2022

Characterizing the Relationship Between Executive Functioning and Social-Emotional Behaviors Following a Severe Pediatric Traumatic Brain Injury

Lakia Kearson
Philadelphia College of Osteopathic Medicine

Philadelphia College of Osteopathic Medicine

School of Professional and Applied Psychology

Department of Clinical Psychology

CHARACTERIZING THE RELATIONSHIP BETWEEN EXECUTIVE FUNCTIONING AND SOCIAL-EMOTIONAL BEHAVIORS FOLLOWING A SEVERE PEDIATRIC TRAUMATIC BRAIN INJURY

By Lakia Kearson

Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Psychology

JUNE 2022

PCOM SCHOOL OF PROFESSIONAL AND APPLIED PSYCHOLOGY™

DISSERTATION APPROVAL

This is to certify that the thesis presented to us by Lakia Kearson

on the 8th day of March, 2022, in partial fulfillment of the requirements for

the degree of Doctor of Psychology, has been examined and is

acceptable in both scholarship and literary quality.

COMMITTEE MEMBERS' SIGNATURES

__Dr. Stephanie Felgoise, Ph.D________, Chairperson

__Dr. Donald Masey, Ph.D_____________

__Dr. Nina Hattiangadi Thomas, Ph.D___

__Dr. Stephanie Felgoise, Ph.D_______, Chair, Department of Clinical Psychology

___Robert DiTomasso, Ph.D___________, Dean, School of Professional & Applied Psychology

ACKNOWLEDGEMENTS

I would like to begin by thanking my amazing dissertation committee for choosing to be my guides throughout this journey. To Dr. Stephanie Felgoise, I am truly going to miss our Friday meetings! I have to admit that I found myself looking forward to each one. Your encouragement and innate ability to ease my concerns made this process such a pleasurable experience for me. You helped me transform each of my thoughts and ideas in a such meaningful way. I'm so proud of the work I have done, and I owe a major part of that to your insight and guidance. To Dr. Donald Masey, as the lone neuropsychologist within the faculty I knew that I had to request you to be a part of my committee. Thank you for contributing to my knowledge of traumatic brain injuries and assessments. Your expertise was such a benefit to my study and will always be appreciated. To Dr. Nina Thomas, you have helped me in more ways than I could ever have imagined. Thank you for your never-ending kindness throughout this journey and being such an amazing mentor! I attribute so much of my current work ethic and foundational knowledge to my early educational experiences with you. You encouraged me to trust in my abilities and for that I am forever grateful. I would also like to extend a special thanks to Dr. Michael Roberts for helping me with my statistical analysis. Lastly, none of this would be possible without the love and support of my family. My motivation to succeed and be the best version of myself stems from the values that were taught at an early age. You have all been a constant force pushing me towards the finish line. Your reminders saying, "You've got this!", "Trust God!" and "We're so proud of you!" have all meant the world to me. I'm so thankful to have each of you in my life and there are not enough words to express how blessed I am to be a part of a family like the one I have. I love you all!

TABLE OF CONTENTS

ABSTRACT

Traumatic brain injury (TBI) is one of the most common acquired neurological conditions in children and adolescents. A TBI sustained in childhood can lead to an increased likelihood of executive functioning (EF) problems with possible short-term and long-term effects. Research has suggested that problems in EF can also lead to longstanding impairments in social skills and behavioral regulation. This study examined the relationship between EF and social-emotional functioning in children with TBI based on parent report using the Child Behavior Checklist (CBCL) and Behavior Rating Inventory of Executive Function (BRIEF) domain and subdomain scores. Quantitative data was retrieved from the Approaches and Decision for Acute Pediatric TBI (ADAPT) multisite study. Participants included 253 children who experienced severe TBI. Parent-report measures include the BRIEF (executive functioning in daily life) and CBCL (emotional/behavioral adjustment). Z- tests and a multiple regression analysis was conducted. As expected, EF difficulties following TBI were common in this pediatric sample, as were emotional and behavioral concerns to a lesser extent. More specifically, inhibition and working memory were found to be the largest areas of deficit. Those with greater impairments in behavior regulation as measured by the BRIEF are likely to exhibit both internalizing and externalizing behaviors following a TBI. The results of this study provide an understanding of how children with TBI who exhibit difficulties in executive functioning also demonstrate impairments in problem solving and emotion regulation. This information provides guidance for treatment that promotes supporting social emotional concerns with a child that has experienced a TBI.

CHAPTER 1: INTRODUCTION

Statement of the Problem

Traumatic brain injury (TBI) is the most common cause of acquired disability and one of the leading sources of morbidity and mortality in children and adolescents (Brown et al., 2016; Narad et al., 2017; Slomine & Jones, 2019; Thurman, 2016). Roughly 5 in 1,000 children experience a TBI yearly and by the age of 16, 1 in 30 children suffer a TBI (Brown et al., 2016). Bigler and colleagues (2013) reported social and emotional development spans the entirety of childhood in correlation with complex neurological brain development. Consequently, children who sustain a TBI during the critical stage of skills acquisition can often be faced with significant disruptions to their development (Wetherington et al., 2010). While children often exceed expectations, even in severe cases, regarding their physical recovery after TBI, TBI can be the catalyst for persisting cognitive, emotional, and behavioral difficulties, personality changes, poorer quality of life, academic struggles, and challenges socially (Aitken et al., 2009; Anaby et al., 2012; Kirk et al., 2015; Li & Liu 2013; Limond et al., 2009; Rivara et al., 2011). Therefore, although initial recovery may seem promising in some areas, there is the potential for residual deficits to become augmented over time and lead to challenges later in child development (Brown et al., 2016).

Both the child and family have to start to address the lingering struggles that remain following intensive rehabilitation, once the child transitions from the hospital and begins to interact with family, friends, and their educational setting (Kirk et al., 2015). Many times, these difficulties can include problems in the areas of attentional control, inhibition, planning, and problem solving (Jacobs & Anderson, 2002). Anderson and Catroppa (2005) found that in a group of children who sustained a TBI between the ages of 8 and 12, all of them displayed improvement in attentional control two years post injury. Yet, those classified as being severely injured were found to exhibit persistent delays with cognitive flexibility and abstract reasoning skills in later developmental periods. Similarly, Ewing-Cobbs, Prasad, Landry, Kramer, and DeLeon (2004) investigated the outcome of children injured between the ages of 1 and 7 five years post injury and noted prolonged executive dysfunction in patients with severe TBIs in comparison to the mild to moderate TBI subgroups. These findings indicate that the recovery of executive functioning skills following childhood TBI are often impacted by time of injury and severity.

Executive functioning (EF) is a set of higher-order cognitive processes which help individuals coordinate and organize their thoughts and behavior in order to achieve goals and plan for the future. These processes include the direction of attention, initiation of activity, cognitive inhibition, working memory, mental flexibility, planning and organizing, problem solving, and regulation of goal-directed behavior (Maloney et al., 2019). Longitudinal studies of typically developing children have revealed that difficulties in the early development of executive functioning are predictive of internalizing and externalizing problem behaviors, and social skill deficits later, which suggests that executive functioning is vital for developmental processes (Vogan et al., 2018). Riggs and colleagues (2003) examined concurrent and 2-year longitudinal associations between the inhibitory control and sequencing aspects of children's executive functioning and behavior, and found that children with competent executive functioning skills exhibited fewer behavioral problems over the course of a 2-year period in comparison to those with executive deficits noted at the pre-test. EF skills related to poor response inhibition and reactive control were observed to influence the development of both internalizing and externalizing behaviors in a study completed by Martel and colleagues (2007). Additionally, low resilience was distinguished as a contributing factor to the development of internalizing problems.

Spinrad and colleagues (2006) examined whether different types of emotion regulation/control differentially predicted children's socially appropriate behavior using longitudinal data and also found that children who developed more effortful control (i.e., executive attention, inhibition, and shifting) could increase their ability to manage their reactive urges. Conversely, the increasing demands of self-regulation, social expectations and executive function skills during adolescence may contribute to emerging neurocognitive and behavioral deficits as the child ages (Fay et al., 2009).

In particular, children and adolescents with moderate and severe TBI have been revealed to exhibit impairments in executive function, in addition to social competence, as common consequences of their injury (Casey et al., 2008; Chapman et al., 2010; Rosema et al., 2012; Steinberg, 2008). Notably, executive function and psychosocial difficulties among children and adolescents following TBIs have been found to be a major concern for parents, as they may have detrimental effects on a child's long-term adaptation, skill acquisition and peer interaction (Anderson et al., 2012; Brown et al., 2016; Silberg et al., 2015). Children and teens impacted by a TBI are predominantly reported to exhibit impulsive and externalizing behavior problems, decreased emotional awareness, poorer emotional recognition, and reduced emotional regulation, especially in the presence of a severe TBI (Chapman et al., 2010; Tlustos et al., 2011). Their social cognition abilities, which includes social problem-solving skills, are also more inclined to be strongly affected (Walz et al., 2009). Consequently, a TBI may disrupt core abilities that support social, emotional, and cognitive performance required to make and retain friends and function at home and in school (Keenan et al., 2018). Hoffman and colleagues (2012) noted that inhibition, working memory, and cognitive flexibility may help to further promote successful self-regulation. The capacity to attend and regulate one's behavior is often linked to social abilities and therefore, the potential to exhibit these skills effectively requires intact executive functioning (i.e., cognitive flexibility, self-monitoring; Levan et al., 2016). Moreover, Levan and colleagues (2016) argued that the ability to anticipate consequences, produce alternative strategies to problems and assess the efficacy of these strategies within social context are determinants of social outcome.

Thus, the regulation of executive functioning is an important component of social outcome, and this would suggest that behavioral impairment in children with TBIs evolve as a result of deficits in executive functioning (Levan et al., 2016).

Additionally, there is concern regarding the development of changes in mood and personality as a result of TBIs in children and adolescents. Schacher, Park, and Dennis (2015) found that even in the absence of psychopathology prior to the injury, individuals with a TBI are less likely to experience anxiety and post-traumatic stress and more likely to experience symptoms related to Attention Deficit Hyperactivity Disorder (ADHD) personality change, and conduct disorder. Their research focused on how traumatic brain injuries are frequently overlooked as relevant to mental health when in fact mental health professionals could be helpful in the prevention and treatment process for both children and parents. Yet, subsequent research found that there is a lack of knowledge among the general public regarding the psychosocial impact of traumatic brain injuries on functional outcome; and that awareness may be one of the greatest benefits to increasing early intervention.

Nonetheless, more emphasis is placed on injury-related factors as determinants of the individual’s prognosis of recovery and the future development of a specific child (e.g., nature and extent of the injury itself, the developmental status of the child), in addition to a number of personal and family variables (e.g., pre-injury cognitive, genetic, and psychological status of the child, family functioning and resources, coping style;

Babikian et al., 2015). Emotional support/counseling, information, provision of therapy/rehabilitation after discharge, provision of hospital–school liaison, and provision of school/educational support are also all identified as needs that have gone unmet by parents of children with TBI (Gfroerer et al., 2008; Glang et al., 2008; Kirk et al., 2015; Roscigno & Swanson, 2011). The existing studies have recognized multiple environmental, genetic, and physiological variables that have not only been shown to impact the family, but also predict outcomes after pediatric TBI which included the magnitude of the impairment, existence of unmet needs, family functioning, and socioeconomic status (Aitken et al., 2009; Limond et al., 2009; Taylor et al., 2002). Research examining the indices of executive functioning among children with TBI is necessary because significant impairments have been found in this area after TBI, although the degree to which these impairments within each index affect social, emotional, and behavioral functioning remains unclear.

Purpose of the Study

The current study will aim to examine the particular scales of executive functioning (i.e., Behavior Rating Inventory of Executive Function; BRIEF) that are most closely correlated with social and emotional functioning (i.e., Child Behavior Checklist; CBCL scales), in an effort to potentially identify appropriate early and targeted areas for interventions following a traumatic brain injury. Oftentimes, clinicians focus on the treatment of children’s physical and intellectual impairments during the recovery process, and less emphasis is placed on emotional, social, and behavioral impairments. This research contributes to the recognition of higher parent ratings of behavioral functioning and executive dysfunction 1 year post injury as a result of pediatric TBI and the impact on recovery outcomes.

Hypotheses

Hypothesis 1

It was hypothesized that children and adolescents with TBIs would demonstrate higher scores (i.e., more impairment) on all EF composite domains in comparison to normative data as assessed by the BRIEF scales; however, there would be a greater impairment on the composite scale of Behavior Regulation.

Hypothesis 2

It was hypothesized that children and adolescents with TBIs would demonstrate higher scores (i.e., more impairment) on all EF subdomain scores in comparison to normative data as assessed by the BRIEF scales; however, there would be a greater impairment on the subdomain scale of Inhibition.

Hypothesis 3

It was hypothesized that children and adolescents with TBIs would demonstrate greater internalizing and externalizing problems as assessed by the CBCL in comparison to normative populations.

Hypothesis 4

With regard to the relation of EF to social/emotional functioning, it was hypothesized that the Behavior Regulation executive functioning domain would emerge as a significant predictor of social/emotional functioning (i.e., both Internalizing and Externalizing problems) in a multivariate model of social-emotional functioning including gender, age at injury, mechanism of injury, and primary executive functioning domain (behavioral regulation versus metacognition).

CHAPTER 2: REVIEW OF THE LITERATURE

Pediatric Traumatic Brain Injuries

A traumatic brain injury is defined as extensive brain damage resulting from an external force or impact to the head, with the frontal lobe most often being compromised (Pearce et al., 2016). The impact of an external force must be accompanied by the following symptoms in order to be classified as a traumatic brain injury: loss of or impaired consciousness, loss of memory for incidents that occurred prior to or after the injury, neurological deficits (e.g., changes in vision, weakness in motor and balance), or mental interference (e.g., confusion, disorientation, slow thinking; Pavlovic et al., 2019). Traumatic brain injuries occur in two phases. The primary injury phase occurs instantly after mechanical forces directly impact the brain tissue resulting in parenchymal (i.e., functional tissue) and vascular damage (Kochanek et al., 2000). This phase is accompanied by a secondary phase in which there is a decrease in the blood supply to the brain. This then leads to an inability for the brain to metabolize oxygen, causing further cellular energy failure (Kochanek et al., 2000). The secondary injury phase has a considerable influence on mortality and morbidity after TBI (Vaewpanich & Reuter-Rice, 2016). Following a pediatric TBI, the initial presence of brain swelling is evidenced by white matter abnormalities observed during a neurological exam. The results of this exam are used to determine the extent of TBI severity, in addition to the Glasgow Coma Scale (Bigler & Bazarian, 2010; Roberts et al., 2014). Specifically, in the case of a moderate or severe TBI there is a likelihood of demyelination and axonal degeneration if white matter abnormalities continue to exist (Budde et al., 2011; Roberts et al., 2014). The consequential damage occurs as a result of that initial damage during the primary phase and can progress over days, weeks, months or even over the course of someone's lifetime (Bramlett & Dietrich, 2015).

