1-1-2015

Development of the DORI-TBI: An Investigation to Develop a New Screening Measure to Determine Consultation with a School-Based Brain Injury Resource Team

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DEVELOPMENT OF THE DORI-TBI:

AN INVESTIGATION TO DEVELOP A NEW SCREENING MEASURE TO DETERMINE CONSULTATION WITH A SCHOOL-BASED BRAIN INJURY RESOURCE TEAM

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A Dissertation

Presented to

the Faculty of the Morgridge College of Education

University of Denver

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

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by

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August 2015

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Title: DEVELOPMENT OF THE DORI-TBI: AN INVESTIGATION TO DEVELOP A NEW SCREENING MEASURE TO DETERMINE CONSULTATION WITH A SCHOOL-BASED BRAIN INJURY RESOURCE TEAM
Advisor: Dr. Gloria Miller
Degree Date: August 2015

Abstract

Brain injury is the leading cause of disability and death in children in the United States. Student re-entry into the school setting following a traumatic brain injury is crucial to student success. Multidisciplinary teams within the school district comprised of individuals with expertise in brain injury are ideal in implementing student specific treatment plans given their specialized training and wide range of expertise addressing student needs. Therefore, the purpose of this study is to develop and initially validate a quantitative instrument that school personnel can use to determine if a student, identified as having a traumatic brain injury, will benefit from district-level consultation from a brain injury team.

Three studies were designed to investigate the research questions. In study one, the planning and construction of the DORI-TBI was completed. Study two addressed the content validity of the DORI-TBI through a comparison analysis with other referral forms, content review with experts in the field of TBI, and cognitive interviews with professionals to test the usability of the new screening tool. In study three, a field administration was conducted using vignettes to measure construct validity. Results produced a valid and reliable new screening instrument that can aid school-based teams to more efficiently utilize district level consultation with a brain injury support team.

Acknowledgements

My interest and love for pediatric brain injury began when I was accepted into a fellowship at the University of Colorado Anschutz Medical Campus in 2009. Through this fellowship, I was introduced and trained in the BrainSTARS consultation model by Dr. Hal Lewis and Dr. Jeanne Dise-Lewis. In the initial stages of this journey, I accepted advice from a dissertation survival manual by creating a "Dissertation Social Support Committee" to help ensure that I made it to this point. The people on this committee included: my husband Joe, our baby girl due in July 2015, my dog Sammy, my parents, my in-laws, my mentor Marybeth Lehto Ph.D., my friend Christine Miller, my "dissertation buddies" Dennis Jackson and Kirsten Hermanutz and my hometown and Denver area friends. This team of people cheered me on, provided me with an endless supply of coffee, and offered me writing breaks and mental health support. In addition to my social support committee, I would also like to thank my dissertation committee Dr. Gloria Miller, Dr. Kathy Green, and Dr. Karin-Dittrick-Nathan for all of their help and guidance on this project. Finally, I would like to thank my CFSP family, my work colleagues, the participants in this dissertation, and all of the students with whom I have had the privilege to work. All of these people have helped support and shape me into the professional I am today.

Table of Contents

List of Tables

Chapter One: Introduction

Problem Statement

As awareness of brain injury in children rises, so does the need for collaboration between the medical community and the school to ensure student success during re-entry into the school setting. Brain injury is the leading cause of disability and death in children in the United States. Almost half a million children in the United States visit emergency rooms for brain-related injuries per year. Children ages 0 to 4 and adolescents ages 15 to 19 are the most likely to sustain a TBI ("Get the Stats," n.d.; Dise-Lewis, Calvery, Lewis, Puls, Griebel, Denlinger, 2002). Almost 2.5 million children in the United States have sustained a TBI and approximately another 200,000 have sustained an acquired brain injury (Dise-Lewis et al., 2002).

Traumatic brain injury is caused by an external force to the head, which results in total or partial disability as well as possible psychosocial impairment (Dise-Lewis et al., 2002; Pangilinan, Kelly, Hornyak, & Smith, 2008). An acquired brain injury results from a loss of oxygen to the brain. Children who receive a brain injury in infancy (birth-age 3) have been documented as having challenges in numerous areas including cognitive functioning, academic outcomes, and social interactions (Dise-Lewis et al., 2002). In addition to the social challenges, children who receive a brain injury in infancy have been documented as requiring more academic support compared to those children who did not receive a brain injury. One study found that although diagnostic tests may indicate that

the student is in the average range, students who receive a TBI required additional educational support (Ashton, 2010). In addition, traumatic brain injuries have been demonstrated to cause memory deficits and deficits in executive functions. These include: reduced attention, as well as challenges with processing speed, planning, reasoning, and recall (Horton, Jr., Soper, & Reynolds, 2010; Savage, & Wolcott, n.d.). Children who have sustained a brain injury in infancy will likely require much more structure, support, and supervision than what is considered age appropriate (Dise-Lewis et al., 2002).

Like other disabilities, there are many myths and misconceptions with regard to traumatic brain injury, especially surrounding the level of impact the TBI has on an individual. Farmer and Johnson-Gerard (1997) were interested in examining these misconceptions about traumatic brain injury. They administered a 40-item questionnaire to TBI rehabilitation professionals and to school professionals, and found statistically significant differences between the misconceptions of rehabilitation professionals and the school professionals. Specifically, education professionals had more misconceptions than rehabilitation professionals about brain injury sequelae and recovery processes such as underestimating the negative impact the injury has on memory and new learning abilities, emotional control, and long-term development. However, they also found that educators showed fewer misconceptions than the general public in certain areas of impact such as knowing the child might have new learning problems and rote memory deficits (Farmer & Johnson-Gerard, 1997).

The inclusion of students in special education into the general education classroom was a paradigm shift in education that has now been around for over 30 years (King, 2003; Obiakor, Harris, Mutua, Rotatori, & Algozzine, 2012). The passing of the Education of All Handicapped Children Act (EAHC) in 1975 provided all students with disabilities with a free and appropriate education (FAPE). This included providing instruction in the Least Restrictive Environment (LRE). In 1990, the EAHC was renamed the Individual with Disabilities Education Act and added traumatic brain injury and autism as new disability categories. The 2004 reauthorization of the Individuals with Disabilities Education Improvement Act increased accountability by requiring schools to use instructional strategies grounded in scientifically based research to improve student performance (Yell, 2006). This shift has increased teacher accountability and required general education teachers to differentiate their curriculum in order to meet students' various needs in their classrooms.

Shade and Stewart (2001) revealed that general education teachers, at both the primary and secondary levels, have a more favorable attitude towards including special education students in the general education classroom when given direct instruction in their teacher education programs. Kaiser, Rosenfield, and Gravois (2009) constructed a study to investigate teachers' perceptions of their instructional strategies after participating in an instructional consultation model. Skills taught in this instructional consultation model focus on enhancing the teacher's ability to manage and address academic and behavior concerns in the general education classroom through a problem-

solving approach with a consultant to enhance their professional development. Results of this study indicate that teachers had positive experiences from participation in the consultation model and reported that they felt more confident in handling similar situations in the future as a result of the skills gained from collaborating with a consultant in this consultee-centered model (Kaiser, Rosenfield, & Gravois, 2009).

Given the complicated and unique sequelae of TBI, it is important that students who have received a traumatic brain injury be appropriately identified in order to provide adequate support, intervention, and accommodations to ensure they receive a FAPE. In order to identify those students who may have received a brain injury, Dettmer, Daunhauer, Detmar-Hanna, and Sample (2007) created a screening tool for school-aged children. The Screening Tool for the Identification of Acquired Brain Injury in School-Aged Children (STI) was designed to identify possible brain injury in students who were struggling in school. While the STI (now known as the Brain Check Survey) has been supported as a valid and accurate screening tool for the possible identification of students with ABI or TBI, this tool does not provide brain injury teams at the school district level with criteria as to whether a student would benefit from district-level consultation (Dettmer et al., 2007).

Student re-entry into the school setting following a traumatic brain injury is crucial to student success. Multidisciplinary teams within the school district comprised of individuals with expertise in brain injury are ideal in implementing student-specific treatment plans given their specialized training and wide range of expertise addressing student needs. This team provides necessary resources, education, and training to those

working with the student to provide support, to facilitate communication, and to identify needs (Deidrick & Farmer, 2005). Cherise, Canto, and Buckley (2011) reported that providing information regarding causes, effects, interventions, mechanisms, and modifications in regard to traumatic brain injury can improve service delivery for students with TBI.

While brain injury in the public school setting has been a relatively unnoticed topic, recently more attention has been paid to it and information provided to professionals in the school setting, especially with regard to concussion management and mild TBI. In 2009, Washington passed the first concussion in sports law. Currently, 43 states have passed concussion in sports laws. Many of these laws included providing education to coaches, parents, and athletes on concussions, removing the athlete from play, and requiring that the athlete obtain permission to return to play ("Get a Heads up," n.d., para. 3). In the United States, several school districts have formed brain injury teams comprised of professionals in multiple specialties that consult with school personnel on students with brain injury. Glang, Tyler, Pearson, Todis, and Morvant (2004) found that training and utilizing a multidisciplinary team of professionals in the school setting is a more efficient and cost effective approach for service delivery to students with TBI in contrast to the single consultant approach. While this model fosters skill building for school personnel in regard to supporting students with TBI, this model does not provide an identification protocol to highlight those students with TBI who might benefit from this level of support (Glang et al., 2004).

Purpose & Research Questions

The purpose of this study is to develop and initially validate a quantitative instrument that school personnel can use to determine if a student, identified as having a traumatic brain injury, will benefit from district level consultation from a brain injury team. The development of a new school-based brain injury-screening tool such as the DORI-TBI may increase service delivery efficiency by reducing inappropriate referrals and more strategically identifying areas of concern. This, in turn, will allow teams to mobilize and target interventions more efficiently, and to capitalize on each team member's unique skills and expertise.

Once the DORI-TBI is developed, the following questions will be addressed: 1) Does the DORI-TBI demonstrate appropriate content validity? 2) Does the DORI-TBI demonstrate appropriate construct validity? 3) Does the DORI-TBI demonstrate appropriate convergent validity?

Definitions Used in Current Study:

Traumatic Brain Injury: The Colorado Department of Education (CDE) defines traumatic brain injury (TBI) as:

> A child with Traumatic Brain Injury (TBI) is a child with an acquired injury to the brain caused by an external physical force resulting in total or partial functional disability or psychosocial impairment, or both, which impairment adversely affects the child's ability to receive reasonable educational benefit from general education. ("Traumatic Brain Injury," n.d., para. 1)

Consultation Team - For the purpose of this study, a consultation team is operationally defined as a multidisciplinary team of professionals working together in a school district.

Disciplines that may be represented as part of a multidisciplinary team include: school psychologists, occupational therapists, physical therapists, speech-language pathologists, and school nurses.

Brain Injury Resource Team is a consultation team whose members have special training or expertise in traumatic brain injury and who also work in a public school setting.

Screening Tool - A screening tool is defined by Cohen & Swerdlik (2009) as:

> An instrument or procedure used to identify a particular trait or constellation of traits at a gross or imprecise level, as opposed to a test of greater precision used for more definitive diagnosis or evaluation. (pp. 289-290)

Diagnostic Observations are observations made by school personnel that are common behaviors observed in students who have received a traumatic brain injury. These behaviors are based on theory and literature review and are identified in the BrainSTARS manual as common behaviors of concern following a TBI (Dise-Lewis et al., 2002).

Intervention - For the purpose of this study, an intervention refers to a specific strategy designed to target the most common academic and behavior concerns in students who sustained a traumatic brain injury. These areas are identified by specific neurodevelopmental clusters identified by the BrainSTARS manual (Dise-Lewis et al., 2002).

Chapter Two: Literature Review

Definition of Traumatic Brain Injury

A Traumatic Brain Injury is defined by the Centers for Disease Control and Prevention as an injury "caused by a bump, blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain" ("Traumatic Brain Injury in the United States," n.d., para. 2). In the public school system, children who sustain a traumatic brain injury can qualify for services under The Individuals with Disabilities Education Act (IDEA), which entitles all students in special education to a free and appropriate education (FAPE). One of the special education categories students can qualify under is Traumatic Brain Injury. As defined by the Colorado Department of Education (CDE), a traumatic brain injury (TBI) is:

> A child with Traumatic Brain Injury (TBI) is a child with an acquired injury to the brain caused by an external physical force resulting in total or partial functional disability or psychosocial impairment, or both, which impairment adversely affects the child's ability to receive reasonable educational benefit from general education. ("Traumatic Brain Injury," n.d., para. 1)

Scope of the Problem

Prevalence of traumatic brain injury.

In the United States, a leading cause of death and disability is traumatic brain injury. According to the Centers for Disease Control and Prevention, there are

approximately 1.7 million TBI's every year in the United States. Broken down, these include approximately 51,000 deaths, 290,000 hospitalizations, and 1,224,000 emergency room visits per year in the United States. Sadly, this number is likely an under estimation of the actual number of TBIs that occur each year because it does not take into account those injuries that go unreported ("Get the Stats," n.d., para 1). Currently, there are approximately 5.3 million people who have a lifetime disability as a result of a TBI which totals a cost of $257 billion dollars for their caregivers. The most common cause of TBI's is motor vehicle accidents (51%), followed by falls (21%), assaults and violence (12%), sports and recreation (10%) and other (6%) (Gorgens, 2013). Approximately 5-10% of all traumatic brain injuries are considered fatal and 70% of deaths occurring from fatal TBI's transpire within three days. Pediatric traumatic brain injury is the leading cause of death and disability in children and adolescents (Gorgens, 2013).

Type and severity of brain injury.

Every brain injury is different and unique to each individual. Even when the same individual sustains two brain injuries, these injuries are not exactly the same. While the effects of brain injury vary from case to case, there are some primary factors that impact an individual's functioning post-injury. These include cause, location, and severity of the brain injury ("Living with Brain Injury," n.d., para. 1; Dise-Lewis et al., 2002).

Brain injuries include both acquired brain injuries (e.g., no oxygen to the brain or loss of oxygen to the brain as a result of seizers, strokes, and cardiac arrest) and traumatic brain injuries (e.g., blow to the head from firearm wounds, motor vehicle collisions, falls, etc.) (About Brain Injury, n.d., para. 3). The focus of the current study will be on

traumatic brain injuries. Traumatic brain injuries are categorized into two main classifications: open-head injuries and closed-head injuries. Open-head injuries are less prevalent than closed head injuries and refer to injuries that occur when an object penetrates the skull. In this type of injury, brain damage typically occurs at the location where the object penetrated the brain tissue (Aldrich & Obrzut, 2012). A penetrating injury is an example of an open-head injury and oftentimes pieces of skull, bone, and hair enter the brain along with the object ("About Brain Injury," n.d., para. 3; "Open-Head Injury," n.d., para. 3; Kazim, Shamim, Tahir, Enam & Waheed, 2011). Closed-head injuries are more common than open-head injuries and include diffuse axonal injury, concussions, second impact syndrome, contusions, and coup-contrecoup injuries ("About Brain Injury," n.d., para. 3). Diffuse axonal injuries are closed head injuries in which axons in the brain are torn apart or disrupted as a result of the brain rapidly moving back and forth inside the skull. They are called diffuse injuries because, unlike other close-head injuries that are typically located in one generalized area, diffuse axonal injuries are wide spread and therefore affect a larger area of the brain. ("About Brain Injury," n.d., para. 3; Dise-Lewis et al., 2002). A concussion refers to a closed-head injury that interrupts the brains normal function and occurs when the brain moves quickly back and forth as a result of a blow to the head or body ("Get a Heads up," n.d., para. 3). Similar to a concussion, second-impact syndrome occurs when an individual sustains a second injury to the brain before the first injury has fully healed. Second-impact syndrome can cause severe brain damage and even death as a result of the increase of intracranial pressure from the swelling of the brain. The vast majority of cases with this type of injury

are reported in the literature in adolescents ("Heads up," 2005, p. 3). A cerebral contusion is a closed-head injury where an area of the brain bleeds and swells around the tissue. This type of injury has an ability to enlarge and lead to increased intracranial pressure (Soustiel, Mahamid, Goldsher, & Zaaroor, 2007). A coup-contrecoup brain injury is another type of closed-head injury that occurs at the site of the impact as well as on the opposite side of the brain ("About Brain Injury," n.d., para. 3). Specifically, a coup brain injury occurs on the adjacent area of the brain from where the skull impacted an external object. This differs from a contrecoup injury where the brain is injured on the opposite area of the brain where the object impacted the skull (Drew & Drew, 2004). Therefore, coup-contrecoup brain injuries occur from a force strong enough to cause bleeding at the site of impact from the object and move the brain to the opposite end of the skull to cause additional damage ("About Brain Injury," n.d., para. 3; Drew & Drew, 2004).

Another important factor that impacts an individual's functioning following a traumatic brain injury is the severity of the injury. The Glasgow Coma Scale is one of the most common rating scales to measure the severity of a brain injury. Traumatic brain injuries are rated on a scale from 3 to 15 based on the individual's eye opening, verbal response, and motor response (Gorgens, 2013; Levin, Benton, & Grossman, 1982). Based on the Glasgow Coma Scale, TBIs are broken down into three categories: Mild, Moderate, and Severe (Levin, Benton, & Grossman, 1982).

