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Development of a Measure of Knowledge: School-Based Professionals Knowledge of Traumatic Brain Injury

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DEVELOPMENT OF A MEASURE OF KNOWLEDGE: SCHOOL-BASED PROFESSIONALS KNOWLEDGE OF TRAUMATIC BRAIN INJURY

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ABSTRACT

DEVELOPMENT OF A MEASURE OF KNOWLEDGE: SCHOOL-BASED PROFESSIONALS KNOWLEDGE OF TRAUMATIC BRAIN INJURY

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The largest rise in traumatic brain injury (TBI) has occurred in adolescents ages ten to fourteen with a 143% increase followed by adolescents ages fifteen to nineteen with an 87% increase (Maier, 2016). School psychologists have a responsibility to continuously identify, locate, and evaluate all children with disabilities to ensure they receive timely interventions (Wright & Wright, 2007). As such, teachers and school psychologists may be among the first to recognize or regrettably not recognize symptoms of TBI. Therefore, it is important to better understand what teachers and school psychologists actually do know about TBIs and what misperceptions they may have. Having a good measure of knowledge of TBIs is important because professionals can use this information to improve educator and school psychologist's knowledge of TBIs, as well as use this information to guide changes in what is taught in graduate training programs. The purpose of this investigation was to develop a scale to measure school-based professional's knowledge of TBIs in the areas of symptoms, treatment, and long-term characteristics of TBIs. Overall, school-based professionals lack knowledge of TBIs across all domains. Although the predictors of TBI knowledge varied, it is possible that the lack of knowledge of TBIs may be due to the lack of research publications in the field, as well as the lack of graduate and post-graduate training opportunities on TBI. To enhance knowledge of TBIs, participants should increase their training on TBIs and learn

where to incorporate didactic and experiential learning opportunities to promote knowledge and skills in this area.

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Chapter I

Introduction

Statement of the Problem

Traumatic brain injuries (TBIs) are particularly harmful to children and adolescents, thus, appropriate and timely evaluation and response is critical. TBIs are a disruption in the normal function of the brain caused by a bump, blow, or jolt to the head or body with enough force causing the brain to move (Centers for Disease Control, 2018). Recently, from 2007 to 2014, there has been a 60% increase in TBIs with 29% of TBIs causing a loss of consciousness (Maier, 2016). The largest rise in TBIs has occurred in adolescents ages ten to fourteen with a 143% increase and in adolescents ages fifteen to nineteen with an 87% increase (Maier, 2016). In addition, nearly six percent of adolescents have reported being diagnosed with more than one concussion (Jochem, 2017). Unsurprisingly, individuals who participated in contact sports like football, ice hockey, and wrestling are more likely to report more than one TBI in their lifetime (Jochem, 2017).

While studies on children and adolescents with a TBI show that five percent visited specialty care, 12% visited an emergency department, and 82% visited primary care and, incidence estimates of pediatric TBI are primarily based on emergency department visits (Center for Disease Control and Prevention, 2018). Because many researchers solely take emergency department visits into account, many TBI visits to primary care, specialty care, or those who do not seek care at all go unreported (Center for Disease Control and Prevention, 2018). Therefore, prevalence rates are assumed to be higher than reported.

TBIs can impair neurological functioning, academic performance, executive functioning, and social behavior (Bohmann, 2007). This includes, but is not limited to, difficulties in memory, word retrieval, expressive language, physical strength and agility, and emotion regulation (Bohmann, 2007). Therefore, academic leaders should be capable of identifying these problematic symptoms (Bohmann, 2007). In the 2009-2010 academic year, national education statistics indicated that 25,000 students received special education services classified as a TBI diagnosis (Smith & Canto, 2015). The National Center for Education Statistics (2016) report an upward trend in the number of children served under the Individuals with Disabilities Education Act (2004) due to TBI. This is particularly important as school-based professionals, particularly teachers and school psychologists, are an important aspect of determining if students qualify for services, therefore, school-based professionals and staff must be knowledgeable about the student, as well as the TBI diagnosis symptoms and criteria (Bohmann, 2007). Even if special education services are not needed, students may need an accommodation plan, such as extra time or abbreviated assignments, to recover from a TBI (Bohmann, 2007). Additionally, school-based professionals can misinterpret social, emotional, or behavioral symptoms of TBI as an emotional disorder (Bohmann, 2007; Davies, 2016).

School psychologists have a responsibility to continuously identify, locate, and evaluate all children with disabilities to ensure they receive timely interventions (Wright & Wright, 2007). As such, teachers and school psychologists may be among the first to recognize symptoms of TBI. Therefore, it is important to measure what teachers and school psychologists actually do know about TBIs and what misperceptions they may have. Having a good measure of teacher and school psychologist's knowledge of TBIs

are important because professionals can use this information to improve teacher and school psychologist's knowledge of TBIs as well as use this information to guide changes in what is taught in graduate training programs. However, school-based professionals and school psychologists may lack knowledge of TBIs due to the fact that school psychology journals do not frequently publish information on how to identify and work with students with traumatic brain injuries (Canto & Pierson, 2015). As such, developing a measure to examine teachers and school psychologist's knowledge of TBIs would allow for a greater understanding of how to further research and enhance practice in this area.

Defining TBIs

TBIs, also known as concussions, occur due to a hit to the head that causes rotational acceleration-deceleration of the head and/or brain (Traumatic Brain Injury & Concussion, 2017; Wang, 2018)). This movement causes blood vessels within the brain to constrict due to an efflux of potassium and an influx of calcium (Collins, Kontos, Reynolds, Murawski, & Fu, 2014; Grady, Master, & Gioia, 2012). The constriction makes it difficult for blood to flow freely in the brain which hinders the ability to properly deliver nutrients such as glucose to the brain. This causes symptoms, such as appearing dazed or confused, being irritable, forgetful or appearing unsteady (Wilmott, 2013), to arise and inhibit individuals from engaging in physical and mental activities (Giza & Hovda, 2014).

In addition, the U.S. Department of Education included the classification of TBI in its list of eligibility categories for special education services, yet IDEA's definition of TBI focuses primarily on symptoms (Individuals with Disabilities Education Act, 2004). TBIs are defined by IDEA as:

> Traumatic brain injury is an acquired injury to the brain caused by an external force, resulting in total or partial functional disability or psychosocial impairment, or both, that adversely affects a child's educational performance. The term applies to open or closed head injuries resulting in impairments in one or more areas, such as cognition, language, memory, attention, reasoning, abstract thinking, judgment, problem-solving, sensory, perceptual and motor abilities, psychosocial behavior, physical functions, information processing, and speech. The term does not apply to brain injuries that are congenital or degenerative, or brain injuries induced by birth trauma (IDEA; Section 300.5).

Diagnosis and Symptoms

Because IDEA specifies symptoms in their definition of TBIs, it is imperative that teachers and school psychologists have knowledge of these symptoms. Often times, TBIs are not physically noticeable, so diagnosis is made based on symptoms in the physical, cognitive, and emotional domains combined. The primary symptom for a TBI diagnosis is confusion, which is characterized by the inability to maintain a coherent thought process, heightened distractibility, and the inability to carry out a specific sequence of movements ("Concussions," 2017). Others may report that an individual who sustains an TBI appears confused, answers questions slowly, repeats questions, can't recall events prior to the injury, shows behavior or personality changes, or forgets their class schedule or assignments (Giza & Hovda, 2014).

Cognitively, individuals suffering from TBIs may experience executive dysfunction, memory problems, diminished attention and impulse control, and processing speed (Davies, 2013). Individuals who have sustained a TBI may also experience

difficulties with expressing words or thoughts, dysarthria speech, or difficulties finding the right word to use in a sentence ("Concussions," 2017). Additional symptoms that may be present include, but are not limited to, prolonged headaches, vision disturbances, dizziness, nausea or vomiting, impaired balance, memory loss, ringing ears, difficulty remembering information, and difficulty concentrating ("Concussions", 2017). Sensory changes are also an indicator including changes in the ability to hear, taste, see, and hypersentivity to light or sound (Halstead et al., 2013). Sleep difficulties such as sleeping more or less than usual or having difficulty falling asleep can also occur due to a TBI. While some of the symptoms appear right away, others may not be noticeable for days or weeks after the impact occurs when the individual resumes their everyday activities (Traumatic Brain Injury & Concussion, 2017). However, 30-60% of children with mild TBI have symptoms that persist one month after the injury (Center for Disease Control and Prevention, 2018).