Wu and colleagues (2010) found abnormal postinjury development of the corpus callosum in children with severe TBI, demonstrating that post injury development of white matter tracts could be impeded based on the particular form of TBI. White matter has a significant impact on the speed and systematic sharing of information between the fronto-striatal circuits in addition to the ease of interaction between the frontal cortex and other regions in the brain (Paus, 2010). The detrimental impact of TBI on white matter integrity threatens the connectivity of neural networks that allow the integration of these specialized processes throughout the brain (Park & Friston, 2013). In particular, vulnerabilities may occur in the formation of white matter connections between brain regions that construct the anatomically disperse "social brain" network, including the medial prefrontal cortex, orbitofrontal cortex, amygdala, temporoparietal junction, and inferior parietal cortex (Adolphs, 2009; Beauchamp & Anderson, 2010). It has been argued that a child's inadequate ability to acquire and advance social skills at a developmentally appropriate rate may result from injuries to these areas, specifically in the case of younger children whose social cognitive functions may be emerging at the time of the injury (Yeates et al., 2007; Semple et al., 2012). Moreover, a diffuse neural injury can compromise general cognitive substrates that include processing speed, working memory, episodic memory, attention, working memory, and executive functioning (Babikian & Asarnow, 2009; Dennis et al., 2015). Deficits in these areas may impede a child's flourishing self-sufficiency and capacity to develop and sustain valuable relationships (Shorland & Douglas, 2010). Yet, Ewing-Cobbs and colleagues (2008) found behavioral evidence indicating that developmental skills that are more fully developed are less vulnerable to severe disruption than skills undergoing rapid maturation.

Causes of Injury

Children and young teenagers are at greater risk for experiencing TBIs, and TBIs in these populations require an extended process to heal because youths' brains are still maturing and developing (Harvey, 2013). Sports and recreation related (SRR) incidents, motor vehicle accidents (MVA), falls, and violence are the cause of a substantial number of TBIs that occur annually; these injuries can also be unreported (Thomas et al., 2015). Most often children experience TBIs related to traumas (e.g., assault), while adolescents and young adults primarily experience TBIs as a result of traffic accidents and violence (Kumar et al., 2019). Faul and colleagues (2010) found that among motor vehicle occupants, the average annual incidence of ED visits for child occupants (0–14 years old) was 13,380, with 3,897 hospitalizations and 505 deaths. Still, approximately 283,000 children below the age of 18 receive emergency care services each year in relation to a TBI caused by a sports and recreation injury (Sarmiento et al., 2019). Males and children ages 10-17 years experienced sports related injuries at the highest rates, with activities such as football, basketball, bicycling, soccer, and playground activities linked to the highest rates of emergency room visits (Sarmiento et al., 2019). Understanding patterns of sports- and recreation-related injuries becomes especially important when considering athletes who play competitive sports are susceptible to repetitive blows to the head. Both severity of primary brain injury and the occurrence of secondary insults influence the outcome of pediatric TBI (Ducrocq et al., 2006). In particular, the degree of neurological deficits is contingent upon the number of head injuries over time and the time between these injuries, with proximal injuries leading to more noticeable deficits than those with greater time lapses in between (Noble-Hauesslein et al., 2019). Also, the estimates mentioned are based on emergency-related visits, and do not include the large number of patients who either do not seek care or receive only outpatient care; therefore, the true incidence rate is likely higher (Arbogast et al., 2016; Fischer et al., 2018). Nevertheless, the data supports the growing concern that TBIs pose a significant health problem for children and adolescents, and therefore further affirms the need for examining its potential effects on development.

Post-concussive symptoms such as cognitive, behavioral, motor, emotional and social deficits can last from days to years post-injury (Watanitanon et al, 2018). Thus, a discrete connection between the brain injury event and the related initial symptoms is often impeded by the manifestation of additional symptoms long after acute symptoms subside (Thomas et al., 2015). Additionally, there have been inconsistencies in examining outcomes after different causes of injury. For instance, Ponsford and colleagues (2000) reported that TBIs related to MVAs have a greater probability of leading to persistent problems than any other causes, while Majdan and colleagues (2011) reported that MVAs involve more critical injuries but lead to better outcomes than assaults and falls. Mathias and colleagues (2014) focused on TBI as a result of physical assaults in comparison to accidental sporting injuries because assaults were assumed to be more psychologically traumatizing. Their results indicated that people experienced poorer psychosocial and emotional outcomes after sustaining a TBI during an assault in comparison to those who acquired injuries due to less traumatizing circumstances. However, there were no significant differences noted in the cognitive and functional (i.e., general outcome, resumption of home, social, and work roles) outcome between both TBI groups (Mathias et al., 2014).

Overall Impact on Cognitive Functioning

Even in the case of mild TBIs about 15% of patients will report prolonged cognitive weaknesses after 1 year post injury (Eme, 2017). Disturbances of attention and memory, slow cognition, increased distractibility, and difficulty with multi-tasking are all associated with the neuropsychological outcome of patients with TBI (Wang & Li, 2016).

The average human has an inherently limited capacity to process information, and so the ability to multitask effectively is assumed to be impacted when cognitive workload increases and results in a weakened ability to react to changes in tasks occurring simultaneously (Strayer et al., 2017; Townsend & Eidels, 2011). Yet specifically, in cases involving children and adolescents with moderate to severe TBI, deficits in the ability to temporarily store and manipulate information in the mind, known as working memory, are also commonly exhibited (Phillips et al., 2017). This can complicate the recovery process to a greater degree when children must not only attempt to regain their former level of functioning, but they also need to continue to acquire new skills to appropriately maintain adequate development (Keenan et al., 2018). They may be faced with difficulties when attempting to perform preinjury tasks and academic activities or follow instructions that would have ordinarily been viewed as routine (Riggio, 2011). There is also the potential for the overlap of a major cognitive deficit in one area to impact the cognitive performance in another area (Riggio, 2011). For example, it is common for a child who is experiencing difficulty with attention to also have difficulty retaining information. Additionally, a child who may be exhibiting memory difficulties could potentially have difficulty with following multi-step directions. Furthermore, cognitive deficits within the areas of impaired attention, memory, and/or executive functioning may elicit changes in personality, impulsivity, irritability, anxiety, depression, emotional lability, and apathy due to frustration (Pavlovic et al., 2019).

Overall Impact on Social-Emotional Development

Childhood and adolescence are significant stages for the development of neurobiological processes that underlie intricate social and emotional behaviors (Choudhury et al., 2006). This understanding of typical child development is especially important considering one of the most distressing consequences for children who sustain a brain injury are the long-term behavior difficulties (Chapman et al., 2010; Yeates et al., 2010). These findings are consistent with prior research that reported elevated scales of internalizing and externalizing behaviors in school-age children and adolescents after TBI (Wade et al., 2006; Schwartz et al., 2003). Also, a set of recent studies discovered that there was an association between long-term problems and injury severity, in which significantly greater behavior problems were linked to severe injuries. These same studies also reported that even after one or more years, unfavorable behavioral symptoms unsuccessfully resolved at long-term follow-ups (Karver et al., 2012).

Although the types of injury resulting in a TBI can produce similar behavioral impairments, there can be a variation in intensity based on a number of factors such as brain localization, injury related events (e.g., traumatic vs. non-traumatic), premorbid conditions, gender, and age (Thomas et al., 2015). Particularly, changes in personality have also been found to be a common and problematic symptom within this population due to its connection to the frontal lobe (Chapman et al., 2010; Max et al., 2015; Yeates et al., 2010). A number of medical providers working in rehabilitation have noted that up to 40% of children who have been consecutively hospitalized with severe TBI exhibit recurring and troublesome changes in personality (Max et al., 2015; Norup & Mortensen, 2015). Given that stable patterns of personality are not fully established until adulthood, any noticeable changes occurring in personality may be classified as a marked digression from normal patterns of development in children and adolescents (Max et al., 2015). Additionally, behaviors that suggest poor control of inhibition such as actions and responses that are socially inappropriate, perseverating on a topic, and responding impulsively without thinking are correlated with damage to orbitofrontal regions (Douglass, 2010). Behaviors such as these have been theorized to result from dysfunction in the executive control of inhibition because it is the executive system that governs the control of cognitive processes (Pearce et al., 2016).

Executive Functioning (EF)

EF has been described in various ways, however each of these descriptions often share one universal theme. EF is the use of higher-level cognitive skills that essentially influence and regulate lower-level processes (e.g., motor responses) in an effort to direct behavior toward a goal (Alvarez & Emory, 2006; Banich, 2009). Unlike our more automatic cognitive processes that have been learned through repetition (e.g., motor, language skills, semantic memory), EF is expressed in nonroutine situations that empower us to respond flexibly to the environment, make quick decisions while evaluating the risks, strategize for the future, prioritize and sequence actions, and manage novel and complex circumstances (Snyder, 2013). In essence, it equips a person to engage in independent, self-directed, and problem-solving behavior efficiently and effectively (Van Den Berg et al., 2018). Given that executive functioning plays a fundamental role in our ability to effectively navigate through day-to-day tasks, an impairment in EF can seriously impact a child's quality of life and functional outcome (Snyder, 2013).

EF evolves at various rates throughout infancy, childhood, and late adolescence and uniquely progresses based on the maturation of an individual's cortical-subcortical pathways (Anderson, 2002; Diamond, 2013). Improvement in inhibition appears to be essential to the developmental changes in EF during the early years. Moreso, EF development during this time is characterized by an increased ability to integrate rules and to control overpowering thoughts (Garon et al., 2008). During the school years, the development of different aspects of EF are evident across different ages. Studies have highlighted improvements in cognitive flexibility in younger school aged children (i.e., ages 6-8) while planning, organizing, strategic thinking and working memory are usually reported to emerge later during this period (i.e., ages 11-12; Anderson, 2002; De Luca et al., 2003). During adolescence, there are structural changes in the frontal cortex of the brain that have been associated with age-related advancements in working memory, decision making and inhibitory control (Hughes, 2011).

McCloskey and Perkins (2013) describe what are known as four essential arenas of involvement in the daily use of executive functioning. The Intrapersonal Arena involves an individuals' ability to direct (i.e., self-regulate) themselves in relation to their own internal state. The Interpersonal Arena involves the ability to direct themselves in relation to others. The Environment Arena involves the ability to direct themselves in relation to the environment. The Symbol Arena involves the ability to direct themselves in relation to academics (e.g., reading, writing, language, and other formal systems of knowledge; McCloskey & Perkins, 2013). It has been proposed that because executive functions are enmeshed in our management of social skills, particularly social problem solving, social cognition, and social behavioral regulation, in addition to everyday functioning in social and academic areas, occupational attainment, and involvement in society, longstanding impairments can occur in these areas when EF is impacted (Arnett et al., 2013; Eslinger et al., 2004; Muscara et al., 2008). Furthermore, there is often debate concerning the measurement of EF with some favoring the use of questionnaire-based methods (e.g., Behavior Regulation Inventory of Executive Functioning; BRIEF) and others favoring the implementation of performance-based neuropsychological assessments (Modi et al., 2018). Rating scales such as the BRIEF evaluate the actual application of skills in real world settings while performance-based measures evaluate distinctive components of EF in isolation (Modi et al., 2018).

Emotional Regulation: Inhibition, Shifting, Emotional Control

Executive functioning has been conceptualized as both a uniform entity and as a set of interconnected constructs that operate together (Lyons et al., 2016). Inhibition is one's ability to inhibit, resist, and refrain from acting on impulse. Shifting is one's ability to transition freely from one situation to another (i.e., cognitive flexibility). Emotional Control is one's ability to modulate their emotional responses. Behavioral Regulation is a person's ability to do all three (i.e., self-regulation; Gioia et al., 2000). Those who experience difficulty in these areas may often demonstrate a lack of personal safety, disrupt others, speak out of turn, and have trouble with the interference of extraneous information within their surroundings (Hughes, 2011).

Cognitive Regulation: Initiating, Working Memory, Plan/Organize, Monitor, Organization of Materials

Initiating is one's ability to independently begin a task or generate ideas or strategies. Working Memory is one's capacity to hold information in mind for the purpose of completing a task. Planning is one's ability to manage current or future oriented task demands. Monitoring consists of one's work checking habits and ability to assess their performance to ensure a goal is met. Organization of Materials is one's orderliness of work, play or storage areas. Metacognition is one's ability to cognitively self-manage each of these areas (Gioia et al., 2000).

Executive Functioning in Relation to TBI

Brain lesions that occur early in life have also been found to disrupt the cognitive and behavioral aspects of EF development (Levin & Hanten, 2005). Following a TBI, one of the more commonly reported areas of cognitive impairment is executive dysfunction and the degree of deficit is typically noted to be in relation to injury severity and younger age at the time of injury (Anderson & Catroppa, 2005; Anderson et al., 2011; Donders & Warschausky, 2007; Nadebaum et al., 2007). It has been suggested that the skills that are in an active state of development or undeveloped at the time of injury are highly vulnerable to the effects of an early brain injury and deficits may only become evident when certain developmental abilities are expected or as the developmental demands on the child intensify (Anderson et al., 2011; Ewing-Cobbs et al., 2004; Thurman, 2016). Moderate-severe TBI often results in damage to the prefrontal circuits due to either focal cortical contusions or diffuse axonal injury (Rabinowitz & Levin, 2014). Frontal system damage after a TBI often leads to deficits in executive functioning (Stuss, 2011), subsequently affecting an individual’s ability to adapt their behavior to changing circumstances (Rakers et al., 2018).

However, it is necessary to take into account that deficits in EF and its association with impairments in behavior are not exclusive to people with TBI. Executive dysfunction has been noted in various clinical groups including individuals with Autism Spectrum Disorder (ASD), ADHD, learning difficulties, congenital heart disease, orthopedic injuries, and coronary artery bypass graft surgery patients (Blijd-Hoogewys et al., 2014; Gerstle, 2016; Rudolph et al., 2006). People diagnosed with disorders such as these often exhibit EF deficits, predominantly with weaknesses displayed in cognitive flexibility, planning/organization, task initiation, and working memory task (Maloney et al., 2020; Newton et al., 2017). The combination of specific EF impairments being linked to behavioral characteristics has been well-documented within these groups (Amorim & Marques, 2018; Newton et al., 2017). For instance, weaknesses in task initiation, working memory and cognitive flexibility have been associated with deficits in communication and social interaction (Maloney et al., 2020). It has also been suggested that there is an association between deficits in working memory, inhibition, monitoring, and self-regulation and the struggle of children with ASD and ADHD to grasp the effects of their behavior on others (Hofmann et al., 2012). Van Den Berg and colleagues (2018) also found that children with executive functioning problems as a result of frontal lobe epilepsy expressed both behavioral and social difficulties.

Internalizing Behaviors: Anxious/Depressed

Depression and anxiety related symptoms are often found to be higher in TBI patients. Both prospective and retrospective studies have described a high occurrence of internalizing disorders related to depression, anxiety, and somatic complaints in up to 60% to 71% of children and adolescents within the first two years following a TBI (Juranek et al., 2012). Internalizing symptoms are more likely to increase over time postinjury, with fewer prominent changes following moderate TBI (Anderson et al., 2006). Major depression is often the most frequently reported, occurring in approximately 25-40% of moderate to severe TBI cases (Riggio & Wong, 2009). Multiple studies have found the prevalence of depression among individuals with traumatic brain injury (TBI) to be greater than in the general population (Alway, et al., 2016; Bombardier et al., 2010; Scholten et al., 2016). These individuals are 10 times more likely to experience a depressive episode during their first year of recovery (Failla et al., 2016). Jorge and Robinson (2002) reported indirect evidence of a depressed mood in about half of their patients at 3, 6 or 12 months following severe brain injury. In addition, although the rate of depression is typically higher at 1 month post injury, there are reports of symptoms still being noted 3-5 years post injury in some cases (Dikmen et al., 2004; Jorge & Robinson, 2002).

