communication (Pelham & Lovell, 2005).

Given that executive functioning is a multifaceted set of higher-order cognitive abilities, assessment requires the use of a battery of tests sensitive to each of the cognitive abilities in question (Bennett, Ong, & Ponsford, 2005a). Assessment varies and may include portions of the following tests: the Wisconsin Card Sorting Test, the Porteus Maze Test, the Trail Making Test, the Controlled One Word Association Test, the Revised Tinker Toy Test, Cognitive Estimation Test, Design Fluency, and the Behavioral Assessment of the Dysexecutive System (Bennet, Ong, & Ponsford, 2005, Pelham & Lovell, 2005, Kersel, Marsh, Havill, & Sleigh, 2001). It is important to note that performance on such tests often fails to identify the significance of the deficits encountered in real-life situations (McCullagh & Feinstein, 2005). Sohlberg & Mateer (1989) advocated the use of informal measures to evaluate executive functions. In their report the authors identified an informal measure that required the client to complete a multi-step task that depends on the use of intact executive functions. By observing client performance, the speech-language pathologist is able to document if and where a breakdown occurs. The speech-language pathologist is thus able to identify which executive functions may be impaired and possibly to what extent. It may also be the case that performance on a test may reflect cognitive impairment other than executive functions due to a lack of validity (Bennet, Ong, & Ponsford, 2005).

Executive functions are a set of higher-order cognitive abilities that are essential for the initiation, generation, selection, planning, and monitoring of goal directed behavior. Damage to forontal-subcortical circuits may produce executive function impairments resulting in the inability to effectively engage with others, impaired planning, organization and problem solving skills, disinhibition, diminished social involvement, and reduced communication. The psychosocial impacts of executive function impairment following a traumatic brain injury can be just as devastating if not more so than a physical impairment. Assessment of executive function impairment requires a combination of standardized test, informal procedures and observations, along with pertinent client history to accurately identify the type and severity of impairment. The following section will examine evidence based practice in the area of traumatic brain injury.

Evidence-Based Practice and Clinical Experience

Prior to the introduction of evidence-based practice, the discipline of Speech-Language Pathology relied on efficacy studies to establish the most effective and efficient methods by which the clinician may provide treatment of communication disorders (Vinson, 1999). Treatment efficacy was designed to ensure that speech-language pathologists utilized therapy techniques that "...do, in fact, work effectively to improve the communication status of the individual..." (Vinson, p.253). While evidence-based practice (EBP) is also focused on determining whether therapeutic intervention is efficacious, there is a unique weight placed on the use of scientific evidence (Reilly, 2004). According to Sackett et al. (1997) as cited in Reilly (2004), EBP constitutes "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (p.3). Irwin (2006) placed the onus on the clinician to critically appraise the relevance, validity, and accuracy of existing evidence to determine whether it represents the best evidence available, and subsequent decision-making regarding the appropriate treatment for each client based on their needs and characteristics. The American Speech-Language-Hearing Association (ASHA, 2006) recognized Sackett's definition of EBP and purports the goal of EBP to be the integration of clinical expertise with the best current evidence and client values in order to provide service of the highest quality. Sackett (2000) proposed five steps in the process of performing EBP. Table 4 provides a summary of the steps.

Table 4: The five steps of EBP

1. Convert the need for information into an acceptable answer.
2. Identify the best evidence with which to answer that question.
3. Critically evaluate that evidence.
4. Integrate the results of this appraisal with clinical expertise and patient values in clinical practice
5. Evaluate your performance.

Adapted from Sackett et al. (2000) p.3-4

Numerous classification scales have been proposed for ranking evidence. Reilly (2004) provided a four level hierarchy for evaluating research methodology in Speech-Language Pathology that was adapted from the Joanna Briggs Institute for Evidence Based Nursing and Midwifery. Table 5 provides a summary of this hierarchy.

Table 5: Levels of Evidence

Level	Evidence obtained from
I	Systematic review of all relevant randomized control trials
II	At least one properly designed randomized control trial
III.1	Well-designed controlled trials without randomization
III.2	Well-designed cohort or case-controlled analytic studies preferably from more than one centre or research group
III.3	Multiple time series with or without the intervention. Dramatic results obtained from uncontrolled experiments.
IV	Opinions of respected authorities based on clinical experience, descriptive studies or reports of expert committees.