Report of Symptoms

It is even more beneficial to have teachers and school psychologists who are knowledgeable about how to identify and treat TBIs because many children and adolescents will not provide a self-report of their symptoms (Maier et al., 2015). Furthermore, as TBI identification relies heavily on self-report many TBIs go undiagnosed (Jochem, 2017). More specifically, recent studies have indicated that athletes commonly underreport TBI symptoms (Maier et al., 2015; Davies & Bird, 2015). As athletes are likely to sustain more than one TBI in their lifetime, this is concerning (Jochem, 2017). One study demonstrated that athletes significantly underreported somatic, psychiatric, and cognitive post-concussive symptoms up to a week after the TBI

(Maier et al., 2015). This is unsurprising as athletes are motivated to return to their sport as quickly as possible. However, athletes who underreported symptoms and who were cleared to play did not fully recovery and still had symptoms one week after their TBI. As students seek to participate in sports post-TBI as soon as possible, it is important that teachers and school psychologists help this process by facilitating identification and intervention. While little information is known about the prevalence of TBIs among adolescents in the United States, a recent study demonstrated that approximately 20% of Canadian adolescents have sustained a TBI (Veliz, McCabe, Eckner, & Schulenberg, 2017).

TBI in the Schools

School psychologists are responsible for the identification, classification, and intervention for children who sustain a TBI (Canto & Pierson, 2015). Fourteen percent of children with mild TBI need educational support services twelve months post-TBI (Center for Disease Control and Prevention, 2018) and sixty one percent of children with moderate to severe TBI experience a disability. Additionally, it is critical to ensure that students receive proper evidence-based accommodations in school (Bush & Burge, 2016). While immediate accommodations are needed, 14% of children who sustain a TBI need educational services twelve months later as well. Under a 504 Plan, students will receive modifications and accommodations to help a student return to their baseline performance levels. While the majority of students with a TBI will not require an IEP, students are eligible for an IEP if they require significant cognitive, physical and emotional support and modifications (Chesire, Buckley, Leach, Scott & Scott, 2015).

Impact and Recovery

While many individuals sustain TBIs, recovery time varies. Most individuals recover within 3-4 weeks (Collins et al., 2006). Part of the recovery process involves returning to school. Children and adolescents take part in the Return to Learn protocol to allow for appropriate and timely school re-entry (Master, Gioia, Leddy & Grady, 2012). According to the Return to Learn protocol, the initial step in the recovery plan is total physical and cognitive rest so their activity level is at a sub-symptom threshold (Return to Learn, n.d.). Physical rest means that individuals should not participate in any physical activity as physical activities magnifies existing symptoms and puts the individual at risk for a more serious TBI (Blefari, Hughes, Graves & Kegel, 2017). Cognitive rest means that the individual may not go to school and should avoid technology (video games, cell phone use, computer use etc.) as these engaging in technological activities make the brain work harder to process information and can exacerbate symptoms making recovery slower.

After engaging in physical and cognitive rest, the student can return to school when they are symptom free for 24 hours. When returning to school, students may receive cognitive rest accommodations which can include having a half-day of school, only attending core classes, having additional breaks when needed, having the teacher not give the student homework, and avoiding reading, video games, texting, and computer time. While cognitive rest is important, studies have shown that some light activities helps individuals maintain a regular schedule, manage their stress, and enhance their sub-symptoms threshold. These activities include yoga, light meditation, light stretching activities, and breathing exercises (Return to Learn, n.d.). Students with symptoms should

receive academic accommodations in a modified learning environment and should not engage in physical activity (Blefari et al., 2017).

There are general academic adjustments, cognitive/thinking academic adjustments, fatigue/physical academic adjustments and emotional academic adjustments that can be made (Blefari et al., 2017). General academic accommodations include adjusting a student's class schedule (alternate days, shortened days, abbreviated class, etc.), allowing no physical education class, allowing students to audit a class, allowing students to avoid noisy environments, and to remove/limit high-stakes projects (Blefari et al., 2017). Because processing speed, memory and concentration deficits put students with TBIs at a disadvantage for studying and completing assignments (Blefari et al., 2017).

Cognitive/thinking academic adjustments include reducing computer work, class assignments and homework assignments that are not essential, providing extended time to complete assignments/tests, allowing a student to demonstrate their understanding orally opposed to through writing, provide the student with written notes and instructions, and to potentially allow the use of notes for test taking.

Fatigue/physical academic adjustments include allowing the student to visit the school nurse when experiencing headaches or other symptoms, allowing strategic rest breaks throughout the day, allowing the student to wear sunglasses indoors to control for light sensitivity, allow the student to study in a quiet place, and provide the student with a quiet environment to take tests (Blefari et al., 2017).

Lastly, emotional academic adjustments include developing a plan to allow the student to discretely leave class to rest as needed, providing a quiet place to allow for de-

stimulation, and developing an emotional plan for the student such as identifying an adult for the student to walk with when they feel overwhelmed (Davies, n.d).

Teacher and School Psychologist's Knowledge of Psychological Disorders

While students can receive academic adjustments and accommodations for psychological disorders, studies show that teachers and school psychologists lack knowledge of variety of disorders such as autism, attention deficit hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and TBIs (Davies, 2013, Hart & More, 2013; Webb, 2017; Weyandt, Gulton, Schepman, Verdi & Wilson, 2009). Researchers developed or used published scales to measure teacher and school psychologist's knowledge of causes of the disorders, symptom identification, treatment plans, and misconceptions of the disorders (Davies, 2013, Hart & More, 2013; Webb, 2017; Weyandt et al., 2009). By understanding what teachers and school psychologists know about TBIs, future research can help encourage graduate training programs to educate school-based professionals more in this area.

These scales indicate that a number of teachers and school psychologists lack knowledge of these psychological disorders, Furthermore, these studies also show that teachers and school psychologists believe that they receive minimal to no preparation in terms of how to identify and intervene using evidence-based practices for them (Davies, 2013, Hart & More, 2013; Webb, 2017; Weyandt et al., 2009). Because teachers and school psychologist may have inadequate knowledge about psychological disorders such as autism, ADHD, ODD, they are unable to make appropriate accommodations and adjust their classroom to better help students with this disorder (Davies, 2013, Hart & More, 2013; Webb, 2017; Weyandt et al., 2009).

Overall, however, school psychologists demonstrated more knowledge compared to general and special education teachers when it came to certain disorders such as ADHD (Weyandt et al.,2009). School psychologists and teachers that graduated from their training programs more recently demonstrated more knowledge than professionals with more experience (Weyandt et al., 2009). Experience and recency of training may be important variables to consider when it comes to examining knowledge and application of that knowledge in practice.

Teacher and school psychologist's knowledge of TBIs are no different than their lack of knowledge for other psychological disorders. Teachers and school psychologists report their lack of knowledge is likely due to the fact that teachers and school psychologists are not adequately trained in understanding TBIs in their graduate programs (Davies, 2013). School psychologists report a large discrepancy in how well TBI was covered in their graduate training programs with some reporting that there was some instruction across different courses and some reporting no instruction at all (Davies, 2013). However, many school psychologists do not feel adequately trained in understanding TBIs in their graduate programs and do not feel prepared to educate and provide school personnel with resources on TBIs (Davies, 2013). This leads to the many misconceptions teachers and school psychologists have pertaining to TBI (Hooper, 2006).

Based on the lack of knowledge and misperceptions noted by teachers and school psychologists on various psychological disorders, researchers recommend additional training in order to effectively identify and intervene (Davies, 2013, Hart & More, 2013; Webb, 2017' Weyandt et al., 2009).

Implications for Practice

The lack of training on TBIs are an important finding for the practice of school psychology (Walk, 2011). Furthermore, the lack of training and knowledge likely limits teacher and school psychologists' ability to effectively identify and intervene with students who have sustained TBIs (Walk, 2011).

By developing a measure, Knowledge of Traumatic Brain Injury scale (K-TBI, Duhning & Terjesen, 2017), to examine teacher and school psychologist's knowledge of TBI, individuals can see what factors are predictive of increased knowledge. Factors include teacher and school psychologist exposure to TBIs, years of experience working with students who have sustained TBIs, the number of workshops they have attended on TBIs, and their exposure to learning about TBIs in their graduate school training etc. If specific factors are reliably identified to be effective predictors of knowledge than perhaps a more concerted effort to increase the opportunities of these factors in training and practice is warranted.

Teachers are in a good position to help identify and refer students with TBI as they see the students regularly and will likely notice changes in the norms. Additionally, school psychologists serve an important role in the identification and intervention process, as well as having the ability to inform teachers of their knowledge of TBI. Therefore, if knowledge of TBI, as measured by the K-TBI, is poor than it would be important to further research in this area, encourage graduate training programs to educate teachers and school psychologists on TBIs, and hold more workshops with the most up-to-date TBI information. This present study hopes to promote future research on TBI.

The Present Investigation

Based on the reviewed literature, this study addresses five main hypotheses with regard to teacher and school psychologist's knowledge of TBI.

As the pilot study (Duhning & Terjesen, 2017) demonstrated that the K-TBI is a reliable measure, after revising the scale items, it was hypothesized that:

1. The K-TBI scale and its subscales will be a reliable measure with high internal consistency and good test-retest reliability.

