Pediatric concussion: knowledge and practices of school speech-language pathologists

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PEDIATRIC CONCUSSION: KNOWLEDGE AND PRACTICES OF SCHOOL SPEECH-LANGUAGE PATHOLOGISTS

by

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ABSTRACT

The identification and management of concussion is a growing public health issue. The science of concussion research and the clinical management of children and adolescents who have experienced concussion are rapidly evolving, presenting many challenges and opportunities for those serving this population. A concussion can impact cognitive, communicative, academic, and social success; students affected by concussion may be eligible for special education services. The current study is a national survey of speech language pathologists (SLPs) aimed at characterizing concussion knowledge and management in the schools. One thousand surveys were sent to school-based SLPs from 10 states. Twenty-eight percent of surveys were returned and the results offer a snapshot of current SLP practices and support improved identification and management of concussed children. Findings indicate school-based SLPs’ uncertainty in some aspects of concussion knowledge and their role in concussion management. Increased training in pediatric TBI and concussion is needed, and research directed at identifying and developing sensitive assessments and effective treatments for pediatric concussion is required to ensure quality service delivery.
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CHAPTER I

REVIEW OF THE LITERATURE

Concussion is a popular topic in the media and stories of complications following concussion frequent newspapers, magazines, and television reports. This heightened awareness is accompanied by increased research demonstrating the potential dangers and detrimental consequences of a concussion, or mild traumatic brain injury. Many states are recognizing the need for youth concussion legislation to manage and prevent concussion complications. As of August 2011, more than 30 states had passed student-athlete concussion legislation (Toporek, 2011; Fjordbak, 2011). Guidelines within the legislation include parent signatures on concussion information forms, immediate removal from play of student-athletes if concussion is suspected, medical clearance before returning to play, and/or annual concussion training for coaches (Toporek, 2011).

The science of concussion research and the clinical management of children and adolescents who have experienced concussions are rapidly evolving. Over the past 20 years, accumulating evidence suggests that even mild brain injuries, such as concussions, can result in significant and persistent cognitive-communication impairments, as well as behavioral, social and emotional problems that negatively impact academic performance and social interactions (Binder, 1986; Kay, 1986; Hugenholtz, Stuss, Stethem, & Richard, 1988; Slagle, 1990; Hux & Hacksley, 1996). These advances present a unique set of challenges and opportunities for those providing clinical or educational services to children who are at risk or who have sustained a concussion, including speech-language pathologists (SLPs).
While the management of cognitive-communication deficits associated with concussion would be the purview of an SLP, there is a dearth of information regarding the knowledge base and current management practices of school SLPs in serving this population. The current study examines the current knowledge base and management practices of SLPs working with school-aged children who have had a concussion. A national survey was disseminated to 1000 school-based SLPs in order to quantify and describe current practices. Before presenting the methods and results of this study, the concussion literature and the role of SLPs in the management of concussion and traumatic brain injury more broadly is reviewed.

**Definition, Demographics, and Pathophysiology**

*Definition of Concussion*

As defined by the American Academy of Neurology, a concussion is a brain injury caused by a direct or indirect blow to head, causing a disruption in normal brain functioning (AAN, 1997). Although loss of consciousness was historically a hallmark feature for diagnosing concussion, there is now consensus that a concussion can occur even in the absence of loss of consciousness (AAN, 1997; Aubry et al., 2002). This precedence began more than 40 years ago when the Congress of Neurological Surgeons (1966) indicated that loss of consciousness is no longer a diagnostic criterion for concussion. Although many attempts have been made to delineate the spectrum of concussion, no consensus has been reached. More than 25 different grading scales for concussion have been published, many of which determine severity based on loss of consciousness, confusion, and amnesia (Johnson, McCrory, Mohtadi, & Meeuwisse, 2001; Halstead & Walter, 2010). The most commonly used grading system was
developed by the American Academy of Neurology (Kelly & Rosenberg, 1997) and the key features of this system are summarized in Table 1. In this system, a Grade 1 concussion is characterized by temporary confusion, no loss of consciousness, and resolution of symptoms within 15 minutes. Athletes commonly refer to a grade one concussion as a “ding” or “bell ringer.” Because the individual does not lose consciousness and experiences only temporary symptoms, this is the most difficult of the three grades to recognize and diagnose. A Grade 2 concussion differs from a Grade 1 in that symptoms remain for more than 15 minutes. If symptoms persist for over an hour, the individual is advised to seek a medical examination. Finally, a Grade 3 concussion occurs when an individual experiences loss of consciousness either brief or prolonged (AAN, 1997). It is important to remember that every concussion regardless of the grade is a brain injury and can potentially cause long-term damage and deficits.