Another widely known scale used to measure brain injury is the Rancho Los Amigos Scale (Gorgens, 2013; "Rancho Levels of Cognitive Functioning," 2012, para. 1). This scale was developed as a rehabilitation tool to assess for cognitive function less

than one-year post onset in individuals who sustain a brain injury. This tool was specially designed to measure the cognitive and behavioral patterns of recovery for individuals in order to develop a personalized and strengths-based treatment plan (Hagen & Malkmus, 1979). The Rancho Los Amigos Scale includes eight levels of cognitive functioning that is typically seen after a brain injury. These include: Cognitive Level I: No Response; Cognitive Level II: Generalized Response; Cognitive Level III: Localized Response; Cognitive Level IV: Confused and Agitated; Cognitive Level V: Confused and Inappropriate; Cognitive Level VI: Confused and Appropriate; Cognitive Level VII: Automatic and Appropriate; and Cognitive Level VIII: Purposeful and Appropriate. While these levels were designed to describe the progression of recovery a person with a brain injury may go though, it is important to remember that every brain injury is unique and there is not typically a smooth transition between levels during the recovery process. Specifically, individuals may spend longer in one level than in another or they may never advance to another level. Further, even if they reach level eight, it does not mean that the person does not have any lingering or long-term changes caused by the brain injury (Family Guide to The Rancho Levels of Cognitive Functioning, 2006).

Pediatric traumatic brain injury.

Each year, approximately 1 million children sustain a head injury. Child abuse accounts for 64% of these injuries (Gordens, 2013). Further, one in 500 school-aged children will receive a head injury severe enough to be hospitalized. Of those children who will be hospitalized following a TBI, one in 10 will sustain moderate to severe impairments as a result of their injury (Gorgens, 2013). It is estimated that in a school

district of 10,000 students, 20 school age students will receive a TBI and require specialized educational support (Max, 2000). It is crucial that teachers understand TBI and the common academic and behavioral implications that student's may experience post injury.

The inclusion of students in special education into the general education classroom has been a paradigm shift in education that has been around for over 30 years (Idol, 2006; Obiakor, Harris, Mutua, Rotatori, & Algozzine, 2012; Yell, 2006). In a program evaluation study of eight public schools located in a large metropolitan school district in a southwestern city, the researchers found that educators are moving toward 100% inclusion of students with disabilities in the general education classroom. In addition, they found that educators had a positive attitude toward inclusion and a positive attitude on the impact students with special needs have on all students in the general education classroom (Idol, 2006). A study done by Shade and Stewart (2001) revealed that general education teachers, at both the primary and secondary levels, have a more favorable attitude towards including students in special education in the general education classroom when they are given direct instruction on how to support the diverse learning styles of their students in their teacher education programs. Woolfson and Brady (2009) found that teachers who felt competent in teaching students with special needs attributed a student's difficulty in learning to external factors, such as the curriculum that was used, rather than a problem located within the student. This suggested that teachers believed

they could influence student learning by their method of teaching. Therefore, it is crucial for students who have traumatic brain injuries to be appropriately identified as early as possible, and for teachers to understand the student's strengths and areas of deficit in order to ensure the most appropriate support to foster academic success.

Common academic concerns of pediatric brain injury.

As previously mentioned, children who receive a brain injury in infancy have been documented as requiring more academic support compared to those children who did not receive a brain injury. Cognitive and academic deficits are common concerns for individuals post brain injury. Academically, children and adolescents who sustain a TBI may have difficulty with reading, writing, mathematic calculation, spelling, and language (Aldrich & Obrzut, 2012). Further, while unique to each individual following a TBI, children and adolescents have impairments in certain cognitive abilities such as visuomotor skills (e.g., hand-eye coordination) and visuospatial skills (e.g., ability to read a map). Further, persistent declines in academic skills including word recognition, oral reading, and mathematics have been displayed in children and adolescents post TBI (Arroyos-Jurado, Paulsen, Merrell, Lindgren, & Max, 2000). Taylor and Alden (as cited in Gil, 2003) reported that a child's developmental achievement may be impaired if the child sustains injuries during early development when the injury disrupts the process of neuronal and axonal development. Therefore, the student may have impaired cognitive abilities, such as difficulty processing higher-level information. Children who sustain a brain injury in infancy will likely require much more structure, support, and supervision

than what may be considered appropriate for their age (Dise-Lewis et al., 2002). Without appropriate intervention and support, the cognitive and academic deficits faced by children and adolescents who sustain a TBI may continue into adulthood and impact future interpersonal relationships and vocational performance (Arroyos-Jurado et al., 2000).

Common behavioral concerns of pediatric brain injury.

Clark (as cited in Arroyos-Jurado, Paulsen, Merrell, Lindgren, & Max, 2000) found that children and adolescents who sustain a TBI are three times more likely to develop behavior challenges than those who do not sustain a TBI. In a study done by Prigatano, Fulton and Wethe (2010), ten common behavior disturbances were investigated in children who received a brain injury. Behavior disturbances were defined as "changes in responding to environmental demands that are maladaptive for the child" (p. 448). Several of the behavior disturbances found to be common in children who have a history of a TBI included: aggression, attention difficulties, impulsive and socially inappropriate behaviors, emotional irritability and anxiety. In a review of the literature, Elsa Arroyos-Jurado, Paulsen, Merrell, Lindgren, & Max (2009) found that common behavioral sequelae of children and adolescents who have sustained a TBI include: difficulties with self-esteem, self-control, social awareness, age-appropriate behavior, interpersonal relationships, and self-care. Prigatano et al. (2010) noted that while these behavior disturbances were common in children with TBI, in some cases these

disturbances were present prior to the injury. When a child sustains a brain injury it is common for the injury to exaggerate the areas of weakness and difficulty (Dise-Lewis et al., 2002).

Outcomes of traumatic brain injury.

Developmental neuropsychologists believe that an interaction between cognitive, behavioral, and brain development are crucial to determining the outcomes for an individual who sustains a TBI (Gil, 2003). Trajectories for recovery of individuals who sustain a traumatic brain injury are typically curvilinear within approximately a year. Recovery is estimated to plateau within about two years (Gorgens, 2013). In a study completed by Majdan et al. (2011) the severity and outcomes of TBI were examined with different causes of injury. Results indicated that traffic-related TBIs had the greatest outcomes and that the age of the individual at the time of the accident improved the outcome. Specifically, there were a statistically significant higher proportion of individuals with positive outcomes one-year post injury in the traffic-related injury group than the falls or other injury groups. Even when controlling for age, those individuals in the traffic-related injuries group continued to show the best outcomes. Further, when analyzing the long-term outcomes of injuries, the traffic related injuries group had significantly higher odds for positive outcomes than the fall related injury group (Majdan et al., 2011).

Consultation teams.

Student re-entry into the school setting following a traumatic brain injury is crucial to student success. Multidisciplinary teams within the school district comprised of

individuals with expertise in brain injury are in an ideal position to implement student specific treatment plans given their specialized training and wide range of expertise addressing student needs. Such teams can provide necessary resources, education, and training to those working with the student to provide support, facilitate communication, and identify needs (Deidrick & Farmer, 2005). Cherise, Canto, and Buckley (2011) reported that providing information regarding causes, effects, interventions, mechanisms, and modifications in regards to traumatic brain injury can improve service delivery for students with TBI.

Summary

Overall, brain injuries include both acquired (lack of oxygen) and traumatic (external blow to the head) injuries. As previously mentioned, approximately 1 million children sustain a head injury every year. Given that traumatic brain injury is one of the special education disability categories students can qualify for and receive special education services through the Individuals with Disabilities Education Act (IDEA), it is crucial that those students who have sustained a TBI are appropriately identified to allow for the best supports and interventions to be put in place for their success. Just as no two brain injuries are alike, the effects of a brain injury also vary case-by-case, making intervention and support complicated. There are some common areas of academic and behavior concerns among individuals that sustain a brain injury, which can help guide recommendations and interventions ("About Brain Injury," n.d., para 1; Dise-Lewis et al., 2002). Brain injury teams in the public school setting can act as a liaison between the hospital and home settings to set the student up for success following re-entry into the

school setting post-injury (Chesire et al., 2011). However, most teams are made up of a multidisciplinary group of volunteers who work in the school district with limited time and resources. In order to provide the most efficient and effective services under these circumstances, brain injury teams will benefit from a screening instrument that will help aid them in the consultation process.

Traumatic Brain Injury Measurement Tools

As the literature has stated, brain injury is complicated. There have been several instruments designed to measure brain injury, brain injury symptoms, and the resulting impacts of brain injury in children and adults. The following section will provide a comprehensive review of measurement tools designed to measure severity of outcomes and common cognitive and behavior and social/emotional concerns post brain injury, perceptions, and cognitive concerns. A comprehensive search for traumatic brain injury screening instruments was conducted using terms that included all variations of traumatic brain injury screening and measurement. All resulting articles were then scanned and kept for further review if a measure was included in the key terms.

Screeners used for brain injury diagnosis.

Many of the screeners available for traumatic brain injury are simply designed to rule in or rule out a diagnosis of TBI. The Ohio State University Traumatic Brian Injury Identification Method (OSU-TBI-ID) is a screening tool designed to measure an individuals' lifetime history of TBI (OSU-TBI, 2013, para. 1). This standardized tool is implemented via a 3-5 minute structured interview to gather a self-report lifetime history

of possible TBIs. The target populations for the OSU-TBI-ID are typically older adults in various settings (e.g., mental health centers, correctional facilities, nursing homes, medical facilities, etc.). The OSU-TBI-ID includes three major steps with an additional number of items presented at each step based on the answers given. The total number of items possible for the OSU-TBI-ID is 24 across all three steps. While there is no "total score" obtained from the OSU-TBI-ID, the interviewer is encouraged to review and interpret the responses in terms of five key areas: worst, first, multiple, recent, and other sources of head injury.

Another screener developed to diagnose a traumatic brain injury is the Traumatic Brain Injury Questionnaire (TBIQ). The TBIQ is designed as an interview-based instrument to assess for head injury in individuals involved in the criminal justice system. The TBIQ is divided into two sections. Part I was developed based on questions originally used to assess for head injury in the military population (Diamond, Harzke, Magaletta, Cummins, & Frankowski, 2007). Part II contains a symptoms checklist based on the HELPS questionnaire to assess the frequency and severity of 15 common cognitive and behavioral sequelae following a head injury. Each symptom includes a yes/no response format followed by a 4-point response scale to document the occurrence of the symptom (e.g., currently, within the past, more than a year ago, or never) and this is followed again by a likert-scale to document the frequency of the symptom (e.g., all the time, less than a month, never). The TBIQ has a total of 27 items: Part I has 12 items and Part II has 15 items. Items are then combined to create a Total Symptom Severity Index (TSSI) as well as a Total Symptom Frequency Inventory (TSFI).

The Brief Traumatic Brain Injury Screen (BTBIS) is an instrument designed to assess for traumatic brain injuries in soldiers (Schwab, Ivins, Cramer, Johnson, Sluss-Tiller, Kiley, Lux, & Warden, 2007). The BTBIS is a one-page, 5-item questionnaire administered in a paper and pencil format. Scoring of the BTBIS includes reviewing the instrument for any endorsement of self-reported incidents and symptoms of TBI. When there is a positive endorsement of TBI symptoms, the individual who completed the instrument is followed up with an interview by a Master's level psychologist to determine if their self-report meets criteria for diagnosis.

The Traumatic Brain Injury Screening Instrument (TBISI) was developed in April 2007 also to identify veterans who may have sustained a TBI during their service (Van Dyke, Axlrod, & Schutte, 2010). The TBISI was developed by professionals including Neurology, Psychology, Primary Care, Physical Medicine and Rehabilitation, Prevention and was based on a prior Brief Traumatic Brain Injury Survey. The TBISI includes 4 sections and 23 items that involve Yes/No responses to gather information on possible head trauma.

Another screening tool is the Brain Injury Screening Questionnaire (BISQ). The BISQ was designed to measure "unidentified" TBI in children and adults. This screener was adapted from the "HELPS," designed by Picard, Scarisbrick and Paluck at Mount Sinai's TBI Rehabilitation and Prevention Center in 1991 and a TBI Symptom Checklist used at the Medical College of Virginia created by Don Lehmukuhl in 1988. The questionnaire is a 100-item self-report that is broken into three parts. Part 1 determines if

the individual meets criteria for a brain injury. Part II documents the symptoms of the brain injury. Finally, Part III examines factors other than brain injury that may account for the individual's impairment. If an individual does not meet criteria in Part I, the survey is complete. If they endorse items that meet criteria, they continue answering Part II and Part III. Twenty-five questions presented in a Likert-type format in Part II are associated with TBI. Upon endorsement of symptoms in Part II and co-morbidities in Part III, a follow-up is scheduled by a clinician (Sacks, Fenske, Gordon, Hibbard, Perez Brandau, Cantor, Ashman, & Spielman, 2009).

Finally, the Brain Check Survey (first known as the Screening Tool for the Identification of Acquired Brain Injury in School-Aged Children) is a screening instrument developed specifically for the school-age population to help identify students who may have received a brain injury (Dettmer et al., 2007). The Brain Check Survey has items organized into four domains: 1) previous injury or illness information, 2) behaviors that affect learning, 3) symptoms, and 4) educational services information. The injury section has a total of 14 items, 13 of which include an option of 6 outcomes and 1 fill-in-the-blank item. The behavior section has 19 items scored on a 6-point Likert-type scale. The symptoms section has 15 items also scored on a 6-point Likert-type scale. Finally, the services section has a total of 9 items involve a fill-in-the-blank or yes/no response.

Screeners that measure school-based academic concerns.

While more difficult to locate than identification tools, there are a few screening instruments developed to assess the academic concerns of students but they are not exclusive to children who sustain a head injury. However, the information gathered by

these instruments is useful to understand the specific areas of strength and deficit in children who have sustained a brain injury and to help decide on academic programming and interventions.

The Behavior Assessment System for Children, Second Edition (BASC-2) (Stein, Watson, & Wickstrom, 2012) measures observable problem and adaptive behavior of individuals between the ages of 2 and 25 and includes a Parent Rating scale (PRS), Teacher Rating Scale (TRS), and Self-Report of Personality scale (SRP). The PRS and TRS include three different forms based on the individual's age: Preschool (ages 2-5), Child (ages 6-11), and Adolescent (ages 12-21). The SRP form also includes three different forms: Child (ages 8-11), Adolescent (ages 12-21), and College (ages 18-25). Most items on the PRS, TRS, and SRP include a 4-point response scale. In addition, the SRP includes a True/False response scale. Items on the PRS, TRS, and SRP yield T-scores and percentile ranks. These scores are used to help to determine educational emotional and behavioral disorders in children and adolescents and to aide in the development of a treatment plan (Stein et al., 2012).

Another scale used to identify strengths and weaknesses in executive functioning in children and adolescents between the ages of 5 and 18 years old is the Behavior Rating Inventory of Executive Function (BRIEF) (Fitzpatrick, & Schraw, 2012). The BRIEF questionnaire is completed by parents and teachers and has a total of 86 items that relate to eight clinical scales: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor. The scores of each subscale are calculated into T-scores and percentile ranks and fall into one of two descriptive

categories: *Elevated* or *Within Normal Limits*. These scores are also combined to create an overall Global Executive Composite, as well as Metacognition Index and Behavioral Regulation Index scores (Fitzpatrick, & Schraw, 2012).

Screeners that measure emotional or behavior concerns.

The Apathy Evaluation Scale (AES) was designed to measure apathy in adults, especially in those adults who have impaired insight as a result of frontal lobe injury or "dementing disease" (Marin, Biedrzycki, & Firinciogullari, 1991). The AES has 18 items and includes a 4-point Likert response scale. There are three forms of the AES available: Clinician (AES-C), Informant (AES-I) and Self-report (AES-S). Items were coded to indicate that a higher score equaled greater apathy.

Another measure of emotional regulation following acquired brain injury was developed by Cattran, Oddy and Wood (2011) and is titled The Brain Injury Rehabilitation Trust (BIRT) Regulation of Emotions Questionnaire (BREQ). There is a self-rated and relative-rated version with 32 items organized into nine content areas: liability, no or insufficient cause for the behavior, extremes of mood, control of behavior, irritability, inappropriate response, regret following an outburst, amnesia for an outburst, and physical symptoms each with a 4-point Likert scale response format. A total score is then calculated from these items.

Screeners that measure neurobehavioral deficits following brain injury.

The Neurological Outcome Scale (NOS-TBI) (Clifton, Kelly, Levin, McCauley, Moretti, & Pedroza, 2010) was developed to assess neurological dysfunction following a traumatic brain injury and is based on the National Institute of Health Stroke Scale used to measure TBI sequelae post injury which impacts the individual's rehabilitation and overall outcome. Domains for the NOS-TBI include: level of consciousness, eye gaze, visual field, facial palsy, and motor arm and motor leg. Each domain is categorically rated by level of impairment. The NOS-TBI has 15 items, some of which have sub-items, for a total of 23 items. Response options are on a 3-, 4-, and 5-level Likert type rating. The total score for the NOS-TBI is calculated using items 1-13, since items 14 and 15 are supplemental (Clifton et al., 2010).

The Frontal Systems Behavior Scales (FrSBe) (Niemeier, Perrin, Holcomb, Nersessova, & Rolston, 2013) is a 46-item scale designed to assess neurobehavioral deficits in individuals who sustain a TBI. There are two versions of the FrSBe, a patient- and family-rating version, which are each divided into three subscales: Apathy, Disinhibition, and Executive Dysfunction. Scores on these scales combine to create an overall score indicating frontal lobe dysfunction.

Overall Summary

In summary, it is important to remember that traumatic brain injuries are the leading cause of death and disability in the United States. It is critical to appropriately identify traumatic brain injury in order to provide adequate support for an individual post injury. Numerous measurement tools have been developed which aid professionals in the

identification of traumatic brain injury for populations such as children, soldiers, and correctional facilities (Dettmer et al., 2007; Diamond et al., 2007; Schwab et al., 2007; Van Dyke, Axlrod, & Schutte, 2010). While many of the tools reviewed above measure common behaviors and symptoms of TBI, many of these instruments focus on adults, are aimed at identifying if the individual has a traumatic brain injury, and most do not seek to identify specific neurodevelopmental clusters associated with TBI in children and adolescents that can quickly help school professionals to design effective future treatment and intervention. Therefore, a gap exists between traumatic brain injury in school-aged children and criteria for district-level consultation. There is a strong need for a screening instrument that helps determine when consultation with school district traumatic brain injury teams is needed for children suspected of traumatic brain injury. The purpose of this study is to develop and initially validate such a screening instrument.