As research (Walk, 2011) has found that teachers and school psychologists do not have an understanding of TBI, it was hypothesized that:

2. Teachers and school psychologists will perform similarly on the K-TBI scale and demonstrate a lack of knowledge, less than 65% correct (Structure of U.S. Education System: U.S. Grading Systems, 2008).

As research (Davies, Sandlund, & Lopez, 2016) has found that school-based professionals who attended TBI trainings were better able to identify and consult on TBI cases, it was hypothesized that:

3. Teachers and school psychologists with a greater history of working with individuals who sustained TBIs will have more knowledge as measured by the K-TBI scale.

As research (Walk, 2011) has found that school-based professionals with more training in TBI have more knowledge of TBI, it is hypothesized that:

4. Teachers and school psychologists with more exposure to TBI (training hours and post-graduate workshops) will have more knowledge as measured by the K-TBI scale.

As Latouche and Gascoigne (2017) found that knowledge of ADHD symptoms/diagnosis and treatment was related to self-efficacy, it was hypothesized that:

5. Teachers and school psychologists with more self- efficacy for the identification and intervention of individuals with TBI will have more knowledge of TBIs as measured by the K-TBI.

Chapter II

Methods

Participants

For the purpose of this study, a minimum of approximately two hundred school-based professionals were desired for recruitment. Participants were recruited through social media websites including Facebook and LinkedIn via posts asking school-based professionals to complete an online questionnaire. This sample consisted of teachers and school psychologists in regular education and special education settings. The participating school-based professionals were state certified teachers and school psychologists and obtained at minimum a bachelor's degree. As TBIs are seen across all developmental levels, school-based professionals across the educational spectrum were recruited, from preschool through high school to obtain a representative sample.

Design and Procedure

A brief description of the study and informed consent (Appendix A) was sent to potential participants electronically. Participants were informed that they would be entered into a raffle to win one of three books about children and TBIs after completing of the questionnaire. Upon completion of the informed consent, participants were asked to complete the online questionnaire consisting of demographic questions related to their professional background and training (Appendix B) and the Knowledge of Traumatic Brain Injury in Schools measure (K-TBI, Duhning, Terjesen & Wellington, 2017; Appendix C). All participants were informed that the questionnaire was expected to take about 15-20 minutes to complete.

Measures

Demographic information. The first portion of the questionnaire addressed demographic information consisting of direct, multiple choice questions regarding the professional's level of degree and training, training in TBI, years of experience, client population and current employment status and site. Participants were also asked about their experiences working with students with TBI. This valuable demographic information provided by participants allowed researchers to analyze the collection of descriptive data of the sample and consider this information along with the remainder of the findings of the study.

Knowledge. The K-TBI scale (Duhning, Terjesen & Wellington, 2017) measured knowledge of TBI in three areas: symptoms/characteristics, treatment/intervention and long-term characteristics of the disorder. Computer searches were conducted using the following databases: Academic Search Premier (EBSCO), Educational Resources Information Center (ERIC) (EBSCO), PsychlNFO (EBSCO), Ebook academic selection (EBSCO) Medline (EBSCO), ProQuest Psychology Journals, and ProQuest Dissertation & Theses to develop items for the K-TBI. The original thirty-six items were piloted among thirty-five school based professionals. Results of the pilot study indicated that the K-TBI had a high internal consistency (a=.83). Teachers and school psychologists demonstrated a lack of knowledge and training on TBIs as measured by the K-TBI as participants only scored correctly on fifty nine percent of the items.

Following the pilot study, the original K-TBI items were revised based on expert feedback. Experts were defined as individuals who have either published multiple scientific articles on TBI, have served on the TBI advisory board, or are practicing

psychologists or medical doctors in the U.S who have listed their specialty area as TBI. Experts' feedback was only considered if they rated their current level of expertise (knowledge and understanding) of the current science behind TBIs an eight or higher out of 10. Experts gave feedback on the original form of the items, with the option of providing feedback on each item. The 30 items with the greatest consensus among TBI experts were the ones chosen to be a part of the revised K-TBI scale. This version was given to school-based professionals to measure their knowledge of TBI and the instrument requires participants to respond, "True," "False," or "Not Sure," to each statement. The "Not Sure" option ensures that responses are not based on a 50-50 chance of guessing the correct answer.

The reliability and validity of the K-TBI was also examined. Internal consistency of the measure was calculated using Cronbach's alpha. To examine test-retest reliability, participants completed the initial survey and then a sub-sample was randomly selected to indicate interest to retake the survey in a month in return for a ten dollar gift card.

Validity was measured through numerous approaches. The K-TBI had already established face validity by experts deciding on whether or not the items represented the TBI content the way that they were intended. Concurrent validity of TBI knowledge cannot be examined as there are no measures of TBI normed on professionals and no measures with psychometrics could be found after conducting an extensive literature review and asking concussion experts (Cournoyer & Tripp, 2014; Dreer, Crowley, Cash, O'Neill, & Cox, 2017; Lin, Salzman, Bachman, Burke, Zaslow, Piasek, et al., 2015; Register-Mihalik, Guskiewicz, McLeod Linnan, Mueller, & Marshall, 2013; Rosenbaum & Arnett, 2010; Wallace, Covassin, Nogle, Gould, & Kovan, 2017). Lastly,

discriminative validity was examined by asking members of the Brain Injury Association of America group and asking those who have published multiple TBI articles to complete the K-TBI to see if they score higher than school-based professional participants.

Efficacy. Professional's perceived efficacy regarding identifying TBIs and intervening with individuals with TBIs was assessed via two additional questions at the end of the survey. These questions asked participants to rate on a 7-point Likert scale how much they agree with the statements, "I feel I can effectively identify a child with TBI" and "I feel I can effectively intervene and help a child who sustained TBI" (1= Not at all True to 7 = Completely True).

Pilot Analysis

A pilot study that consisted of 150 school-based professionals averaging 40.39 years of age (*SD* = 13.80) was completed to provide some preliminary feedback on the measure. Sixty five percent (*n* = 92) reported that they were employed as a teacher, nineteen percent were employed as a school psychologist (*n* = 27), and five percent were employed as a school counselor (*n* = 7). In terms of degree level, three percent (*n* = 4) earned a doctoral degree, 24 percent earned a specialist degree (*n* = 34), 58 percent earned a master's degree (*n* = 82), and 13 percent earned a bachelor's degree (*n* = 18).

A pilot analysis of the K-TBI demonstrated good reliability as the overall internal consistency of the K-TBI was high (*a* = .86). The Symptoms/Characteristics subscale consisted of 13 items (*a* = .77, the Treatment subscale consisted of seven items (*a* = .59), and the Long-Term Characteristics subscale consisted of 10 items (*a* = .71).

Pilot results also demonstrated a lack of teacher and school psychologist knowledge and training on TBIs. The data showed that participants only scored correctly

on 60 percent of the items (M = 18.01, SD = 5.57). Participants scored a 59 percent on the Symptoms/Characteristics subscale (M = 7.65, SD = 2.63), a 58 percent on the Treatment subscale (M = 4.08, SD = 1.67), and a 63 percent on the Long-Term Characteristics subscale (M = 6.28, SD = 2.24).

To further examine participant's knowledge, training, and experience level with TBIs, a series of Pearson Product Moment Correlations were conducted. Results indicated that length of time since graduation was not significantly related to overall knowledge of TBIs (r (139) = -.059, p = .488). Results also indicated that there was a significant difference in overall knowledge of TBIs with those who attended workshops or training programs on TBIs having more knowledge (t (146) = .2.26, p = .025), yet only 22.7% of participants indicated that they have attended a workshop or training program on TBIs (n = 34). This finding is consistent with previous studies indicating that most school psychologists receive little to no training on TBIs (Doran-Myers, 2011). This is concerning as 42% of participants had a history of working with children or adolescents who have sustained a TBI (n = 63).

Lastly, there was a significant correlation between overall knowledge and self-efficacy in identifying a TBI (r (146) = .478, $p < .01$), as well as a significant correlation between overall knowledge and self-efficacy when intervening with children or adolescents who have sustained a TBI (r (.148) = .476, $p < .01$).

Chapter III:

Results

All statistical analyses were conducted using IBM SPSS Statistics software version 26 to examine the demographic data, test all hypotheses, and look further into the reliability and validity of the K-TBI. An alpha level of .05 was used for all statistical tests unless otherwise noted.

Preliminary data analysis. Prior to analyzing the data for this study, several steps were taken to prepare the final data set. Out of the 433 participants that began participating in the study, 12 participants were removed from the data set due to not answering at least half of the items on the K-TBI measure. Therefore, the sample was then 421 participants. Missing data was handled with mean imputation for the K-TBI participant scores; missing values were imputed with the mean of the variable on the basis of the non-missing values for that variable (Little & Rubin, 2019). Five items had one missing participant. Four items had two missing participants. Two items had four missing participants. One item had five missing participants. One item had six missing participants. One item had nine missing participants. One item had fifteen missing participants. After the mean imputation was completed to address the missing data, there were 407 participants with complete data and the mean of these participants' K-TBI scores replaced the missing data.