Reilly (2004) p.27

Reilly provided a hierarchy for the evaluation of research methodologies to aid SLPs in determining the validity and strength of research studies. This allows SLPs to critically appraise the information they encounter and integrate it with their clinical experience, and their patient's values, a key step in performing EBP.

The majority of information regarding EBP comes from medical fields outside of the discipline of Speech-Language Pathology. There are, however, organizations within the discipline that are committed to developing and promoting EBP. The Academy of Neurologic Communication Disorders and Sciences is currently developing EBP guidelines, while The American Speech-Language-Hearing Association is developing the National Outcome Measurement System to collect and establish a national outcome database for SLPs. Both organizations and their respective projects will be discussed in the following sections.

The Academy of Neurologic Communication Disorders and Sciences

The Academy of Neurologic Communication Disorders and Sciences (ANCDS) with support from the American Speech-Language-Hearing Association and the Department of Veterans Affairs National Speech-Language Pathology Organization have begun to develop a project aimed at aiding clinicians in their decision-making process for the management of communication disorders in neurologically impaired individuals. The project aims to improve the quality of services provided to these individuals by providing clinicians with guidelines based on research evidence (Golper et al, 2001).

The ANCDS has recognized the push toward establishing a research evidence base for providing treatment for neurologic communication disorders including: dysarthria, aphasia, apraxia of speech, cognitive-communication disorders (CCD) related to traumatic brain injury (TBI), dementia, and right hemisphere damage (Golper et al, 2001; Frattali, Bayles, Beeson, Kennedy, & Yorkston, 2003.) Every disorder type has a committee of experts in each specialty area that will gather and interpret evidence from research literature and expert opinion to develop propositions for management options. The committee involved with establishing practice guidelines for cognitive communication disorders related to traumatic brain injury has developed four modules to review the evidence, one of which specifically addresses intervention for metacognitive and executive dysfunction. While the committee has published a technical report examining the evaluation and assessment of TBI (Turkstra et al, 2003), they continue to research and develop an evidence base for intervention and management of the various impairments possible after TBI including executive dysfunctions.

National Outcome Measurement System

About NOMS

The American Speech-Language-Hearing Association (ASHA, 2005b) developed a data collection system to identify the significance of speech-language pathology and audiology services provided to adults and children. This system, known as The National Outcome Measurement System (NOMS), was established to collect national outcome data in the areas of speech-language pathology and audiology in the school and healthcare settings. The system relies on ASHA's functional communication measures (FCMs) to demonstrate the amount of change between a patient's abilities at admission and at discharge. The following sections will provide a description of the benefits of NOMS, and the data related to the treatment of TBI in adults.

Benefits

The National Outcomes Measurement System asserts that SLPs and administrators in the health care setting are able to benefit from implementing and participating in the system. (ASHA, 2005a; ASHA 2005b). Benefits to SLPs include facilitation with caseload planning and management, ability to put entrance and dismissal criteria into practice, determining amount of progress expected, determine preferred type and model of service delivery by disorder type, and an overall improved quality of services provided to the patient (ASHA, 2005a). The administrator will also benefit from NOMS in numerous ways including ability to establish preferred practice patterns, improve the quality of services provided, advocate for speech and language services, and ability to better allocate finances and personnel (ASHA, 2005a; ASHA, 2005b). Facilities that participate in data collection for NOMS receive data reports that include national data.

Clinical Experience

As previously stated, Evidence Based Practice requires the integration of critically appraised best-evidence with clinical expertise and patient values. The critically appraised evidence is the reason an SLP would decide to "...support a specific treatment decision for a specific patient under specific and potentially idiosyncratic clinical circumstances" (Ylvisaker et al, 2002, p.xviii). Ideally, an SLP would choose a specific treatment (a) supported by a large amount of high quality evidence, (b) for which there is no conflicting evidence, (c) for a patient identical to those in a study, (d) for which no other treatment has equivalent support, and (e) resources for providing the treatment (Ylvisaker et al.). It is rare in the field of speech-language pathology for these ideal circumstances to occur, and when there is not a clear evidence base to support a treatment decision, clinical expertise becomes of increasing importance. As Ylvisaker et al. described, the SLP must also use rational decision making in regards to cost-benefit analysis, patient specific hypothesis testing, single-subject experiments, and intervention related decisions.