Chapter Three: Method

Overview

This chapter describes three studies conducted to develop and validate a new instrument that can be used by personnel in a school setting to determine when further referral to a district level brain injury team is warranted. Appropriate scale development typically follows a sequential process involving four phases: Planning, Construction, Quantitative Evaluation, and Validation (Benson & Clark, 1982). In the Planning Phase, the purpose for the scale, the content or constructs being measured, and the target population is identified. In the Construction Phase, objectives are developed regarding the purpose of the instrument (DeVellis, 2012). These two phases were completed in Study One. The Validation Phase is the focus of Study Two, which is designed to examine both content validity (how well the items cover the identified domain) and construct validity (how well the scale measures what it is intended to measure) (Benson & Clark, 1982). Finally, in Study Three, the Quantitative Evaluation Phase was completed. The purpose of the Quantitative Evaluation Phase is to further establish the psychometric properties of the instrument by administering it to a group of individuals for whom the instrument is targeted.

Study One: The Development of the Original Scale

In study one, the planning and construction of the DORI-TBI version one was completed. In the planning step, a focus group was conducted with a team of experts and a literature review was completed leading to the development of the initial format and content of the DORI-TBI. The focus group was comprised of a group of seven participants who were members of a suburban school district's traumatic brain injury team. A two-page open-ended questionnaire assessed the team member's perception of the need to implement a referral-screening instrument. Team members were asked to write thoughts and opinions about six questions referring to efficiency of current team referrals, need for a TBI screening measure, and to add other comments or ideas as desired. The complete questionnaire can be found in Appendix A. The results of this focus group indicated a need for a TBI screening tool to appropriately address and manage referrals made to the team. Specifically, team members reported numerous inappropriate referrals made to the team as well as concerns around the difference between TBI and acquired brain injury (ABI), and the need for recommendations and interventions for school teams.

After this information was gathered, a literature review was conducted to help refine and determine the domains to include in the new instrument. The response format and wording were carefully selected to reduce redundancy and avoid double-barreled items. In regard to the response format, most of the items were written to require a "yes," or "no" response, with either a score of "1" or a "0" assigned, respectively, to each option. On some items a 4-point rating scale response format was employed consisting of

"Never," "Sometimes," "Often," or "Almost Always," as options. Scores were assigned to each response as "0," "1," "2," or "3," respectively. These response options were selected based on Wright (2000). A 4-point scale was selected over the more commonly used 3-point or 5-point scale in order to provide an even number of response choices and eliminate a neutral alternative. In addition, this 4-point response scale is commonly used in psychometric instruments such as the Brown Attention Deficit Disorder Scales (Jennings & Wilkinson, 2012), Disruptive Behavior Rating Scale (Gomez, 2012), and the Behavior Assessment System for Children, Second Edition (Stein et al., 2012), especially when rating an individual's perception of another individual's behavior. Given the validity and reliability established with these instruments, this 4-point rating scale was adopted for the DORI-TBI.

Study One Results

After this review, a new measure was developed, the Development of Recommendations and Interventions for Traumatic Brain Injury (DORI-TBI). The DORI-TBI includes general demographic information of the child (e.g., age, gender, grade, and school) in addition to items that measure diagnostic, academic, and behavioral symptoms of TBI. The 56 items on the DORI-TBI were organized into three domains explained in more detail below. These domains are titled the Diagnosis Index, Symptom Index, and Interventions Index. Each index was designed to capture a unique aspect of the TBI sequelae observed in the school setting. Instructions were also provided for each domain.

The scoring of the DORI-TBI was intended to yield a score for each domain as well as a total score. The total score is made up of the sum of all the domain scores.

Based on this total score, a "cutoff score," was determined based on literature review and a review of previous traumatic brain injury instruments. This cutoff score is designed to quickly inform school personnel if a referral for consultation with a school-based brain injury team will be beneficial. There are three possible results for the cutoff score: 1) Does not meet criteria for a full consultation, 2) Does not meet criteria for a full consultation at this time but please re-administer in a month, or 3) Meets criteria for a full consultation. It is possible for a student to meet criteria for a full consultation with only Domain I, and Domain II of the DORI-TBI completed. This is included to make sure that those students who meet criteria for a diagnosis of a TBI, and who are having numerous academic and behavioral difficulties in school, are not missed solely based on previous interventions attempted. Therefore, the scoring cutoffs are determined based on the total number of symptoms, behaviors, and interventions attempted for the child as long as diagnostic criteria for a TBI are met. Those children who have numerous academic and behavioral difficulties who do not meet diagnostic criteria for a TBI will be advised to consult with other academic and behavioral support teams in the district.

Domain I: Diagnosis index.

Domain I was designed to quickly determine if the student meets diagnostic criteria for traumatic brain injury. According to a position statement on the definition of traumatic brain injury, a TBI is defined as "an alteration in brain function, or other evidence of brain pathology, caused by an external force," (Menon, Schwab, Wright, & Maas, 2010, p. 1367). Because this screening instrument is developed for the school setting, it was also important to include the definition of TBI in the school setting. As

previously mentioned, a traumatic brain injury (as defined by the Colorado Department of Education, "Traumatic Brain Injury," n.d., para. 1) is defined as:

> A child with Traumatic Brain Injury (TBI) is a child with an acquired injury to the brain caused by an external physical force resulting in total or partial functional disability or psychosocial impairment, or both, which impairment adversely affects the child's ability to receive reasonable educational benefit from general education. ("Traumatic Brain Injury", n.d., para. 1)

Prognosis of TBI has been linked to numerous factors including: loss of consciousness, the length of time from occurrence of the injury to when the child received medical care, the presence of lingering symptoms of TBI such as headaches and dizziness, and the total number of brain injuries that the child has sustained in his/her life. Therefore, 10 items were written in Domain I to capture qualifications for diagnosis as well as factors that impact prognosis. Items 9 and 10 were included to measure the legal criteria when a child is identified with a TBI in the educational setting. When a child qualifies for an individualized education plan (IEP) or a 504 plan in the school setting, this impacts the interventions the child will receive.

Domain II: Symptoms index.

There are a total of 19 items in Domain II that were written to capture the behavioral and academic symptoms of TBI that are commonly observed in a school setting. These items were written in a way that school personnel could easily understand what this may look like in an academic setting. Because this domain measures the perceptions of others on a student's behavior, a 4-point scale (Never, Sometimes, Often, and Almost Always) was chosen for the response format to control for a neutral response alternative. The structure of this 4-point scale was chosen based on DeVellis (2012).

Domain III: Intervention index.

The final domain of the DORI-TBI instrument measures specific interventions based on neurocognitive areas of deficit most commonly noticed in school-aged children who have sustained a TBI. These interventions are based on the BrainSTARS manual Problem-Solving Index and are linked to four main content areas most commonly impacted by traumatic brain injury. These include memory, self-regulation, impulsivity, and organization and transition (Dise-Lewis et al., 2002). There are a total of 27 items in Domain III. Items included in this domain were broken into three specific intervention areas: academic, social/emotional relationships, and social/emotional self-regulation. This was done to identify areas of previous intervention to guide recommendations and foster further intervention development. Please see Appendix B for an example of version one of the DORI-TBI.

Study Two: Content Verification of the Original Scale

Study two, was designed to address the content validity of the new DORI-TBI Screener. This was addressed in three ways: First, the content between the DORI-TBI and eight referral forms used by other brain injury teams in the United States were examined and compared. Second, a panel of identified experts in the field of traumatic brain injury reviewed the DORI-TBI. Third, the usability of the new screener was evaluated by conducting consumer (cognitive) interviews with a target group of practitioners who completed the DORI-TBI. Each of these steps and the results are summarized below.

Comparison analysis.

Referral forms currently used in brain injury teams across the United States were identified by contacting a blog post of the National Association of School Psychologists Traumatic Brain Injury Interest Community group and asking members of brain injury teams in a school district in the United States to respond. After these districts were identified, they were asked to share their current referral forms. Once eight forms were received, a comparison of the content of the DORI-TBI and the other referral forms was conducted. The comparison involved contrasting the items on each form with those across the three domains of the DORI-TBI. This comparison of items is captured in a comparison chart that can be found in Appendix C.

Comparison analysis results.

Results of the comparison analysis were compiled into a table and analyzed for content. The total number of domain areas that include a "yes" were calculated for each instrument. These data were then reviewed to determine common content areas in addition to identifying what instrument is the most similar to the DORI-TBI. Results from the comparison analysis indicated that Form E had the most similarity to the DORI-TBI. Specifically, Form E had 16 items that were similar to the 56 total items on the DORI-TBI, resulting in a 26.8% similarity of content. However, these 16 items from Form E differed from the DORI-TBI in that they were not grouped into domains, were not used to calculate an overall total score, and were not used to inform a school team if a student met criteria for consultation as the DORI-TBI does. Please refer to Appendix D to review the summary comparison analysis chart.

Expert panel.

To further assess the DORI-TBI for content validity, a panel of experts was asked to review the DORI-TBI, version one. Three professional experts in the field of brain injury, as identified by specialized training, degrees, and/or experience in brain injury, contacted via email agreed to participate. They included: a neuropsychologist, a sports medicine physician, and a clinical professor of neuropsychology. They were then sent a link via Survey Monkey to review the DORI-TBI, version one. The experts were asked to rate the overall scale for specific content criteria including: traumatic brain injury diagnosis, observable behaviors and academic concerns following traumatic brain injury, as well as length and clarity of the form and instructions, and appropriateness of the items and domains. Please see Appendix E for the questions that were given to the expert reviewers. In addition, these same experts were asked to review three vignettes that represented a "mild," "moderate," and "severe," TBI symptoms for which to apply the DORI-TBI. The vignettes are described in greater detail in study three. Please see Appendix F for the protocol and questions that were given to the experts while reviewing the three vignettes.

Expert panel results.

Similar to the comparison analysis, following the expert panel review, a total number and percentage were calculated based on the "yes" responses, to indicate if professionals felt the item was important to have on the screener.

Following this expert panel review, 35 modifications were made to the DORI-TBI. A majority of these changes involved: removing items, adding items, elaborating on

examples for certain items, and clarifying wording of items and in the instructions. Please see Appendix H for a list of all modifications made to the DORI-TBI following the expert panel review.

Consumer (cognitive) interviews.

Finally, to assess the practicality of the new screener, eight local school professionals who are likely to use such an instrument were asked to review the form and discuss their impression of the DORI-TBI. These professionals read the medium vignette (described in more detail in study three) and then scored the vignette using the DORI-TBI. In addition, they were asked to talk about the screener in terms of length, clarity, ease of use, and to give recommendations for improvement. This information provided yet another form of professional feedback on the practicality and usability of the DORI-TBI in the school setting. The format for this consumer interview can be found in Appendix G.

Consumer (cognitive) interview results.

The responses from the consumer interviews were analyzed in a similar fashion to the comparison analysis and expert panel. The items for each domain were kept on the screener if the total percent of "yes" responses was 80% or greater. Items were replaced, revised or omitted if the total number of "yes" responses was 79% or less. Please see Appendix H for a list of item modifications based on the comparison analysis, expert review, and cognitive interviews.

Summary of Study Two

Study Two was designed to address the first research question: 1) Does the Traumatic Brain Injury Screener demonstrate appropriate content validity? Overall, the results of the comparison analysis, expert review, and the consumer interviews in Study Two were used to determine how to revise the format and the content of the original screener. Based on these results, a final version of three vignettes was developed, as was the second version of the DORI-TBI. The second version of the DORI-TBI and the final version of the three vignettes were then tested in a field administration in study three.

Study Three Field Administration- Main Study

Study three was designed as the main study to evaluate the reliability and validity of the second version of the DORI-TBI. In this study, professionals likely to employ such a screener in the future were asked to complete the revised DORI-TBI Version Two after reading three hypothetical vignettes that presented cases reflecting mild, moderate, and severe TBI symptoms

Participants.

To locate participants for Study Three, the researcher posted a discussion thread on the National Association of School Psychologists (NASP) website, American School Counselor Association (ASCA), American Speech-Language-Hearing Association (ASHA) and the National Association of School Nurses (NASN) website informing members of the study. NASP members are professionals retired or functioning as a school psychologist, consultant, or trainer of school psychologists, or who are currently enrolled in a school psychology-training program. Members of ASCA are either

credentialed by a state, district, or territory of the United States as a current school counselor, retired school counselor, graduate trainer of school counselors, or are enrolled in a graduate school counselor program. American-Speech-Language-Hearing Association members include audiologists, speech-language pathologists, speech, language, and hearing scientists, audiology and speech-language pathology support personnel, and undergraduate, graduate, and doctoral students in communication sciences and disorders. Almost all members of ASHA are certified in their specialty. All members of the NASN have degrees in the healthcare field related to nursing (e.g., Med, BSN, RN, APN, NCSN, FNASN) and most members are currently licensed as a school nurse and are employed in a school district. Due to message board policies, the NASP and NASN message boards messages were removed shortly after being posted by a community moderator. Therefore, to recruit school psychologists, the president of each state school psychology association was located on the NASP website and contacted via email. Each president was then asked to disseminate a recruitment email to his or her association's listserv, which included the survey link. A total of three requests were made to each association president via email. Further, school psychologists were recruited through flyers placed at the annual National Association of School Psychologists conference and word of mouth from those who chose to participate. Given the high cost to include members of NASN, they were no longer recruited.

Materials.

The vignettes designed to assess the DORI-TBI second version were developed based on a literature review and reviewed by identified experts in the field of brain injury. As previously mentioned in study two, the experts asked to review the DORI-TBI also reviewed the vignettes and provided feedback. A total of three vignettes were constructed that were designed to yield one "mild," one "moderate," and one "severe" case when scored using the DORI-TBI. Each vignette was approximately 6 to 8 sentences long and included information on the age, grade, and gender of the student, on the behavior and academic status of the student and on previously used interventions by the school or family. Please see Appendix I for the vignettes.

Procedure.

For those members who contacted the researcher via email, the purpose of the study and the study link were sent out. The first page of the survey included the consent form. Once consent was given, participants were asked to first read one vignette. Then, they were asked to "score" that vignette using the DORI-TBI. After the DORI-TBI form was completed, they were then taken to the second vignette, and then asked to complete another DORI-TBI form. Once this form was completed, they were taken to the third vignette, and asked to complete the DORI-TBI form again. Once participants "scored" each vignette, they were not allowed to review their previously scored forms. To control for bias responses, vignettes were distributed among all participants using counterbalancing to avoid presenting them in any order, such as a progressive order of

mild, moderate, and severe cases. Three individual survey links were created that presented each vignette in a different order (survey link one: mild, moderate, severe; survey link two: moderate, mild, severe, and survey link three: severe, moderate, mild).

In addition to scoring each vignette using the DORI-TBI, the participants were asked a set of demographic questions regarding their location, professional training in TBI, and personal and professional experience in TBI. This was done to determine if region of the United States, training, and experience, impacted scores on the DORI-TBI. Please see Appendix J and K for the professional consent and professional vignette protocol respectively.

Chapter Four: Results

Study Three: Participants.

A total of 189 participants responded to the survey request. However, only 121 participants completed the DORI-TBI using all three vignettes. Out of the sample of 121, 59.5% school psychologists, 8.3% school nurses, 15.37% speech/language pathologists, and 16.5% counselors participated. Participant training in traumatic brain injury indicated 24% had no training, 62.8% some training, and 13.2% had specialized training. Distribution by region of the United States reflected 48.8% Western, 10.7% Southeast, 24.8% North Central, .8% Southwest, and 14.9% Northeast. Please see Table 1 for a summary of participant demographic information.

Table 1

Participant Demographic Information

Variable	n	%
Profession		
School Psychologist	72	59.5
School Nurse	10	8.3
Speech/Language Pathologist	19	15.7
Counselor	20	16.5
Training		
No Training	29	24.0
Some Training	76	62.8
Specialized Training	16	13.2
Experience		
No Experience	12	9.9
Some Experience	109	90.1
Region		
Western	59	48.8
Southeast	13	10.7
North Central	30	24.8
Southwest	1	.8
Northeast	18	14.9

Note: All demographic data were self-reported.

Study Three: Reliability

The reliability of the three domains of the DORI-TBI was estimated for the mild, moderate, and severe vignettes. Cronbach's alpha for Domain I for both the medium and severe vignettes resulted in poor reliability of 0.19 and 0.14 respectively. While Cronbach's alpha was higher for items in Domain I for the mild vignette (0.64), due to the overall low reliability of all eight items in Domain I for all three vignettes, these items were no longer grouped together as a Domain. Instead, these items were ungrouped and only two items were retained and turned into screening criteria to determine if the school team should administer the complete DORI-TBI. The two items retained from Domain I were items 1 and 2: "Does the student have a medically documented traumatic brain injury?" and "Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?" These items were kept as the screening criteria because only when one or both of these questions are scored "yes" should a school team continue completing the DORI-TBI. If answers to both of these questions are scored "no," the student has not yet been identified as having sustained a traumatic brain injury and therefore, they do not meet criteria for further consideration for consultation with a district level traumatic brain injury resource team. Further, results from repeated measures ANOVA of responses to the remaining items suggested deletion of the remaining Domain I items (see pages 44-49 below).

Cronbach's alpha for the mild vignette for Domain II and III were .92 and .96. Cronbach's alpha for the moderate vignette for Domain II and III were 0.91 and 0.92.

Finally, Cronbach's alpha for the severe vignette for Domain II and III were 0.91 and 0.95. Detailed results for all Domains for each level of vignette are presented in Table 2.

Table 2

Reliability for Domain's I, II, and III for the Mild, Moderate, & Severe Vignettes.