Descriptive data of the sample. Complete demographic information for the sample is shown in Table 1. Four hundred and twenty-one school-based professionals averaging 36.92 years of age (SD = 9.71) participated in this study. Ninety one percent of the participants were female (n = 384) and the majority of participants reported being

Caucasian (n = 360). Forty seven percent of the participants reported that they possessed a master's degree (n = 199), whereas thirty one percent obtained a specialist or doctoral degree. The majority of participants in this sample consisted of teachers (n = 273) and school psychologists (n = 118) with few participants being part of an allied mental health profession (n = 8). Allied mental health professionals included social workers, director of special education, and chairpersons on the Committee of Special Education.

Knowledge of TBIs. Complete knowledge scores for the sample are shown in Table 3. In order to calculate the total and subscale K-TBI scores, correct true/false responses were coded as one and incorrect answers as 0. Participants responses' of "not sure" were also coded as zero indicating an incorrect response, but allowed researchers to exam misconceptions which will be discussed below. Overall**, r**esults support the hypothesis that school-based professionals lack knowledge and training on TBIs as participants scored less than a 65% correct (Structure of U.S. Education System: U.S. Grading Systems, 2008). In fact, the data show that participants only scored correctly on fifty three percent of the items (M = 15.88, SD = 6.36). There was not much variability across subscales of the knowledge measure as participants lacked knowledge across all areas. Participants scored a fifty three percent on the Symptoms/Characteristics subscale (M = 6.91 out of 10, SD = 3.02), a fifty percent on the Treatment subscale (M = 3.47 out of 7, SD = 1.82), and a fifty four percent on the Long-term Characteristics subscale (M = 5.36 out of 10, SD = 2.52).

Although results revealed a lack of knowledge overall across all participants, a one way ANOVA demonstrated significant differences in TBI knowledge between teachers, school psychologists, and allied mental health professions [$F(2, 404) = 5.58$, p

< .01]. A Bonferroni post-hoc indicated that the three professions were significantly different from each other. Those in a psychology profession scored the highest (M = 17.54, SD = 5.16) and significantly differed from teachers (M = 15.24, SD = 7.24). Although not significantly different from teachers and psychologists, allied mental health professionals performed the worst (M = 12.29, SD = 6.99). Although school psychologists demonstrated the most knowledge of TBIs, school psychologists, teachers and allied mental health professionals all have poor knowledge of TBIs. The data show significant differences between teachers, school psychologists, and allied mental health professionals on the Symptoms subscale [F (2, 404) = 5.39, p < .01] with psychologists demonstrating the most knowledge (M = 6.65, SD = 2.26), which significantly differed from teacher (M = 6.65, SD = 3.23). Allied mental health professionals did not significantly differ (M = 5.38, SD = 4.03), which is likely due to a small sample size (n = 8). The post hoc for the Treatment [F (2, 404) = 3.57, p < .03] and Long Term characteristics [F (2, 404) = 3.73, p < .03] were not significant.

Misconceptions about TBIs. The true-false- don't know format of the K-TBI allows for differentiation between a lack of information ("don't know" responses) from common misperceptions about TBIs (incorrect responses). More than twenty five percent of participants answered five items on the K-TBI incorrectly indicating misperceptions. However, on eight items, over fifty percent of participants indicated 'not sure' responses (items that participants admitted to not knowing) indicating an evident lack of knowledge. The items with the highest incorrect responses (misconceptions) and highest 'not sure' responses (lack of knowledge) were noted across all domains: symptoms, treatment, and long-term characteristics.

TBI Background and Knowledge. Complete background and experience information for the sample is shown in Table 2. In regard to TBIs, participants reported that they lack training in this area. As a whole, school-based professionals reported only being exposed to TBI training for 5.30 hours on average after their graduate training program, although there was significant variability (*SD* = 15.05). On average, participants only received 3.69 hours (*SD* = 12.44) of formal education on TBIs with a large amount of variability, and only thirty-six participants reported attending a workshop on TBIs. School-based participants reported that they have only read 4.01 books or articles on TBIs on average (*SD* = 6.83), which is an issue as the data also show that knowledge of TBI was found to be positively related to the number of books and articles that participants read on TBIs and overall knowledge of TBIs (r (286) = .247, $p < .01$). Furthermore, an ANOVA demonstrated significant differences in the number of books or articles read between teachers, school psychologists, and allied mental health professionals [F (2, 283) = 5.23, $p < .01$). A Bonferroni post hoc demonstrated that psychologists have read almost double the reading material on TBIs (*M* = 6.21, *SD* = 8.35) in comparison to teachers (*M* = 3.29, *SD* = .97), but allied mental health professionals did not differ from either group (*M* = 1.67, *SD* = 1.53). This is likely due to the small sample number of participants in the allied mental health professionals group (*n* = 8). In addition, school based professionals only reported working with 2.32 students (*SD* = 7.89) who have sustained a TBI, which is very low.

Table 4 shows the complete series of Pearson correlations ($a = .05$, two-tailed) that were used to explore the relationships between participant's knowledge of TBIs with various background characteristics. However, knowledge of TBIs, as measured by the K-

TBI, was unrelated to various characteristics including hours of graduate training on TBIs and having a history of working with children who have sustained TBIs (p's > .05). Of note, the number of participants who reported having a history of working with children who sustained a TBI may have been higher if the question was worded as having experience with teaching children who sustained a TBI.

Efficacy. Just like the experts, school-based professionals were also asked to rate on a scale of 1 (not at all) to 5 (completely true) their perceived self-efficacy to identify and intervene with a child who has sustained a TBI. Unsurprisingly, due to the lack of training and experience participants have with TBIs, participants reported that they do not feel very confident in identifying (M = 1.68, SD = .88) or intervening. Although all participants lack confidence, an ANOVA indicated a significant difference in self-efficacy when identifying a child with a TBI [F (2, 355) = 16.04, p < .01] and when intervening with a child with a TBI [F (2, 234) = 4.37, p < .01]. A Bonferroni test indicated that school psychologists feel significantly more confident (M = 2.09, SD = .94) than teachers (M = 1.53, SD = .79) in identifying a child with a TBI, but allied mental health professionals did not differ from either group (M = 1.43, SD = 1.27). Similarly, psychologists are also significantly more confident (M = *2.18,* SD = .96) than teachers (M = 1.86, SD .97), but mental health professionals did not differ from either group (M = 1.57, SD = .98).

Lastly, there was a significant correlation between overall knowledge and school based professions self-efficacy in identifying a TBI (r (358) = .217, p < .01), as well as a significant correlation between overall knowledge and self-efficacy when intervening with children or adolescents who have sustained a TBI (r (357) = .220, p < .01). This is

an issue considering participants are somewhat confident in their abilities to identify and intervene with students with a TBI, yet their knowledge of TBIs is poor.

Overall, in regards to the development of the K-TBI measure, the data show that the K-TBI is an internally consistent measure of school-based professionals' knowledge of TBIs. Data examining face validity, discriminative validity, and test-retest reliability indicate that the K-TBI is a valid and reliable measure. An EFA yielded eight interpretable factors which accounted for different amounts of variance, but primarily load on the first factor, which was cognitive and mood symptoms and services as a result of TBI. Results indicate that school-based professionals lack knowledge and training on TBIs. Teachers, school psychologists and allied mental health professionals report little TBI exposure in their graduate training program, reading minimal articles on TBIs, and attending little to no workshops.

Descriptive Statistics for the K-TBI. Descriptive statistics and alpha coefficients for the K-TBI are presented in Table 3. The high overall alpha coefficient for the K-TBI total score indicates that the K-TBI is an internally consistent measure of school-based professionals' knowledge of TBIs (a = .90). In addition, each of the subscales demonstrate acceptable to high internally consistency (a = .64 - .80). Each of the K-TBI subscales correlated highly with the K-TBI total score (range r = .76 to r = .92), but this was expected as the subscale items make up the total score. There was some degree of intercorrelation among the three K-TBI subscales (range r = .60 to r = .74). These correlations are not too high because knowledge in one area of TBIs is likely related to participant's knowledge in other areas. If a participant is unknowledgeable about TBIs as

a whole, they likely will perform similarly on each subscale as they lack knowledge in each area.

Reliability and Validity of the K-TBI. Previously, face validity was established before the pilot study through expert consensus where experts concluded that the K-TBI items represent TBI content the way that it was intended. To examine discriminative validity, a new sample consisting of an additional fifteen TBI experts who have published multiple articles on TBIs or who are a part of the Brain Injury Association of New York completed the K-TBI. The experts consisted of eights females and seven males, and primarily identified as Caucasian (n =14). Experts averaged 46.40 years of age (SD = 13.33) ranging from 27 to 69 years old. The majority of participants earned their doctoral degree (n = 8) or their medical degree (n = 4). Experts earned degrees in various areas including clinical neuropsychology, rehabilitation counseling, occupational therapy, pediatric neurology, etc. Currently, these expert participants work as clinical neuropsychologists, occupational therapists, physical therapists, and in neurology rehabilitation centers across seven different states. Please see Table 5 for complete expert demographic information.