Utilization

Little research has been conducted to assess SLPs use of EBP in the clinical setting. Zipploli & Kennedy (2005) reported conducting a survey of randomly selected ASHA certified SLPs for which the response rate was 49.2% (240/488). Their research demonstrated that the SLPs in their study "... used significantly more traditional than evidence-based sources of information to guide their clinical decision making." (p.215). This study while one of a kind, demonstrated the necessity for professionals more proficient with the use of EBP.

In developing an evidence base and collecting outcome data, Speech-Language Pathologists are able to limit the variations in clinical practice that may have detrimental effects on patient outcomes, increase the cost effectiveness, and increase the value of and reimbursement for SLP services by third-party payers (Irwin, 2006). However, clinical expertise along with patient values must be integrated with best evidence when making clinical decisions. While evidence-based practice has received much attention over the past decade, speech language pathologists have reportedly relied on traditional methods for clinical decision making. Treatment for impairments of executive function related to traumatic brain injury will be discussed in the next section with emphasis on the evidence base for providing therapy to this population.

Treating Executive Functioning in TBI

The Academy of Neurologic Communication Disorders and Sciences established the Writing Committee for Evidence-Based Practice Guidelines in Cognitive-Communication Disorders after Traumatic Brain Injury. This committee is responsible for the development of evidence-based practice guidelines for the management of cognitive-communication disorders after TBI (Kennedy, 2002). In the initial report, Kennedy reported that "The ultimate goal of cognitive-communication intervention is the highest level of communicative participation in everyday living" (p.x). Coelho, DeRuyter, & Stein (1996) reported on the current treatment efficacy for cognitive communication disorders following traumatic brain injury. The results of their study supported "...the notion that a period of intensive inpatient rehabilitation is beneficial for cognitive-communicative deficits secondary to TBI... intervention should be provided as necessary along the continuum of care" (p. S13). Management of executive function impairment may differ based on a number of patient specific factors including the individual's cognitive profile, self regulatory capacity, and level of awareness (Mateer & Raskin, (1999). Regardless of the treatment style chosen, Hart & Evans (2006) identified important considerations regarding goal selection in the rehabilitation of patients with TBI. Table 6 provides a summary of Hart & Evans' recommendations.

Table 6: Goal Selection

Goal recommended	Goal not recommended
Challenging	Easy
Distal and proximal	Distal or proximal alone
Learning	Performance
Specific targets	General targets
Enjoyment/preference of task	Dislike of task
Participant endorsement of soundness	Participant dose not endorse soundness

Adapted from Hart & Evans, 2006 p.147

The treatment of executive function impairments in adults with TBI may be divided into four broad categories 1) cognitive rehabilitation, 2) therapy for specific executive function impairment or component training, 3) compensatory training, and 4) environmental adaptations. The salient aspects of each category will be reviewed and associated evidence based practice studies will be described.

Cognitive Rehabilitation

According to Coelho et al. (1996) cognitive rehabilitation is "...aimed at increasing functional abilities in everyday life by improving an individual's capacity to process and interpret incoming information" (p. S7). It is hypothesized that therapy directed at the remediation of particular cognitive processes will result in improved performance on a variety of activities that rely on these processes (Brookshire, 2003). The National Institutes of Health's (NIH) consensus statement on the Rehabilitation of Persons with Traumatic Brain Injury (1998) identified cognitive rehabilitation as:

> *"The goals of cognitive and behavioral rehabilitation are to enhance the person's capacity to process and interpret information and to improve the person's ability to function in all aspects of family and community life. Restorative training focuses on improving a specific cognitive function, whereas compensatory training focuses on adapting to the presences of cognitive deficit. Compensatory approaches may have restorative effects at certain times. Some cognitive rehabilitation programs rely on a single strategy (such as computer-assisted cognitive training), while others use an integrated or interdisciplinary approach. A single program can target either an isolated cognitive function or multiple functions concurrently"* (p.9).