Anxiety is also potentially a significant psychological problem due to its impact on post injury outcomes and quality of life (Franulic et al., 2004; Osborn et al., 2016). Bertisch and colleagues (2013) reported that anxiety related symptoms were more likely to influence social and community function than cognitive impairment following a brain injury. Similar to depression, there is considerable variation in the prevalence of anxiety with a range of 2% to 83% (McLaughlin & King, 2015; Koponen et al., 2002). One explanation for the variation is that the term “anxiety” can have a very general meaning and the symptoms can range in severity from mild apprehension to extremely debilitating distress (Osborn et al., 2016). More often than not, these children's problems can be easily overlooked early in the recovery process, as they may be viewed as attributable to the TBI itself rather than to depression or anxiety (Llie et al., 2014; Osborn et al., 2016). Therefore, it can be assumed that these symptoms will dissipate as the brain begins to heal itself. Yet these symptoms are distressing in and of themselves, and post-TBI depression and anxiety has been associated with increased risk of suicide attempt or ideation as well as poor mental and psychological health compared with non-TBI adolescents (Llie et al., 2014; Tsaousides et al., 2011). The severity of these symptoms is often not recognized until children and adolescents begin to have difficulty keeping up with grade-level academics, difficulty building and maintaining appropriate social relationships, and the frequency of disruptions within the home setting intensifies (Hart et al., 2011; Ryan et al., 2015).

Externalizing Behaviors: Aggression

The rising prevalence of externalizing behaviors problems among the children and adolescent TBI population has become a major concern, especially given the potential consequences of these behaviors such as detention/expulsion from school or problems with the law (Raj et al., 2013). The behavioral disturbances exhibited by an individual with TBI can cause increased distress and lead to greater difficulties with adjusting to the physical and cognitive aspects of their injury. Studies have also found that antisocial behavior, having fewer friends, aggressive tendencies, substance abuse, and an inability to tolerate frustration are all common results of a TBI (Llie et al., 2014). These symptoms were reported to continue into adulthood and lead to difficulties with maintaining employment (Llie et al., 2014). Of these symptoms studied, aggression has been the most reported by parents, with verbal aggression being more prevalent than physical aggression (Roy et al., 2017). A study conducted by Sabaz and colleagues (2014) reported on 507 subjects with severe TBI and found the prevalence of aggression within 6 months postinjury to be 31.7%. Tateno and colleagues (2003) conducted a similar study and found related reports of aggression at 6 months with a prevalence rate of 33.7%, however their study also noted that aggressive behavior was associated with depression. Moreover, Roy and colleagues (2017) observed that the presence of aggression at 3 months post-injury predicted aggression at 6- and 12-months post-injury. These studies indicate that early targeted intervention following a TBI may help to prevent the gradual development of aggressive behavior during the first year or later.

Mental Health: Impact on Home Environment

Various pharmacological and nonpharmacological strategies are immersed in the treatment of psychiatric disorders that ensue following a TBI. Some would presume that remedies for neurobehavioral consequences would be implemented in the advanced stages following an acute injury, however caregivers are reporting that this is not always the case (Jorge & Robinson, 2002). Behavioral change is often reported by family members, and studies have indicated that neurobehavioral or personality change in patients and recovery following injury are significant stressors for families, resulting in emotional distress, burden, strain, financial difficulties, and impaired quality of life (Aitken et al., 2009; Diaz et al., 2014; Ganesalingam et al., 2008; Jordan & Linden, 2013; Norup & Mortensen, 2015; Stancin et al., 2008). Zgaljardic and colleagues (2015) found that the neurobehavioral aspects are in fact recognized by caregivers as a more notable cause of anguish than the physical or cognitive deficits experienced by their child. Research indicates that greater general distress during the initial 18 months is reported by parents of children who sustain a TBI in the preschool years and parents of children injured later in childhood are associated with higher levels of parental distress further in the recovery process (Fay et al., 2009; Yeates et al., 2010). Therefore, it is not only the child but also his or her extended environment that may need to readjust to the new circumstances (Silberg et al., 2015). Parents are faced with distinctive stressors concerning their child's recovery, including anxiety regarding their long-term functioning, adjustment to arising behavioral difficulties, and implications for independence (Babikian et al., 2015). This burden can be overwhelming for parents and may exacerbate impairment or negative outcomes as a result (Wetherington et al., 2010).

Concerns with Treatment

A high frequency and variability of psychiatric symptoms are reported in patients with TBI, in spite of how severe the injury may be. These symptoms can include maladaptive social behaviors, psychosis (e.g., delusions, and/or hallucinations), poor disability adjustment, reduced coping skills, depressed mood, anxiety, personality changes (e.g., poor anger/impulse control and irritability), and cognitive impairment (e.g., executive dysfunction; (Zgaljardic et al., 2015). Silver and colleagues (2001) noted that compared to the 20% of non-TBI participants in their study, 43% of TBI patients had received at least one diagnosis of a psychiatric disorder. Similarly, Goldstrohm and Arffa, (2005) reported that the rate of developing a psychiatric disorder was three times more common in severe cases of TBI (post-traumatic amnesia for more than 22 days). In some cases, the post-TBI psychiatric symptoms may occur as a reaction to the injury itself and/or the realization of being hospitalized and losing a sense of independence (Zgaljardic et al., 2015).

Often, the injury limits a person's ability to re-engage with their preinjury environments (e.g., home, recreational, or workplace and/or academic settings) which results in an abrupt reduction of their usual everyday socialization with family and friends. Thus, leading to 60% of patients reporting feelings of social isolation immediately following TBI (Hoofien et al., 2001). During the rehabilitation process individuals with TBI must adjust to newfound cognitive and physical weaknesses, in addition to the serious likelihood that their life may not be the same as it once was prior to the injury (Zgaljardic et al., 2015). Any maladaptive behaviors and psychiatric symptoms encountered by patients during the post-acute period also have the potential to impact a person's participation in rehabilitation therapy services (Reid-Arndt et al., 2007).

Although ways to address these factors in acute inpatient rehabilitation have been recognized, there is still substantial disparity in adherence to addressing the neurobehavioral, psychosocial, cognitive, and communication needs as it pertains to facilitating community reintegration (Ennis et al., 2014; Rivara et al., 2012). The psychoeducation and follow-up that is offered to families upon their transition home from inpatient rehabilitation varies from setting to setting, leaving many uneducated and unprepared when problems occur, thus delivering appropriate and routine follow-up care is a vital component to increasing a patient's optimal functioning following a trauma, especially with a TBI (Zgaljardic et al., 2015). Unfortunately, there are a number of studies that note low rates of mental health and medical follow-up in this population, despite of the established need (Karver et al., 2012; Keenan et al., 2013; Kurowski et al., 2013; Slomine et al., 2006). Colantonio and colleagues (2010) noted that 86% of TBI patients do not receive any long-term therapy focusing on their psychological or psycho-educational needs. This low rate of therapeutic intervention was even prominent in more severe cases (Catroppa et al., 2012). Systematic integration of mental health services into standard outpatient care may be beneficial to advancing the long-term outcomes after TBI (Bombardier et al., 2010). Within inpatient rehabilitation, integrated clinical healthcare practices can be utilized to form treatment plans that focus on early identification, risk assessments, possible diagnoses and a guideline driven management of care. Systematic mental health screenings and stepped care treatment protocols should be assimilated into routine outpatient care to support transitions (Bombardier et al., 2010).

Cognitive Behavioral Therapy

Cognitive Behavioral Therapy (CBT) is an evidenced-based psychosocial intervention that was originally developed by Beck to treat depression in adults, however, the model has now been extended to address the causes of anxiety and depression in children and adolescents (Chorpita, 2007). CBT is based on the philosophy that our cognitions contribute to the development and continuance of certain behaviors and emotions (Heimberg, 2002). Therefore, the main objective of CBT is to instruct individuals in how to recognize irrational beliefs, monitor automatic thoughts, and substitute their automatic thoughts with more rational and adaptive ones by focusing on the "here and now" (Kendall & Hedke, 2006). CBT also generally promotes self-efficacy through the implementation of behavioral methods such as graded exposure, activity scheduling, social skills training, and relaxation training (Chorpita, 2007). CBT typically revolves around the use of a structured manual approach or modular format entailing cognitive restructuring, coping skills, and problem solving (Kendall & Hedke, 2006). The structured manualized approach involves the practice of explicit cognitive and behavioral techniques based on specific instructions during a particular session, while the modular method allows for added flexibility and can be tailored to fit the individual's needs (Chorpita, 2007). No matter the format, many CBT interventions are typically provided weekly for 12 weeks in length (Reaven et al., 2011).

Prior studies have advocated for the effectiveness of CBT for treatment of children with emotional and behavioral problems, anxiety, and depression, as it offers the most structured approach to focusing on concrete thoughts and behaviors (Hodgson et al., 2005; Kendall & Hedtke, 2006; Rith-Najarian et al., 2019). A meta-analysis conducted by Silverman and colleagues (2008) revealed that 95% of the studies focusing on CBT treatments noted that at least 46% of the participants exhibited diagnostic recovery by post-treatment. Higa-McMillan and colleagues (2016) replicated and extended the earlier reviews by examining 111 treatment outcome studies testing treatment conditions for anxiety in children and adolescents published between 1967 and 2013. Their findings supported the effectiveness of CBT as a first line of treatment for youth with anxiety. Furthermore, Weersing and colleagues (2017) reviewed randomized controlled trials focusing on the evidence-based treatment of depression in youth published between 1998 and 2014 and noted that CBT continues to be the best-supported treatment model for the treatment of depression in children and adolescents. CBT was distinctly shown to be the more influential intervention model in the literature and met criteria for a “well-established” intervention across group and individual formats (Weersing et al., 2017). CBT programs that target anxiety help to address the cognitive distortions and avoidant behaviors that are typical of this population. For example, youth may demonstrate cognitive biases that can contribute to a belief that they may be unequipped to handle certain anxiety-provoking situations such as returning to school following a TBI (Suveg et al., 2009).

CBT aims to help youth in defining cognitions, recognizing somatic features of anxiety, and creating a plan for coping in anxiety-provoking situations (Suveg et al., 2009). Improving coping skills or altering coping mechanisms is also important in helping youth to manage stressful events and challenges that can lead to depressive symptoms (Chu & Harrison, 2007). Children and parents have reported improvements in psychological adjustment and in the ability to cope following the implementation of CBT active strategies (Chu & Harrison, 2007). CBT has also been found to address aggressive behaviors by focusing on deficits in emotion regulation and social problem-solving skills (Dodge, 2003). CBT approaches typically revolve around the regulation of excessive anger, developing social skills as an alternative to aggressive behaviors and learning social problem-solving strategies (Sukhodolsky et al., 2016). However, it is pertinent to remember that impairments in attention, memory, executive functioning, and social awareness may affect an individual's ability to benefit from traditional psychological therapy. Therefore, adjusting therapy to include repetition and prompting, simplified self-monitoring forms, manualized handouts and visual prompts, management strategies for executive functioning difficulties, and an emphasis on concrete behavioral strategies can maximize its benefits can be essential when considering cognitive impairments (Ponsford et al., 2015). Booster sessions can be especially helpful to individuals with executive and memory difficulties (Ponsford et al., 2015). Neuropsychological deficits have been found to be associated with functional outcomes in mood disorders, and therefore the integration of cognitive remediation strategies that are specifically designed to focus on executive function and attention deficits may be paramount to the treatment process (Groves et al., 2015).

CHAPTER 3: METHOD

This current study identifies the particular scales of executive functioning (i.e., BRIEF, BRIEF-P) that are most closely correlated with social and emotional functioning (i.e., CBCL scales) in order to guide future studies which, seek to implement early and targeted interventions following a traumatic brain injury. This study used a cross-sectional observational design to examine the relationship of behavior regulation (i.e., the ability to shift cognitive set and modulate emotions and behaviors via appropriate inhibitory control) scales and metacognition (i.e., the ability to cognitive self-manage tasks and monitor performance) scales of the BRIEF and BRIEF-P to the internalizing (i.e., anxious, withdrawn, depressed) scale and externalizing (i.e., rule breaking and aggressive behavior) scale on the CBCL. The correlational relationships found between each scale could suggest that the degree to which a deficit in one dimension (e.g., lack of metacognition) could account for a deficit in another dimension (e.g., internalizing behaviors).

Participants

Data for 253 children and adolescents with severe TBI collected as part of an Approaches and Decision for Acute Pediatric TBI (ADAPT) study was provided. The severity of TBI was determined by the Glasgow Coma Scale (GCS), which was administered by the hospital at the time of admission. Relevant data (e.g., age, race, ethnicity, gender, past history of brain injury, mechanism of injury) was collected through a review of patients' medical records.

Inclusion and Exclusion Criteria

Eligible participants included all those admitted with severe TBI (GCS ≤ 8 after resuscitation) who had intracranial pressure (ICP) monitoring placed as part of their routine care. The participants were children and adolescents ranging in age from age 1 through 18 years old. Children and adolescents were excluded if their ICP monitor was placed at another hospital prior to the study hospital. Participants were also excluded from the data analysis as a result of incomplete data.

Screening and Recruitment

Most families were previously known through their participation in clinical care for treatment associated with a TBI. Each family was contacted by phone at 3- and 6-months post injury to schedule a 12-month follow up visit and assessment session. Staff were available to complete assessment sessions during the evenings. The BRIEF, BRIEF-P, and CBCL were administered to caregivers by a site neuropsychologist or technician trained in the administration of neuropsychological tests 12 months post TBI.

Measures

Behavior Regulation Inventory of Executive Functioning (BRIEF)

The BRIEF originated as a measure of executive functioning (EF) in daily life and is widely defined as an assessment of purposeful, goal-directed behaviors for novel problem-solving and adaptation (Gioia et al., 2000). This version is designed for children ages 5-18. There are eight interrelated clinical scales that are designed to reflect these various aspects of executive functioning in real world settings. The Behavior Regulation Index consists of the Inhibit, Shift, and Emotional Control scales. The Metacognition Index consists of the Initiate, Working Memory, Plan/Organize, Organization of Materials and Monitor scales. Both of these domains comprise the Global Executive Composite. The 86-item rating scale can be answered by the child's family (reflecting behavior at home) and the child's teacher (reflecting behavior and organization in the classroom). The rater responds based on the occurrence of behaviors observed by circling "N" for Never, "S" for Sometimes or "O" for Often with higher scores reflecting a greater degree of pathology. A *T*-score over 65 is considered an area of concern on this measure. Several studies have utilized the BRIEF and found evidence supporting its sensitivity to deficits in EF within the pediatric TBI population (Mangeot et al., 2002; Vriezen & Pigott, 2002). There is also substantiating evidence for the validity of its underlying constructs (Donders et al., 2010), and criterion-related evidence has suggested the measure's sensitivity to the seriousness of the TBI (Sesma et al., 2008). The BRIEF has generally good reliability, with internal consistency ranging from 0.80 to 0.97, and test–retest correlations between 0.76 and 0.85, in the normative sample (Gioia et al., 2000).