Expert participants scored correctly on seventy-two percent of the items on the K-TBI demonstrating a lack of knowledge on TBI (M = 21.73, SD = 2.76). Expert participants scored a seventy eight percent on the Symptoms/Characteristics subscale with thirteen items (M = 10.13, SD = 1.55), a sixty six percent on the Treatment subscale with seven items (M = 4.60, SD = 1.40), and a seventy percent on the Long-term Characteristics subscale with ten items (M = 7.00, SD = 1.07). While experts demonstrated greater knowledge of TBIs in comparison to school-based professionals,

revisions still need to be made to the K-TBI as the poor response by experts is a concern. Despite variability in responses, experts reported that they have received significant hours of training on TBIs (M = 836.33, SD = 1753.70) and have experience working with many individuals who have sustained a TBI (M = 493.33, SD = 513.35). Experts were also asked to rate on a scale of 1 (not at all) to 5 (completely true) their perceived self-efficacy to identify and intervene with a child who has sustained a TBI also reported high levels of efficacy when it comes to effectively identifying (M = 4.33, SD =1.11) and intervening (M = 4.47, SD = .64) with children who have sustained a TBI. Please see table 6 for complete expert experience and background information.

There was a significant difference in TBI knowledge between TBI experts, teachers, school psychologists, and allied mental health professionals on the overall K-TBI scale [F (3, 372) = 7.61, $p < .01$], the Symptoms/Characteristics subscale [F (3, 394) = 9.10, $p < .01$], the Treatment subscale [F (3, 410) = 4.24, $p < .01$], and the Long-term Characteristics subscale [F (3, 391) = 4.53, $p < .01$]. In regards to K-TBI total scores, a Scheffe post hoc comparison demonstrated that experts have the most TBI knowledge and significantly differed from all school-based professionals, p = .03. Overall, the experts still performed better than non-experts.

Next, I examined test-retest reliability of the K-TBI after a one month period using a sub-sample of the school-based professional population. After collecting data from all participants, every tenth participant was asked to complete the K-TBI a second time. The data show excellent test-retest reliability for the overall K-TBI scale (r(34) = .878, $p < .01$) as well as good test-retest reliability for all three subscales:

Symptoms/characteristics subscale ($r(36) = .724$, $p < .01$), the treatment subscale ($r(38) = .877$, $p < .01$) and the long term characteristics subscale ($r(36) = .843$, $p < .01$).

K-TBI Factor Structure. An exploratory factor analysis (EFA) was used to determine if there were a small number of core factors underlying the participant's knowledge of TBIs. Guilford (1954) recommended a minimum of 200 participants when examining factor structure and, therefore, our 407 participants were sufficient. Principal components extraction was used prior to factor analysis to estimate the number of factors, presence of variable outliers, absence of multicollinearity and singularity, and factorability of the correlation matrix. Eight factors were extracted using the principal component analysis and were then rotated using a Varimax rotation procedure. The factor loadings yielded six interpretable factors (Table 7) which accounted for different amounts of the item variance (Table 8). The factors with the most to least variance are as follows: Cognitive and mood disorder symptoms and services, damage and changes to the brain, risk and return to activities, behavior/motor skills, resolving symptoms and receiving services, and research findings/TBI classifications. Two items did not fall under a specific factor. In addition, although interpretable, the factors yielded by the EFA did not align with the three factors/subscales originally developed, symptoms/characteristics, treatment, and long-term characteristics.

Chapter IV:

Discussion

The current findings provide insight regarding teacher and school psychologist's knowledge of TBI. This study also sought to examine the reliability and validity of the K-TBI measure.

Psychometrics of the K-TBI. The K-TBI scale and its subscales are reliable with high internal consistency and good test-retest reliability. Despite adequate reliability across subscales, having less items on the treatment subscale may be a factor for the lower reliability in comparison to the symptom and long term characteristics subscales (Abdelmoula, Chakroun, Akrout, 2015). The significant difference found between school-based professionals and TBI experts further supports that validity of this measure. While previous researchers have developed questionnaires that examine TBI knowledge, researchers either did not examine the psychometrics of the scale, had poor psychometrics, or were normed on non-professionals such as sports coaches, athletes, etc. (Cournoyer & Tripp, 2014; Dreer et al., 2017; Lin et al., 2015; Register-Mihalik et al., 2013; Rosenbaum & Arnett, 2010; Wallce, Covassin, Nogle, Gould, & Kovan, 2017). Therefore, these findings are a stepping stone in the development of a measure of TBI for school-based professionals as no previous psychometrically sound measures exist.

Results of the EFA demonstrate that the K-TBI has six factors, which do not specifically align with our originally proposed three subscales. However, school-based professionals demonstrated low TBI knowledge scores with a lack of variability across areas including symptoms/characteristics, treatment, and long term characteristics. The lack of distinct factors may be a function of having minimal variability across different

areas; individuals who lack knowledge in one area likely lacks knowledge in another area. These results are consistent with current research on TBIs and other disorders such as ADHD, which demonstrate that individuals who lack knowledge in one area likely lack knowledge in another area of the disorder (Alkahtani, 2013; Ettel, Glang, Todis, & Davies, 2016; Glang et al., 2017).

TBI Knowledge. Results are consistent with the pilot study and continue to support the hypothesis that school based professionals lack knowledge of TBI. Although school psychologists demonstrated the most knowledge, school psychologists, teachers, and allied mental health professionals demonstrated low and poor knowledge of TBI as measured by the K-TBI. Although using measures that have not yet been validated, the finding that school-based professionals have poor knowledge is consistent with previous research School-based professionals are front line individuals who interact with students on a regular basis meaning they are in the unique position of being able to detect changes in behavior, and academic performance given the tools to do so (Bohmann, 2007). School-based professionals should have the knowledge to identify impairments in neurological functioning, academic performance, executive functioning, and social behavior. It is also imperative that school based professionals are knowledgeable about TBIs because they must be able to collaborate with family members and medical personnel in order to facilitate identification and intervention. Lack of knowledge leads to a lack of communication among personnel which can hinder a student's progress and, furthermore, is a primary reason for parents' dissatisfaction with school services (Gfroerer, Wade, & Wu, 2008; Glang, Tyler, Pearson, Todis, & Morvant, 2004).

However, our results fill a gap in the literature by demonstrating that teachers and school psychologists have inadequate knowledge and lack training on TBIs. This is problematic when there are students that could benefit from identification and subsequent interventions. In addition, teachers and school psychologists have similar amounts of TBI knowledge overall. Without sufficient TBI knowledge, students may not receive intervention at all, let alone intervention in a timely manner. Even though Chesire et al., (2015) reported that most students will not require an IEP for services, teachers and school-based professionals may still be able to provide evidence-based cognitive, physical, and emotional modifications if they see that a student is struggling. Because school psychologists have slightly more knowledge in comparison to teachers and other allied mental health professionals, school psychologists should take the initiative to increase their own knowledge and subsequently hold workshops to educate other school-based professionals.

Because the degree of TBI education in graduate training programs greatly differs, but is minimal across the board, faculty members and administration should collaborate on how to incorporate specific TBI training into the curriculum. The knowledge gap on TBI would be greatly diminished if there was more consistency in the education of TBI across training programs. Given the amount of overlap between manifestations of TBI and other learning disabilities or emotional/behavioral disorders, training on TBI is important in order to differentiate TBIs from other disorders (Glang et al., 2017). The issue lies in graduate training programs because if school-based professionals are not educated on TBIs then they are unable to inform others who interact with children who have sustained a TBI such as physical therapists, occupational

therapists, speech therapists, sports coaches, tutors, etc. (Glang et al., 2017). In particular, school psychologists are the gatekeepers for special education services and are in a unique position to improve the identification and intervention services for students with TBI (Glang et al., 2017).

Lastly, although knowledge for all groups across all three subscales was poor, school-based professionals have the most knowledge of symptoms followed by long term characteristics and treatment respectively. This shows that school based professionals may be able to identify TBI symptoms, but are unsure of how to intervene with students and do not know of the long-term impact of TBI. Despite having the most knowledge of symptoms, participants still have poor knowledge and need further education in order to reduce the chances of misdiagnosis as TBI symptomology is similar to symptoms of other disorders (Glang et al., 2017). In addition, many participants indicated the 'not sure' response for many items; this furthers the point that, although there are some misconceptions about TBIs, there is a significant lack of knowledge that is recognized by school-based professionals. However, because TBI experts also demonstrated poor knowledge of TBIs, more revisions to the K-TBI measure are needed.