Ylvisaker, Hanks, & Johnson-Greene (2002) identified two frameworks for defining cognitive rehabilitation, the traditional paradigm whose goal is described in the NIH consensus statement and the contextualized paradigm. The goal of the contextualized paradigm is to "...help individuals with cognitive impairment achieve functional objectives and participate in chosen activities that are least temporarily blocked by the impairment" (p.195). The evidence base behind providing cognitive rehabilitation for executive function impairments following TBI has been analyzed by a special interest group from the American Congress of Rehabilitation Medicine and will be discussed in the next section.

Brain Injury-Interdisciplinary Special Interest Group, American Congress of Rehabilitation Medicine

The Cognitive Rehabilitation Task Force from the Brain Injury-Interdisciplinary Special Interest Group of American Congress of Rehabilitation Medicine published an update to their 2000 publication Evidence-based Cognitive Rehabilitation Recommendations (Cicerone et al, 2005). The task force classifies their recommendations based on levels of evidence to distinguish practice standards, guidelines, and options. Cicerone et al. recommend practice standards based on a minimum of one well-designed Class I study with adequate samples, with support from Class II or III studies that provide "substantive evidence of effectiveness" (p.8). Practice guidelines are based on at least one Class I study with methodological limitations or well-designed Class II studies with adequate samples that provide "evidence of probable effectiveness" (p.8). Finally Practice options are based on Class II and III studies that explicitly address the effectiveness of a treatment and provide "evidence of possible effective". A summary of the recommendations based on levels of evidence is provided in table 7.

Table 7: Levels of Recommendations

	Class of study	Evidence
Practice Standards	≥1 well-designed Class I Support from Class II or Class III	Substantive evidence of effectiveness
Practice Guidelines	≥1 Class I with methodological limitations or well-designed Class II	Evidence of probable effectiveness
Practice Options	Class II or Class III	Evidence of possible effectiveness

Adapted from Cicerone et al. 2005 p. 8

Using levels of evidence to determine clinical recommendations for the use of cognitive rehabilitation in the treatment of executive function impairments, Cicerone et al. developed the following recommendations. The evidence supports *Practice Guidelines* recommending formal training of problem solving strategies based on one Class I and one Class III study that are consistent with evidence from a Class I study from the initial review. A *Practice Option* was recommended in the initial review to "promote internalization of self-regulation strategies, through self-instruction and self monitoring" (p.38). The updated recommendations support this option based on one Class I and two Class III studies. Three Class I studies were also identified that demonstrate self-instruction training as an effective factor for treating deficits of attention, visual neglect, and memory. The Cognitive Rehabilitation task force recognizes and attributes the limited recommendations for treating executive function impairments to an insufficient number of adequate studies.

Therapy for specific executive function impairment

Inhibition

Individuals with inhibition deficits have the inability to "initiate use of specific preserved abilities, monitor performance, and utilize feedback effectively to regulate behavior" (Matter& Raskins, 1999 p.264). Behavior modification therapy targets behaviors to increase the frequency of adaptive behaviors (desired) and decrease the frequency of maladaptive behaviors (undesired) (Brookshire, 2003).

Evidence-Based Practice

Alderman and colleagues (2005) (as cited in Murray & Clark, 2006, and Mateer & Raskins, 1999) reported using a response cost behavior modification technique to treat patients with inhibition deficits. The response cost technique provides the patient with tokens that are to be exchanged for a concrete reward at a predetermined time. The patient is instructed not to perform a certain undesired behavior. If the patient exhibits the undesired behavior they are required to provide a staff member with one of their tokens and to explain why they are giving the staff the token. The advantage of this technique is that "...it facilitates directing the patient's attention to aspects of his or her behavior that are not being monitored, it enables salient feedback to be extracted from the environment, it places minimal load on memory, it facilitates procedural learning, and it increases awareness" (Mateer & Raskins, p. 264). However, this technique is limited in that it failed to transfer to a second environment.

Problem solving

Gordon, Cantor, Ashman, & Brown (2006) identified five steps involved in the remediation of problem solving impairments, they are 1) recognizing that there is in fact a problem, 2) defining the problem, 3) determining the possible solutions or the steps involved to solve the problem, 4) implementing a solution, and 5) evaluating the outcome. Murray & Clark (2006) provided an approach to treating goal setting and problem solving concurrently by teaching task-specific routines. A functionally relevant task is identified for a specific patient and is segmented into a series of simple less complex steps. The clinician and patient develop a checklist and review the list to view the order in which the steps must be completed. Patients are instructed to record when each step is completed. Extensive practice is done to ensure both the use of the checklist and the target behavior become automated. Periodic re-training sessions take place to ensure the behavior is automated.