Behavior Regulation Inventory of Executive Functioning- Preschool (BRIEF-P)

The BRIEF-P originated as a measure of executive functioning (EF) in the daily life of children ages 2-5 (Gioia et al., 2003). There are five interrelated clinical scales that are designed to reflect these various aspects of executive functioning in real world settings. The Inhibitory Self-Control Index consists of the Inhibit and Emotional Control scales. The Flexibility Index consists of the Shift and Emotional Control scales. The Emergent Metacognition Index consists of the Initiate, Working Memory, and Plan/Organize scales. Each of these domains comprise the Global Executive Composite. Similar to the BRIEF, the 63-item rating scale can be answered by the child's family (reflecting behavior at home). The rater responds based on the occurrence of behaviors observed by circling "N" for Never, "S" for Sometimes or "O" for Often with higher scores reflecting a greater degree of pathology. A *T*-score over 65 is considered an area of concern on this measure. There is evidence to support high internal consistency reliabilities for the BRIEF-P (αs =0.80–0.90), as well as moderate to high test-retest reliability (*rs* = 0.78–0.90; Gioia et al., 2003).

Child Behavior Checklist (CBCL)

The CBCL assesses eight inter-related clinical scales that reflect various aspects of emotional/behavioral adjustment (Achenbach & Rescorla, 2001). The Internalizing Index consists of the Anxious/Depressed, Withdrawn/ Depressed and Somatic Complaints scales, whereas the Externalizing Index consists of Rule-Breaking Behavior and Aggressive Behavior scales. Social Problems, Thought Problems and Attention Problems are three additional scales that are factored into the Total Problems Index, but do not contribute to the Internalizing or Externalizing domains. The 113-item rating scale requires parental responses of *Not True* (0), *Somewhat* or *Sometimes True* (1), or *Very True or Often True* (2) to a range of descriptions with higher scores reflecting a greater degree of pathology. In multiple studies of pediatric TBI, the CBCL has been utilized with evidence for diversified post-injury profiles (Hayman-Abello et al., 2003) and an interaction effect where problems with long-term adjustment increases proportionately in children who sustained a severe brain injury during early development (Karver et al., 2012). The CBCL has test-retest reliability of 0.73-0.94, internal consistency reliability (alphas) of 0.63-0.97, and inter-rater reliability of 0.57-0.88 in the normative sample (Achenbach, 2001).

Glasgow Coma Scale (GCS)

The TBI group will be restricted to children with severe TBI. The severity of TBI will be determined by the Glasgow Coma Scale (GCS). The GCS is the most common measure used to determine the level of consciousness after a TBI. The scale is typically administered at the time of injury and measures the following: eye opening, verbal response, and motor impairment. Consistent with established conventions, scores range from 3 to 15. Severe TBI will be defined based on a lowest post-resuscitation GCS score of 8 or less, moderate TBI will be a GCS score of 9–12, and complicated mild TBI will be a GCS score of 13–15 in association with trauma-related abnormalities on neuroimaging at the time of hospitalization (Sternbach, 2000; Teasdale & Jennett, 1974).

Procedure

An ADAPT TBI team completed an observational study of 253 children to evaluate the effectiveness of six therapies encompassing intracranial hypertension therapies, secondary insult prevention, and metabolism. The clinical trial enrolled 253 study participants from over 32 clinical sites. The demographic data was collected by reviewing patient's medical records. Each patient was enrolled via the Matrix data system which is a password-protected database located within the Epidemiology Data Center. A Genuine Unique Identifier Number was generated using personal health information (first name, middle name, last name, date of birth, city of birth, country of birth) for all subjects who agreed to participate. All data was entered and verified by each participating site within a Matrix database located in the Data Coordinating Center at the University of Pittsburgh. Prior to each evaluation, informed consent and child assent was obtained. Upon being classified as medically stable and deemed eligible by the ADAPT research coordinator, pediatric patients with severe TBI were evaluated within an outpatient setting and data was collected. The caregivers were asked to complete the BRIEF or BRIEF-P and the CBCL, while their child or adolescent completed the neuropsychological evaluation in a separate room. All outcome testing was completed in December 2017. The archival data was retrieved from the ADAPT organization upon the submission of a proposal. Following the review of The Children's Hospital of Philadelphia's and Philadelphia College of Osteopathic Medicine's Institutional Review Boards in which it was deemed that this study was exempt from requiring IRB approval as it did not meet criteria for human subjects research due to the lack of identifiable personal information, the de-identified neuropsychological outcome data was obtained from the ADAPT organization. A de-identified data set was requested which included limited demographic data (e.g., gender, age at injury, severity of injury, and mechanism of injury) as well as parent reports on the BRIEF and CBCL for children with pediatric TBI. All data was provided in a password-protected file.

CHAPTER 4: RESULTS

Descriptive Analyses

Descriptive analyses were run on demographic variables, including gender, age at injury, mechanism of injury, and severity of injury, to describe the sample. A total sample size of 230 participants were included in the analyses. In reference to gender, 64.3% (*n* = 148) of the participants were identified as male and 35.7% (*n* = 82) were identified as female. The participants' ages ranged from 1 to 18 years (*M* = 9.39, *SD* = 5.04). In regards to the mechanism of injury, a large majority of the participants had been involved in a motor vehicle accident (44.3%; *n* = 102). In regard to severity of injury, all participants fell within the severe TBI (GCS $\geq$ 8 after resuscitation) range consistent with study inclusion criteria, however the majority were identified with a GCS score of 3 (28.7%; *n* = 66) which is the lowest possible score. The larger study included data from an additional 23 participants who were not included in the analyses described here due to missing information on the BRIEF-P/BRIEF or CBCL. Description of the 23 excluded participants is as follows: gender, 43.5% (*n* =10) male and 56.5% (*n* = 23) female, ranging in age from 1 to 18 years (*M* = 5.52, *SD* = 5.99). The majority of the excluded participants' mechanism of injury was via motor vehicle accident (30.4%; *n* = 7) consistent with the overall sample. All participants fell within the severe TBI (GCS $\leq$ 8 after resuscitation) range; however the majority were identified with a GCS score of 3 (43.5%; *n* = 10) which is the lowest possible score. Frequencies for all demographic variables included in the analyses can be found in Table 1. Frequencies for all demographic variables included in the larger study can be found in Table 2.

Table 1

Frequencies for Demographic Variables

Demographic Variables	*n*	%
Sex		
Male	148	64.3
Female	82	35.7
Mechanism of Injury		
Railway	2	.9
Motor vehicle traffic accident	102	44.3
Motor vehicle nontraffic accident	25	10.9
Other road vehicle accidents	6	2.6
Water transport accident	1	.4
Vehicle accident not elsewhere specified	1	.4
Accidental fall	46	20.0
Accident due to natural factors	2	.9
Homicide & injury purposely inflicted by other persons	22	9.6
Other accidents	23	10.0
Glasgow Coma Scale		
3	66	28.7
4	17	7.4
5	20	8.7
6	38	16.5
7	55	23.9
8	34	14.8

Table 2

Frequencies for Demographic Variables of Participants Excluded from Current Study

Demographic Variables	*n*	%
Sex		
Male	10	43.5
Female	13	56.5
Mechanism of Injury		
Motor vehicle traffic accident	7	30.4
Accidental fall	6	26.1
Homicide & injury purposely inflicted by other persons	6	26.1
Other accidents	4	17.4
Glasgow Coma Scale		
3	10	43.5
4	1	4.3
5	2	8.7
6	3	13
7	4	17.4
8	3	13

Analyses for Each Hypothesis

Hypothesis 1

To evaluate whether children and adolescents with TBI have higher (more impaired) scores on all EF composite domains in comparison to normative data (normative data for *T*-scores equals a mean of 50 and a standard deviation of 10), individual *z*-tests were performed. Results indicated more impaired executive functioning in Global Executive Composite $M = 58$, $z(216) = 11.782$, $p = .000$, Behavior Regulation Composite $M = 57$, z(218) = 10.309, $p = .000$, and Metacognition $M = 58$, $z(218) = 11.688$, $p = .000$ within the TBI population. There was a larger effect size noted in the Metacognition composite (Cohen's $d = .79$) in comparison to the Behavior Regulation

(Cohen's *d* = .70) composite indicating a greater impairment in Metacognition (Table 3).

Table 3

Z-test Outcome for Parent-Reported Executive Functioning at 12 Months Post Injury: All Ages

Composites	Mean	z	df	p	Effect size
General Executive Composite [a]	58	11.782	216	.000	.80
Behavioral Regulation [b]	57	10.309	218	.000	.70
Metacognition [c]	58	11.688	218	.000	.79

[a] *G*lobal Executive Composite (GEC) is a combined variable consisting of BRIEF-P GEC and BRIEF GEC. [b] Behavior Regulation Composite is a combined variable consisting of BRIEF-P Inhibitory Self-Control Index (ISCI) and BRIEF Behavior Regulation Index (BRI). [c] Metacognition Composite is a combined variable consisting of BRIEF-P Emergent Metacognition Index (EMI) and BRIEF Metacognition Index (MI).

Hypothesis 2

To evaluate whether children and adolescents with TBI have higher (more impaired) scores on all EF subdomains in comparison to normative data (normative data for *T*-scores equals a mean of 50 and a standard deviation of 10), individual *z*-tests were performed. *Z*-tests statistics relative to population norms revealed children with TBI demonstrated impaired EF (caregiver-reported BRIEF scores) in every subdomain (Inhibit $M = 58$, $z(218) = 11.702$, $p = .000$, Shift $M = 53$, $z(218) = 4.464$, $p = .001$, Emotional Control $M = 57$, $z(218) = 9.641$, $p = .000$, Working Memory $M = 62$, $z(218) = 17.576$, $p = .000$, Plan/Organize $M = 57$, $z(218) = 8.335$, $p = .000$, Initiate $M = 55$, $z(154)$

= 6.007, *p* = .000, Monitor *M* = 58, *z*(154) = 11.782, *p* = .000) except for Organization of Materials *M* = 49, *z*(154) = -.062, *p* = .950. The largest effect size was noted in the subdomains of Inhibition (Cohen's *d* = .79) and Working Memory (*d* = 1.19; Table 4).

Table 4

Z-test Outcome for Parent-Reported Executive Functioning at 12 Months Post Injury: All Ages

Subdomains	Mean	z	df	*p*	Effect size
Inhibit [a]	58	11.702	218	.000	.79
Shift [a]	53	4.464	218	.000	.30
Emotional Control [a]	57	9.641	218	.000	.65
Working Memory [a]	62	17.576	218	.000	1.19
Plan/Organize [a]	56	8.335	218	.000	.56
Initiate [b]	55	6.007	154	.000	.48
Monitor [b]	56	6.919	154	.000	.55
Organization of Materials [b]	49	-.062	154	.950	-.005

[a] Composed of BRIEF-P and BRIEF. [b] Composed of BRIEF only.

Hypothesis 3

To evaluate whether children and adolescents with TBI demonstrate greater internalizing and externalizing problems (higher scores) in comparison to normative data (normative data for *T*-scores equals a mean of 50 and a standard deviation of 10), individual *z*-tests were performed. *Z*-tests statistics relative to population norms revealed smaller but still significant effect sizes for both externalizing (Cohen's *d* = .26) and internalizing (Cohen's *d* = .33) symptoms as reported on the CBCL. Both externalizing problems *M* = 53, *z* (228) = 3.927, *p* = .000 and internalizing problems *M* = 53, *z*(228) = 4.974, *p* = .000 were greater within the TBI population (Table 5).

Table 5

Z-test Outcome for Parent-Reported Social/Emotional Functioning at 12 Months Post Injury: All Ages

Composites	Mean	*z*	df	*p*	Effect size
Externalizing Composite	53	3.927	228	.000	.26
Internalizing Composite	53	4.974	228	.000	.33

Hypothesis 4

A multiple regression was conducted to determine if gender, mechanism of injury, age at time of injury, severity of injury, BRIEF Behavior Regulation and BRIEF Metacognition predict externalizing behaviors. Tests of assumptions indicated that no autocorrelation of residuals was detected based on the Durbin-Watson statistic of 2.330. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was evidence of multicollinearity, as assessed by tolerance values greater than 0.1. This combination of predictive variables resulted in a prediction that gender, mechanism of injury, age at injury, severity of injury, BRIEF Behavior Regulation and BRIEF Metacognition contribute to externalizing behaviors in children and adolescents who have experienced a TBI, F (6, 211) = 64.701, $p < .000$, adj. $R^2 = .638$ (Table 6). This would suggest that approximately 64% of the variance observed in externalizing behaviors can be attributed to the combination of these variables. Yet, BRIEF Behavior Regulation was found to contribute most to predicting externalizing behaviors ($p < .000$). Regression coefficients and standard errors can be found in Table 7. When the model excluded the other variables, a significant prediction was noted with BRIEF Behavior Regulation, F (1, 216) = 389.157, $p < .000$, which also accounted for 64% of the variance (adj $R^2 = .641$).

Table 6

Model Summary

Model	*R*	R^2	*Adjusted* R^2	Effect size
1	.805	.648	.638	.000

Note. Predictors: (Constant, BRIEF Metacognition, BRIEF Behavior Regulation, Glasgow Coma Scale Total, TBI Cause, SEX, Age in Years).

Table 7

Regression Model of Analysis of Variance: Externalizing Behaviors

Model	*SS*	*df*	*MS*	*F*	*p*
Regression	19426.20	6	3237.70	64.701.	.000
Residual	10558.68	211	50.04		
Total	29984.88	217			

Note. Dependent Variable: CBCL Externalizing T-Score. Predictors: (Constant, BRIEF Metacognition, BRIEF Behavior Regulation, Glasgow Coma Scale Total, TBI Cause, SEX, Age in Years).

A multiple regression was conducted to determine if gender, mechanism of injury, age at time of injury, severity of injury, BRIEF Behavior Regulation and BRIEF Metacognition predict internalizing behaviors. Tests of assumptions indicated that no autocorrelation of residuals was detected based on the Durbin-Watson statistic of 2.027. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was evidence of multicollinearity, as assessed by tolerance values greater than 0.1. This combination of variables resulted in a prediction that gender, mechanism of injury, age at injury, severity of injury, BRIEF Behavior Regulation and BRIEF Metacognition contribute to internalizing behaviors in children and adolescents who have experienced a TBI, F (6, 211) = 35.958, $p < .000$, adj. $R^2 = .492$ (Table 8). This would suggest that approximately 49% of the variance observed in internalizing behaviors can be attributed to the combination of these variables. Yet, age at injury, BRIEF Behavior Regulation and BRIEF Metacognition were found to contribute most to predicting internalizing behaviors ($p < .05$). Regression coefficients and standard errors can be found in Table 9. When the model excluded the other variables, a significant prediction was noted with age at injury, BRIEF Behavior Regulation and BRIEF Metacognition, F (3, 214) = 67.909, $p < .000$, which accounted for 48% of the variance (adj $R^2 = .481$).