Vignette Level	**Cronbach's Alpha**	**Number of Items**
Mild		
Domain I	.64	8
Domain II	.92	16
Domain III	.96	24
Moderate		
Domain I	.19	8
Domain II	.91	16
Domain III	.92	24
Severe		
Domain I	.14	8
Domain II	.91	16
Domain III	.95	24

Study Three: Validity

Several different steps were taken to address the question - Does the Traumatic Brain Injury Screener demonstrate appropriate construct validity? All of the four studies mentioned below were designed to address the validity of the DORI-TBI in different ways. First, an examination was made of differences in the mean item score for Domain 1. Given the low reliability of items in Domain 1 when analyzed together as a total score, each item in Domain 1 was examined by conducting repeated-measure ANOVAs to determine effect of vignette level on each item. In addition, a paired-samples t-test was conducted to compare the means for each pair of vignettes (e.g., mild to moderate, moderate to severe, and mild to severe) to determine if there was a significant difference

between vignette level. It was anticipated that scores would increase across vignette severity level for separate items on Domain 1 if the DORI-TBI were a valid measure of TBI severity.

Second, the effect of vignette-level on total mean item scores across all items in Domain 2 and 3 were examined across the three vignettes by conducting repeated-measure ANOVAs. These analyses were completed in order to assess if there were significant differences between the "mild," "moderate," and "severe" vignettes, which had been judged by experts as reflecting different levels of TBI severity. Further, a paired samples t-test was conducted on to compare means for each pair of vignette severity. Similar to the separate items in Domain I, it was anticipated that scores would increase across vignette level for the total score on Domain 2 and 3 if the DORI-TBI were a valid measure of TBI severity.

Third, a chi-square test was conducted to compare the proportions of observed and expected referrals across the three vignettes for the following categories: "Do not refer," "Re-administer at a later time," and "Refer immediately." This was done to determine if referral outcomes differed more than expected due to chance. It was anticipated that DORI-TBI scores above a certain cut-off would distinguish referral level and a significant association (gamma) would be found between DORI-TBI categorization and referral.

Finally, a crosstabulation was completed on the total score for item totals in Domain 2 and 3 for the mild, moderate, and severe vignettes to determine if a new cut-off was warranted for referral level. The cut-off score that produced the highest level of gamma, indicating the most significant association, was then determined to be the most appropriate cut-off range for scores on the DORI-TBI.

Repeated-Measures ANOVA

Domain I.

A repeated measures ANOVA was used to determine the effect of vignette-level on each of the eight items in this domain. Of the eight items, significant mean differences were found across the vignettes on only item one and item two. Item one was: "Does the student have a diagnosis of a traumatic brain injury?" Assumptions of repeated-measure ANOVAs were met. The mean difference across the three vignettes for this item was statistically significant $F(2, 240) = 331.13$, $p < .001$, $p\eta^2 = .73$ (Table 3). A paired-sample t-test was conducted to compare the means between each pair of vignettes for item one. There was a significant difference in scores between the mild and moderate (M= -.71, SD= .51, $t(120) = -15.4$, $p < .001$) with a higher mean for moderate, moderate and severe (M= -.20, SD= .40, $t(120) = -5.45$, $p < .001$) with a higher mean for severe, and mild and severe vignettes (M= -.91, SD=.29, $t(120) = -34.64$, $p < .001$) with a higher mean for severe. Item two was: "Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?" Again, assumptions of repeated measure ANOVA were met. The mean difference across the

three vignettes was statistically significant $F(2, 240)=52.86$. $p=<.001$. $p\eta^2 = .306$ (Table 3). A paired-samples t-test was conducted to compare the means between each pair of vignettes for item two. There was a significant difference in scores between the mild and moderate (M= -.16, SD=.52, $t(120) = -3.48$, $p = .001$) with a higher mean for moderate, moderate and severe (M= -.32 , SD=.49, $t(120) = -7.28$ $p <.001$) with a higher mean for severe, and mild and severe vignettes, (M= -.49, SD=.58, $t(120) = -9.26$, $p <.001$ with a higher mean for severe.

No other significant differences were found across all three-vignette severity levels for any of the other six items on Domain 1 indicating that these six items should be dropped. If an item was a valid measure of TBI severity, the proportion of agreement to the item should have increased across vignette severity level. Since this did not occur and these items lacked contribution to the Domain overall, these items were deleted. Therefore, Domain 1 resulted in two items: "Does the student have a medically documented traumatic brain injury?" and "Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?" See Tables 3 and 4 below for a summary of the Repeated-Measure ANOVAs and descriptive statistics for each item in the mild, moderate, and severe vignette for Domain I.

Table 3

Repeated Measure ANOVA Summary Table for Items in Domain I

Source	SS	df	MS	F	p	Partial η^2
Item 1: Does the student have a diagnosis of a traumatic brain injury	55.30	2	27.65	331.13	<.001	.73
Error	20.04	240	.08			
Item 2: Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries	14.88	2	7.44	52.86	<.001	.31
Error	33.79	240	.14			
Item 3: Has the student's academics performance been impacted post brain injury?	40.82	2	20.40	264.49	<.001	.69
Error	18.52	240	.077			
Item 4: Did the student lose consciousness after sustaining the injury?	72.27	2	36.14	1032.84	<.001	.90
Error	8.39	240	.035			
Item 5: Is this the first brain injury the student has sustained?	16.36	2	8.18	78.69	<.001	.40
Error	24.96	240	.104			
Item 6: Does the student currently suffer from headaches?	58.66	2	29.33	376.99	<.001	.76
Error	18.672	240	.078			
Item 7: Does the student currently suffer rom dizziness (e.g. balance difficulties, being more clumsy now, walking into walls or door jambs)?	59.51	2	29.76	416.22	<.001	.78
Error	17.16	240	.071			
Item 8: Does the student have an individualized education plan (IEP) or did the student have a 504 plan prior to the incident?	66.09	2	33.05	706.052	<.001	.86
Error	11.234	240	.047			

Table 4

Vignette Level Including Item Mean, Standard Deviation, Skewness, and Kurtosis

Vignette Level/Item	Mean	SD	N	Skewness	Kurtosis
Mild					
1) Does the student have a medically documented traumatic brain injury?	.09	.29	121	2.89	6.41
2) Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?	.09	.29	121	2.89	6.41
3) Has the student's academic performance been impacted post brain injury?	.26	.44	121	1.08	-.85
4) Did the student lose consciousness after sustaining the injury?	.70	.25	121	3.54	10.69
5) Is this the first brain injury the student has sustained?	.50	.50	121	.05	-2.03
6) Does the student currently suffer from headaches?	.04	.20	121	4.67	20.11
7) Does the student currently suffer from dizziness (e.g. balance difficulties, being more clumsy now, walking into walls or door jambs)?	.03	.18	121	5.29	26.41
8) Does the student have an individualized education plan (IEP) or did the student have a 504 plan prior to the incident?	.05	.21	121	4.20	15.92
Moderate					
1) Does the student have a medically documented traumatic brain injury?	.08	.40	121	-1.53	.35
2) Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?	.26	.44	121	1.13	-.73
3) Has the student's academic performance been impacted post brain injury?	.96	.20	121	-4.67	20.11
4) Did the student lose consciousness after sustaining the injury?	.04	.20	121	4.67	20.11
5) Is this the first brain injury the student has sustained?	.03	.18	121	5.29	26.41
6) Does the student currently suffer from headaches?	.96	.20	121	-4.67	20.11
7) Does the student currently suffer from dizziness (e.g. balance difficulties, being more clumsy now, walking into walls or door jambs)?	.95	.22	121	-4.20	15.92
8) Does the student have an individualized education plan (IEP) or did the student have a 504 plan prior to the incident?	.02	.16	121	6.19	36.92
Severe					
1) Does the student have a medically documented traumatic brain injury?	1.0	.00	121		
2) Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?	.58	.50	121	-.32	-1.93
3) Has the student's academic performance been impacted post brain injury?	.99	.10	121	-11.00	121.00
4) Did the student lose consciousness after sustaining the injury?	1.0	.00	121		
5) Is this the first brain injury the student has sustained?	.04	.20	121	4.67	20.11
6) Does the student currently suffer from headaches?	.20	.40	121	1.60	.57
7) Does the student currently suffer from dizziness (e.g. balance difficulties, being more clumsy now, walking into walls or door jambs)?	.16	.37	121	1.83	1.35
8) Does the student have an individualized education plan (IEP) or did the student have a 504 plan prior to the incident?	.94	.23	121	-3.84	12.92

Total Score Domain II and Domain III

A repeated-measures ANOVA was used to determine the effect of vignette level on the total score of Domain II. Assumptions of repeated-measures ANOVA were met. The mean difference across the three vignettes was statistically significant $F(2, 240)=$ 4626.45. $p < .001$. $p\eta^2 = .515$ (Table 5). A paired-samples t-test was conducted to compare the means between each pair of vignettes for Domain II. There was a significant difference in scores between the mild and moderate (M= -4.94 SD = 8.41, $t(120) = -6.46$, $p <.001$) with a higher mean for mild, moderate and severe (M = -7.35, SD =8.0, $t(120) =$ -10.10 $p <.001$) with a higher mean for severe, and mild and severe vignettes, (M = -12.29, SD = 9.10, $t(120) = -14.85$, $p <.001$ with a higher mean for severe.

A repeated-measures ANOVA was used to determine the effect of vignette level on the total score of Domain III. Assumptions of repeated-measure ANOVA were met. The mean difference across the three vignettes was statistically significant $F(2, 240) = 155.44$. $p < .001$. $p\eta^2 = .060$ (Table 5). A paired-samples t-test was conducted to compare the means between each pair of vignettes for Domain III. There was a significant difference in scores between the moderate and severe vignette (M = -2.30, SD =5.94, $t(120) = -4.20$ $p <.001$) with a higher mean for severe, but not between the mild and moderate (M = 1.04 SD = 6.10, $t(120) = 1.88$, $p = .062$) with a higher mean for mild, and the mild and severe vignettes, (M = -1.22, SD = 6.96, $t(120) = -1.93$, $p = .056$ with a higher mean for severe.

Overall, results from all Repeated-Measures ANOVAs indicated that the DORI-TBI was measuring TBI severity in the way it was intended. Large effect sizes were found for Domain II, but only medium effect sizes were found for Domain III. While

Domain II is showing that the DORI-TBI is strongly distinguishing TBI severity level, Domain III is not showing as strong a distinction. When examining scores in Domain III further, scores for the mild TBI case are slightly higher than for the moderate TBI case.

Table 5
Repeated Measures ANOVA Summary Table for Total Score in Domains II and III

Source	**SS**	**df**	**MS**	**F**	**p**	**Partial η^2**
Domain II	9253.702	2	4626.851	127.525	<.001	.515
Error	8707.631	240	36.282			
Domain III	310.90	2	155.44	7.72	<.001	.060
Error	4835.102	240	20.146			

Table 6
Mean, Standard Deviations, Skewedness, Kurtosis for Domain II and III

Source	**Mean**	**SD**	**N**	**Skewness**	**Kurtosis**
Domain II Mild	11.35	9.04	121	1.24	1.06
Domain II Moderate	16.29	9.09	121	.91	.33
Domain II Severe	26.64	9.35	121	.48	-.09
Domain III Mild	10.26	8.10	121	.34	-1.44
Domain III Moderate	9.22	7.24	121	1.10	.84
Domain III Severe	11.49	6.74	121	.75	-.95

Chi Square

To compare the proportions of observed and expected referrals for the following categories: "Do not refer," "Re-administer in a month," and "Refer immediately," A Chi-square test of association was used to determine if referral outcomes differed more than expected due to chance by vignette level. Results indicated that there was a significant association between level of vignette and referral rate, X^2 (4, N= 121) = 81.67, $p < .001$. These results indicated that there was a relationship between level of vignette and referral rate.

Cut-off Score Determination

Given the reliability results for Domain I, new total scores were calculated using only the total scores from Domain II and Domain III for the mild, moderate, and severe vignette. Next, a crosstabulation was computed on the total score for Domain II and III on each vignette level to determine new cutoff scores for the DORI-TBI.

Once new total scores were calculated, gamma was reviewed to determine what new cutoff scores produced the highest value of gamma. Gamma is a measure of association between two variables with ordered categories. A value of zero indicates the absence of association. Results of the analysis indicated that the new cutoff scores should be decreased from the original scores by eight points in order to produce the strongest association, as indicated by a gamma value of .53. Therefore, the new cutoff scores should be as follows: 2 or Below: Do not refer; 3-21: Re-administer in a month; and 22 or Greater: Refer Immediately. Please see Appendix L for the third version of the DORI-TBI based on these results.

Chapter Five: Discussion

Pediatric traumatic brain injury is a growing topic of interest, especially in the school setting. The increased awareness of concussion symptoms, treatment, and prognosis has brought increased attention to brain injury for many educators (Mason, 2013). Prior to the DORI-TBI, there have not been any screeners designed to specifically determine if a student, identified as having a traumatic brain injury, would benefit from consultation with a school-based brain injury team. While many screening tools exist to help educators and medical personnel determine if a student has received a traumatic brain injury, these screeners do not provide the next step in the management of these students (Dettmer et al., 2007; Picard, Scarisbrick & Paluck, 2004). Therefore, the DORI-TBI was developed to help assist school-based brain injury teams determine if a student: 1) meets criteria for district level consultation, and 2) if so, what neurodevelopmental clusters to focus on.

The results of this dissertation indicated that brain injury sequelae can be measured quantitatively and used to help school teams determine the need for student consultation. In this chapter, a summary of the major findings is initially presented, followed by overall implications. Next, limitations of the current study and future research ideas are presented. Finally, overall conclusions are discussed.

Summary of the Major Findings

The DORI-TBI was created as a screening tool that school personnel might easily use to determine if a student meets criteria for consultation with a district brain injury team. An initial version of the DORI-TBI was developed after an extensive review of the literature to differ from other brain injury screeners in several ways. First, the DORI-TBI was not designed to determine if a student had received a TBI. Instead, it was designed to already assume that a student had sustained a TBI. Second, it included common symptoms associated with TBI based on specific neurodevelopmental clusters. This was done to help school-based teams more quickly and efficiently develop solid intervention recommendations and strategies in the management of students who have a TBI in a school setting.

Study two was designed to verify the content included on the DORI-TBI and entailed three steps. Step1) the content of the DORI-TBI was compared to eight other TBI referral forms across the United States, Step 2) identified experts in the field of TBI were asked to review the DORI-TBI, and three vignettes designed to reflect student cases with differing levels of TBI symptoms in order to test the validity of the DORI-TBI in a field administration in study three, and Step 3) cognitive interviews were completed with eight school professionals to test the usability of the DORI-TBI using only the moderate symptom level vignette. The outcomes from these three steps led to the next revision of the DORI-TBI as well as a final version of the three vignettes.

In the third, and main study of this dissertation, the revised DORI-TBI was further validated through a field administration to a nationally recruited sample of 121 school psychologists, school nurses, speech/language pathologists, and counselors who were recruited through national professional organizations and websites.

Study three was designed to assess if the revised DORI-TBI demonstrated appropriate reliability and validity. Participants were asked to use the screener to differentiate hypothetical cases that reflect different levels of TBI symptomology. The purpose of study three was to create a final version of the screener and then to identify appropriate cutoff scores to use in the future to make important decisions about whether or not to refer a student for district level consultation.

In regard to overall reliability, Domain II and Domain III of the DORI-TBI were determined to have good reliability across all vignette levels, as indicated by Cronbach's alpha levels ranging from α =.91 to α =.96. However, not all items in Domain I had appropriate reliability across all vignette levels as indicated by Cronbach's alpha levels ranging from α =.14 to α =.64 (Nunnally, 1978).

Because of these findings, items in Domain I were no longer grouped together as a Domain or added together with Domain II and III to determine a cut-off score. Instead, only two items were retained as a preliminary screening section of the DORI-TBI in order to help school teams determine whether or not to continue using the rest of the DORI-TBI with a student of concern.

Scores based on the next two sections of the DORI-TBI did result in significant differences across the three vignettes designed to measure mild, moderate, and severe TBI symptoms. The medium (Domain III MS= 155.44) to large (Domain II MS= 4626.851) effect sizes found in the repeated-measures ANOVAs suggested that the DORI-TBI was differentiating among levels of TBI severity reflected in the vignettes as intended. This was particularly true for the mean total score across all items in Domain II, which showed a very large effect size in differentiating TBI severity level.

Results of the repeated-measures ANOVAs revealed that the effect size for Domain III was only medium. Because Domain III measures previously implemented interventions, the smaller effect size in Domain III may be due to a lack of differences in the number of interventions implemented between the mild and the moderate TBI case.

The above results were instrumental in constructing a final version of the screener and then determining an appropriate cutoff score to use that might be able to indicate when a student would need further services from a school-based TBI team. A final version of the DORI-TBI constructed based on these findings included a screening section with two items for teams to complete to quickly determine if full completion of is necessary. It also included items in two domains that measure TBI symptoms and current interventions. A total composite score is calculated from items in Domains I and II and is then compared to a predetermined cut-off score. The score that produced the strongest association, as determined by a gamma value of .53, was: Do Not Refer (scores 2 and below), Re-administer at a Later Time (scores between 3-21) and Refer Immediately (scores of 22 and above). This new lower cut-off score will hopefully capture those

students who will most benefit from district level consultation. Changes were also made to the instructions of the DORI-TBI, so that respondents now are directly told to circle "never" if the behavior has not been observed.

Overall, the results from study one, study two, and study three, supported the reliability and validity of the DORI-TBI indicating that school teams can use it to help determine if a student, identified as having a traumatic brain injury, meets qualification for district level consultation with a brain injury support team. The DORI-TBI was found to have appropriate content and construct validity and also demonstrated appropriate reliability for Domains II and III.