Evidence-Based Practice

Cicerone et al. identified Levine, Robertson, Clare, Carter, Hong, Wilson, Duncan, & Stuss's 2000 study on the Goal Management Training (GMT) approach to treating problem solving as a Class I study. Goal Management Training "...involved a sequential and recursive five-stage model consisting of orientation toward relevant goals, selection of goals, stating of subgoals, encoding, and retention of goals and subgoals, and self-monitoring" (Cicerone et al.). Thirty three-to-four year post injury subjects with TBI were randomly assigned to either the treatment or the comparison group. The treatment group completed a one hour GMT training session, while the comparison group received a one hour motor skills training session. Results from the study demonstrated that the patients that received GMT had improved performance on paper-and-pencil tasks that were associated with everyday situations.

Compensatory Training

Treatment focused on compensatory training may be necessary for a couple of reasons: if a patient is in a very acute stage of rehabilitation, if the executive function deficits are extremely severe, or if there are residual deficits that are unlikely to improve any further (Mateer & Raskin 1999).The goal of compensatory training is "to improve particular cognitive functions and to compensate for specific deficits" (NIH, 1998) by structured, sequenced and repetitive practice. Brookshire (2003) noted that compensatory strategies are "...deliberate, volitional (and sometimes unconventional) behaviors that allow a patient to carry on activities that would otherwise be impossible" (p.445). There are four categories of compensatory strategies; they include external compensations, situational compensations, recognition compensations, and anticipatory compensations (Brookshire).

External compensations are best suited to patients who are unaware of their deficits and will not recognize when their deficits cause problems. These compensations are synonymous with environmental adaptations and will be discussed in further detail later in the next section.

Situational compensations are suitable for patients that recognize their impairment but cannot discern when these impairments cause problems. Compensatory strategies are taught to be used routinely in all appropriate situations.

Recognition compensations are appropriate for patients who are able to recognize when a problem occurs due to their impairment but who are not able to anticipate this occurrence. These patients are taught to use specific strategies when a certain problem occurs. Recognition compensations differ from situational compensations in that they are not used on a routine basis; they are used only if a problematic situation occurs.

Finally, anticipatory compensations are beneficial for patients that are able to anticipate a problem based on their impairment. Patients are instructed to use a strategy at the first sign of an imminent problem to circumvent the problem. Table 8 provides a number of possible compensatory strategies that may be used for any of the previously described categories.

Table 8: Compensatory strategies

- Keep a daily journal to record daily activities to help orientation
- Post patient-relevant photographs of important people and objects
- Provide maps and diagrams of familiar routes
- Develop and use checklists showing the steps of routine activities
- Post visual reminders (symbols or written words) to cue desired behaviors
- Write down pertinent information when reading or following verbal instruction
- Develop and use routines for organizing thinking and problem solving
- Mentally rehearse problem situations, use visual imagery and write plans to organize responses to problems
- Organize workplace materials, in groups or in order of use
- Eliminate distractions (visual, auditory etc.)
- Request extra time to complete activities

Adapted from Brookshire, 2003 p.446

Environmental adaptations

Patients with severe executive function impairments may require a very controlled setting in order to facilitate their cognitive functioning in their daily environment. The environment may thus be manipulated to provide external support for functional, appropriate behavior (Gordon et al.).

Murray & Clark (2006) offered two environmental adaptations suitable for the management of executive function impairments. The first option is to reduce task demands in both the therapy setting and during daily activities. Task demands may be reduced by 1) simplifying a task and reducing the number of steps required for its completion, 2) providing more time to complete a task, 3) minimizing or removing extraneous stimuli that cause undesired behavior, 4) allowing for breaks during task completion to reduce fatigue and frustration, and 5) minimizing or eliminating environmental stimuli. The second type of environmental adaptation is to offer external support with cues and prompts. Verbal reminders and alarm systems are options for providing cues and prompts to patients who may have adequate ability to identify the steps or skills required to perform an activity, but may fail to apply this knowledge to complete the task.