There is considerable overlap in the use of the terms concussion and mild traumatic brain injury (mTBI) and some authors use the terms interchangeably to suggest that concussion and mTBI are equivalent. Other authors have argued for distinct definitions but there is not resolution to date in the literature. The World Health Organization Collaborating Centre Task Force on Mild TBI defines mTBI as a brain injury that results from external forces and includes one or more of the following: confusion or disorientation, loss of consciousness for less than 30 minutes, post-traumatic amnesia of less than 24 hours, and transient neurological abnormalities (Carroll, Cassidy, Holm, Kraus, & Coronado, 2004). This definition uses mTBI as an umbrella term that captures both concussion and mTBI; however, concussion falls on the less severe end of the spectrum. In contrast, McCrory and colleagues called for a differentiation between the
terms concussion and mild traumatic brain injury (mTBI), indicating that these are
different injuries. In that paper, only a definition for concussion is provided. The authors
state that concussion is a “complex pathophysiological process affecting the brain,
induced by traumatic biomechanical forces” (McCrory et al., 2008). They continue to
describe several clinical, pathologic, and biomechanical features that may be used to
define a concussive head injury. These include: 1) a direct blow to the body creating a
force transmitted to the head; 2) rapid onset of temporary neurologic impairment; 3) a
functional disturbance in the brain as opposed to a structural injury; 4) a graded set of
clinical symptoms (may or may not include loss of consciousness) are present and
typically follow a sequential course; however, postconcussive symptoms may be
prolonged in a small percentage of cases; 5) absence of abnormality on structural
neuroimaging studies (McCrory et al., 2008). Despite efforts to separate the terms
concussion and mTBI, the two are frequently conflated and used interchangeably in the
literature. The terms will be used interchangeably in this review as well.

Incidence

The Center for Disease Control and Prevention estimates that 1.7 million TBI-
related hospitalizations, emergency room visits, and deaths occur each year with 75% of
these cases classified as concussions or other mTBIs (Faul, Xu, Wald, & Coronado,
2010; CDC, 2003). Other estimates propose 300,000 to 3.8 million injuries annually are
the result of recreation- and sports-related concussions (Thurman, Branche, & Sniezek,
1998; Langlois, Rutland-Brown, & Wald, 2006). It is estimated that 65% of recreation
and sports-related concussions seen in emergency departments are among children ages
5-18 years (CDC, 2007). Concussions commonly result from trauma to the head during
sports; however, any bump or jolt to the head may cause a concussion, including falls and collisions. Obtaining accurate incidence data on concussion in school-aged children has been challenging because of the potential for underreporting. For example, concussion data are often based on the number of individuals who lose consciousness or visit the emergency room, which does not take into account individuals who are treated by a general practitioner or those who do not receive any medical care (CDC, 2003; Bakhos, Lockhart, Myers & Linakis, 2010; McCrea, Hammeke, Olsen, Leo, & Guskiewic, 2004; Williamson & Goodman, 2005). Further research is needed to quantify pediatric concussions.