Overall Implications

The development of the DORI-TBI is an important contribution to tools professionals can use when dealing with pediatric traumatic brain injury. As previously mentioned, brain injury is the leading cause of disability and death in children in the United States ("Get the Stats," n.d.; Dise-Lewis, Calvery, Lewis, Puls, Griebel, & Denlinger, 2002). Given the prevalence of TBI in school-aged children, many multidisciplinary teams have been created that are dedicated to supporting these students during the transition from the hospital back into the school setting. Because these teams are typically composed of professionals who volunteer their limited time to consult with others in a district, it is important to have a succinct process for handling the multiple referrals that can come to a TBI district team. A tool such as the DORI-TBI can help school-based teams more quickly determine if a student meets qualification for a district level TBI team consultation. Students who do not meet initial criteria when using the first

two items of the DORI-TBI, may be better candidates for consultation with other specialized teams in the district, such as behavior and educational and support teams. The DORI-TBI is designed to more accurately identify whether those students who have been diagnosed with a TBI should be considered for consultation with professionals on a designated TBI team who have specialized training to understand pediatric TBI, TBI sequelae, and common symptoms and interventions appropriate for addressing these unique injuries.

There is no other tool similar to the DORI-TBI available to help school teams when making the important decision whether to refer a student for district-level consultation. While there are other tools, such as the BrainCheck survey and the OSU-TBI, to help school teams determine if a student has sustained a brain injury, these tools do not take the next step in helping teams to make a decision about whether to refer the student to a district brain injury support team.

Finally, the DORI-TBI not only helps support teams when making this decision, but also provides information on the specific neurodevelopmental clusters commonly impacted by brain injury while also identifying potential interventions and strategies to implement with the student. Results from cognitive interviews support this.

Catroppa and Anderson (2008) reported that to best facilitate successful re-entry into the community for a child who has sustained a traumatic brain injury, family and school collaboration as well as access to multidisciplinary rehabilitation services have been found to be most important factors for successful outcomes. These services include:

behavioral interventions, psycho-educational approaches, environmental modifications and supports, and psychological treatments. By using the DORI-TBI, school teams can improve outcomes for children by increasing collaboration and quickly identifying targeted interventions unique to the student. The identification and implementation of these services is critical for overall student success post-injury and the DORI-TBI may be the tool needed to provide this population with the support they need.

When considering the optimal time to refer a child who has sustained a traumatic brain injury to a specialized team, it is important to consider several factors. First, as previously mentioned, each brain injury is unique. Academic outcome and educational impact for children have been linked to severity of their injury (Ewing-Cobbs, Barnes, Fletcher, Levin, Swank, & Song, 2004). The more severe the injury, the more support the child is likely going to require when entering back into the school setting. For students that sustain severe injuries, completing the DORI-TBI before the child transitions from the hospital back into the school setting is ideal. Along with severity of the injury, it is also important to consider Deidrick and Farmer ‘s (2005) four phases of successful reentry into the school setting. These include: 1) assessment, 2) multidisciplinary teams, 3) facilitating peer interactions, and 4) planning for revision and withdrawal of support. Each of these stages are specifically designed to support a child who sustains a brain injury once he or she is ready to transition back into school post injury. The assessment phase is particularly important when deciding when to refer a child to a specialized team because it will provide the school team with critical information on the child’s current

physical, cognitive, and behavioral presentation. For mild and moderate injuries, the school team should review these four phases and consider results from formal and informal assessments while considering previous interventions attempted when deciding when to complete the DORI-TBI (Deidrick & Farmer, 2005).

Limitations

This study resulted in the initial development and validity of the DORI-TBI. Results indicated that the final revised DORI-TBI has potential as a new screening instrument to help school teams determine when consultation might be best sought from a district brain injury resource team. However, several areas of limitations merit further consideration, including the design of the study, the overall strategies employed to assess the psychometric properties of the measurement tool, items, and the respondents who were included in the final sample.

Design of the study.

Although the measurement tool was designed for respondents to complete without having any experience or knowledge in traumatic brain injury, one limitation of the study may include the experience level of the participants. This includes their experience working with students with traumatic brain injury, their background knowledge in traumatic brain injury, and the number of years working in a school setting. Another limitation of the design may include the respondents not wanting to answer the questions in error to protect their professional image. Finally, the DORI-TBI was specifically

designed to address concerns resulting from traumatic brain injuries. While the DORI-TBI could be used to measure concerns related to acquired brain injuries, injuries resulting from traumatic brain injuries were isolated for this study given the Colorado Department of Education's individual disability category of TBI as well as the unique challenges given to the student, school, and family when a student sustains a traumatic brain injury.

Strategies to address the psychometric properties.

There are several limitations relative to the approaches employed to assess the overall psychometric properties of the DORI-TBI. One limitation of the way content validity was established is the procedure used to collect TBI referral forms. Cronbach defines content validity as the ability of items to adequately cover content domains (as cited in Benson & Clark, 1982). By only contacting members of a TBI special interest group through a discussion post on the National Association of School Psychology community group, school district TBI teams across the state who do not have a member represented in this interest group may have been excluded and therefore, referral forms may have been missed. These missed referral forms may have included crucial items needed to determine appropriate content validity. Another way to assess content validity might be to post the same discussion post on numerous professional websites including professions such as: speech/language pathologists, occupational therapists, school nurses, counselors, social workers, and physical therapists in order to gather more referral forms to conduct a more complete content review.

Another limitation may be the procedures used to determine construct validity of the DORI-TBI. Benson and Clark (1982) reported that one method for establishing construct validity, or how well the DORI-TBI measures the need for district-level consultation, is to run a factor analysis to determine how many factors are being measured by the DORI-TBI. However, this study did not use factor analysis for the DORI-TBI due to the limited sample size. Future research should investigate how many factors underlie the DORI-TBI in order to address structural validity.

Convergent validity was also not investigated in the current study given the fact that there was not another valid tool to use as a convergent measure in which to measure predictive capacity of the DORI-TBI (Devellis, 2012). This is another limitation to the procedures in this study. Future research should include using the TBI referral form identified as the most similar to the DORI-TBI (established in study two) in a convergent validity study to determine whether participants are coming to the same decision to refer the student to a district level brain injury team or not when using the DORI-TBI and another TBI severity form.

One limitation of the data used to evaluate the validity of this instrument may be how the vignettes were constructed. The length of the vignettes were short and possibly participants may have had difficulty answering certain items on the tool given the limited information provided in each vignette. This limited information may have impacted their responses. Future research is needed for further validation of the instrument that includes the design and implementation of additional sets of mild, moderate, and severe vignettes.

Another limitation of the steps taken to assess this new measurement tool is that criterion-related validity has not yet been established. Because there is not an assessed outcome measure, the relationship between DORI-TBI scores and a true criterion cannot be predicted (Benson & Clark, 1982). Therefore, future research should include administering the DORI-TBI along with another similar measure to assess criterion-related validity. To do this, schools teams should administer the DORI-TBI as well as a similar measurement tool at the same time and then compare scores on both measures. Criterion-related validity would be established if scores on the DORI-TBI and the identified measure are similar.

Future studies should also investigate participants' satisfaction while using the DORI-TBI. To do this, future research should investigate schools that use the DORI-TBI to refer students to a brain injury support team and compare them to schools that do not use the DORI-TBI when referring students. This will help determine if the population for whom the instrument is designed to support is satisfied with the results when using the tool to make these important decisions.

Domain II was designed to include possible interventions for those students who sustain a traumatic brain injury. The Colorado Department of Education recently published an instructional accommodations manual that includes a page of accommodations specific to brain injury, including traumatic brain injury. While there may be some overlap between the accommodations found in this manual and the interventions suggested in the DORI-TBI, this manual was not used in the development

of the DORI-TBI. Future research should investigate what, if any, accommodations provided in this manual overlap with the suggested interventions in the DORI-TBI to further develop Domain II of the DORI-TBI.

The differences in effect size between Domain II and Domain III is another limitation to the DORI-TBI. This may be due to items in Domain II measuring TBI characteristics commonly observed in an academic setting while items in Domain III were designed to provide a list of interventions to address the neuropsychological clusters commonly impacted by TBI. This was done for two reasons: 1) to inform district brain injury teams on interventions previously implemented and 2) to bring awareness to school teams of interventions that are successful for students who have sustained a brain injury to possibly implement in the future, especially if the child did not meet qualification for referral. While it was expected that large differences in scores would be observed in symptoms across the mild, moderate, and severe vignettes, the amount of interventions previously implemented may not differ as significantly. This may be due to the limited knowledge and training of school personnel in the unique sequelae of TBI and of specific interventions available to support students who sustain a TBI. In a study done by Linden, Braiden, and Miller (2013), it was found that educators who had taught a child with brain injury exhibited a greater understanding of brain injury and sought out information to help these students be successful at school than those who have not. However, they report that given the high prevalence of pediatric brain injury and the relatively low number of participants who reported they had experience teaching a student who has sustained a brain injury, many professionals may not be aware when a

child has sustained a brain injury. They explain that brain injury training for educators appears to be more reactive than proactive and suggest that by including brain injury in on going professional development, educators may become more aware of the signs and symptoms of children who have received a brain injury. With increased awareness, educators can assist in early identification and intervention for these students (Linden, Braiden, & Miller, 2013).

Therefore, while it may be easier for school personnel to report symptoms observed in an academic setting on a student (especially while reviewing a list of symptoms specific to brain injury) without knowledge, training, or awareness of specific interventions to help students with brain injury, scores in Domain III of the DORI-TBI area may vary greatly and may not increase with TBI severity as previously expected.

In a study conducted by Arenett, Peterson, Kirkwood, Taylor, Stancin, Brown, and Wade (2013), behavior ratings of executive functioning for pediatric traumatic brain injury was found to predict educational outcomes for students who received a moderate to severe TBI. Therefore, another study that could be conducted with the DORI-TBI would investigate the correlation of referral rates determined by the DORI-TBI and educational outcomes for students identified as having sustained a traumatic brain injury. This type of study may provide crucial information on the importance of district TBI teams as well as the importance for appropriate referral to these teams to maximize student success.

To continue to strengthen the appropriateness of the DORI-TBI cutoff score, future research should investigate the scoring used in each Domain within the DORI-TBI as well as the calculation of the total score. Currently, a student is referred when using the DORI-TBI if they obtain a score of 22 or greater. It does not matter if they obtain this score entirely from one domain or from a combination of the total score from both Domain I and Domain II. In addition, it will be important to continue to review the gamma value and attempt to produce a higher value for gamma. This will help to determine what cutoff score is most suitable to best capture those students who truly benefit from consultation.

Finally, several items were dropped from Domain I based on results from reliability as well as from the repeated-measures ANOVAs. Future research should examine those items dropped from Domain I for each level of vignette to determine if there are any patterns between the dropped items and vignette level.

Population.

Overall, the total number of respondents was 121. Fowler (2009) suggests that when developing a new measure at least 300 participants are required for appropriate psychometric indices to be calculated. Therefore, one limit to the study was the small sample size. However, when the population is homogenous such as it was in this case, considering that participants include professionals who work in a school setting, this number can be smaller (Fowler, 2009). Nevertheless, future research should include more participants.

In terms of professions represented by the respondents, there were many professionals who were not included in the target population that may potentially complete the DORI-TBI in a school setting such as: teachers, behavior coaches, principals, and occupational therapists. The majority of participants were school psychologists (n=72). Counselors had the next highest representation (n=20) followed by Speech/Language Pathologists (n=19) and finally Nurses (n=10). Therefore, equal representativeness across professions is another limitation.

Another limitation to the population was national region representativeness. While the DORI-TBI was administered to a national group of professionals, there were a low number of participants from the Southwest (n=1), Southeast (n=13), and Northeast (n=18). Future research should include more participants from these three regions to have better regional representation.

The level of experience of the participants is another limitation to the study. Most participants (n=109) reported some type of experience with TBI (e.g., they have a diagnosis of TBI, know someone with a diagnosis of a TBI, work with a student/client with a diagnosis of a TBI, or have one or more family members or friends who have been diagnosed with a TBI). Also most participants reported having some training in TBI (n=76) while few reported specialized training in TBI (n=16). Therefore, future research should include more participants who have not had any experience with TBI as well as those with specialized and with no training in TBI in order to have better overall

representation. Including questions about experience might also help determine if professional development and training in TBI would be a beneficial investment for a school district.

Implications of Results

The DORI-TBI can be used to help school teams determine if a student, identified as having a traumatic brain injury, meets criteria for district-level consultation from a school-based brain injury support team. The first two items of the DORI-TBI will help decide if the identified student meets initial criteria of having sustained a traumatic brain injury and whether or not to continue completing the DORI-TBI. If the answers to both of these two screening questions are no, then the student does not meet criteria for completion of the DORI-TBI because they have not yet been identified as having sustained a traumatic brain injury. However, if these items are yes, then the rest of the items on the DORI-II would be filled out and used to determine when a referral might be made to a district brain injury support team that includes a team of professionals with expertise in TBI symptoms, sequelae, and intervention. The DORI-TBI also can be used in conjunction with other brain injury screening tools, such as the BrainCheck Survey (Dettmer et. al., 2007). When used together, school teams might more quickly identify brain injury in students and begin to engage in consultation with a school-based brain injury team. Screening tools are important for early and sensible referrals to specialty teams in a school district (Thompson, Tuli, Saliba, DiPietro, & Nackhi, 2010). These specialized teams can provide crucial support to teachers, administration, and families for

students in both general and special education. Working collaboratively can improve the design of interventions and strategies that will help guarantee greater academic and social/emotional success of referred students (Cole & Brown, 1997).

The intervention portion of the DORI-TBI (Domain III) is also a useful source of information that is tied to specific neurodevelopmental clusters typically impacted by brain injury. While answering these questions, school teams can begin to identify possible interventions to address specific concerns so that possible interventions could be implemented sooner. This section of the screener can also alert members on the team to other professional disciplines who may need to be contacted for further support and follow up consultation.

The DORI-TBI is designed to help support school teams with the important decision to refer a student to a school-based brain injury support team. It is imperative to note that the DORI-TBI was not designed to replace other social/emotional screeners. There are no "critical items" specifically designed to refer a student immediately to a school-based brain injury support team. This was done for several reasons. First, the DORI-TBI is designed to determine if a student meets criteria for consultation with a school-based brain injury team. It was not designed to measure acute crisis situations the student may be experiencing. Next, because school-based brain injury support teams have limited time and availability to meet with students, families, and school teams, there is no guarantee that they will be able immediately to address any "critical items" endorsed by a

school team. Therefore, it is recommended that another social/emotional screener (such as the Behavior Assessment System for Children, Second Edition BASC-2) be administered along with the DORI-TBI to capture these "critical items." If a school team scores the social/emotional screener and notes that any critical items were endorsed, the school team should address these items right away. The school team should not wait to refer a child with serious social/emotional concerns to a school-based brain injury team to address these concerns.

Final Conclusion

Pediatric traumatic brain injury is a growing topic of concern in the school setting, since educators and support professionals are highly likely to encounter a student who has sustained a traumatic brain injury (Turkstra, Politis, & Forsyth, 2014; Dise-Lewis et al., 2002). This poses a challenge since many school professionals have not received specialized training on the unique sequelae of TBI and thus, may not know how to best support these students in an academic setting. There are a number of specialized brain injury resource teams in the school setting that are designed to help support school-based teams with the management of pediatric traumatic brain injury. While a number of screening tools have been developed to help professionals determine if a child has sustained a traumatic brain injury, there is currently no screening tool available for school teams to use to help determine if consultation with a brain injury resource team is warranted. The newly developed DORI-TBI was designed specifically to support the work of these school teams. Based on the findings reported here, it appears that the final

revised DORI-TBI-III may be such a screening instrument. With further research on its reliability and validity, this new instrument may have the potential to be a critical tool in helping school-based teams to more efficiently utilize district level consultation with a brain injury support team when a student is identified as having a traumatic brain injury.

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Appendices

Appendix A

School District Traumatic Brain Injury Team Focus Group Questions

1. Do you believe that a TBI screener would be beneficial to the TBI team? Why or why not?

2. What types of questions would you want answered to help make a determination if a student needs referred to the TBI team?

3. Do you think our team gets referrals that do not require our consultation? If so, how many?

4. Do you think a screener would help increase the efficiency of our team? Why or why not?

5. Of the students identified on the screener as not requiring our services, do you think a handout on intervention ideas in school and home would be beneficial for the student, school, and family?

6. Any other comments, ideas, or suggestions that may be helpful in development of this measure?

Appendix B

Development of Recommendations and Interventions in Traumatic Brain Injury (DORI-TBI) Version One

Student's name:_____ Student's grade:_____ Student's gender____
How long known student_____
School personnel's name:_____ Name of school:_____

Domain I- Diagnosis Index: Factors associated with TBI diagnosis			
		Yes	**No**
1.	Does the student have a medically documented traumatic brain injury?	1	0
2.	Does the student have a credible history (clear consistent details collected through an in-depth interview) of one or more traumatic brain injuries?	1	0
3.	Has the student's academic performance been impacted post brain injury?	1	0
4.	Did the student lose consciousness after sustaining the injury?	1	0
5.	Did the student receive medical attention within one hour of injury?	0	1
6.	Is this the first brain injury the student has sustained?	0	1
7.	Does the student currently suffer from headaches?	1	0
8.	Does the student currently suffer from dizziness?	1	0
9.	Does the student have an individualized education plan (IEP)?	1	0
10.	Does the student have a 504?	1	0
	Total		

Instructions: Please have someone who has known the student for at least 3 months and who interacts with the student during learning complete the following information regarding the identified student's injury (s).

Instructions: Please complete the following information regarding the identified student's current academic performance within the last 6 months. Please select only one response per item. Select 0 if the child never displays the symptom or behavior, 1 if the child sometimes displays the symptom or behavior, 2 if the child often displays the symptom or behavior, and 3 if the child almost always displays the symptom or behavior.