Environmental adaptations may also be made for patients who have achieved a relatively high level of improvement. Patients who wish to return to work may have recovered significantly from executive function impairment, but may still exhibit some residual deficits. Modification of the work environment may allow some patients to return to their premorbid career and others to participate in a work environment that is less cognitively demanding (Sohlberg & Mateer, 1989). While external cueing systems and reduced task demands may be beneficial in this setting, a highly structured routine may reduce executive demands.

This study will demonstrate how clinical years of experience impact the manner in which Speech-Language Pathologists make treatment decisions for adult patients with executive function impairments secondary to traumatic brain injury. A discussion of the methodology that will establish how Speech-Language Pathologists utilize evidence-based practice and clinical experience based on their years of experience to make treatment decisions will follow.

Methodology

Purpose of the study

The purpose of this study is to determine how certified Speech-Language Pathologists (SLPs) make decisions regarding the treatment of executive function impairments in adults with traumatic brain injuries (TBI). This study will also determine how the factors of clinical years of experience and attitudes toward the use of evidence-based practice influence the clinician's decision making process.

Research participants

Speech-Language Pathologists (SLPs) that belong to the American Speech-Language-Hearing Association's (ASHA) Special Interest Division 2 list serve will be asked to participate in this study. It is assumed that the SLPs involved with Division 2, Neurophysiology and Neurogenic Speech and Language Disorders are most likely to have experience treating executive function impairments in adults with TBI.

Research tools

Each participant will be requested to fill out an opinion survey regarding relevant education and current treatment decision-making practices in the area of executive functioning impairments in adults with traumatic brain injury. The instrumentation was developed upon analysis of previously published research, as presented in the literature review, regarding traumatic brain injury in adults, executive functions and their respective impairments, and evidence-based practice in the previously mentioned areas.

Protocols and procedures

Participants will be recruited through ASHA's Special Interest Division 2 list serve. The list serve will provide the participants with a link to an external website in conjunction with Minnesota State University Moorhead. This link will provide the participant with an explanation of the study. In completing and submitting the survey the participant will be providing implied consent.

Results

There are no results to report at this time. Future results will include 1) background data including the clinician's level of education and primary practice setting, 2) clinician attitudes toward evidence-based practice (EBP), and 3) clinician use of EBP. The results obtained from the survey will be able to answer the main research question: Do clinical years of experience impact a clinician's use of evidence-based practice when making treatment decisions for executive function impairments in adults with traumatic brain injury? The results from the survey will 1) demonstrate the correlation between clinical years of experience and attitudes toward EBP, 2) demonstrate the correlation between clinical years of experience and the use of EBP, and 3) will predict clinician utilization of EBP for treating executive function impairments in adults with traumatic brain injury.

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Opinion Survey

Sara Paterson
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Department of Speech/Language/Hearing Sciences

1. In what state did you obtain your undergraduate degree? ______In what year?______

2. In what state did you obtain your master's degree? ______In what year?______

3. Do you have any degrees beyond a master's? (Select all that apply)

PhD _____ D.A._____ Other ______

EdD _____ Specialist _____

4. a) Which settings did you work in prior to obtaining your master's degree and for how long? (Select all that apply)

______ Preschool
______ School
______ Hospital-Acute with adults
______ Hospital-Rehab with adults
______ Nursing home
______ Private Practice with adults
______ College/university clinic with adults
______ Residential center for Traumatic Brain Injury (TBI) rehab with adults
______ Day treatment center for TBI rehab with adults
______ Other – Specify:______________________________

b) Which settings did you work in since obtaining your master's degree and for how long? (Select all that apply)

______ Preschool
______ School
______ Hospital-Acute with adults
______ Hospital-Rehab with adults
______ Nursing home
______ Private Practice with adults
______ College/university clinic with adults
______ Residential center for Traumatic Brain Injury (TBI) rehab with adults
______ Day treatment center for TBI rehab with adults
______ Other – Specify:______________________________

5. a) What is (are) your current work setting(s)? (Select all that apply)

______ Preschool
______ School
______ Hospital-Acute with adults
______ Hospital-Rehab with adults
______ Nursing home
______ Private Practice with adults
______ College/university clinic with adults
______ Residential center for Traumatic Brain Injury (TBI) rehab with adults
______ Day treatment center for TBI rehab with adults
______ Other – Specify:______________________________

b) What percentage of your current caseload consists of patients/clients with TBI?