Pathophysiology

A concussion is a brain injury that results in the stretching, twisting, and tearing of axons in the brain. When an individual receives a direct or indirect blow to the head, rotational acceleration and deceleration forces act on the moving brain within the skull and can strain or tear axons, resulting in diffuse axonal injury, cell death, or intracranial hemorrhage (Ommaya & Gennarelli, 1974; McCrory et al., 2001). Diffuse axonal injury is considered the signature injury of traumatic brain injury.

A concussion also results in metabolic changes at the cellular level, which have been studied and described in detail by using animal models. The healthy brain is constantly working to maintain equilibrium (i.e., a steady ratio of neurotransmitters, constant cerebral blood flow, etc.). A concussion causes a disruption and resultant metabolic cascade. These events include: sudden neuronal depolarization, release of excitatory neurotransmitters, abnormal ion influxes, and altered glucose metabolism and cerebral blood flow. When a concussion occurs, there is an abrupt release of excitatory
neurotransmitters, resulting in ionic shifts. In attempt to restore equilibrium, the sodium-potassium (Na+ - K+) pump is forced to work overtime, which requires increased amounts of adenosine triphosphate (ATP). Glucose metabolism is then dramatically increased, causing “hypermetabolism.” Following this initial period of hyperglycosis, the brain experiences a period of slowed metabolism and this dysautoregulation can persist for hours, days, or weeks (Giza & Hovda, 2001). Figure 1 displays the neurometabolic cascade following concussion (Giza & Hovda, 2000).

When an individual who has sustained a concussion goes to the emergency room, a doctor may order an MRI scan to rule out intracranial bleeding. This type of imaging, which reveals the structural integrity of the gray matter in the brain, is helpful in visualizing the damage associated with severe head injuries. MRIs are not helpful in observing the consequences of a concussion because MRI lacks the specificity and sensitivity to observe the chemical changes or white matter damage (i.e., diffuse axonal injury) associated with mTBI and concussion (Kay, 1986; Kirkwood, Yeates, & Wilson, 2006; McCrory et al., 2008).

**Signs and Symptoms**

Concussion signs and symptoms can be divided into four categories: physical, cognitive, emotional, and sleep. Physical symptoms can include but are not limited to: headache, balance problems, nausea or vomiting, blurred vision, fatigue, and sensitivity to light or noise. Cognitive symptoms can include: difficulty concentrating, difficulty thinking clearly, inability to remember new information, confusion about recent events, and feeling slowed down. Some emotional symptoms are irritability, sadness,
nervousness, or labile emotions. Sleep symptoms may be sleeping more or less than usual or insomnia (CDC, 2003; Halstead & Walter, 2010).

An important consideration is that the symptoms of a concussion can appear similar to those of depression, anxiety, and attention deficit disorders (Duff, 2004; Bailey, Samples, Broshek, Freeman & Barth, 2010; Preece & Geffen, 2007). Concussion can also cause these disorders (Gerring et al., 2000; Lee & Fine, 2010). Sequelae of concussion can also present like learning disabilities and/or cognitive delays (Halstead & Walter, 2010). Because of these overlapping symptoms, recognizing a concussion can be challenging. Additionally, it is important to remember that an individual with a TBI, who has an acquired injury in the context of normal development, is not a “peer” of individuals with other disabilities such as a learning disability (Blosser & DePompei, 1994). Blosser and DePompei (1994) identified some of the key characteristics that differentiate TBI from other disabilities:

- A previous successful experience in academic and social settings
- A premorbid self-concept of being normal
- Discrepancies in ability level
- Inconsistent patterns of performance
- Recovery variability and fluctuation resulting in unpredictable and unexpected spurts of progress
- More problems with generalizing, integrating, or structuring information
- Poor judgment and loss of emotional control, which make the student appear to be emotionally disturbed at times
- Cognitive deficits that are present as in other disabilities but are uneven in extent of damage and rate of recovery
• Combinations of conditions resulting from TBI that are unique and do not fall into usual categories of disabilities
• Inappropriate behaviors that may be more exaggerated (more impulsive, more difficulty with memory, information processing, organization, and/or flexibility)
• Learning style that requires utilization of a variety of compensatory and adaptive strategies
• Some high level skills, which may be intact, making it difficult to understand why the student has problems performing lower level tasks
• A previously learned based of information, which assists rapid relearning (adapted from Blosser & DePompei, 1994, p. 30).