Table 8

Model Summary

Model	*R*	R^2	*Adjusted* R^2	Effect size
1	.711	.506	.492	.000

Note. Predictors: (Constant, BRIEF Metacognition, BRIEF Behavior Regulation, Glasgow Coma Scale Total, TBI Cause, SEX, Age in Years).

Table 9

Regression Model of Analysis of Variance: Internalizing Behaviors

Model	*SS*	*df*	*MS*	*F*	*p*
Regression	16161.04	6	2693.50	35.958	.000[b]
Residual	15805.44	211	74.91		
Total	31966.48	217			

Note. Dependent Variable: CBCL Internalizing T-Score. Predictors: (Constant, BRIEF Metacognition, BRIEF Behavior Regulation, Glasgow Coma Scale Total, TBI Cause, SEX, Age in Years).

CHAPTER 5: DISCUSSION

Interpretation and Implications

This current study set out to explore the relationship between executive functioning and social-emotional functioning within the pediatric TBI population. As expected, executive functioning difficulties following TBI were common in this pediatric sample, as were emotional and behavioral concerns to a lesser extent. More specifically, inhibition and working memory were found to be the largest areas of deficit. Furthermore, those with greater impairments in behavior regulation as measured by the BRIEF are likely to exhibit both internalizing and externalizing behaviors following a TBI. This study demonstrates that children who experience deficits in executive functioning as per caregiver rating are more likely to experience changes in their behavior to some degree as a result of the TBI. Therefore, interventions that focus on EF abilities, in addition to conventional psychosocial therapies, can be viewed as more constructive when caring for children with this type of injury even in the absence of extreme negative behaviors. Previous studies also provide support for the effectiveness of parent training programs (i.e., InTERACT and Signposts) that emphasize the importance of consistent discipline and warm responsiveness in the improvement of executive functioning and internalizing/externalizing symptoms following TBI (Aguilar et al., 2019; Patrick et al., 2012). Moreover, it has been shown that children with ADHD, ASD, Orthopedic Impairment as well as children of normal development also exhibit similar behavioral difficulties as a result of an impairment in executive functioning; further supporting the need for alternative approaches to treatment.

Oftentimes, clinicians focus on the treatment of physical and cognitive impairments during the initial recovery process, and less emphasis is placed on overall post-TBI mental health care (Huebner et al., 2018; Kurowski et al., 2013). Parents are then left to cope with the stressors and burdens that come with caring for a child who has experienced a TBI and exhibiting changes in behavior all on their own. The implementation of online family problem solving treatment can be used to aid in the improvement of problem-solving skills and self-regulation following a TBI (Wade et al., 2017). Wade and colleagues (2011) found the Teen Online Problem-Solving program to be effective in lessening parent-teen conflict and ameliorating externalizing and internalizing behaviors. Research has shown that the EF skills associated with behavior regulation are vital for later emotional and behavioral functioning, and the EF skills associated with cognition are more vital for social functioning (Vogan et al., 2018). Impulsive and maladaptive emotional reactions can be the result of an inability to reflectively control behavior due to impaired cognition. This may be why there is a higher likelihood for children with impaired cognitive functioning, and weaknesses in the areas of inhibitory control, emotional control, shifting and working memory to express mental health concerns (Tajik-Parvinchi et al., 2021). The current study's findings have important practical implications for interventions designed to help parents and children manage their behavior following a TBI and can provide additional data from which to develop further interventions based on EF deficits.

For instance, if inhibitory control, emotional control, shifting, and working memory function as predictors in the development of internalizing and externalizing problems in children, then the development of therapeutic plans that include strengthening and training in these areas may be helpful in alleviating emotional symptoms. Direct training also referred to as cognitive remediation, process specific training, restitution training or restorative approaches represent a comprehensive group of interventions that are designed to restore specific executive processes (Sherer & Sander, 2014). This type of training is hypothesized to result in the direct improvement of targeted areas of executive functioning through the implementation of a stimulus drill approach. Training activities usually consist of repetitive drills or exercises (e.g., detecting targets in the presence of distractors, sorting words in alphabetical order) that are presented in a manner in which they increase in difficulty as the patient exhibits improvement over time (Sherer & Sander, 2014). A recent meta-analysis by Stamenova and Levine (2018) specifically examined and found Goal Management Training (GMT) to be effective in the rehabilitation of executive functioning following a TBI. GMT is an outlined, interactive, and manual based rehabilitation protocol that instructs individuals in the process of problem solving through a step-by-step goal attainment strategy. Individuals are taught to inhibit automatic responses (e.g., stop and think), focus on a specific goal, break the overall goal down into subgoals, and then monitor and adjust goals as necessary (Stamenova & Levine, 2018). Interventions have been shown to be effective in improving inhibitory control, working memory, planning, and selective attention (Kim et al., 2018; Lawton & Huang, 2019) while CBT is a widely used form of treatment to reduce anxiety, depression, and anger (Eiraldi et al., 2016; Weersing et al., 2017). Thus, it should be used in conjunction with traditional CBT so that it can be applied to meaningful real-world contexts and address patients' emotional and behavioral concerns.

Psychologists are also encouraged to assist their patients with utilizing problem solving and planning strategies that can empower them to make behavioral changes independently. These strategies can include setting 10 minutes aside at the start of each day to review scheduled tasks for individuals who have difficulty with organization. For those who are experiencing difficulties with working memory, the use of planners, calendars, and phones to maintain an agenda and reminders or important deadlines is recommended. Establishing routines (e.g., placing a backpack near the front door) at home to prevent a person from misplacing objects around the home is a strategy that can also reduce frustration. The incorporation of specific interventions and approaches such as those described are designed to enhance cognitive control, address maladaptive behavior regulation processes early in recovery and may be beneficial in the development of targeted treatment plans of those with TBIs (Sherer & Sander, 2014). Overall, the findings support that each of these areas are subject to improvement with appropriate interventions and modifications. There is hope that this study contributes to the awareness that specific interventions for inhibition, cognitive flexibility, emotional control (i.e., all comprise behavioral regulation) and working memory could contribute to a possible reduction in aggressive/oppositional behavior or possible improvements in anxious/depressive symptoms and greater social functioning.

Additionally, an interprofessional approach to patient care and inclusion of psychologists on all teams may be of increasing importance in building a comprehensive system. Training pediatricians to screen and refer or incorporate psychological referrals into their healthcare follow-up visits can be valuable to improving optimal patient recovery; especially given the rising ability to triage patients to other resources more quickly and efficiently. Being that children and adolescents would be expected to transition back into the educational setting following rehab, communication with their schools prior to discharge would be beneficial. Psychologists or social workers working within inpatient rehab settings should be providing assistance especially considering that additional special education support is likely to be needed following a severe TBI. This may involve coordinating meetings so that school teams have a greater awareness of practices that may reduce internalizing and externalizing behaviors and change maladaptive coping strategies.

Limitations

Parent report was used to assess behavioral and emotional problems; therefore, ratings are subject to biases. Additionally, there was no report of present or previous therapy treatments noted at the time in which the measures were completed by the parents. Any level of treatment provided could impact behavioral outcomes. This study also did not take socioeconomic status and resources into account. Furthermore, the restriction of the sample (severe TBI requiring placement of an ICP monitor) and inability to determine causality should be considered and may be important factors for other researchers to consider when analyzing treatment for all populations.

Future Directions

Further research in this area may support evidence based TBI treatments for families following the injury. Future studies would benefit from longitudinal data collection to better delineate the potential predictive impact of early executive functioning deficits on later behavioral and emotional concerns, collection of direct reports from patients, and expansion of enrollment to include mild, moderate, and severe TBI. Future studies should also explore the efficacy of EF-based interventions in decreasing comorbid psychopathology and social challenges in children and adolescents with TBIs given the implications of EF on behavioral outcomes and daily functioning. We know that families are adversely affected, thus in order to facilitate successful adaptation as a family, parents need to understand how to manage and cope with the psychological changes of their child. Furthermore, while findings may imply that extensive treatment is not needed for all families of children who have experienced a TBI, it is important to understand that arising social/emotional concerns may play a role in the development of family strain over time. Additionally, schools may need to monitor for fluctuations in children's behavior because as the demands required of children increase, deficits may become more apparent and lead to greater frustration, and/or anxious or depressive symptoms. Early intervention may equip families and educational settings with the tools needed to successfully manage these developmental and transitional periods.

References

Achenbach, T.M., & Rescorla, L.A. (2001). Manual for the ASEBA School-Age Forms & Profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.

Adolphs, R. (2009). The social brain: Neural basis of social knowledge. *Annual Review of Psychology*, *60*, 693–716. https://doi.org/10.1146/annurev.psych.60.110707.163514

Aguilar, J. M., Shultz, E. L., Wade, S. L., Cassedy, A. E., Kirkwood, M. W., Stancin, T., Taylor, H. G., & Yeates, K. O. (2019). A Comparison of 2 Online Parent Skills Training Interventions for Early Childhood Brain Injury: Improvements in Internalizing and Executive Function Behaviors. *Journal of Head Trauma Rehabilitation*, *34*(2), 65–76. https://doi.org/10.1097/HTR.0000000000000443

Aitken, M.E., McCarthy, M.L., Slomine, B.S., Ding, R., Durbin, D.R., Jaffe, K.M., Paidas, C.N., Dorsch, A.M., Jr, C., & Makenzie, E.J. (2009). Family burden after traumatic brain injury in children. *Pediatrics*, *123*(1), 199–206. https://doi.org/10.1542/peds.2008-0607

Alvarez, J. A., & Emory, E. (2006). Executive Function and the Frontal Lobes: A Meta-Analytic Review. *Neuropsychology Review*, *16*(1), 17–42. https://doi.org/10.1007/s11065-006-9002-x

Alway, Y., Gould, K. R., Johnston, L., Mckenzie, D., & Ponsford, J. (2016). A prospective examination of Axis I psychiatric disorders in the first 5 years following moderate to severe traumatic brain injury. *Psychological Medicine*, *46*(6), 1331–1341. https://doi.org/10.1017/S0033291715002986

Amorim, W. N., & Marques, S. C. (2018). Inhibitory control and cognitive flexibility in children with attention-deficit/hyperactivity disorder. *Psychology & Neuroscience*, *11*(4), 364–374. https://doi.org/10.1037/pne0000156

Anaby, D., Law, M., Hanna, S., & Dematteo, C. (2012). Predictors of Change in Participation Rates Following Acquired Brain Injury: Results of a Longitudinal Study. *Developmental Medicine & Child Neurology*, *54*(4), 339–346. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=eric&AN=EJ959831&site=ehost-live&scope=site&custid=s6636215

Anderson, P. (2002). Assessment and Development of Executive Function (EF) During Childhood. *Child Neuropsychology*, *8*(2), 71. https://doi.org/10.1076/chin.8.2.71.8724

Anderson, V. A., Catroppa, C., Dudgeon, P., Morse, S. A., Haritou, F., & Rosenfeld, J. V. (2006). Understanding predictors of functional recovery and outcome 30 months following early childhood head injury. *Neuropsychology*, *20*(1), 42–57. https://doi.org/10.1037/0894-4105.20.1.42

Anderson, V., & Catroppa, C. (2005). Recovery of executive skills following paediatric traumatic brain injury (TBI): a 2 year follow-up. *Brain Injury*, *19*(6), 459–470. https://doi.org/10.1080/02699050400004823

Anderson, V., Brown, S., Newitt, H., & Hoile, H. (2011a). Long-term outcome from childhood traumatic brain injury: Intellectual ability, personality, and quality of life. *Neuropsychology*, *25*(2), 176–184. https://doi.org/10.1037/a0021217

Anderson, V., Le Brocque, R., Iselin, G., Eren, S., Dob, R., Davern, T. J., Mckinlay, L., & Kenardy, J. (2012). Adaptive ability, behavior and quality of life pre and posttraumatic brain injury in childhood. *Disability & Rehabilitation*, *34*(19), 1639–1647. https://doi.org/10.3109/09638288.2012.656789

Anderson, V., Spencer-Smith, M., & Wood, A. (2011b). Do children really recover better? Neurobehavioural plasticity after early brain insult. *Brain: A Journal of Neurology*, *134*(8), 2197–2221. https://doi.org/brain/awr103

Arbogast, K. B., Curry, A. E., Pfeiffer, M. R., Zonfrillo, M. R., Haarbauer-Krupa, J., Breiding, M. J., Coronado, V. G., & Master, C. L. (2016). Point of Health Care Entry for Youth With Concussion Within a Large Pediatric Care Network. *JAMA Pediatrics*, *170*(7), e160294. https://doi.org/10.1001/jamapediatrics.2016.0294

Arnett, A. B., Peterson, R. L., Kirkwood, M. W., Taylor, H. G., Stancin, T., Brown, T. M., & Wade, S. L. (2013). Behavioral and cognitive predictors of educational outcomes in pediatric traumatic brain injury. *Journal of the International Neuropsychological Society*, *19*(8), 881–889. https://doi.org/10.1017/S1355617713000635

Association., A. P., Ramano, E. M., & de Beer, M. (2020). Diagnostic and Statistical Manual of Mental Disorders--Fifth Edition. *Occupational Therapy in Mental Health*, *36*(1), 29–54.

https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=hpi&AN=HaPI-445805&site=ehost-live&scope=site&custid=s6636215

Babikian, T., Merkley, T., Savage, R. C., Giza, C. C., & Levin, H. (2015). Chronic aspects of pediatric traumatic brain injury: Review of the literature. *Journal of Neurotrauma*, *32*(23), 1849–1860. https://doi.org/10.1089/neu.2015.3971

Banich, M. T. (2009). Executive Function: The Search for an Integrated Account. *Current Directions in Psychological Science*, *18*(2), 89–94. https://doi.org/10.1111/j.1467-8721.2009.01615.x

Beauchamp, M., Catroppa, C., Godfrey, C., Morse, S., Rosenfeld, J. V., & Anderson, V. (2011). Selective Changes in Executive Functioning Ten Years After Severe Childhood Traumatic Brain Injury. *Developmental Neuropsychology*, *36*(5), 578–595. https://doi.org/10.1080/87565641.2011.555572

Bertisch, H. C., Long, C., Langenbahn, D. M., Rath, J. F., Diller, L., & Ashman, T. (2013). Anxiety as a primary predictor of functional impairment after acquired brain injury: A brief report. *Rehabilitation Psychology*, *58*(4), 429–435. https://doi.org/10.1037/a0034554

Bigler, E. D., & Bazarian, J. J. (2010). Diffusion tensor imaging: A biomarker for mild traumatic brain injury? *Neurology*, *74*(8), 626–627. https://doi.org/10.1212/WNL.0b013e3181d3e43a

Bigler, E. D., Yeates, K. O., Dennis, M., Gerhardt, C. A., Rubin, K. H., Stancin, T., Gerry Taylor, H., & Vannatta, K. (2013). Neuroimaging and social behavior in children after traumatic brain injury: Findings from the Social Outcomes of Brain Injury in Kids (SOBIK) study. *NeuroRehabilitation*, *32*(4), 707–720. https://doi.org/10.3233/NRE-130896

Blijd-Hoogewys, E., Bezemer, M., & Geert, P. (2014). Executive Functioning in Children with ASD: An Analysis of the BRIEF. *Journal of Autism & Developmental Disorders*, *44*(12), 3089–3100. https://doi.org/10.1007/s10803-014-2176-9