Training and Exposure to TBIs. The current study examined the different ways that school-based professionals could be exposed to TBI information**.** Overall knowledge of TBIs, as measured by the K-TBI, was unrelated to hours of graduate training on TBIs. Results may have demonstrated a lack of relationship; however, this may be due to the fact that 47% of participations have received no graduate training on TBI at all, with 92% reporting receiving less than 10 hours total of graduate training. This is consistent with previous research which found a large discrepancy in how well TBI was covered in their

graduate training program (Davies, 2015). These findings have important implications for graduate training programs in identifying the specific gaps in knowledge that need to be addressed within the coursework. Teachers and school psychologists are required to meet the needs of diverse students with varying abilities, but they lack the graduate training to do so. Consistent with prior research which found that 12% of school psychology faculty received no coursework on TBIs in their graduate programs, participants in this current study also demonstrated an extreme lack of formal education on TBIs within their graduate training program. Furthermore, if faculty members are not trained on TBIs, they are unable to educate others including students, coworkers, and other professionals. Because teachers are considered an important part of the multidisciplinary school-based team, it's imperative for teachers to have knowledge about TBIs as teachers have the most exposure to children. Because symptoms are likely to be more potent in school, where the cognitive demand is high, teachers need to be able to accurately identify these symptoms in order to refer the student to the school psychologist for further evaluation.

Even post-graduation, only nine percent of participants attended a continuing education workshop on TBI. Post-graduation, teachers and school psychologists can take the initiative to set up workshops and training for other school-based professionals. Many schools throughout the United States are beginning to appoint a concussion team school leader (Davies, 2016). Because the types of continuing education opportunities significantly vary, teachers and school psychologists may need encouragement to attend a topic they are more unfamiliar with like TBI (Hux, Bush, Evans & Simanek, 2013), although, attendance is important as research indicates that workshops effectively increase TBI knowledge (Davies & Ray, 2014; Syed & Hussein, 2010). Previous research

also found that online concussion training is just as effective as face-to-face training, which is an additional cost and time-efficient way to increase knowledge (Davies & Tedesco, 2018). Overall, this lack of knowledge and TBI training is key for graduate training programs as well as continuing education workshops as all practitioners need to have the most up to date information.

Exposure to TBI was also examined by looking at the number of articles or books that participants have read on TBIs. While participants only read approximately four books on average, school-based professionals who read more about TBI had more knowledge of TBI as demonstrated by their score on the K-TBI. Although allied mental health professionals did not differ from teachers and school psychologists in the number of books/articles read, this is likely due to the small number of participants in the allied mental health professionals group (Rusticus & Lovato, 2014). The link between knowledge and exposure to information through literature, graduate training, or workshops is consistent with previous research on psychological disorders (Scuitto et al., 2016). This lack of TBI reading may also reflect the fact that school psychology journals do not publish enough information on working with students with TBIs (Canto & Pierson, 2015). This is consistent with previous research which found that less than one percent of articles in eight school psychology journals were related to TBI over the course of almost thirty years (Smith & Canto, 2015). Because the TBI incidence rate continues to increase, peer-reviewed journals should add to school-based professionals' knowledge by focusing on the pertinent issues as they relate to TBIs.

Surprisingly, knowledge of TBIs was not significantly related to having a history of working with child who have sustained a TBI. This is inconsistent with the results of

the pilot study as well as previous research which indicates that exposure to or experience working with individuals with a psychological disorder (i.e., ADHD) is related to knowledge (Anderson, Watt, Noble, Shanley, 2012; Scuitto, 2015). This may be due to a lack of exposure to students with TBI as 49% of participants reported never working with a student with a TBI and 95% reporting working with less than five students with a TBI. While school-based professionals are reporting a low frequency of working with this population, this may also be due to a lack of knowledge and not being able to recognize the correct symptoms.

Perceived Efficacy. Results support the hypothesis that teachers and school psychologists with more self-efficacy for the identification and intervention of individuals with TBI have more knowledge of TBI as measured by the K-TBI. Although the data indicates that higher self-efficacy ratings is related to higher K-TBI scores, school-based professionals are on average reporting that it is only "somewhat true" that they can "effectively identify a child with mTBI" and "effectively intervene and help a child who sustained mTBI." Therefore, if we increase knowledge of TBIs, perceived self-efficacy should also increase. This is consistent with research on other diagnoses which found that knowledge is related to confidence and efficacy (Alkahtani, 2013, Pascal Latouche, & Gascoigne, 2017). Because knowledge of TBI is poor, efficacy is also likely to be low which results in significant implications for accurate and appropriate identification and intervention.

Limitations of the Present Investigation

Although the present study holds promise in facilitating research examining school-based professionals' knowledge of TBI, it had limitations that warrant mention.

First, given the number of factors yielded by the EFA, researchers should reevaluate the items that make up each subscale to ensure that they measure what they intend to.

While attempts were made to conduct this research with a sound methodology, participants were primarily recruited through social media groups (King, O'Rourke, & DeLongis, 2014). While this convenience sampling allowed me to recruit a large pool of participants across the country, it was difficult to prevent participants from ultimately sharing the link independently although the anonymous link was distributed to the group. Next, the criteria used to recruit TBI experts for discriminative validity purposes was too vague and it would have been useful to look further into the quantity and quality of their publications before defining them as experts. If we had more information about their background and specific TBI research interests, it could have aided in the interpretation of expert responses. However, exploratory item analyses indicated that more than seventy five percent of experts and school based professionals scored incorrectly on three K-TBI items so these items will be revised for subsequent versions of the measure. For example, the wording and scope of the items of the K-TBI could be further evaluated by a greater number of experts to ensure that the items fully capture the full range of TBI. Irrespective of these limitations, however, these findings highlight the need to increase school-based professionals' knowledge of TBI.

Chapter V

Implications of the Results for Practice

The lack of school-based professionals' knowledge of TBI is an important implication for the field of school psychology. NASP's vision and core purpose reflects the importance of promoting learning, behavior, and mental health of all children and youth (Firmin, DeWitt, Smith, Ellis, & Tiffan, 2018). However, it is difficult to identify and implement interventions to assist these children when there is a knowledge deficit. Furthermore, the results of this study demonstrate that teachers and school psychologists lack training and education in this area and, therefore, do not have an adequate understanding of TBIs. It is imperative that graduate training programs educate future school-based professionals on TBIs to ensure accurate and timely identification and intervention. Graduate training programs should focus on explicitly incorporating information on TBI symptomology, treatment, and long-term characteristics of TBI into their coursework.

It is also important for school-based professionals to stay up to date and engage in professional development activities post-graduation through activities such as workshops, conference attendance, and reading recent research publications. While teachers and school psychologists are expected to implement evidence based practices, the lack of publications on TBIs in school psychology journals does not aid in the professional development process. Because school psychologists are viewed as academic leaders and have slightly more knowledge than other school-based professionals, school psychologists should take the initiative to increase their own knowledge and subsequently hold workshops to educate other school-based professionals. In addition, increasing

knowledge of TBIs also enhances self-efficacy allowing school-based professionals to feel more confident in their identification and intervention abilities.

Based on these results, researchers can focus on revising and finalizing the K-TBI measure. Overall, this data has important implications for graduate training programs, continuing education, and in identifying specific knowledge gaps that need to be addressed with school-based professionals.

Appendix A:
Recruitment Letter

Dear Educator/Practitioner,

My name is Courtney Duhning, and I am a doctoral candidate in the School Psychology Doctoral Program at St. John's University. As part of my graduate studies, which is under the direction of Dr. Mark Terjesen, I am conducting a study to investigate knowledge and practices of neurological injuries in adolescents.

Your cooperation and honest responses in completing the questionnaires are earnestly appreciated and will help increase knowledge in this area. If you decide to take part in this study, your participation will involve answering a questionnaire that should take 15-20 minutes. **After completion of the surveys, you may choose to enter a raffle for a chance to win one of three $50 American Express gift cards.**

Your participation in this study is completely voluntary and your responses will remain confidential.

If you would like to participate in this study, please click on the following link or cut and paste it into your browser. This link will bring you to the questionnaires. By completing the survey online and using the link provided, you are providing your consent for participation in this study. If you would like a summary of the findings or have any questions, you may contact Courtney Duhning at courtney.duhning16@stjohns.edu. You can also reach Dr. Mark Terjesen at 718-990-5860 or terjesem@stjohns.edu. I thank you in advance for your valued time and cooperation.

Sincerely,
Courtney Duhning
Doctoral Candidate

Appendix B:
Consent Form

You have been invited to take part in a research study to learn more about knowledge and practices of neurological injuries among school based professionals and graduate students. This study will be conducted by Courtney Duhning, a doctoral student of psychology at St. John's University, as part of her doctoral dissertation. Her faculty sponsor is Mark Terjesen, Ph.D., director of the Doctor of Psychology Program in School Psychology, St. John's University.

Your participation in this study is completely voluntary. You may refuse to participate, refuse to respond to specific items, or terminate your participation at any time during the study. There are no risks anticipated and your participation may help increase knowledge in this area. If you have any questions, you may contact one of the principal investigators.