Keeping these in mind is of upmost importance for individuals working with children. Before diagnosing or considering any of these disorders, it is important to find out if the child sustained a head injury at any point in time.

Concussion Management

Growing evidence suggests that the effects of concussion may differ by age, sex, and concussion history. These new findings significantly impact the intervention and management of pediatric concussion. It is important to recognize that many of these findings come from the literature on sports-related concussion and more severe TBIs. More research is needed to further understand the impact of these factors; however, the current findings are reviewed in the following sections.

Effects of Age

Concussions in children and adults differ significantly (Ommaya, Goldsmith, & Thibault, 2002; McCrory, Collie, Anderson & Davis, 2004), and an understanding of these differences is important for providing quality intervention for concussed children.
The first area in which concussion differs between children and adults is the biomechanical properties of concussion. Regardless of age, an individual experiences acceleration and/or deceleration forces that cause twisting, tearing, and stretching of axons. The effects of these forces are age-dependent due to the differing compositional and mechanical properties of the head and brain (Kirkwood et al., 2006). These differences are the result of age-dependent physiological responses to mechanical stress, which are influenced by brain water content, cerebral blood volume, level of myelination, differing geometry of skull and brain, and less well developed neck and shoulder musculature in children (Bauer & Fritz, 2004; Gefen et al., 2003; Prins & Hovda, 2003; Thibault & Margulies, 1998; Kirkwood et al., 2006; McCrory et al., 2004). Moreover, research suggests that a child must experience a force that is two or three times greater than an adult to be symptomatic (McCrory et al., 2004). It is also important to consider that if a child demonstrates symptoms of concussion, this injury may be much more severe than an adult exhibiting the same difficulties (McCrory et al., 2004).

Additionally, the pathophysiological response following concussion differs between adults and children. As discussed above, a concussion causes a metabolic shift and research has demonstrated that this cascade is different for developing organisms. For instance, in rare cases, some children and teenagers experience cerebral swelling, which can lead to death (McCrory et al., 2004).

The traditional view of recovery from brain injury has been that children make faster and fuller recoveries than adults. Often referred to as the “Kennard principle” (Kennard, 1936), the notion that children have better functional recoveries than adults comes from the belief that similar injuries cause less impairment because of...
neuroplasticity. More recent work, has challenged this view demonstrating that the developing brain is actually more vulnerable following diffuse damage than equivalent damage in an adult and that children often have poorer neurobehavioral outcomes (Anderson et al., 1997; Levin, Song, Ewing-Cobbs, Chapman & Mendelsohn, 2001; Webb, Rose, Johnson, & Attree, 1996). This is not completely understood but several theories exist to explain why children’s brains are more vulnerable:

…skills not well yet well established at the time of insult could be more susceptible to disruption than well-established ones; the brain systems responsible for skill acquisition could be affected directly by diffuse injury; functional recovery may be restricted by the injured child’s smaller repertoire of existing skills; and an injury to the immature brain could interfere neurobiologically with the intricate sequence of chemical and anatomic events necessary for normal development (Kirkwood et al., 2006, p. 1361).

In addition, Chapman (2006) and Gamino, Chapman, & Cook (2009) describe a “cognitive stall” in which TBI during childhood is followed by a failure to develop cognitive, behavioral, or social skills during adolescence or at least one-year post injury. When an individual “fails to thrive,” his/her abilities to learn, maintain friendships, and perform well in school or a job are negatively affected (Chapman, 2006; Gamino, Chapman, & Cook, 2009).