Domain II- Symptoms Index: TBI characteristics commonly observed in the school setting					
		Never	**Sometimes**	**Often**	**Almost Always**
1.	The student experiences cognitive fatigue.	0	1	2	3
2.	The student has difficulty processing multistep directions.	0	1	2	3
3.	The student experiences irritability.	0	1	2	3
4.	The student has difficulty with physical transitions.	0	1	2	3
5.	The student has difficulty with mental transitions (ability to shift from one idea, train of thought, or activity to another).	0	1	2	3
6.	The student has difficulty completing school workload.	0	1	2	3
7.	The student has difficulty with organizing his/her materials needed for class.	0	1	2	3
8.	The student has difficulty resisting impulses.	0	1	2	3
9.	The student has difficulty starting new tasks.	0	1	2	3
10.	The student has difficulty planning short-term goals.	0	1	2	3
11.	The student has difficulty planning long-term goals.	0	1	2	3
12.	The student has difficulty sustaining appropriate attention in class.	0	1	2	3
13.	The student blurts out what he or she is thinking.	0	1	2	3
14.	The student requires extra assistance to complete tasks.	0	1	2	3
15.	The student turns in assignments without proofing them first.	0	1	2	3
16.	The student requires extra time to complete tasks.	0	1	2	3
17.	The student has difficulty with memory.	0	1	2	3
18.	The student has vision difficulties.	0	1	2	3
19.	The student has physical difficulties.	0	1	2	3
	Total				

Instructions: Please complete the following information regarding interventions previously implemented for the student. Please select Yes if the intervention has been implemented for this student and No if the intervention has not yet been implemented for this student.

	Domain III: Interventions Index: Interventions used to address the neurodevelopmental clusters affected by TBI		
	School- Academic	**Yes**	**No**
1.	Preferential seating (e.g., front of the classroom near the teacher).	1	0
2.	Cognitive rest (e.g., rest time in nurses office).	1	0
3.	Reduced homework load (e.g., by 50% or greater).	1	0
4.	Modified assignments (e.g., chunking steps into small parts).	1	0
5.	Modified assignments (e.g., shorten number of problems required)	1	0
6.	Visual supports (e.g., examples of completed problems, equations, schedule).	1	0
7.	One-on-one assistance (e.g., with a teacher or paraprofessional).	1	0
8.	Assignments graded on content vs. appearance (e.g., detail vs. handwriting).	1	0
9.	New topics are previewed before they are introduced in the classroom (e.g., read book on topic).	1	0
10.	Verbal 5-minute warning before transitioning to a new activity (e.g., "in 5 minutes we will..").	1	0
11.	Check-in with a trusted adult (e.g., Check-in/Check-out)	1	0
	Social/Emotional- Relationships	**Yes**	**No**
12.	Social/Emotional Skill Building (e.g., participation in group with mental health provider).	1	0
13.	Social/Emotional Skill Building (e.g., participation in outside therapy).	1	0
14.	Verbal feedback is provided for specific behavior (e.g., "I like how you let Suzie play on the swing first").	1	0
15.	Use of a positive peer to model and reinforce appropriate behavior (e.g., sit next to positive peer).	1	0
16.	Specific routines are developed, described, and taught for everyday situations (e.g., role play).	1	0
17.	Participation in an organized group that provides structure and supervision (e.g., boy scouts).	1	0
	Social/Emotional- Emotion Regulation		
18.	Role-play appropriate reactions to specific stressful events (e.g., what to do when my friend is mean).	1	0
19.	Learn appropriate physical behaviors to release tension (e.g. running around the gym, ripping up paper)	1	0
20.	Learn alternative phrases to swear words to use when upset (e.g., "This stinks!")	1	0
21.	Teach how to identify size of the problem and appropriate size of response to match the problem.	1	0
22.	Scheduled breaks throughout the day to relax and regain stability in mood (e.g., rest in nurse's office).	1	0
23.	Positive reinforcement when learning new skills (e.g., point out successes)	1	0
24.	Provide opportunity to practice successful skills several times a day (e.g., in social skills group).	1	0
25.	Behavior that is expected from student is described and modeled (e.g., "walk in the hall" vs. "don't run).	1	0
26.	Short verbal cues are given to reinforce instruction (e.g., "inside voice," "writing time,")	1	0

27.	Provide student with a quiet space to use when he or she is feeling overwhelmed (e.g., cozy corner).	1	0
	Total		

Domain I Total:	**Domain II Total:**	**Domain III Total:**	**Total Composite:**

Total Composite Score For All Domains 10 or Below	**Low. Does not meet criteria for TBI team referral.**
Total Composite Score For All Domains Between 11-29 *AND* a score of 1 on item 1 and/or item 2 in Domain One	**Medium. Does not meet criteria for TBI Team referral at this time. Please re-administer in one month.**
Total Composite Score For All Domains 30+ *AND* a score of 1 on item 1 and/or item 2 in Domain One	**High. Refer to TBI Team immediately.**

Appendix C

Traumatic Brain Injury Comparison Chart

DORI-TBI Items		Referral Form A	Referral Form B	Referral Form C	Referral Form D	Referral Form E	Referral Form F	Referral Form G	Referral Form H
1.	Instrument Name								
2.	USA region used								
3.	District/State								
4.	Purpose								
5.	Psychometric Information (if available)								
6.	Does the student have a medically documented traumatic brain injury?								
7.	Does the student have a credible history (clear consistent details collected through an in-depth interview) of one or more traumatic brain injuries?								
8.	Has the student's academic performance been impacted post brain injury?								
9.	Did the student lose consciousness after sustaining the injury?								
10.	Did the student receive medical attention within one hour of injury?								
11.	Is this the first brain injury the student has sustained?								
12.	suffer from								
13.	Does the student currently suffer from dizziness?								
14.	Does the student have an individualized education plan (IEP)?								
15.	Does the student have a 504?								
16.	The student experiences cognitive fatigue.								
17.	The student has difficulty processing multistep directions.								
18.	The student experiences irritability.								
19.	The student has difficulty with								

	physical transitions.								
20.	The student has difficulty with mental transitions (ability to shift from one idea, train of thought, or activity to another).								
21.	The student has difficulty completing school workload.								
22.	The student has difficulty with organizing his/her materials needed for class.								
23.	The student has difficulty resisting impulses.								
24.	The student has difficulty starting new tasks.								
25.	The student has difficulty planning short-term goals.								
26.	The student has difficulty planning long-term goals.								
27.	The student has difficulty sustaining appropriate attention in class.								
28.	The student blurts out what he or she is thinking.								
29.	The student requires extra assistance to complete tasks.								
30.	The student turns in assignments without proofing them first.								
31.	The student requires extra time to complete tasks.								
32.	The student has difficulty with memory.								
33.	The student has vision difficulties.								
34.	The student has physical difficulties.								
35.	Preferential seating (e.g., front of the classroom near the teacher).								
36.	Cognitive rest								

	(e.g., rest time in nurses office).								
37.	Reduced homework load (e.g., by 50% or greater).								
38.	Modified assignments (e.g., chunking steps into small parts).								
39.	Modified assignments (e.g., shorten number of problems required)								
40.	Visual supports (e.g., examples of completed problems, equations, schedule).								
41.	One-on-one assistance (e.g., with a teacher or paraprofessional).								
42.	Assignments graded on content vs. appearance (e.g., detail vs. handwriting).								
43.	New topics are previewed before they are introduced in the classroom (e.g., read book on topic).								
44.	Verbal 5-minute warning before transitioning to a new activity (e.g., "in 5 minutes we will...").								
45.	Check-in with a trusted adult (e.g., Check-in/Check-out)								
46.	Social/Emotional Skill Building (e.g., participation in group with mental health provider).								
47.	Social/Emotional Skill Building (e.g., participation in outside therapy).								
48.	Verbal feedback is provided for specific behavior (e.g., "I like how you let Suzie play on the swing first").								
49.	Use of a positive peer to model and reinforce appropriate behavior (e.g., sit next to positive peer).								
50.	Specific routines are developed, described, and								

	taught for everyday situations (e.g., role play).								
51.	Participation in an organized group that provides structure and supervision (e.g., boy scouts).								
52.	Role-play appropriate reactions to specific stressful events (e.g., what to do when my friend is mean).								
53.	Learn appropriate physical behaviors to release tension (e.g., running around the gym, ripping up paper)								
54.	Learn alternative phrases to swear words to use when upset (e.g., "This stinks!")								
55.	Teach how to identify size of the problem and appropriate size of response to match the problem.								
56.	Scheduled breaks throughout the day to relax and regain stability in mood (e.g., rest in nurse's office).								
57.	Positive reinforcement when learning new skills (e.g., point out successes)								
58.	Provide opportunity to practice successful skills several times a day (e.g., in social skills group).								
59.	Behavior that is expected from student is described and modeled (e.g., "walk in the hall" vs. "don't run).								
60.	Short verbal cues are given to reinforce instruction (e.g., "inside voice," "writing time,")								
61.	Provide student with a quiet space to use when he or she is feeling overwhelmed (e.g., cozy corner).								

Appendix D

Traumatic Brain Injury Comparison Chart Completed

DORI-TBI Items		Referral Form A	Referral Form B	Referral Form C	Referral Form D	Referral Form E	Referral Form F	Referral Form G	Referral Form H
1.	Does the student have a medically documented traumatic brain injury?	Yes*	Yes*	Yes*	Yes*	No	No	No	Yes*
2.	Does the student have a credible history (clear consistent details collected through an in-depth interview) of one or more traumatic brain injuries?	No	No	No	No	No	No	No	No
3.	Has the student's academic performance been impacted post brain injury?	No	No	Yes*	No	Yes*	No	Yes*	Yes*
4.	Did the student lose consciousness after sustaining the injury?	No	No	No	No	Yes*	No	Yes*	Yes*
5.	Did the student receive medical attention within one hour of injury?	Yes*	No	No	No	Yes*	No	Yes*	Yes*
6.	Is this the first brain injury the student has sustained?	No	No	No	No	Yes*	No	No	No
7.	Does the student currently suffer from headaches?	No	No	No	No	No	No	No	Yes*
8.	Does the student currently suffer from dizziness?	No	No	No	No	No	No	No	Yes*
9.	Does the student have an individualized education plan (IEP)?	No	Yes*	Yes*	Yes*	Yes*	Yes*	Yes*	No
10.	Does the student have a 504?	No	Yes*	Yes*	No	Yes*	Yes*	Yes*	No
11.	The student experiences cognitive fatigue.	No	No	No	No	Yes*	No	No	Yes*
12.	The student has difficulty processing multistep directions.	No	No	No	No	Yes*	No	Yes*	No
13.	The student experiences irritability.	No	No	No	No	No	No	No	Yes*
14.	The student has difficulty with physical transitions.	No	No	No	No	No	No	No	No
15.	The student has difficulty with mental transitions (ability to shift	No	Yes*	No	No	Yes*	No	No	No

	from one idea, train of thought, or activity to another).								
16.	The student has difficulty completing school workload.	No	No	No	No	No	No	No	Yes*
17.	The student has difficulty with organizing his/her materials needed for class.	No	No	No	No	Yes*	No	No	No
18.	The student has difficulty resisting impulses.	No	Yes*	No	No	Yes*	No	No	No
19.	The student has difficulty starting new tasks.	No	Yes*	No	No	Yes*	No	No	No
20.	The student has difficulty planning short-term goals.	No	Yes*	No	No	Yes*	No	No	No
21.	The student has difficulty planning long-term goals.	No	Yes*	No	No	Yes*	No	No	No
22.	The student has difficulty sustaining appropriate attention in class.	No	Yes*	No	No	Yes*	No	No	Yes*
23.	The student blurts out what he or she is thinking.	No	No	No	No	No	No	No	No
24.	The student requires extra assistance to complete tasks.	No	No	No	No	No	No	No	No
25.	The student turns in assignments without proofing them first.	No	No	No	No	No	No	No	No
26.	The student requires extra time to complete tasks.	No	No	No	No	No	No	No	No
27.	The student has difficulty with memory.	No	Yes*	No	No	Yes*	No	Yes*	Yes*
28.	The student has vision difficulties.	No	No	No	No	No	No	Yes*	Yes*
29.	The student has physical difficulties.	No	No	Yes*	No	No	No	Yes*	No
30.	Preferential seating (e.g., front of the classroom near the teacher).	No	No	No	No	No	No	No	No
31.	Cognitive rest (e.g., rest time in nurses office).	No	No	No	No	No	No	No	No
32.	Reduced homework load (e.g., by 50% or greater).	No	No	No	No	No	No	No	No
33.	Modified	No	No	No	No	No	No	No	No

	assignments (e.g., chunking steps into small parts).								
34.	Modified assignments (e.g., shorten number of problems required)	No	No	No	No	No	No	No	No
35.	Visual supports (e.g., examples of completed problems, equations, schedule).	No	No	No	No	No	No	No	No
36.	One-on-one assistance (e.g., with a teacher or paraprofessional).	No	No	No	No	No	No	No	No
37.	Assignments graded on content vs. appearance (e.g., detail vs. handwriting).	No	No	No	No	No	No	No	No
38.	New topics are previewed before they are introduced in the classroom (e.g., read book on topic).	No	No	No	No	No	No	No	No
39.	Verbal 5-minute warning before transitioning to a new activity (e.g., "in 5 minutes we will..").	No	No	No	No	No	No	No	No
40.	Check-in with a trusted adult (e.g., Check-in/Check-out)	No	No	No	No	No	No	No	No
41.	Social/Emotional Skill Building (e.g., participation in group with mental health provider).	No	No	No	No	No	No	No	No
42.	Social/Emotional Skill Building (e.g., participation in outside therapy).	No	No	No	No	No	No	No	No
43.	Verbal feedback is provided for specific behavior (e.g., "I like how you let Suzie play on the swing first").	No	No	No	No	No	No	No	No
44.	Use of a positive peer to model and reinforce appropriate behavior (e.g., sit next to positive peer).	No	No	No	No	No	No	No	No
45.	Specific routines are developed, described, and taught for everyday situations (e.g., role play).	No	No	No	No	No	No	No	No
46.	Participation in an organized group that	No	No	No	No	No	No	No	No

	provides structure and supervision (e.g., boy scouts).								
47.	Role-play appropriate reactions to specific stressful events (e.g., what to do when my friend is mean).	No	No	No	No	No	No	No	No
48.	Learn appropriate physical behaviors to release tension (e.g., running around the gym, ripping up paper)	No	No	No	No	No	No	No	No
49.	Learn alternative phrases to swear words to use when upset (e.g., "This stinks!")	No	No	No	No	No	No	No	No
50.	Teach how to identify size of the problem and appropriate size of response to match the problem.	No	No	No	No	No	No	No	No
51.	Scheduled breaks throughout the day to relax and regain stability in mood (e.g., rest in nurse's office).	No	No	No	No	No	No	No	No
52.	Positive reinforcement when learning new skills (e.g., point out successes)	No	No	No	No	No	No	No	No
53.	Provide opportunity to practice successful skills several times a day (e.g., in social skills group).	No	No	No	No	No	No	No	No
54.	Behavior that is expected from student is described and modeled (e.g., "walk in the hall" vs. "don't run).	No	No	No	No	No	No	No	No
55.	Short verbal cues are given to reinforce instruction (e.g., "inside voice," "writing time,")	No	No	No	No	No	No	No	No
56.	Provide student with a quiet space to use when he or she is feeling overwhelmed (e.g., cozy corner).	No	No	No	No	No	No	No	No
Total		2	10	5	2	16	2	9	12

Appendix E

Expert Review DORI-TBI Protocol

Instructions:

Please complete this form while reviewing the DORI-TBI. Each Domain will begin with a short description describing the purpose and content for the items in the domain. As you review each item in each of the three domains, please mark *Yes* if you agree with the statement in each of the three columns and mark *No* if you disagree with the statement in each of the three columns. Finally, please include any additional comments you think would be helpful and/or necessary for each item.

Domain I was created to help school personnel quickly determine if a student meets criteria for a diagnosis of traumatic brain injury. In addition to the medical documentation and educational impact, other factors that have been found to impact prognosis of a head injury are also included in Domain I.

Domain I- Diagnosis Index: Factors associated with TBI diagnosis	**This Item is Appropriate To This Domain**	**This Item is Clear**	**This Item is Needed**	**Additional Comments**
1. Does the student have a medically documented traumatic brain injury?				
2. Does the student have a credible history (clear consistent details collected through an in-depth interview) of one or more traumatic brain injuries?				

3. Has the student's academic performance been impacted post brain injury?				
4. Did the student lose consciousness after sustaining the injury?				
5. Did the student receive medical attention within one hour of injury?				
6. Is this the first brain injury the student has sustained?				
7. Does the student currently suffer from headaches?				
8. Does the student currently suffer from dizziness?				
9. Does the student have an individualized education plan (IEP)?				

10. Does the student have a 504?				

Domain II was designed to capture the behavioral and academic symptoms of TBI that are commonly observed in a school setting. These items were written in a way that school personnel can easily understand what this may look like in an academic setting.

Domain II- Symptoms Index: Behavioral and academic symptoms of TBI that are commonly observed in a school setting	**This Item is Appropriate To This Domain**	**This Item is Clear**	**This Item is Needed**	**Additional Comments**
11. The student experiences cognitive fatigue.				
12. The student has difficulty processing multistep directions.				
13. The student experiences irritability.				
14. The student has difficulty with physical transitions.				

15. The student has difficulty with mental transitions (ability to shift from one idea, train of thought, or activity to another).				
16. The student has difficulty completing school workload.				
17. The student has difficulty with organizing his/her materials needed for class.				
18. The student has difficulty resisting impulses.				
19. The student has difficulty starting new tasks.				
20. The student has difficulty planning short-term goals.				
21. The student has difficulty planning long-				

term goals.				
22. The student has difficulty sustaining appropriate attention in class.				
23. The student blurts out what he or she is thinking.				
24. The student requires extra assistance to complete tasks.				
25. The student turns in assignments without proofing them first.				
26. The student requires extra time to complete tasks.				
27. The student has difficulty with memory.				
28. The student has vision difficulties.				
29. The student				

has physical difficulties.				