____ less than 10%
____ 10%
____ 20%
____ 30%
____ 40%
____ 50%
____ 60%
____ 70%
____ 80%
____ 90%
____ 100%

IF YOU HAVE NOT SEEN PATIENTS/CLIENTS WITH TRAUMATIC BRAIN INJURY IN THE PAST FIVE YEARS PLEASE STOP HERE.

Use the following information to answer question 6 & 7:

Executive functions are a set of higher-order cognitive abilities that are required to initiate, generate, select, plan and monitor goal-directed behavior during the completion of a purposeful task or novel behavior (Murray & Clark, 2006).

The cognitive abilities that comprise the term "executive functioning" may include: reasoning, judgment, mental flexibility, concept formation, planning, organizing, inhibition, impulse control, social adaptive functioning, attentional control, working memory, set shifting, and generativity (Pelham & Lovell, 2005; McCullagh & Feinstein, 2005 Hart, Whyte, Kim & Vaccaro, 2005).

6. In the past five years, what percentage of therapy you provided to adults with TBI focused on the remediation of executive function impairments?

____ less than 10%
____ 10%
____ 20%
____ 30%
____ 40%
____ 50%
____ 60%
____ 70%
____ 80%
____ 90%
____ 100%

7. In the past five years, have you seen TBI patients/clients with any of the following deficits (check all that apply):

____ Reasoning
____ Judgment
____ Mental flexibility
____ Concept formation
____ Planning
____ Organizing
____ Inhibition
____ Impulse control
____ Social adaptive functioning
____ Attentional control
____ Working memory
____ Set shifting
____ Generativity

8. Which formal measures do you use to assess adults with TBI? Check all that apply

☐ Scales of Cognitive Ability for Traumatic Brain Injury
☐ Ross Information Processing Assessment-Second Edition
☐ Woodcock-Johnson Psycho-Educational Battery-Revised
☐ Peabody Individual Achievement Test-Revised
☐ Cognitive Linguistic Quick Test
☐ Other-specify ______________________________

9. Describe the informal measures you use to assess adults with traumatic brain injury.

____

10. When it comes to treating executive function impairments (such as impaired reasoning, judgment, mental flexibility, concept formation, planning, organizing, inhibition, impulse control, social adaptive functioning, attentional control, working memory, set shifting, and generativity) in adults with TBI, do you use any particular therapy techniques to treat specific impairments.

____ YES ____ NO If yes, please describe below.

____

Use the following information to answer questions 11-13:

Evidence-based practice (EBP) constitutes "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" (Sackett et al. 1997).

11. a) Were you exposed to EBP in your graduate academic program?

____ YES ____ NO

b) Have you been exposed to EBP through workshops or seminars since you have been a practicing speech-language pathologist?

____ YES ____ NO If yes, please describe below.

____

c) Do you feel you have the necessary knowledge to use evidence-based practice for making treatment decisions for executive function impairments in adults with TBI?

____ YES ____ NO If yes, please describe below. ______________________________

12. Using a scale of 1 to 7 (with 1 being the most important and 7 the least important) rate the following decision making factors based on your opinion of their importance in formulating treatment objectives for executive function impairments in adults with TBI.

☐ Clinical experience (i.e. what you've done in the past has worked so you stick with it.)
☐ Expert opinion (i.e. ask another professional that is an expert in the area)
☐ Evidence-based journals articles
☐ Textbooks or course notes (i.e. textbooks and notes to make decisions)
☐ Consult a colleague
☐ Workshop or specialized training
☐ Networking Group (i.e. professionals meet on a regular basis to share therapy ideas)
☐ Other-specify ______________________________

13. Using your top three responses to question 12, indicate how often you use these methods when making treatment decisions for the following executive function impairments in adults with TBI.

#1(Enter your #1 response from Question 12 here)
Drop down options: (always, most of the time, half of the time, sometimes, never)
#2 (Enter your #2 response from Question 12 here)
Drop down options: (always, most of the time, half of the time, sometimes, never)
#3 (Enter your #3 response from Question 12 here)
Drop down options: (always, most of the time, half of the time, sometimes, never)

14. Other comments.
Is there anything else you would like to add regarding how you base your decisions for treating executive function impairments in adults with TBI? ______________________________

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