Finally, the contextual expectations for children and adults differ significantly. While adults continue to learn, most of their knowledge and skills are established, allowing them to successfully carry out everyday activities. Children on the other hand are expected to continually acquire new knowledge both in and out of school (Kirkwood et al., 2006). In addition, the needs and demands of children and adolescents differ depending on the age at the time of injury. Academic and social demands vary
dramatically from kindergarten to high school, so it is important that these are taken into consideration in the rehabilitation process.

Because of these significant and numerous differences between adult and pediatric concussions, a more conservative management approach such as prolonged recovery time before returning to play, school, or work is suggested for children compared to adults (Kirkwood et al., 2006; McCrory et al., 2004). More research is needed to examine recovery rates and long-term outcomes in children and adolescents following a concussion in order to create a better intervention plan for the pediatric population.

Effects of Sex

Concussion research suggests that sex may be a factor in outcomes following a brain injury; however, inconsistent results and the small number of studies in this area point towards a need for further investigation in this area. Broshek and colleagues performed baseline neurocognitive testing on 2340 high school and collegiate athletes, and then reevaluated those who sustained a sports-related concussion. They found that even when controlling for factors such as concussion history and type of play, females had a greater decline in simple and complex reaction times and were cognitively impaired about 1.7 times more frequently than males following concussion. Additionally, females reported more postconcussion symptoms than males (Broshek et al., 2005). While it is unknown if women have more postconcussion symptoms or are more apt to report them, this result combined with the greater decline on neuropsychological testing in women suggests that sex may be an important factor in brain injury outcome.
The broader TBI literature on the relationship between sex and recovery is also equivocal. Farace and Alves conducted a meta-analysis of eight TBI studies comparing outcomes for men and women and found that women suffer worse outcomes than men for 85% of the measured variables (Farace & Alves, 2000). In contrast, other studies have found males fare worse after a concussion or more severe TBI. Groswasser and colleagues found that after a severe TBI, female patients had better outcomes than males in their ability to work following an inpatient rehabilitation program (Groswasser, Cohen, & Keren, 1998). In a study of pediatric TBI, Donders and Hoffman found that boys scored significantly lower than girls 1 year post-head injury on the California Verbal Learning Test-Children’s Version (CVLT-C), suggesting boys have an increased risk for retrieval deficits following TBI (Donders & Hoffman, 2002). Furthermore, Tsushima, Lum, and Geling found no significant differences in the performance of males and females on a variety of neuropsychological tests following mild TBI (Tsushima, Lum, & Geling, 2009).

Effects of Multiple Concussions

Considerable research has been directed towards understanding the effects of multiple concussions, as this has been the impetus for the development of valid management strategies (e.g., return to play guidelines). This line of research has focused on two primary issues. First, is the issue of whether multiple concussions result in poorer neuropsychological/behavioral outcomes. The results to date are conflicting. Some studies (Collins et al., 1999; Collins et al., 2002) suggest that multiple concussions are associated with lower scores on neurological tests, persistent learning difficulties, and increased susceptibility to another head injury than individuals with one or no
concussion. Other studies (Iverson et al., 2006; Macciocchi et al., 2001) demonstrate no differences between athletes with one or two concussions on neurocognitive tests or immediate presentation of symptoms. Second, is the issue of the timing between concussions. Some researchers believe that after sustaining a concussion, an individual is more vulnerable to a second injury until equilibrium is achieved once again at the cellular level. If the individual has not recovered fully from the first concussion, a second injury can be catastrophic. Regardless of the severity of the second injury, the individual can experience severe consequences such as brain swelling, permanent brain damage, and even death (Halstead & Walter, 2010; Cantu, 1998). This is referred to as second-impact syndrome.

Implications from Sports-Related Concussion Literature

While factors such as age and sex should be considered when creating a management plan, it is important to note that the bulk of the concussion literature and research focuses on sports-related concussion in high school and collegiate athletes. Two trends overwhelm this literature: return to play guidelines and baseline neuropsychological assessments.