Domain III measures specific interventions based on neurocognitive areas of deficit most commonly noticed in school-aged children who have sustained a TBI. These interventions are based on the Brain STARS manual Problem-Solving Index and are linked to four main content areas most commonly impacted by traumatic brain injury. These include: memory, self-regulation, impulsivity, and organization and transition.

Domain III: Interventions Index: Interventions used to address the neurodevelopmental clusters affected by TBI	**This Item is Appropriate To This Domain**	**This Item is Clear**	**This Item is Needed**	**Additional Comments**
30. Preferential seating (e.g., front of the classroom near the teacher).				
31. Cognitive rest (e.g., rest time in nurses office).				
32. Reduced homework load (e.g., by 50% or greater).				
33. Modified assignments (e.g., chunking steps into small parts).				
34. Modified assignments (e.g.,				

shorten number of problems required)				
35. Visual supports (e.g., examples of completed problems, equations, schedule).				
36. One-on-one assistance (e.g., with a teacher or paraprofessional).				
37. Assignments graded on content vs. appearance (e.g., detail vs. handwriting).				
38. New topics are previewed before they are introduced in the classroom (e.g., read book on topic).				
39. Verbal 5-minute warning before transitioning to a new activity (e.g., “in 5 minutes we will...”).				
40. Check-in with a trusted adult (e.g., Check-in/Check-out)				
41. Social/Emotional Skill Building (e.g., participation in group with mental health provider).				

42. Social/Emotional Skill Building (e.g., participation in outside therapy).				
43. Verbal feedback is provided for specific behavior (e.g., "I like how you let Suzie play on the swing first").				
44. Use of a positive peer to model and reinforce appropriate behavior (e.g., sit next to positive peer).				
45. Specific routines are developed, described, and taught for everyday situations (e.g., role play).				
46. Participation in an organized group that provides structure and supervision (e.g., boy scouts).				
47. Role-play appropriate reactions to specific stressful events (e.g., what to do when my friend is mean).				
48. Learn appropriate physical behaviors to release tension (e.g.,				

running around the gym, ripping up paper)				
49. Learn alternative phrases to swear words to use when upset (e.g., “This stinks!”)				
50. Teach how to identify size of the problem and appropriate size of response to match the problem.				
51. Scheduled breaks throughout the day to relax and regain stability in mood (e.g., rest in nurse’s office).				
52. Positive reinforcement when learning new skills (e.g., point out successes)				
53. Provide opportunity to practice successful skills several times a day (e.g., in social skills group).				
54. Behavior that is expected from student is described and modeled (e.g., “walk in the hall” vs. “don’t				

run).				
55. Short verbal cues are given to reinforce instruction (e.g., "inside voice," "writing time,")				
56. Provide student with a quiet space to use when he or she is feeling overwhelmed (e.g., cozy corner).				

Other Questions. These questions are additional questions designed to allow for further feedback on the DORI-TBI overall. Please mark *Yes* if you agree with each statement, and mark *No* if you disagree. In addition, please include any additional comments you believe will be helpful in your assessment of the DORI-TBI.

Other Questions	**Yes**	**No**	**Additional Comments**
1. Overall, the DORI-TBI measures brain injury criteria, symptoms, and interventions in an academic setting.			
2. The instructions for Domain I are clear.			
3. The instructions for Domain II are clear.			

4. The instructions for Domain III are clear.			
5. The cutoff scores for referral are clear.			
6. The cutoff scores for referral are appropriate.			
7. Domain I measures traumatic brain injury criteria and initial injury impact.			
8. Domain II measures characteristics of TBI observed in an academic setting.			
9. Domain III measures specific interventions related to neurodevelopmental clusters commonly affected by TBI.			

Appendix F

Expert Review Vignette Protocol

1. Read each vignette (e.g. mild, moderate, and severe).
2. As you read each vignette, please refer to the DORI-TBI to interpret how someone may score this vignette.
3. After reading each vignette and reviewing the DORI-TBI, please complete the following questions on each vignette (mild, moderate, and severe).

Questions For Mild Vignette	**Yes**	**No**	**Additional Comments**
1. Is this vignette clear?			
2. Does this vignette represent a "mild" TBI case (as indicated by the low cutoff score on the DORI-TBI) based on the number of identifiers?			
3. Are the proportions of TBI characteristics representative of a "mild" TBI case?			
4. Would you add any additional information to this vignette? If yes, please describe in the additional comments section.			
5. Would you remove any information from this vignette? If yes, please describe in the additional comments section.			
6. Please provide any further feedback/information you think is necessary for this vignette on the space below. _____ _____ _____ _____			

Questions For Moderate Vignette	Yes	No	Additional Comments
1. Is this vignette clear?			
2. Does this vignette represent a "moderate" TBI case (as indicated by the low cutoff score on the DORI-TBI) based on the number of identifiers?			
3. Are the proportions of TBI characteristics representative of a "moderate" TBI case?			
4. Would you add any additional information to this vignette? If yes, please describe in the additional comments section.			
5. Would you remove any information from this vignette? If yes, please describe in the additional comments section.			
6. Please provide any further feedback/information you think is necessary for this vignette on the space below. _____ _____ _____ _____			

Questions For Severe Vignette	Yes	No	Additional Comments
1. Is this vignette clear?			
2. Does this vignette represent a "severe" TBI case (as indicated by the high cutoff score on the DORI-TBI) based on the number of identifiers?			
3. Are the proportions of TBI characteristics representative of a "severe" TBI case?			
4. Would you add any additional information to this vignette? If yes, please describe in the additional comments section.			
5. Would you remove any information from this vignette? If yes, please describe			

in the additional comments section.			

6. Please provide any further feedback/information you think is necessary for this vignette on the space below.

_____

_____

_____

_____

Appendix G

Cognitive Interview Protocol

1. Participants will be asked to individually read the moderate vignette.
2. Then, each participant will be asked to sit down with the researcher while they are read each item of the DORI-TBI aloud and asked to give a response based on the vignette.
3. Participants will then be asked why they gave the response they gave.
4. Finally, the participants will be asked a series of questions to determine the usability of the screener.

Cognitive Interview Questions

Profession (Please circle one):

School Psychologist School Nurse Teacher

Speech Language Pathologist Occupational Therapist Other

(Explain)

Domain I- Diagnosis Index: Factors associated with TBI diagnosis	**Yes**	**No**	**How Did You Come To This Decision?**	**Additional Comments**
1. Does the student have a medically documented traumatic brain injury?				
2. Does the student have a credible history (clear consistent details collected through an in-depth interview) of one or more traumatic brain injuries?				
3. Has the student's academic performance been impacted post				

brain injury?				
4. Did the student lose consciousness after sustaining the injury?				
5. Did the student receive medical attention within one hour of injury?				
6. Is this the first brain injury the student has sustained?				
7. Does the student currently suffer from headaches?				
8. Does the student currently suffer from dizziness?				
9. Does the student have an individualized education plan (IEP)?				
10. Does the student have a 504?				

Domain II- Diagnosis Index: Factors associated with TBI diagnosis	**Yes**	**No**	**How Did You Come To This Decision?**	**Additional Comments**
11. The student experiences cognitive fatigue.				
12. The student has difficulty processing				

multistep directions.				
13. The student experiences irritability.				
14. The student has difficulty with physical transitions.				
15. The student has difficulty with mental transitions (ability to shift from one idea, train of thought, or activity to another).				
16. The student has difficulty completing school workload.				
17. The student has difficulty with organizing his/her materials needed for class.				
18. The student has difficulty resisting impulses.				
19. The student has difficulty starting new tasks.				
20. The student has difficulty planning short-term goals.				
21. The student has difficulty planning				

long-term goals.				
22. The student has difficulty sustaining appropriate attention in class.				
23. The student blurts out what he or she is thinking.				
24. The student requires extra assistance to complete tasks.				
25. The student turns in assignments without proofing them first.				
26. The student requires extra time to complete tasks.				
27. The student has difficulty with memory.				
28. The student has vision difficulties.				
29. The student has physical difficulties.				

Domain III: Interventions Index: Interventions used to address the neurodevelopmental clusters affected by TBI	**Yes**	**No**	**How Did You Come To This Decision?**	**Additional Comments**
30. Preferential seating (e.g., front of the classroom near the teacher).				
31. Cognitive rest (e.g., rest time in nurses office).				
32. Reduced homework load (e.g., by 50% or greater).				
33. Modified assignments (e.g., chunking steps into small parts).				
34. Modified assignments (e.g., shorten number of problems required)				
35. Visual supports (e.g., examples of completed problems, equations, schedule).				
36. One-on-one assistance (e.g., with a teacher or paraprofessional).				

37. Assignments graded on content vs. appearance (e.g., detail vs. handwriting).				
38. New topics are previewed before they are introduced in the classroom (e.g., read book on topic).				
39. Verbal 5-minute warning before transitioning to a new activity (e.g., “in 5 minutes we will...”).				
40. Check-in with a trusted adult (e.g., Check-in/Check-out)				
41. Social/Emotional Skill Building (e.g., participation in group with mental health provider).				
42. Social/Emotional Skill Building (e.g., participation in outside therapy).				
43. Verbal feedback is provided for specific behavior (e.g., “I like how you let Suzie play on the swing first”).				
44. Use of a positive peer to model and reinforce appropriate behavior				

(e.g., sit next to positive peer).				
45. Specific routines are developed, described, and taught for everyday situations (e.g., role play).				
46. Participation in an organized group that provides structure and supervision (e.g., boy scouts).				
47. Role-play appropriate reactions to specific stressful events (e.g., what to do when my friend is mean).				
48. Learn appropriate physical behaviors to release tension (e.g., running around the gym, ripping up paper)				
49. Learn alternative phrases to swear words to use when upset (e.g., "This stinks!")				
50. Teach how to identify size of the problem and appropriate size of response to match the problem.				
51. Scheduled breaks throughout the day to relax and regain stability				

in mood (e.g., rest in nurse's office).				
52. Positive reinforcement when learning new skills (e.g., point out successes)				
53. Provide opportunity to practice successful skills several times a day (e.g., in social skills group).				
54. Behavior that is expected from student is described and modeled (e.g., "walk in the hall" vs. "don't run).				
55. Short verbal cues are given to reinforce instruction (e.g., "inside voice," "writing time,")				
56. Provide student with a quiet space to use when he or she is feeling overwhelmed (e.g., cozy corner).				

Other Questions	**Yes**	**No**	**Additional Comments**
1. Overall, the length of this instrument is appropriate for school personnel.			
2. The instructions for Domain I are clear.			

3. The instructions for Domain II are clear.			
4. The instructions for Domain III are clear.			
5. This instrument is easy to use			
6. Please provide any recommendations for improvement you have for the instrument.			

Appendix H

Modifications Made to The DORI-TBI and Vignettes

Study	Original Item	Modification	Rationale
Content Expert Review-DORI-TBI	Does the student have a credible history (clear consistent details collected through an in-depth interview) of one or more traumatic brain injuries?	Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?	The inclusion of a specific tool, the OSU-TBI, was accepted to help respondents understand what indicates a credible history.
Content Expert Review-DORI-TBI	Did the student receive medical attention within one hour of injury?	Omitted	Experts reported that this wasn't crucial for referral.
Content Expert Review-DORI-TBI	Does the student currently suffer from dizziness?	Does the student currently suffer from dizziness (e.g. balance difficulties, being more clumsy now, walking into walls or door jambs)?	Decision to include specific examples to help respondents score this item.
Content Expert Review-DORI-TBI	Does the student have an individualized education plan (IEP)?	Does the student have an individualized education plan (IEP) or did the student have a 504 plan prior to the incident?	Combined this question with the 504 plan question below for less questions for respondents.
Content Expert Review-DORI-TBI	Does the student have a 504?	Combined with above	Combined this question with the IEP question for less questions for respondents.
Content Expert	**Instructions:** Please complete	**Instructions:** Please complete	Included the word "changes"

Review-DORI-TBI	the following information regarding the identified student's current academic performance within the last 6 months. Please select only one response per item. Select 0 if the child never displays the symptom or behavior, 1 if the child sometimes displays the symptom or behavior, 2 if the child often displays the symptom or behavior, and 3 if the child almost always displays the symptom or behavior.	the following information regarding changes in the identified student's current academic performance since the incident but within the last 6 months. Please select only one response per item. Select 0 if the child never displays the symptom or behavior, 1 if the child sometimes displays the symptom or behavior, 2 if the child often displays the symptom or behavior, and 3 if the child almost always displays the symptom or behavior.	to better capture TBI symptoms.
Content Expert Review-DORI-TBI	The student experiences cognitive fatigue.	The student experiences cognitive fatigue (his or her brain has to work harder to concentrate on tasks than before).	Included example of cognitive fatigue to help respondents with scoring.
Content Expert Review-DORI-TBI	The student has difficulty processing multistep directions.	The student has difficulty understanding and completing multistep	Changed "processing" to "understanding and completing" for

		directions.	more accurate scoring.
Content Expert Review-DORI-TBI	The student experiences irritability.	The student demonstrates irritability.	Changed "experiences" to "demonstrates" for more accurate scoring.
Content Expert Review-DORI-TBI	The student has difficulty with physical transitions.	The student has difficulty with physical transitions (ability to move from one room or position to another) or with mental transitions (ability to shift from one idea, train of thought, or activity to another).	Included an example to help respondents with scoring.
Content Expert Review-DORI-TBI	The student has difficulty with mental transitions (ability to shift from one idea, train of thought, or activity to another).	The student has difficulty with physical transitions (ability to move from one room or position to another) or with mental transitions (ability to shift from one idea, train of thought, or activity to another).	Combined this question with the physical transition question for less questions for respondents.
Content Expert Review-DORI-TBI	The student has difficulty completing school workload.	The student has difficulty completing classroom assignments or homework compared to prior	Included a definition for school workload and also included a comparison to prior

		performance.	performance for more accurate TBI symptom.
Content Expert Review-DORI-TBI	The student has difficulty with organizing his/her materials needed for class.	The student has difficulty organizing his/her materials needed for class.	Took out the extra word "with" to clean the question.
Content Expert Review-DORI-TBI	The student has difficulty resisting impulses.	Omitted	Question was omitted based on feedback that this question isn't specific to TBI.
Content Expert Review-DORI-TBI	The student has difficulty planning short-term goals.	The student has difficulty planning short-term goals (identifying a goal and completing the necessary steps necessary to achieve that goal such as turning in homework to earn a good grade in a class.)	Included examples of short-term goals to help respondents with scoring.
Content Expert Review-DORI-TBI	The student has difficulty planning long-term goals.	Omitted	Question omitted based on feedback that it was not specific to TBI.
Content Expert Review-DORI-TBI	The student blurts out what he or she is thinking.	The student blurts out what he or she is thinking (e.g., does not stop and think about the appropriateness or consequences before speaking or does not raise hand and wait to	Included examples to help respondents with scoring.

		be called on before speaking.)	
Content Expert Review-DORI-TBI	The student turns in assignments without proofing them first.	Omitted	Question omitted based on feedback that it was not specific to TBI.
Content Expert Review-DORI-TBI	The student requires extra time to complete tasks.	The student requires extra time to complete timed tasks.	Included the word "timed" for more accurate symptom of TBI
Content Expert Review-DORI-TBI	The student has difficulty with memory.	The student has difficulty with memory (short and/or long term memory).	Included examples to help respondents with scoring.
Content Expert Review-DORI-TBI	The student has vision difficulties.	The student has changes in vision since the incident.	Included the word "changes" for more accurate symptom of TBI.
Content Expert Review-DORI-TBI	The student has physical difficulties.	Omitted	Question was omitted based on feedback that it was not specific to TBI.
Content Expert Review-DORI-TBI	**New Item Added**	The student has sleep difficulties.	Question added based on feedback that this symptom is associated with TBI.
Content Expert Review-DORI-TBI	**New Item Added**	The student demonstrates new emotional dysregulation.	Question added based on feedback that this symptom is associated with TBI.
Content Expert	Modified assignments (e.g.	Modified assignments (e.g.,	Changed the word

Review-DORI-TBI	chunking steps into small parts).	breaking problems or questions into smaller, more manageable steps).	"chunking" into clearer language for accurate scoring.
Content Expert Review-DORI-TBI	Modified assignments (e.g. shorten number of problems required)	Modified assignments (e.g., shorten number of problems required to complete to demonstrate competency)	Included more detailed example to help respondents with scoring.
Content Expert Review-DORI-TBI	New topics are previewed before they are introduced in the classroom (e.g. read book on topic).	New topics are previewed before they are introduced in the classroom (e.g., read a book on upcoming topic at home).	Included more detailed example to help respondents with scoring.
Content Expert Review-DORI-TBI	Check-in with a trusted adult (e.g. Check-in/Check-out)	Student check-in/check-out with a trusted adult at the start and end of the day to preview and review day.	Included definition of Check-in/Check-out to help respondents with scoring.
Content Expert Review-DORI-TBI	Social/Emotional Skill Building (e.g. participation in group with mental health provider).	Social/Emotional Skill Building (e.g., participation in group with mental health provider at school).	Clarified participation should be in a school setting for scoring.
Content Expert Review-DORI-TBI	Social/Emotional Skill Building (e.g. participation in outside therapy).	Social/Emotional Skill Building (e.g., participation in therapy outside of the school setting).	Clarified participation should be outside of a school setting for scoring.