Bombardier, C. H., Fann, J. R., Temkin, N. R., Esselman, P. C., Barber, J., & Dikmen, S. S. (2010). Rates of major depressive disorder and clinical outcomes following traumatic brain injury. *Jama*, *303*(19), 1938–1945. https://doi.org/10.1001/jama.2010.599

Bramlett, H. M., & Dietrich, W. D. (2015). Long-term consequences of traumatic brain injury: Current status of potential mechanisms of injury and neurological outcomes. *Journal of Neurotrauma*, *32*(23), 1834–1848. https://doi.org/10.1089/neu.2014.3352

Brown, E. A., Kenardy, J., Chandler, B., Anderson, V., Mckinlay, L., & Le Brocque, R. (2016). Parent-reported health-related quality of life in children with traumatic brain injury: A prospective study. *Journal of Pediatric Psychology*, *41*(2), 244–255. https://doi.org/10.1093/jpepsy/jsv090

Budde, M. D., Janes, L., Gold, E., Turtzo, L. C., & Frank, J. A. (2011). The contribution of gliosis to diffusion tensor anisotropy and tractography following traumatic brain injury: Validation in the rat using Fourier analysis of stained tissue sections. *Brain: A Journal of Neurology*, *134*(8), 2248–2260. https://doi.org/10.1093/brain/awr161

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*, 111–126. https://doi.org/10.1196/annals.1440.010

Catroppa, C., Godfrey, C., Rosenfeld, J. V., Hearps, S. S., & Anderson, V. A. (2012). Functional recovery ten years after pediatric traumatic brain injury: Outcomes and predictors. *Journal of Neurotrauma*, *29*(16), 2539–2547. https://doi.org/10.1089/neu.2012.2403

Chapman, L. A., Wade, S. L., Walz, N. C., Taylor, H. G., Stancin, T., & Yeates, K. O. (2010). Clinically significant behavior problems during the initial 18 months following early childhood traumatic brain injury. *Rehabilitation Psychology*, *55*(1), 48–57. https://doi.org/10.1037/a0018418

Chorpita, B. F. (2007). *Modular cognitive-behavioral therapy for childhood anxiety disorders* (Ser. Guides to individualized evidence-based treatment). Guilford Press. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=psyh&AN=2006-22217-000&site=ehost-live&scope=site&custid=s6636215

Choudhury, S., Blakemore, S.-J., & Charman, T. (2006). Social cognitive development during adolescence. *Social Cognitive and Affective Neuroscience*, *1*(3), 165–174. https://doi.org/10.1093/scan/nsl024

Chu, B. C., & Harrison, T. L. (2007). Disorder-Specific Effects of CBT for Anxious and Depressed Youth: A Meta-Analysis of Candidate Mediators of Change. *Clinical Child and Family Psychology Review*, *10*(4), 352–372.

https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=eric&AN=EJ785094&site=ehost-live&scope=site&custid=s6636215

Colantonio, A., Harris, J. E., Ratcliff, G., Chase, S., & Ellis, K. (2010). Gender differences in self reported long term outcomes following moderate to severe traumatic brain injury. *BMC Neurology*, *10*, 102–108. https://doi.org/10.1186/1471-2377-10-102

Colantonio, A., Howse, D., Kirsh, B., Chiu, T., Zulla, R., & Levy, C. (2010). Living environments for people with moderate to severe acquired brain injury. *Healthcare Policy = Politiques De Sante*, *5*(4), e120–e138. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=cmedm&AN=21532762&site=ehost-live&scope=site&custid=s6636215

De Luca, C. R., Wood, S. J., Anderson, V., Buchanan, J.-A., Proffitt, T. M., Mahony, K., & Pantelis, C. (2003). Normative Data From the Cantab. I: Development of Executive Function Over the Lifespan. *Journal of Clinical & Experimental Neuropsychology*, *25*(2), 242. https://doi.org/10.1076/jcen.25.2.242.13639

Dennis, B. B., Roshanov, P. S., Naji, L., Bawor, M., Paul, J., Plater, C., Pare, G., Worster, A., Varenbut, M., Daiter, J., Marsh, D. C., Desai, D., Samaan, Z., & Thabane, L. (2015). Opioid substitution and antagonist therapy trials exclude the common addiction patient: a systematic review and analysis of eligibility criteria. *Trials*, *16*, 475. https://doi.org/10.1186/s13063-015-0942-4

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

Diaz, A. P., Schwarzbold, M. L., Guarnieri, R., Oliveira Thais, M. E., Hohl, A., Nunes, J. C., Linhares, M. N., Schroder Prediger, R. D., & Walz, R. (2014). Posttraumatic Amnesia and Personality Changes after Severe Traumatic Brain Injury: Preliminary Findings. *CNS Neuroscience & Therapeutics*, *20*(5), 479–482. https://doi.org/10.1111/cns.12256

Dikmen, S.S., Bombardier, C.H., Machamer, J.E., Fann, J.R., & Temkin, N.R. (2004). Natural history of depression in traumatic brain injury. *Archives of Physical Medicine & Rehabilitation*, *85*(9), 1457–1464. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=jlh&AN=106557164&site=ehost-live&scope=site&custid=s6636215

Dodge, K. A. (2003). Do social information-processing patterns mediate aggressive behavior? In B. B. Lahey, T. E. Moffitt, & A. Caspi (Eds.), (pp. 254–274). The Guilford Press. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=psyh&AN=2003-88137-009&site=ehost-live&scope=site&custid=s6636215

Donders, J., & Warschausky, S. (2007). Neurobehavioral outcomes after early versus late childhood traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *22*(5), 296–302. https://doi.org/10.1097/01.htr.0000290974.01872.82

Douglas, J.M. (2010). Relation of executive functioning to pragmatic outcome following severe traumatic brain injury. *Journal of Speech, Language & Hearing Research*, *53*(2), 365–382. https://doi.org/10.1044/1092-4388(2009/08-0205)

Ducrocq, S.C., Meyer, P.G., Orliaguet, G.A., Blanot, S., Laurent-Vannier, A., Renier, D., Carli, P.A. (2006). Epidemiology and early predictive factors of mortality and outcome in children with traumatic severe brain injury: experience of a French pediatric trauma center. *Pediatric Critical Care Medicine*, *7*(5), 461–467. https://doi.org/10.1097/01.pcc.0000235245.49129.27

Eiraldi, R., Power, T. J., Schwartz, B. S., Keiffer, J. N., Mccurdy, B. L., Mathen, M., & Jawad, A. F. (2016). Examining Effectiveness of Group Cognitive-Behavioral Therapy for Externalizing and Internalizing Disorders in Urban Schools. *Behavior Modification*, *40*(4), 611–639. https://doi.org/10.1177/0145445516631093

Eme, R. (2017). Neurobehavioral Outcomes of Mild Traumatic Brain Injury: A Mini Review. *Brain Sciences (2076-3425)*, *7*(5), 46. https://doi.org/10.3390/brainsci7050046

Ennis, S. K., Jaffe, K. M., Mangione-Smith, R., Konodi, M. A., Mackenzie, E. J., & Rivara, F. P. (2014). Rehabilitation following pediatric traumatic brain injury: Variability in adherence to psychosocial quality-of-care indicators. *The Journal of Head Trauma Rehabilitation*, *29*(3), 208–216. https://doi.org/10.1097/HTR.0b013e3182987dd4

Ewing-Cobbs, L., Prasad, M. R., Landry, S. H., Kramer, L., & Deleon, R. (2004). Executive Functions Following Traumatic Brain Injury in Young Children: A Preliminary Analysis. *Developmental Neuropsychology*, *26*(1), 487–512. https://doi.org/10.1207/s15326942dn2601_7

Failla, M. D., Juengst, S. B., Arenth, P. M., & Wagner, A. K. (2016). Preliminary Associations Between Brain-Derived Neurotrophic Factor, Memory Impairment, Functional Cognition, and Depressive Symptoms Following Severe TBI. *Neurorehabilitation & Neural Repair*, *30*(5), 419–430. https://doi.org/10.1177/1545968315600525

Faul, M., Xu, L., Wald, M. M., Coronado, V., & Dellinger, A. M. (2010). Traumatic brain injury in the United States: national estimates of prevalence and incidence, 2002–2006. *Injury Prevention (1353-8047)*, *16*, A268–A268. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=s3h&AN=66043302&site=ehost-live&scope=site&custid=s6636215

Fay, T. B., Yeates, K. O., Wade, S. L., Drotar, D., Stancin, T., & Taylor, H. G. (2009). Predicting longitudinal patterns of functional deficits in children with traumatic brain injury. *Neuropsychology*, *23*(3), 271–282. https://doi.org/10.1037/a0014936

Fischer, J. T., Hannay, H. J., Alfano, C. A., Swank, P. R., & Ewing-Cobbs, L. (2018). Sleep disturbances and internalizing behavior problems following pediatric traumatic injury. *Neuropsychology*, *32*(2), 161–175. https://doi.org/10.1037/neu0000420

Franulic, A., Carbonell, C.G., Pinto, P., & Sepulveda, I. (2004). Psychosocial adjustment and employment outcome 2, 5 and 10 years after TBI. *Brain Injury*, *18*(2), 119–129. https://doi.org/10.1080/0269905031000149515.

Ganesalingam, K., Yeates, K. O., Taylor, H. G., Walz, N. C., Stancin, T., & Wade, S. (2011). Executive functions and social competence in young children 6 months following traumatic brain injury. *Neuropsychology*, *25*(4), 466–476. https://doi.org/10.1037/a0022768

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive Function in Preschoolers: A Review Using an Integrative Framework. *Psychological Bulletin*, *134*(1), 31–60. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=eric&AN=EJ783091&site=ehost-live&scope=site&custid=s6636215

Gfroerer, S.D., Wade, S.L., & Wu, M. (2008). Parent perceptions of school-based support for students with traumatic brain injuries. *Brain Injury*, *22*(9), 649–656. https://doi.org/10.1080/02699050802227162

Gioia, G. A., Espy, K. A., Isquith, P. K., Gioia, G. A., Espy, K. A., & Isquith, P. K. (2000). *Behavior Rating Inventory of Executive Function--Preschool Version.* (Ser. BRIEF-P). https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=hpi&AN=HaPI-334588&site=ehost-live&scope=site&custid=s6636215

Gioia, G. A., Isquith, P. K., Guy, S. C., Kenworthy, L., Ng-Cordell, E., Hanley, M., Kelly, A., & Riby, D. M. (2018). Behavior Rating Inventory of Executive Function. *Journal of Autism and Developmental Disorders*, *48*, 796–808. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=hpi&AN=HaPI-438865&site=ehost-live&scope = si te&custid=s6636215

Glang, A., Todis, B., Thomas, C.W., Hood, D., Bedell, G., & Cockrell, J. (2008). Return to school following childhood TBI: who gets services? *NeuroRehabilitation*, *23*(6), 477–486. https://doi.org/10.3233/nre-2008-23604.

Goldstrohm, S. L., & Arffa, S. (2005). Preschool children with mild to moderate traumatic brain injury: an exploration of immediate and post-acute morbidity. *Archives of Clinical Neuropsychology : the Official Journal of the National Academy of Neuropsychologists*, *20*(6), 675–695. https://doi.org/10.1016/j.acn.2005.02.005

Groves, S. J., Porter, R. J., Jordan, J., Knight, R., Carter, J. D., Mcintosh, V. V., Fernando, K., Frampton, C. M., Mulder, R. T., Lacey, C., & Joyce, P. R. (2015). Changes in neuropsychological function after treatment with metacognitive therapy or cognitive behavior therapy for depression. *Depression & Anxiety (1091-4269)*, *32*(6), 437–444. https://doi.org/10.1002/da.22341

Harvey, H. H. (2013). Reducing Traumatic Brain Injuries in Youth Sports: Youth Sports Traumatic Brain Injury State Laws, January 2009-December 2012. *American Journal of Public Health*, *103*(7), 1249–1254. https://doi.org/10.2105/AJPH.2012.301107

Heimberg, R. G. (2002). Cognitive-behavioral therapy for social anxiety disorder: Current status and future directions. *Biological Psychiatry*, *51*(1), 101–108. https://doi.org/10.1016/S0006-3223(01)01183-0

Higa-McMillan, C. K., Francis, S. E., Rith-Najarian, L., & Chorpita, B. F. (2016). Evidence Base Update: 50 Years of Research on Treatment for Child and

Adolescent Anxiety. *Journal of Clinical Child and Adolescent Psychology : the Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53*, *45*(2), 91–113. https://doi.org/10.1080/15374416.2015.1046177

Hodgson, J., Mcdonald, S., Tate, R., & Gertler, P. (2005). A Randomised Controlled Trial of a Cognitive-Behavioural Therapy Program for Managing Social Anxiety After Acquired Brain Injury. *Brain Impairment*, *6*(3), 169–180. https://doi.org/10.1375/brim.2005.6.3.169

Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, *16*(3), 174–180. https://doi.org/10.1016/j.tics.2012.01.006

Hoofien, D., Gilboa, A., Vakil, E., & Donovick, P.J. (2001). Traumatic brain injury (TBI) 10-20 years later: a comprehensive outcome study of psychiatric symptomatology, cognitive abilities and psychosocial functioning. *Brain Injury*, *15*(3), 189–209. https://doi.org/10.1080/026990501300005659

Hughes, C. (2011). Changes and challenges in 20 years of research into the development of executive functions. *Infant & Child Development*, *20*(3), 251–271. https://doi.org/10.1002/icd.736

Hughes, C., Ensor, R., Wilson, A., & Graham, A. (2010). Tracking executive function across the transition to school: A latent variable approach. *Developmental Neuropsychology*, *35*(1), 20–36. https://doi.org/10.1080/87565640903325691

Ilie, G., Mann, R. E., Boak, A., Adlaf, E. M., Hamilton, H., Asbridge, M., Rehm, J., & Cusimano, M. D. (2014). Suicidality, bullying and other conduct and mental health correlates of traumatic brain injury in adolescents. *PloS One*, *9*(4), e94936. https://doi.org/10.1371/journal.pone.0094936

Jacobs, R., & Anderson, V. (2002). Planning and Problem Solving Skills Following Focal Frontal Brain Lesions in Childhood: Analysis Using the Tower of London. *Child Neuropsychology*, *8*(2), 93. https://doi.org/10.1076/chin.8.2.93.8726

Jacobs, R., & Anderson, V. (2002). Planning and Problem Solving Skills Following Focal Frontal Brain Lesions in Childhood: Analysis Using the Tower of London. *Child Neuropsychology*, *8*(2), 93. https://doi.org/10.1076/chin.8.2.93.8726

Jorge, R., & Robinson, R. G. (2002). Mood disorders following traumatic brain injury. *NeuroRehabilitation*, *17*(4), 311–324. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=mdc&AN=12547979&site=ehost-live&scope=site&custid=s6636215

Juranek, J., Johnson, C. P., Prasad, M. R., Kramer, L. A., Saunders, A., Filipek, P. A., Swank, P. R., Cox, C. S., & Ewing-Cobbs, L. (2012). Mean diffusivity in the amygdala correlates with anxiety in pediatric TBI. *Brain Imaging and Behavior*, *6*(1), 36–48. https://doi.org/10.1007/s11682-011-9140-5