If you decide to take part in this study, your participation will involve answering basic questions about your professional background. You will then be presented with a questionnaire regarding information about neurological injuries. The estimated participation time of this part of the study is 15 – 20 minutes. **After completion of the surveys, you will be provided with a link to enter a raffle for a chance to win one of three $50 American Express gift cards.**

Completion of the following questionnaires will be an indication of consent to participate. It is recommended that you print a copy of this consent form and keep it for your records I thank you in advance for your valued time and cooperation.

If you would like a summary of the findings or have any questions, you may contact Courtney Duhning at (631) 707-3257 or Courtney.duhning16@stjohns.edu. You can also reach Dr. Mark Terjesen at 718-990-5860 or terjesem@stjohns.edu. For questions about your rights as a research participant, you may contact Dr. Raymond DiGiuseppe, Chair of the University's Human Subjects Review Board, St. John's University, 718-990-1440.

Appendix C:
Demographic Information

Please answer all questions

1. What is your gender?
   Male
   Female

2. How old are you?

3. Please select the race/ethnicity group that you identify with.
   American Indian/Alaskan Native
   Asian
   Black or African American
   Caucasian
   Native Hawaiian or Other Pacific Islander
   Hispanic/Latino
   Other: _____
   I prefer not to answer this question

4. Please Indicate the highest degree that you have earned
   Bachelor's Degree in _____
   Master's Degree (30+ credits) in _____
   Specialist Degree (60+ credits) in _____
   Doctoral Degree (Ph.D) in _____
   Doctoral Degree (Psy.D) in _____
   Doctoral Degree (Ed.D) in _____
   Medical Degree (MD) in _____
   Other: _____

5. What state did you earn your highest degree in?

6. How many years ago did you graduate from your graduate/training program?
   _____
   Still training
   Less than one year

7. If still training, how many credits have you completed thus far?

8. What is your current primary job title?
   - Assistant Professor
   - Associate Professor
   - Billingual School Psychologist
   - Chairperson Committee on Preschool Special Education
   - Chairperson Committee on Special Education
   - Director of Special Education
   - Graduate Student
   - Intern
   - Medical Doctor
   - Professor
   - Psychologist
   - School Counselor
   - School Psychologist
   - Teacher
   - Other: _____

9. Are you currently employed as an educator/school psychologist in either private or public school?
   - Private School
   - Public School
   - Neither

10. Please select your PRIMARY employment setting:
   - Clinic
   - Public School
   - Private School
   - Hospital
   - Private Practice
   - University/College
   - University/College Center for Psychological Services
   - In-patient treatment center
   - Out-patient treatment center
   - Other _____

11. In what state(s) do you presently work in?

12. Please select the PRIMARY age/grade level with which you work:
   - Early Intervention (0-2)
   - Preschool (3-5)
   - Primary Grades (K-2nd grade)
   - Elementary Grades (K – 5th grade)
   - Middle Grades (6th – 8th grade)
   - High School (9th – 12th grade)

College (18 – 22 years old)
Adults
Geriatrics
Other: _____

13. Please indicate to the best of your ability the number of hours of training (including graduate work) you have received for the following disorders.
    Attention-Deficit Hyperactive Disorder
    Anxiety Disorders
    Conduct Disorders
    Traumatic Brain Injury
    Learning Disability
    Oppositional Defiant Disorders

14. Post graduate school (if applicable), which of the following have you attended workshops or training programs on? (Please check all that apply)
    Attention-Deficit Hyperactive Disorder
    Anxiety Disorders
    Conduct Disorders
    Traumatic Brain Injury
    Learning Disability
    Oppositional Defiant Disorders

15. On a scale of 1to 5 please rate the level proficiency you feel in diagnosing the following disorders.
    1=Not at all Proficient, 2=Slightly Proficient, 3= Moderately Proficient, 4=Very Proficient, 5=Extremely Proficient
    Attention-Deficit Hyperactive Disorder
    Anxiety Disorders
    Conduct Disorders
    Traumatic Brain Injury
    Learning Disability
    Oppositional Defiant Disorders

16. Do you have a history of working with children or adolescents who have sustained a TBI?
    Yes
    No

17. How many hours of formal education have you had on TBIs in a university/college based training program?
    _____

18. Approximately how many books/articles have you read on TBIs?
    _____

19. What is your perceived efficacy of working with children or adolescents who have sustained a TBI?
    1= Not at All True, 2= Somewhat True, 3=Moderately True, 4=Mostly True, 5=Completely True
    a. "I feel I can effectively identify a child with TBI."
    b. "I feel I can effectively intervene and help a child who sustained TBI."

Appendix D:
Knowledge of Traumatic Brain Injury scale (K-TBI)

Please read the following statements and indicate your response next to each item.
T=True F=False NS=Not Sure of the Answer

1.	T	F	NS	Inflammation post-TBI contributes to both neurodegenerative processes and repair
2.	T	F	NS	A long-term effect is Chronic Traumatic Encephalopathy (Degenerative disease of the brain)
3.	T	F	NS	There is no increased risk of a mood disorder or anxiety disorder in people who suffer from TBI
4.	T	F	NS	It is important to provide coordinated medical rehabilitation and community-based support services to promote positive outcomes post-TBI
5.	T	F	NS	Depending upon school funding, students who experience a TBI and have prolonged symptoms are eligible to receive specialized accommodations through Section 504
6.	T	F	NS	TBI doesn't have the potential to result in neurocognitive and sensory-motor deficits to actually affect academic, social, behavioral and emotional functioning (7)
7.	T	F	NS	School psychologists can use assessments to make accommodations for children with TBIs
8.	T	F	NS	Sleep disturbances including too little or too much sleep is associated with TBI
9.	T	F	NS	Depression, anxiety disorders, and post-traumatic stress disorder may develop or exacerbate after TBI
10.	T	F	NS	Inflammation typically improves and lessens after a few weeks of TBI incident
11.	T	F	NS	Individuals who sustain TBIs have cognitive deficits that often resolve acutely
12.	T	F	NS	Between 15-20% of students who need services for TBI actually receive them
13.	T	F	NS	Evidence suggests that female may be a greater risk for concussions
14.	T	F	NS	Repeated head injury does not worsen brain structure and function

15.	T	F	NS	TBI symptoms typically do not fully resolve until 6-9 months
16.	T	F	NS	One of the most widely used systems to classify outcome from head injury is the Glasgow Outcome Scale (GOS)
17.	T	F	NS	Symptoms such as memory and concentration problems can appear during the recovery stages of TBI rather than forming during the initial set of symptoms that occur after a TBI
18.	T	F	NS	Research suggests cognitive and physical rest for 1-2 days after a TBI
19.	T	F	NS	Because of behavioral difficulties that results from TBI, school psychologists should create a concrete daily routine
20.	T	F	NS	TBIs are identified as a risk factor for chronic depression and mild cognitive impairment
21.	T	F	NS	Typically athletes can return to sports 10-14 days post-TBI
22.	T	F	NS	Persistent post TBI symptoms can result in school absenteeism, impaired academic performance, depressed mood, loss of social activities, and lower quality of life
23.	T	F	NS	Long-term post TBI symptoms include depression, paranoia, agitation, impaired judgments and aggressive behavior
24.	T	F	NS	Cognitive behavioral and light therapies, medications, and continuous positive airway pressure (CPAP) or oral appliances for disordered sleep breathing can help with sleep from TBI
25.	T	F	NS	TBI affects fine motor coordination which impairs academic performance
26	T	F	NS	Post-TBI, students do not have to be back at their "baseline" before returning to sports, physical activities, or other extracurricular activities
27.	T	F	NS	Most parents of children with TBI are most concerned if the child displays subsequent learning disabilities, headaches or difficulty sleeping
28.	T	F	NS	TBI can cause diffused lesions on the brain which result in biochemical changes
29.	T	F	NS	Children who experience a TBI tend to have more difficulty with receptive vocabulary than the acquisition of expressive vocabulary
30.	T	F	NS	Concussion is a form of TBI

Table 1

Participants Demographics

Characteristics	
Age, *M* (*SD*)	36.92 (9.71)
Gender, *n* (%)	
Female	384 (91.2)
Male	35 (8.3)
Ethnicity, *n* (%)	
American Indian	2 (.5)
Asian	12 (2.9)
African American	13 (3.1)
Caucasian	360 (85.5)
Hispanic	19 (4.5)
Multi-ethnic	11 (2.6)
Highest Degree Level, *n* (%)	
Bachelor's Degree	73 (17.3)
Master's Degree	199 (47.3)
Specialist Degree	92 (21.9)
Ph.D.	9 (3.6)
Psy.D	3 (2.1)
Other	11 (2.6)
Current Job Title, *n* (%)	
Assistant Professor	7 (1.7)
Chairperson Committee of Special Education	3 (.7)
Director of Special Education	1 (.2)
Psychology Graduate Student/Intern	14 (3.4)
School Psychologist	94 (22.3)
Teacher	280 (66.5)
Social Worker	5 (1.2)
Private Practice Psychologist	3 (.7)
Current Employment Setting, *n* (%)	
Private School	58 (14.1)
Public School	301 (73.2)
Other	46 (11.2)
Primary Age/Grade Level, *n* (%)	
Early Intervention (ages 0-2)	5 (1.2)
Preschool (ages 3-5)	44 (10.5)
Primary Grades (K-2)	59 (14.0)
Elementary Grades (K-5)	136 (32.3)
Middle Grades (6-8)	53 (12.6)
High School (9-12)	53 (12.6)