Content Expert Review-DORI-TBI	Participation in an organized group that provides structure and supervision (e.g. boy scouts).	Participation in an organized group that provides structure and supervision (e.g., school choir, boy scouts).	Included an extra example to help respondents with scoring.
Content Expert Review-DORI-TBI	Teach how to identify size of the problem and appropriate size of response to match the problem.	Omitted	Question omitted due to feedback on confusing nature of intervention.
Content Expert Review-DORI-TBI	Positive reinforcement when learning new skills (e.g. point out successes)	Omitted	Question omitted based on feedback that it is not specific to TBI.
Content Expert Review-DORI-TBI	Provide opportunity to practice successful skills several times a day (e.g. in social skills group).	Provide opportunity to practice social skills several times a day (e.g., in social skills group) with immediate feedback.	Included immediate feedback to help respondents with scoring.
Content Expert Review-DORI-TBI	Behavior that is expected from student is described and modeled (e.g. "walk in the hall" vs. "don't run).	Omitted	Question omitted based on feedback it is not specific to TBI.
Content Expert Review-Vignettes	One week ago, while at softball practice, Carly was hit in the face with a softball.	Three weeks ago, while at softball practice, Carly was hit in the face with a softball.	Length of time between initial injury was extended to make vignette more true to level.
Content Expert	Carly went back to school	Carly went back to school	Length of time between initial

Review-Vignettes	approximately 3 days after her injury.	approximately 2 weeks after her injury.	injury and return to school was increased to make vignette more true to level.
Content Expert Review-Vignettes	**New sentence added**	These symptoms continue to linger four weeks post injury	New sentence added to make vignette more true to level.
Content Expert Review-Vignettes	Carly is anxious to get back to school to begin catching up on all the work she has missed.	Carly is anxious to get back to her routine and to begin catching up on all the work she has missed.	Included routine instead of school to make vignette more clear.
Content Expert Review-Vignettes	**New sentence added**	Fluorescent lighting and bright outdoor light irritate Carly and she is more easily distracted and forgetful than before the accident.	New sentence added to help make vignette more true to level.
Cognitive Interviews-DORI-TBI	One total score for each column.	One total score for each column AND a domain total score added for easy scoring at the end.	Included the total score for each domain to help respondents understand scoring.
Cognitive Interviews-DORI-TBI	Response options: Never, Sometimes, Often, Almost Always	Response Options changed to: Never 0%, Sometimes less than 50%, Often greater than 50%, Almost Always 90-100%	Included percentages for each response to help respondents with scoring.
Cognitive Interviews-DORI-TBI	Item 16: The student demonstrates new emotional	Item 16: The student demonstrates new emotional	Included an example to help respondents with scoring.

	dysregulation.	dysregulation (inability to control or regulate emotional responses).	
Cognitive Interviews-DORI-TBI	No Scoring Instructions	Scoring instructions: Please add each Domain Total together to obtain a Total Composite Score. Then, follow the chart below to locate the Total Composite Score and determine the school's suggested response.	Included scoring instructions to help respondents accurately score the DORI-TBI.
Cognitive Interviews-DORI-TBI	New Feature Added	Addition signs added between Domain Total Scores and an equal sign added before Total Composite Score.	Included addition signs to help respondents with final scoring of DORI-TBI.
Cognitive Interviews-DORI-TBI	New Feature Added	Moved Total Composite to the left side for easy viewing and included labels for total composite and school response columns.	Included this feature to help respondents with final scoring of DORI-TBI.
Cognitive Interviews-DORI-TBI	Domain III Feedback	Feedback on the intervention section from several participants included their satisfaction when	No modifications were made from this feedback.

		reviewing the interventions listed in Domain III as possible interventions to try in the future.	
Cognitive Interviews-Vignettes	New sentence added	Her doctor also diagnosed her with a concussion.	New sentenced added to help make vignette clear.

Appendix I

Vignettes

Instructions: Please read the vignette below. Once you have finished reading the vignette, please complete the DORI-TBI using only the information from the vignette.

Vignette #1 (Mild)

Ashton is an 11-year-old student attending Cotton Elementary School. Academically, Ashton is performing in the partially proficient range in all subjects. Socially, Ashton is having difficulty interacting with peers. Specifically, he has some difficulty with impulse control, sustaining back-and-forth conversations, and occasionally has trouble with emotional regulation. For example, recently at recess, Ashton got upset when a peer did not follow the rules of a game. He yelled at the friend and refused to continue to play the game. He is currently undergoing a small group intervention in reading and math through the Response to Intervention (RtI) process at his elementary school and has demonstrated some success. However, he is still performing behind his peers. He is also participating in a small social skill-building group. He does not take any medications, passed his most recent vision and hearing screen, and does not have any diagnoses. Recently, in an interview with the school psychologist, Ashton's father reported that while his mother was pregnant with Ashton, she fell down the stairs. She did not lose consciousness, but was taken to the hospital to undergo a medical evaluation. She did not sustain any major injuries and an ultra sound of the baby did not indicate any injury to the baby. Ashton's father wants to know if his mother's fall may be the cause of his difficulty both academically and socially at school.

Vignette #2 (Moderate)

Carly is a 13-year-old eighth grade student attending Apple Middle School. She typically receives A's and B's in her core classes and is involved in softball. Further, Carly loves to read. Three weeks ago, while at softball practice, Carly was hit in the face with a softball. She did not lose consciousness, but was sent to the emergency room due to the injuries she sustained from the impact. Specifically, Carly sustained an edema to her left eye and left cheek. Her doctor also diagnosed her with a concussion. Carly went back to school approximately 2 weeks after her injury. During her first day back at school, Carly complained of dizziness, headaches, and fatigue. In addition, she had difficulty concentrating and reported an increased sensitivity to light. These symptoms continue to linger four weeks post injury. Carly is anxious to get back to her routine and to begin catching up on all the work she has missed. However, she notices that she is having a hard time keeping up with her classmates. The school nurse offered Carly the option to rest in her office throughout the day when she is tired, feels dizzy, or has a headache. Fluorescent lighting and bright outdoor light irritate Carly and she is more easily distracted and forgetful than before the accident. In addition, her teachers have started providing Carly with copies of class notes. Carly really wants to pick up right where she left off and is really worried that if she misses any more school, it will

affect her grades. The school team wants to know how they can best support Carly while she recovers from her concussion.

Vignette #3 (Severe)
Tyler is a 17-year-old junior at Blossom High School. He is currently on an individualized education plan (IEP) with a primary disability listed as specific learning disability. In June, a car hit Tyler while he was crossing the street. He lost consciousness and was in the ICU for 6 days. The doctors reported that Tyler sustained a traumatic brain injury and that his injuries included bleeding on the brain and sheering of his axons and neurons. After being released from the hospital, Tyler was admitted to a rehabilitation center for three weeks where he regained physical body strength. He is able to walk, talk, and take care of himself. Prior to his injury, Tyler's teacher's reported that he was a little withdrawn from his classmates and often engaged in work avoidance behaviors. They also reported that he had difficulty with work completion. Currently, his teachers report that while Tyler attempts assignments, he is still withdrawn from his classmates. In addition, he often complains that he is tired, has difficulty remembering names of classmates and teachers he used to know, remembering his class schedule, and transitioning between topics and classrooms. Further, his academic performance has slightly decreased since his injury. To help him be successful, Tyler's teachers have implemented several interventions at school. These include: cognitive rest, preferential seating, a check-in/check-out system with a trusted adult, reduced homework load, and have modified his assignments by shortening the amount of problems required. Even with these interventions, Tyler continues to have difficulty with memory, fatigue, and work completion. He also has difficulty with multi-step directions, completing schoolwork, and requires extra assistance to complete tasks. Tyler has an upcoming re-evaluation meeting and his school team wants to know if they should continue with the specific learning disability as his primary label, or if he qualifies for a primary label of traumatic brain injury. They would also like some advice and support on how to best help Tyler succeed in school.

Appendix J

Study Three: Informed Consent Form- Professionals

Dear Professional,

You are invited to participate in a study that will ask about academic performance and social behavior. The University of Denver Institutional Review Board has approved this study. It is being conducted by DoriAnn Adragna, Ed.S., NCSP and will investigate how brain injury impacts academic performance and social behavior. This information will be used to develop a questionnaire for school personnel in the district to complete before referring a child to the district traumatic brain injury team. Questionnaire results can then be used to guide family and school teams with appropriate next steps, and to develop intervention strategies. Results will be used for presentation and/or publication. If you have questions, DoriAnn Adragna can be reached at 970-270-5407, dori.adragna@du.edu. This project is supervised by Dr. Gloria Miller, Morgridge College of Education, University of Denver, Denver, CO 80208, 303-871-3340, glmiller@du.edu

Participation in this project is strictly voluntary, and should take about 45-60 minutes of your time. Participation will involve responding to questions about brain injury, academic performance, social behavior, and interventions previously implemented. The risks associated with this project are minimal. If, however, you experience discomfort you may request to opt out at any time. We respect your right to choose not to answer any questions that may make you feel uncomfortable. Refusal to participate or withdrawal from participation will involve no penalty or loss of benefits to which you are otherwise entitled.

Your information will be identified by code number only and will be kept separate from information that could identify you. This is done to protect the confidentiality of your information. Only the researcher will have access to your individual data, as well as any reports generated as a result of this study. Reports will include group averages and paraphrased wording only. However, should any information contained in this study be the subject of a court order or lawful subpoena, the University of Denver might not be able to avoid compliance with the order or subpoena. Although no questions in this study address it, we are required by law to tell you that if information is revealed concerning suicide, homicide, or child abuse and neglect, it is required that this be reported to the proper authorities.

If you have any concerns or complaints about how your information will be obtained, please contact Paul Olk, Chair, Institutional Review Board for the Protection of Human Subjects, at 303-871-4531, or you may email du-irb@du.edu, Office of Research and Sponsored Programs or call 303-871-4050 or write to either at the University of Denver, Office of Research and Sponsored Programs, 2199 S. University Blvd., Denver, CO 80208-2121. You may keep this page for your records.

Please sign and return the attached signature page if you understand and agree to the above. If you do not understand any part of the above statement, please ask the researcher any questions you have.

Authorization:
I have read and understood the description of the research project. I have asked for and received a satisfactory explanation of any language that I did not fully understand. I agree to participate in this study. I understand that I may withdraw my consent at any time. By signing below I agree to participate in this study.

Name Date

Appendix K

Professional DORI-TBI Protocol

1. Please complete the following demographic information:

Profession	School Psychologist	School Nurse	Speech/Language Pathologist		Counselor	
Region of the United States	Western	Southeast	North Central		Southwest	Northeast
Level of experience with TBI	No Training	Some Training	Specialized Training			
Level of experience with TBI: Personal (Check all that apply)	I do not know anyone who has been diagnosed with a TBI.	I have been diagnosed with a TBI	Someone I know has been diagnosed with a TBI.	One or more of my family members have been diagnosed with a TBI.	One or more of my friends have been diagnosed with a TBI.	A client/student I work with has a TBI.

2. There will be a total of three vignettes presented to you. For each vignette, please follow the instructions below.
3. Please read the first vignette.
4. After reading the first vignette, please complete the DORI-TBI based only on the information gathered from reading the vignette.
5. Once you have answered all questions regarding the first vignette, please read the second vignette.
6. After reading the second vignette, please complete the DORI-TBI, but this time based only on the information read in the second vignette.
7. Finally, after you have answered all questions on the second vignette, please read the third and final vignette.
8. After reading the third vignette, please complete the DORI-TBI again, but this time based only on the information read in the third vignette.

Appendix L

DORI-TBI-III

Development of Recommendations and Interventions in Traumatic Brain Injury (DORI-TBI) Version Three

Student's name:_____ Student's grade:_____ Student's gender____
How long known student_____
School personnel's name:_____ Name of school:_____

Instructions: Please have someone who has known the student for at least 3 months and who interacts with the student during learning complete the following information regarding the identified student's injury (s).

Initial Screening Questions			
1	Does the student have a medically documented traumatic brain injury?	**Yes**	**No**
2	Does the student have a documented history (using a creditable interview tool such as the OSU-TBI) of one or more traumatic brain injuries?	**Yes**	**No**
If the answer if Yes to one of both of these questions, please continue using the DORI-TBI. If both answers are No do not continue completing the DORI-TBI			

Instructions: Please complete the following information regarding changes in the identified student's current academic performance since the incident, but within the last 6 months. Please select only one response per item. Select 0 if the child never displays the symptom or behavior or if the behavior has not been observed, 1 if the child sometimes displays the symptom or behavior, 2 if the child often displays the symptom or behavior, and 3 if the child almost always displays the symptom or behavior.

Domain I- Symptoms Index: TBI characteristics commonly observed in the school setting					
		Never (0%)	**Sometimes (Less Than 50%)**	**Often (Greater Than 50%)**	**Almost Always (90-100%)**
1	The student experiences cognitive	0	1	2	3

	fatigue (his or her brain has to work harder to concentrate on tasks than before).				
2	The student has difficulty understanding and completing multistep directions.	0	1	2	3
3	The student demonstrates irritability.	0	1	2	3
4	The student has difficulty with physical transitions (ability to move from one room or position to another) or with mental transitions (ability to shift from one idea, train of thought, or activity to another).	0	1	2	3
5	The student has difficulty completing classroom assignments or homework compared to normal.	0	1	2	3
6	The student has difficulty organizing his/her materials needed for class.	0	1	2	3
7	The student has difficulty starting new tasks.	0	1	2	3
8	The student has difficulty	0	1	2	3

	planning short-term goals (identifying a goal and completing the necessary steps necessary to achieve that goal such as turning in homework to earn a good grade in a class.)				
9	The student has difficulty sustaining appropriate attention in class.	0	1	2	3
10	The student blurts out what he or she is thinking (e.g., does not stop and think about the appropriateness or consequences before speaking or does not raise hand and wait to be called on before speaking.)	0	1	2	3
11	The student requires extra assistance to complete tasks.	0	1	2	3
12	The student requires extra time to complete timed tasks.	0	1	2	3
13	The student has difficulty with memory (short and/or long term memory).	0	1	2	3

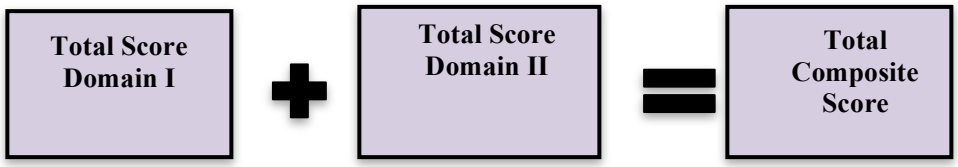
14	The student has changes in vision since the incident.	0	1	2	3	
15	The student has sleep difficulties.	0	1	2	3	
16	The student demonstrates new emotional dysregulation (inability to control or regulate emotional responses).	0	1	2	3	**Total Domain I**
	Total					

Instructions: Please complete the following information regarding interventions that the school team has implemented prior to submitting this referral for the student. Please select Yes if the intervention has been implemented for this student and No if the intervention has not yet been implemented for this student.

Domain II: Interventions Index: Interventions used to address the neurodevelopmental clusters affected by TBI			
School- Academic		**Yes**	**No**
1	Preferential seating (e.g., front of the classroom near the teacher).	1	0
2	Cognitive rest (e.g., rest time in nurses office).	1	0
3	Reduced homework load (e.g., by 50% or greater).	1	0
4	Modified assignments (e.g., breaking problems or questions into smaller, more manageable steps).	1	0
5	Modified assignments (e.g., shorten number of problems required to complete to demonstrate competency)	1	0
6	Visual supports (e.g., examples of completed problems, equations, schedule).	1	0
7	One-on-one assistance (e.g., with a teacher or paraprofessional).	1	0
8	Assignments graded on content vs. appearance (e.g., detail vs. handwriting).	1	0
9	New topics are previewed before they are introduced in the classroom (e.g., read a book on upcoming topic at home).	1	0
10	Verbal 5-minute warning before transitioning to a new activity (e.g., "in 5 minutes we will...").	1	0
11	Student check-in/check-out with a trusted adult at the start and end of the day to preview and review day.	1	0
Social/Emotional- Relationships		**Yes**	**No**
12	Social/Emotional Skill Building (e.g., participation in group with mental health provider at school).	1	0
13	Social/Emotional Skill Building (e.g., participation in therapy outside of the school setting).	1	0
14	Verbal feedback is provided for specific behavior (e.g., "I like how you let Suzie play on the swing first").	1	0
15	Use of a positive peer to model and reinforce appropriate behavior (e.g., sit next to positive peer).	1	0
16	Specific routines are developed, described, and taught for everyday situations (e.g., role play).	1	0
17	Participation in an organized group that provides structure and supervision (e.g., school choir, boy scouts).	1	0
Social/Emotional- Emotion Regulation		**Yes**	**No**
18	Role-play appropriate reactions to specific stressful events (e.g., what to do when my friend is mean).	1	0
19	Learn appropriate physical behaviors to release	1	0

	tension (e.g., running around the gym, ripping up paper)			
20	Learn alternative phrases to swear words to use when upset (e.g., "This stinks!")	1	0	
21	Scheduled breaks throughout the day to relax and regain stability in mood (e.g., rest in nurse's office).	1	0	
22	Provide opportunity to practice social skills several times a day (e.g., in social skills group) with immediate feedback.	1	0	
23	Short verbal cues are given to reinforce instruction (e.g., "inside voice," "writing time,")	1	0	
24	Provide student with a quiet space to use when he or she is feeling overwhelmed (e.g., cozy corner).	1	0	**Total Domain II**
	Total			

Scoring Instructions: Please add each Domain Total together to obtain a Total Composite Score. Then, follow the chart below to locate the Total Composite Score and determine the school's suggested response.



Total Composite Score	School Response
2 or Below	Mild. Does not meet criteria for TBI team referral.
3-21	Moderate. Does not meet criteria for TBI Team referral at this time. Please re-administer in one month.
22 or greater	Severe. Refer to TBI Team immediately.