Karver, C. L., Wade, S. L., Cassedy, A., Taylor, H. G., Stancin, T., Yeates, K. O., & Walz, N. C. (2012). Age at injury and long-term behavior problems after traumatic brain injury in young children. *Rehabilitation Psychology*, *57*(3), 256–265. https://doi.org/10.1037/a0029522

Keenan, H. T., Clark, A. E., Holubkov, R., Cox, C. S., & Ewing-Cobbs, L. (2018). Psychosocial and executive function recovery trajectories one year after pediatric traumatic brain injury: The influence of age and injury severity. *Journal of Neurotrauma*, *35*(2), 286–296. https://doi.org/10.1089/neu.2017.5265

Kendall, P. C., & Suveg, C. (2006). Treating Anxiety Disorders in Youth. In P. C. Kendall (Ed.), (pp. 243–294). The Guilford Press. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=psyh&AN=2006-12734-007&site=ehost-live&scope=site&custid=s6636215

Ki, H., M, F., B, B., & Ch, H. (2004). The relationship between social behavior and severity of language impairment. *Journal of Speech, Language & Hearing Research*, *47*(3), 647–662. https://doi.org/10.1044/1092-4388(2004/050)

Kim, E. J., Bahk, Y.-C., Oh, H., Lee, W.-H., Lee, J.-S., & Choi, K.-H. (2018). Current status of cognitive remediation for psychiatric disorders: A review. *Frontiers in Psychiatry*, *9*. https://doi.org/10.3389/fpsyt.2018.00461

Kirk, S., Fallon, D., Fraser, C., Robinson, G., & Vassallo, G. (2015). Supporting parents following childhood traumatic brain injury: a qualitative study to examine information and emotional support needs across key care transitions. *Child: Care, Health & Development*, *41*(2), 303–313. https://doi.org/10.1111/cch.12173

Kochanek, P. M., Clark, R. S. B., Ruppel, R. A., Adelson, P. D., Bell, M. J., Whalen, M. J., Robertson, C. L., Satchell, M. A., Seidberg, N. A., Marion, D. W., & Jenkins, L. W. (2000). Biochemical, cellular, and molecular mechanisms in the evolution of secondary damage after severe traumatic brain injury in infants and children:

Lessons learned from the bedside. *Pediatric Critical Care Medicine : a Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, *1*(1), 4–19. https://doi.org/10.1097/00130478-200007000-00003

Koponen, S., Taiminen, T., Portin, R., Himanen, L., Isoniemi, H., Heinonen, H., Hinkka, S., & Tenovuo, O. (2002). Axis I and II psychiatric disorders after traumatic brain injury: A 30-year follow-up study. *The American Journal of Psychiatry*, *159*(8), 1315–1321. https://doi.org/10.1176/appi.ajp.159.8.1315

Kumar, R., Kumar, A., & Singh, A. K. (2019). Psychosocial Impact of Brain Injury: A Review. *Indian Journal of Neurosurgery*, *8*(1), 11–15. https://doi.org/10.1055/s-0039-1687713

Kurowski, B. G., Wade, S. L., Kirkwood, M. W., Brown, T. M., Stancin, T., & Taylor, H. G. (2013). Behavioral predictors of outpatient mental health service utilization within 6 months after traumatic brain injury in adolescents. *PM & R: Journal of Injury, Function & Rehabilitation*, *5*(12), 1026–1034. https://doi.org/10.1016/j.pmrj.2013.08.589

Kurowski, B. G., Wade, S. L., Kirkwood, M. W., Brown, T. M., Stancin, T., Cassedy, A., & Taylor, H. G. (2013). Association of Parent Ratings of Executive Function With Global- and Setting-Specific Behavioral Impairment After Adolescent Traumatic Brain Injury. *Archives of Physical Medicine & Rehabilitation*, *94*(3), 543–550. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=s3h&AN=85895514&site=ehost-live&scope=site&custid=s6636215

Lawton, T., & Huang, M.-X. (2019). Dynamic cognitive remediation for a Traumatic Brain Injury (TBI) significantly improves attention, working memory, processing speed, and reading fluency. *Restorative Neurology and Neuroscience*, *37*(1), 71–86. https://doi.org/10.3233/RNN-180856

Levin, H. S., & Hanten, G. (2005). Executive Functions After Traumatic Brain Injury in Children. *Pediatric Neurology*, *33*(2), 79–93. https://doi.org/10.1016/j.pediatrneurol.2005.02.002

Li, L., & Liu, J. (2013). The effect of pediatric traumatic brain injury on behavioral outcomes: A systematic review. *Developmental Medicine & Child Neurology*, *55*(1), 37–45. https://doi.org/10.1111/j.1469-8749.2012.04414.x

Limond, J., Dorris, L., & McMillan, T.M. (2009). Quality of life in children with acquired brain injury: parent perspectives 1-5 years after injury. *Brain Injury*, *23*(7/8), 617–622. https://doi.org/10.1080/02699050902997870

Luciana, M. (2003). Practitioner Review: Computerized assessment of neuropsychological function in children: clinical and research applications of the Cambridge Neuropsychological Testing Automated Battery (CANTAB). *Journal of Child Psychology & Psychiatry & Allied Disciplines*, *44*(5), 649–663. https://doi.org/10.1111/1469-7610.00152

Lyons Usher, A. M., Leon, S. C., Stanford, L. D., Holmbeck, G. N., & Bryant, F. B. (2016). Confirmatory factor analysis of the Behavior Rating Inventory of Executive Functioning (BRIEF) in children and adolescents with ADHD. *Child*

Neuropsychology, *22*(8), 907–918. https://doi.org/10.1080/09297049.2015.1060956

Majdan, M., Mauritz, W., Brazinova, A., Rusnak, M., Leitgeb, J., Janciak, I., & Wilbacher, I. (2011). Severity and outcome of traumatic brain injuries (TBI) with different causes of injury. *Brain Injury*, *25*(9), 797–805. https://doi.org/10.3109/02699052.2011.581642

Maloney, K. A., Schmidt, A. T., Hanten, G. R., & Levin, H. S. (2020). Executive dysfunction in children and adolescents with behavior disorders and traumatic brain injury. *Child Neuropsychology*, *26*(1), 69–82. https://doi.org/10.1080/09297049.2019.1640868

Martel, M. M., Nigg, J. T., Wong, M. M., Fitzgerald, H. E., Jester, J. M., Puttler, L. I., Glass, J. M., Adams, K. M., & Zucker, R. A. (2007). Childhood and adolescent resiliency, regulation, and executive functioning in relation to adolescent problems and competence in a high-risk sample. *Development and Psychopathology*, *19*(2), 541–563. https://doi.org/10.1017/S0954579407070265

Mathias, J. L., Harman-Smith, Y., Bowden, S. C., Rosenfeld, J. V., & Bigler, E. D. (2014). Contribution of psychological trauma to outcomes after traumatic brain injury: Assaults versus sporting injuries. *Journal of Neurotrauma*, *31*(7), 658–669. https://doi.org/10.1089/neu.2013.3160

Max, J. E., Wilde, E. A., Bigler, E. D., Hanten, G., Dennis, M., Schachar, R. J., Saunders, A. E., Ewing-Cobbs, L., Chapman, S. B., Thompson, W. K., Yang, T. T., & Levin, H. S. (2015). Personality change due to traumatic brain injury in children and adolescents: Neurocognitive correlates. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *27*(4), 272–279. https://doi.org/10.1176/appi.neuropsych.15030073

Mccloskey, G., & Perkins, L. A. (2012). Essentials of Executive Functions Assessment. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=ir00716a&AN=pcom.scholarly.papers.2042&site=ehost-live&scope=site&custid=s6636215.

Modi, A. C., Vannest, J., Combs, A., Turnier, L., & Wade, S. L. (2018). Pattern of executive functioning in adolescents with epilepsy: A multimethod measurement approach. *Epilepsy & Behavior*, *80*, 5–10. https://doi.org/10.1016/j.yebeh.2017.12.021

Muscara, F., Catroppa, C., & Anderson, V. (2008). The Impact of Injury Severity on Executive Function 7-10 Years Following Pediatric Traumatic Brain Injury. *Developmental Neuropsychology*, *33*(5), 623–636. https://doi.org/10.1080/87565640802171162

Nadebaum, C., Anderson, V., & Catroppa, C. (2007). Executive Function Outcomes Following Traumatic Brain Injury in Young Children: A Five Year Follow-Up. *Developmental Neuropsychology*, *32*(2), 703–728. https://doi.org/10.1080/87565640701376086

Narad, M. E., Moscato, E., Yeates, K. O., Taylor, H. G., Stancin, T., & Wade, S. L. (2019). Behavioral health service utilization and unmet need after traumatic brain injury in childhood. *Journal of Developmental and Behavioral Pediatrics*, *40*(6), 451–457. https://doi.org/10.1097/DBP.0000000000000681

Narad, M. E., Yeates, K. O., Taylor, H. G., Stancin, T., & Wade, S. L. (2017). Maternal and Paternal Distress and Coping Over Time Following Pediatric Traumatic Brain Injury. *Journal of Pediatric Psychology*, *42*(3), 304–314. https://doi.org/10.1093/jpepsy/jsw079

Newton, K. J., Sperling, R. A., & Martin, A. J. (2017). Learning disabilities, attention-deficit hyperactivity disorder, and executive functioning: Contributions from educational psychology in progressing theory, measurement, and practice. *Contemporary Educational Psychology*, *50*, 1–3. https://doi.org/10.1016/j.cedpsych.2016.12.003

Noble-Hauesslein, L. J., & Robertson, C. L. (2019). Multi-disciplinary perspectives on pediatric traumatic brain injuries: Where we currently stand and future directions. *Experimental Neurology*, *320*, 113002. https://doi.org/10.1016/j.expneurol.2019.113002

Norup, A., & Mortensen, E. L. (2015). Prevalence and Predictors of Personality Change After Severe Brain Injury. *Archives of Physical Medicine & Rehabilitation*, *96*(1), 56–62. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=s3h&AN=100133665&site=ehost-live&scope=site&custid=s6636215

Osborn, A. J., Mathias, J. L., & Fairweather-Schmidt, A. K. (2016). Prevalence of anxiety following adult traumatic brain injury: A meta-analysis comparing measures, samples and postinjury intervals. *Neuropsychology*, *30*(2), 247–261. https://doi.org/10.1037/neu0000221

Park, H.-J., & Friston, K. (2013). Structural and Functional Brain Networks: From Connections to Cognition. *Science*, *342*(6158), 1238411–1238411. https://doi.org/10.1126/science.1238411

Patrick, P. D., Savage, R. C., Woods, D. T., Catroppa, C., Giallo, R., Matthews, J., & Anderson, V. A. (2012). Feasibility and consumer satisfaction ratings following an intervention for families who have a child with acquired brain injury. *NeuroRehabilitation*, *30*(3), 189–198. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=ccm&AN=104449206&site=ehost-live&scope=site&custid=s6636215

Paus, T. (2010). Growth of White Matter in the Adolescent Brain: Myelin or Axon? *Brain and Cognition*, *72*(1), 26–35. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=eric&AN=EJ869591&site=ehost-live&scope=site&custid=s6636215

Pavlovic, D., Pekic, S., Stojanovic, M., & Popovic, V. (2019). Traumatic brain injury: neuropathological, neurocognitive and neurobehavioral sequelae. *Pituitary*, *22*(3), 270–282. https://doi.org/10.1007/s11102-019-00957-9

Pearce, B., Cartwright, J., Cocks, N., & Whitworth, A. (2016). Inhibitory control and traumatic brain injury: The association between executive control processes and social communication deficits. *Brain Injury*, *30*(13/14), 1708–1717. https://doi.org/10.1080/02699052.2016.1202450

Phillips, N. L., Parry, L., Mandalis, A., & Lah, S. (2017). Working memory outcomes following traumatic brain injury in children: A systematic review with meta-analysis. *Child Neuropsychology*, *23*(1), 26–66. https://doi.org/10.1080/09297049.2015.1085500

Ponsford, J., Willmont, C., Rothwell, A., Cameron, P., Kelly, A.-M., Nelms, R., Curran, C., & Ng, K. (2000). Factors influencing outcome following mild traumatic brain injury in adults. *Journal of the International Neuropsychological Society*, *6*(5), 568–579. https://doi.org/10.1017/S1355617700655066

Ponsford, J., Wong, D., Mckay, A., Haines, K., Alway, Y., Downing, M., Furtado, C., Lee, N. K., & O'Donnell, M. L. (2016). Efficacy of motivational interviewing and cognitive behavioral therapy for anxiety and depression symptoms following traumatic brain injury. *Psychological Medicine*, *46*(5), 1079–1090. https://doi.org/10.1017/S0033291715002640

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

Raj, S. P., Wade, S. L., Cassedy, A., Taylor, H. G., Stancin, T., Brown, T. M., & Kirkwood, M. W. (2014). Parent psychological functioning and communication predict externalizing behavior problems after pediatric traumatic brain injury. *Journal of Pediatric Psychology*, *39*(1), 84–95. https://doi.org/10.1093/jpepsy/jst075

Rakers, S. E., Scheenen, M. E., Westerhof-Evers, H. J., de Koning, M. E., van der Horn, H. J., van der Naalt, J., & Spikman, J. M. (2018). Executive functioning in relation to coping in mild versus moderate-severe traumatic brain injury. *Neuropsychology*, *32*(2), 213–219. https://doi.org/10.1037/neu0000399

Reaven, J., Blakeley-Smith, A., Culhane-Shelburne, K., & Hepburn, S. (2012). Group Cognitive Behavior Therapy for Children with High-Functioning Autism Spectrum Disorders and Anxiety: A Randomized Trial. *Journal of Child Psychology and Psychiatry*, *53*(4), 410–419. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=eric&AN=EJ956041&site=ehost-live&scope=site&custid=s6636215

Reid-Arndt, S. A., Nehl, C., & Hinkebein, J. (2007). The Frontal Systems Behaviour Scale (FrSBe) as a predictor of community integration following a traumatic brain injury. *Brain Injury*, *21*(13-14), 1361–1369. https://doi.org/10.1080/02699050701785062

Riggio, S. (2010). Traumatic brain injury and its neurobehavioral sequelae. *Psychiatric Clinics of North America*, *33*(4), 807–819. https://doi.org/10.1016/j.psc.2010.08.004

Riggio, S., & Wong, M. (2009). Neurobehavioral Sequelae of Traumatic Brain Injury. *Mount Sinai Journal of Medicine*, *76*(2), 163–172. https://doi.org/10.1002/msj.20097

Riggs, N. R., Blair, C. B., & Greenberg, M. T. (2003). Concurrent and 2-Year Longitudinal Relations Between Executive Function and the Behavior of 1st and

2nd Grade Children. *Child Neuropsychology*, *9*(4), 267–276. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=pbh&AN=12059576&site=ehost-live&scope=site&custid=s6636215

Rith-Najarian, L. R., Mesri, B., Park, A. L., Sun, M., Chavira, D. A., & Chorpita, B. F. (2019). Durability of cognitive behavioral therapy effects for youth and adolescents with anxiety, depression, or traumatic stress: A meta-analysis on long-term follow-ups. *Behavior Therapy*, *50*(1), 225–240. https://doi.org/10.1016/j.beth.2018.05.006