Table 2

Participant Experience	*M* (*SD*)
Hours of Training on TBIs, *M* (*SD*)	5.30 (15.05)
Workshops on TBIs, *n* (*%*)	36 (8.6)
History of Working with Students who Sustained a TBI, *M* (*SD*)	2.32 (7.89)
Books/Articles on TBIs Read, *M* (*SD*)	4.01 (6.83)
Identification Efficacy, *M* (*SD*)	1.68 (.88)
Intervention Efficacy, *M* (*SD*)	1.95 (.97)

*Workshops on TBIs: *n* (%)

** Identification and Intervention Efficacy (1= Not at all True to 7 = Completely True).

Table 3

Cronbach's Alpha and Descriptive Statistics for the Knowledge of Traumatic Brain Injury Scale (K-TBI)

Scale	No. items	Mean	Standard Deviation	Cronbach's Alpha (*a*)	Test Retest Reliability (*r*)
K-TBI					
Total	30	15.88	6.36	.90	.88
Symptoms	13	6.91	3.03	.80	.72
Treatment	7	3.47	1.82	.64	.88
Long Term Characteristics	10	5.36	2.83	.76	.84

Note. $N = 407$

Table 4

Correlations of Participant Background Experience/Perceived Efficacy and Knowledge on the K-TBI

	1	2	3	4	5	6	7	8	9	10	11
1. K-TBI total score	--										
2. K-TBI long term	.913**	--									
3. K-TBI symptoms	.945**	.791**	--								
4. K-TBI treatment	.830**	.635**	.700	--							
5. Years ago graduating	-.003	.008	-.013	.012	--						
6. Hours of training on TBIs	.098	.164*	.097	-.030	-.091	--				.	.
7. No. of TBI students worked with	.103	.133*	.102	.002	-.012	.400**	--				
8. Hours of graduate education on TBIs	.114	.148*	.125*	-.004	-.016	.841**	.438**	--			.
9. Perceived efficacy for identifying a TBI	.232**	.214**	.259**	.156**	-.042	.309**	.316**	.343**	--		
10. Perceived efficacy for intervening with a child with a TBI	.238**	.223**	265**	.215**	-.050	303**	.217**	.314**	649**	--	
11. No. of articles/books read on TBIs	.252**	.249**	.276**	.115	-.032	.298**	.493**	.342**	.356**	.364**	--

Table 5

Expert Demographics	*n* (%)
Gender, *n* (%)	
Female	8 (53.3)
Male	7 (46.7)
Ethnicity, *n* (%)	
Asian	1 (6.7)
Caucasian	14 (93.3)
Highest Degree Level, *n* (%)	
Bachelor's Degree	1 (6.7)
Master's Degree	2 (13.3)
Ph.D	8 (53.3)
Medical Degree	4 (26.7)
Current Job Title, *n* (%)	
Neurology Rehabilitation	4 (13.3)
Clinical Neuropsychologist	6 (40.2)
Occupational Therapist	4 (13.3)
Physician	1 (6.7)
Expert Experience	
Hours of Training on TBIs, *M* (*SD*)	836.33 (1753.70)
History of Working with Students who Sustained a TBI, *M* (*SD*)	493.33 (513.35)
Books/Articles on TBIs Read, *M* (*SD*)	331.33 (378.08)
Identification Efficacy, *M* (*SD*)	4.33 (1.11)
Intervention Efficacy, *M* (*SD*)	4.47 (.64)

** Identification and Intervention Efficacy: (1= Not at all True to 5 = Completely True).

Table 6

Expert Descriptive Statistics for the Knowledge of Traumatic Brain Injury Scale (K-TBI)

Scale	No. items	*M*	*SD*
K-TBI			
Total	30	21.73	2.76
Symptoms/Characteristics	13	10.13	1.55
Treatment	7	4.60	1.40
Long Term Characteristics	10	7.00	1.07

Note. $N = 15$

Table 7

Factor Loadings

Item No.	1	2	3	4	5	6
Long-term post TBI symptoms include depression, paranoia, agitation, impaired judgments and aggressive behavior	.756	.143	.068	.106	.000	.040
There is no increased risk of a mood disorder or anxiety disorder in people who suffer from TBI	.755	.226	.003	.063	-.037	-.081
TBIs are identified as a risk factor for chronic depression and mild cognitive impairment	.750	.195	.020	-.036	.080	.034
Persistent post TBI symptoms can result in school absenteeism, impaired academic performance, depressed mood, loss of social activities, and lower quality of life	.744	.112	.209	.115	.064	.072
Symptoms such as memory and concentration problems can appear during the recovery stages of TBI rather than forming during the initial set of symptoms that occur after a TBI	.721	.339	.146	-.019	.059	-.039
TBI doesn't have the potential to result in neurocognitive and sensory-motor deficits to actually affect academic, social, behavioral and emotional functioning	.714	.152	-.049	.185	-.008	-.051
Depression, anxiety disorders, & post-traumatic stress disorder may develop or exacerbate after TBI	.713	.000	.181	.090	.190	.079
It is important to provide coordinated medical rehabilitation and community-based support services to promote positive outcomes post-TBI	.708	-.075	.193	.262	-.029	-.001
Repeated head injury does not worsen brain structure and function	.672	.062	.041	.306	-.228	-.191
Sleep disturbances including too little or too much sleep is associated with TBI	.593	.277	-.059	.050	.247	-.11
Most parents of children with TBI are most concerned if the child displays subsequent learning disabilities, headaches or difficulty sleeping	.522	-.003	.466	.231	.082	-.017
Depending upon school funding, students who experience a TBI and have prolonged symptoms are eligible to receive specialized accommodations through Section 504	.493	.061	-.158	.003	.130	.078
Inflammation post-TBI contributes to both neurodegenerative processes and repair	.142	.740	.116	.061	-.043	.068
A long-term effect is Chronic Traumatic Encephalopathy (Degenerative disease of the brain)	.196	.671	.171	.042	-.052	.199
TBI can cause diffused lesions on the brain which result in biochemical changes	.281	.651	.095	.037	.204	-.232
Evidence suggests that female may be a greater risk for concussions	-.071	.218	.665	.124	.093	.069
Typically, athletes can return to sports 10-14 days post-TBI	.074	.067	.644	-.431	.059	.085
Post-TBI, students do not have to be back at their "baseline" before returning to sports, physical activities, or other extracurricular activities	.197	.311	.425	.143	.002	-.173
Concussion is a form of TBI	.231	-.028	.393	.146	.007	-.086
Because of behavioral difficulties that results from TBI, school psychologists should create a concrete daily routine	.160	.115	.072	.730	.102	.051
TBI affects fine motor coordination which impairs academic performance	.424	-.048	.130	.652	.058	.216
Cognitive behavioral and light therapies, medications, and continuous positive airway pressure (CPAP) or oral appliances for disordered sleep breathing can help with sleep from TBI	.188	.235	.023	.586	.474	.019
TBI symptoms typically do not fully resolve until 6-9 months	.017	.029	.049	.151	.803	-.029
Individuals who sustain TBIs have cognitive deficits that often resolve acutely	.019	-.183	.166	-.005	.487	.417
Between 15-20% of students who need services for TBI actually receive them	.251	.273	.371	.027	.385	-.258
School psychologists can use assessments to make accommodations for children with TBIs	.221	.155	.139	.058	-.004	.055
Research suggests cognitive and physical rest for 1-2 days after a TBI	.285	.240	.143	.038	.213	.599
Children who experience a TBI tend to have more difficulty with receptive vocabulary than the acquisition of expressive vocabulary	.256	.070	.144	-.128	.196	-.576
One of the most widely used systems to classify outcome from head injury is the Glasgow Outcome Scale (GOS)	.195	.383	-.097	.090	.077	.430
Inflammation typically improves and lessens after a few weeks of TBI incident	.138	-.07	.188	.065	-.026	-.025

Table 8

Descriptive statistics for the EFA factors (n = 421)

Factor No.	Name of Factor	No. of items	% Variance
Factor 1	Cognitive and mood disorder symptoms and services	12	24.42
Factor 2	Damage and changes to the brain	3	6.71
Factor 3	Risk and return to activities	4	5.92
Factor 4	Behavior and motor skills	3	5.04
Factor 5	Resolving symptoms and receiving services	3	4.06
Factor 6	Research findings and TBI classifications	3	3.76

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