Rivara, F. P., Koepsell, T. D., Wang, J., Temkin, N., Dorsch, A., Vavilala, M. S., Durbin, D., & Jaffe, K. M. (2012). Incidence of Disability Among Children 12 Months After Traumatic Brain Injury. *American Journal of Public Health*, *102*(11), 2074–2079. https://doi.org/10.2105/AJPH.2012.300696

Roberts, B. W., & Mroczek, D. (2008). Personality Trait Change in Adulthood. *Current Directions in Psychological Science*, *17*(1), 31–35. https://doi.org/10.1111/j.1467-8721.2008.00543.x

Roscigno, C. I., & Swanson, K. M. (2011). Parents' Experiences Following Children's Moderate to Severe Traumatic Brain Injury: A Clash of Cultures. *Qualitative Health Research*, *21*(10), 1413–1426. https://doi.org/10.1177/1049732311410988

Rosema, S., Crowe, L., & Anderson, V. (2012). Social function in children and adolescents after traumatic brain injury: A systematic review 1989–2011. *Journal of Neurotrauma*, *29*(7), 1277–1291. https://doi.org/10.1089/neu.2011.2144

Roth, R., Isquith, P. K., Gioia, G. A., Giancola, P. R., Godlaski, A. J., & Roth, R. M. (2012). Behavior Rating Inventory of Executive Function--Adult Version. *Psychology of Addictive Behaviors*, *26*(2), 201–211. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=hpi&AN=HaPI-398024&site=ehost-live&scope=site&custid=s6636215

Roy, D., Vaishnavi, S., Han, D., & Rao, V. (2017). Correlates and prevalence of aggression at six months and one year after first-time traumatic brain injury. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *29*(4), 334–342. https://doi.org/10.1176/appi.neuropsych.16050088

Rudolph, J.L., Jones, R.N., Grande, L.J., Milberg, W.P., King, E.G., Lipsitz, L.A., Levkoff, S.E., & Marcantonio, E.R. (2006). Impaired executive function is associated with delirium after coronary artery bypass graft surgery. *Journal of the American Geriatrics Society*, *54*(6), 937–941. https://doi.org/10.1111/j.1532-5415.2006.00735.x

Ryan, T. J., Roy, D. S., Pignatelli, M., Arons, A., & Tonegawa, S. (2015). Engram cells retain memory under retrograde amnesia. *Science*, *348*(6238), 1007–1013. https://doi.org/10.1126/science.aaa5542

Sabaz, M., Simpson, G. K., Walker, A. J., Rogers, J. M., Gillis, I., & Strettles, B. (2014). Prevalence, comorbidities, and correlates of challenging behavior among community-dwelling adults with severe traumatic brain injury: A multicenter study. *The Journal of Head Trauma Rehabilitation*, *29*(2), E19–E30. https://doi.org/10.1097/HTR.0b013e31828dc590

Sarmiento, K., Thomas, K. E., Daugherty, J., Waltzman, D., Haarbauer-Krupa, J. K., Peterson, A. B., Haileyesus, T., & Breiding, M. J. (2019). Emergency Department Visits for Sports- and Recreation-Related Traumatic Brain Injuries Among Children - United States, 2010-2016. *MMWR: Morbidity & Mortality Weekly Report*, *68*(10), 237–242. https://doi.org/10.15585/mmwr.mm6810a2

Schachar, R. J., Park, L. S., & Dennis, M. (2015). Mental health implications of traumatic brain injury (TBI) in children and youth. *Journal of the Canadian Academy of Child and Adolescent Psychiatry / Journal De L'Académie Canadienne De Psychiatrie De L'enfant Et De L'adolescent*, *24*(2), 100–108. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=psyh&AN=2015-40258-004&site=ehost-live&scope=site&custid=s6636215

Scholten, A. C., Haagsma, J. A., Cnossen, M. C., Olff, M., van Beeck, E. F., & Polinder, S. (2016). Prevalence of and Risk Factors for Anxiety and Depressive Disorders after Traumatic Brain Injury: A Systematic Review. *Journal of Neurotrauma*, *33*(22), 1969–1994. https://doi.org/10.1089/neu.2015.4252

Schwartz, L., Taylor, H. G., Drotar, D., Yeates, K. O., Wade, S. L., & Stancin, T. (2003). Long-term behavior problems following pediatric traumatic brain injury: Prevalence, predictors, and correlates. *Journal of Pediatric Psychology*, *28*(4), 251–263. https://doi.org/10.1093/jpepsy/jsg013

Semple, B. D., Canchola, S. A., & Noble-Haeusslein, L. J. (2012). Deficits in social behavior emerge during development after pediatric traumatic brain injury in mice. *Journal of Neurotrauma*, *29*(17), 2672–2683. https://doi.org/10.1089/neu.2012.2595

Sherer, M., & Sander, A. M. (2014). *Handbook on the neuropsychology of traumatic brain injury*. (M. Sherer & A. M. Sander, Eds.) (Ser. Clinical handbooks in neuropsychology). Springer Science + Business Media. https://doi.org/10.1007/978-1-4939-0784-7

Shorland, J., & Douglas, J.M. (2010). Understanding the role of communication in maintaining and forming friendships following traumatic brain injury. *Brain Injury*, *24*(4), 569–580. https://doi.org/10.3109/02699051003610441

Silberg, T., Tal-Jacobi, D., Levav, M., Brezner, A., & Rassovsky, Y. (2015). Parents and teachers reporting on a child's emotional and behavioural problems following severe traumatic brain injury (TBI): The moderating effect of time. *Brain Injury*, *29*(4), 481–489. https://doi.org/10.3109/02699052.2014.984758

Silver, J. M., Kramer, R., Greenwald, S., & Weissman, M. A. (2001). The association between head injuries and psychiatric disorders: Findings from the New Haven NIMH Epidemiologic Catchment Area Study. *Brain Injury*, *15*(11), 935–945. https://doi.org/10.1080/02699050110065295

Snyder, H. R. (2013). Major depressive disorder is associated with broad impairments on neuropsychological measures of executive function: A meta-analysis and review. *Psychological Bulletin*, *139*(1), 81–132. https://doi.org/10.1037/a0028727

Spinrad, T. L., Eisenberg, N., Cumberland, A., Fabes, R. A., Valiente, C., Shepard, S. A., Reiser, M., Losoya, S. H., & Guthrie, I. K. (2006). Relation of emotion-related regulation to children's social competence: A longitudinal study. *Emotion*, *6*(3), 498–510. https://doi.org/10.1037/1528-3542.6.3.498

Stamenova, V., & Levine, B. (2019). Effectiveness of goal management training® in improving executive functions: A meta-analysis. *Neuropsychological Rehabilitation*, *29*(10), 1569–1599. Retrieved June 5, 2022, from https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=s3h&AN=138988466&site=ehost-live&scope=site&custid=s6636215.

Stancin, T., Drotar, D., Taylor, H. G., Yeates, K. O., Wade, S. L., & Minich, N. M. (2002). Health-related quality of life of children and adolescents after traumatic brain injury. *Pediatrics*, *109*(2), E34. https://doi.org/10.1542/peds.109.2.e34

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, *28*(1), 78–106. https://doi.org/10.1016/j.dr.2007.08.002

Strayer, D. L., Cooper, J. M., Turrill, J., Coleman, J. R., & Hopman, R. J. (2017). The smartphone and the driver's cognitive workload: A comparison of Apple, Google, and Microsoft's intelligent personal assistants. *Canadian Journal of Experimental Psychology/Revue Canadienne De Psychologie Expérimentale*, *71*(2), 93–110. https://doi.org/10.1037/cep0000104

Stuss, D. T. (2011). Functions of the frontal lobes: Relation to executive functions. *Journal of the International Neuropsychological Society*, *17*(5), 759–765. https://doi.org/10.1017/S1355617711000695

Sukhodolsky, D. G., Smith, S. D., Mccauley, S. A., Ibrahim, K., & Piasecka, J. B. (2016). Behavioral interventions for anger, irritability, and aggression in children and adolescents. *Journal of Child and Adolescent Psychopharmacology*, *26*(1), 58–64. https://doi.org/10.1089/cap.2015.0120

Suveg, C., Sood, E., Comer, J. S., & Kendall, P. C. (2009). Changes in Emotion Regulation Following Cognitive-Behavioral Therapy for Anxious Youth. *Journal of Clinical Child & Adolescent Psychology*, *38*(3), 390–401. https://doi.org/10.1080/15374410902851721

Tajik-Parvinchi, D., Farmus, L., Tablon Modica, P., Cribbie, R. A., & Weiss, J. A. (2021). The role of cognitive control and emotion regulation in predicting mental health problems in children with neurodevelopmental disorders. *Child: Care, Health and Development*, *47*(5), 608–617. https://doi.org/10.1111/cch.12868

Tateno, A., Jorge, R. E., & Robinson, R. G. (2003). Clinical correlates of aggressive behavior after traumatic brain injury. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *15*(2), 155–160. https://doi.org/10.1176/appi.neuropsych.15.2.155

Thomas, T. C., Colburn, T. A., Korp, K., Khodadad, A., & Lifshitz, J. (2015). Translational Considerations for Behavioral Impairment and Rehabilitation Strategies after Diffuse Traumatic Brain Injury. In F. H. Kobeissy (Ed.), *Brain*

Neurotrauma: Molecular, Neuropsychological, and Rehabilitation Aspects. CRC Press/Taylor & Francis.

Thurman, D. J. (2016). The epidemiology of traumatic brain injury in children and youths: A review of research since 1990. *Journal of Child Neurology*, *31*(1), 20–27. https://doi.org/10.1177/0883073814544363

Tlustos, S. J., Kirkwood, M. W., Taylor, H. G., Stancin, T., Brown, T. M., & Wade, S. L. (2016). A randomized problem-solving trial for adolescent brain injury: Changes in social competence. *Rehabilitation Psychology*, *61*(4), 347–357. https://doi.org/10.1037/rep0000098

Townsend, J. T., & Eidels, A. (2011). Workload capacity spaces: a unified methodology for response time measures of efficiency as workload is varied. *Psychonomic Bulletin & Review*, *18*(4), 659–681. https://doi.org/10.3758/s13423-011-0106-9

Tsaousides, T., Cantor, J. B., & Gordon, W. A. (2011). Suicidal ideation following traumatic brain injury: Prevalence rates and correlates in adults living in the community. *The Journal of Head Trauma Rehabilitation*, *26*(4), 265–275. https://doi.org/10.1097/HTR.0b013e3182225271

Vaewpanich, J., & Reuter-Rice, K. (2016). Continuous electroencephalography in pediatric traumatic brain injury: Seizure characteristics and outcomes. *Epilepsy & Behavior*, *62*, 225–230. https://doi.org/10.1016/j.yebeh.2016.07.012

van den Berg, L., de Weerd, A., Reuvekamp, M., Hagebeuk, E., & van der Meere, J. (2018). Executive and behavioral functioning in pediatric frontal lobe epilepsy. *Epilepsy & Behavior*, *87*, 117–122. https://doi.org/10.1016/j.yebeh.2018.07.022

Vogan, V. M., Leung, R. C., Safar, K., Martinussen, R., Smith, M. L., & Taylor, M. J. (2018). Longitudinal examination of everyday executive functioning in children with ASD: Relations with social, emotional, and behavioral functioning over time. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.01774

Wade, S. L., Michaud, L., & Brown, T. M. (2006). Putting the pieces together: Preliminary efficacy of a family problem-solving intervention for children with traumatic brain injury. *The Journal of Head Trauma Rehabilitation*, *21*(1), 57–67. https://doi.org/10.1097/00001199-200601000-00006

Wade, S. L., Narad, M. E., Kingery, K. M., Taylor, H. G., Stancin, T., Kirkwood, M. W., & Yeates, K. O. (2017). Teen online problem solving for teens with traumatic brain injury: Rationale, methods, and preliminary feasibility of a teen only intervention. *Rehabilitation Psychology*, *62*(3), 290–299. https://doi.org/10.1037/rep0000160

Wade, S. L., Walz, N. C., Carey, J., Mcmullen, K. M., Cass, J., Mark, E., & Yeates, K. O. (2011). Effect on behavior problems of teen online problem-solving for adolescent traumatic brain injury. *Pediatrics*, *128*(4), e947–e953. https://doi.org/10.1542/peds.2010-3721

Wade, S.L., Waltz, N.C., Cassedy, A., Taylor, H.G., Stancin, T., & Yeates, K.O. (2010). Caregiver functioning following early childhood TBI: do moms and dads respond differently? *NeuroRehabilitation*, *27*(1), 63–72. https://doi.org/10.3233/NRE-2010-0581

Walz, N. C., Yeates, K. O., Wade, S. L., & Mark, E. (2009). Social information processing skills in adolescents with traumatic brain injury: Relationship with social competence and behavior problems. *Journal of Pediatric Rehabilitation Medicine*, *2*(4), 285–295. https://doi.org/10.3233/PRM-2009-0094

Wang, M.-L., & Li, W.-B. (2016). Cognitive impairment after traumatic brain injury: The role of MRI and possible pathological basis. *Journal of the Neurological Sciences*, *370*, 244–250. https://doi.org/10.1016/j.jns.2016.09.049

Watanitanon, A., Lyons, V. H., Lele, A. V., Krishnamoorthy, V., Chaikittisilpa, N., Chandee, T., & Vavilala, M. S. (2018). Clinical Epidemiology of Adults With Moderate Traumatic Brain Injury. *Critical Care Medicine*, *46*(5), 781–787. https://doi.org/10.1097/CCM.0000000000002991

Weersing, V. R., Jeffreys, M., Do, M.-C. T., Schwartz, K. T., & Bolano, C. (2017). Evidence Base Update of Psychosocial Treatments for Child and Adolescent Depression. *Journal of Clinical Child and Adolescent Psychology : the Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53*, *46*(1), 11–43. https://doi.org/10.1080/15374416.2016.1220310

Wetherington, C. E., Hooper, S. R., Keenan, H. T., Nocera, M., & Runyan, D. (2010). Parent ratings of behavioral functioning after traumatic brain injury in very young children. *Journal of Pediatric Psychology*, *35*(6), 662–671. https://doi.org/10.1093/jpepsy/jsp081

Yeates, K. O., Bigler, E. D., Dennis, M., Gerhardt, C. A., Rubin, K. H., Stancin, T., Taylor, H. G., & Vannatta, K. (2007). Social Outcomes in Childhood Brain Disorder: A Heuristic Integration of Social Neuroscience and Developmental Psychology. *Psychological Bulletin*, *133*(3), 535–556. https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=eric&AN=EJ766794&site=ehost-live&scope=site&custid=s6636215

Yeates, K. O., Taylor, H. G., Walz, N. C., Stancin, T., & Wade, S. L. (2010). The family environment as a moderator of psychosocial outcomes following traumatic brain injury in young children. *Neuropsychology*, *24*(3), 345–356. https://doi.org/10.1037/a0018387

Zgaljardic, D. J., Seale, G. S., Schaefer, L. A., Temple, R. O., Foreman, J., & Elliott, T. R. (2015). Psychiatric disease and post-acute traumatic brain injury. *Journal of Neurotrauma*, *32*(23), 1911–1925. https://doi.org/10.1089/neu.2014.3569