Management of sports-related concussion is highly variable; there are over 22 published concussion severity grading scales and return to play guidelines. The use of these guidelines has been useful in promoting a uniform terminology within the management of concussion, but they also come with some disadvantages. Return to play guidelines are not based on scientific data, and they assume a “one size fits all” approach for managing the injury (Collins & Hawn, 2002). That is, the decision making process does not take into account the age or sex of the individual and makes only broad strokes
at characterizing the presenting symptoms of the individual. In recognition of the inadequacy of concussion management guidelines, three international symposia on concussion in sport have been held in 2001, 2004, and 2008 with the goal of improving and individualizing concussion management. The first was held in Vienna, and a consensus statement for sports-related concussion was created (Aubry et al., 2002) and updated in the subsequent meetings in Prague and Zurich (McCrory et al., 2005; McCrory et al., 2009). In addition to advocating for baseline neuropsychological testing (described below), the guidelines recommend that return-to-play protocols make use of a step-wise approach moving gradually from no activity to complete return to play. The most recent conference in Zurich proposed the following graduated return to play guidelines (McCrory et al., 2009):

1. No activity
2. Light aerobic exercise
3. Sport-specific exercise
4. Non-contact training drills
5. Full-contact practice
6. Return to play

The individual is to proceed through each level of this protocol if asymptomatic at the current level. Each step takes a minimum of 24 hours, so it should take the individual at least one week to complete the full rehabilitation protocol. If the individual becomes symptomatic (e.g., headache, dizziness) at any level, the patient should drop back to the previous level for at least 24 hours and/or until asymptomatic (McCrory et al., 2009). The panel also recognized the differences between concussions in children and adults,
suggesting a more conservative approach for return to play be used for children (McCrory et al., 2009). Moreover, it has been suggested that this idea of return to play be used for returning students to a full day of school. This stepwise approach would begin with no school until the student is asymptomatic and utilize accommodations until the student is able to return for a full day (Duff, 2009).

Despite the lack of consensus on a management approach, most guidelines suggest both cognitive and physical rest until the individual is asymptomatic (McCrory et al., 2009; Logan, 2009; Purcell, 2009; Halstead & Walter, 2010). Cognitive rest allows for the metabolic disruption to return to normal and symptoms to subside. It may be suggested that the student not attend school or have a shortened school day. During the immediate period after injury, exposure to devices like television, video games, and computers should be avoided, as these can exacerbate symptoms (Halstead & Walter, 2010). Additionally, physical rest is equally important, as physical activity following a concussion has been shown to intensify symptoms and lengthen recovery (Majerske et al., 2008). The student should continue to rest and limit stimulation or activities until asymptomatic.

Related to the use of return-to-play guidelines is the implementation of baseline standardized assessments. The use of standardized assessment tools allows for an individualization of concussion management. The three most widely used programs are ImPACT (Immediate Postconcussion Assessment and Cognitive Test), Concussion Resolution Index, and CogSport. These are computerized, baseline testing programs that collect data on athletes’ preseason abilities across neuropsychological domains (e.g., memory, attention, orientation). Additionally, demographic, biographical, and medical
information are obtained. After an athlete sustains a concussion during practice or on the field, a detailed report can be created documenting symptoms and any changes from baseline performance. This information can then be used to make return to play decisions. The athlete is reassessed after the injury until symptom-free and test performance returns to the baseline level. A significant advancement of baseline testing protocols is the increased sensitivity of the neuropsychological measures over the observation and reporting of concussion symptoms alone. For example, Van Kampen and colleagues compared ImPACT scores and postconcussion symptom scores at baseline and after injury. Results showed that although an athlete may present as asymptomatic, he/she may not score at baseline on neurocognitive measures such as processing speed and reaction time (Van Kampen, Lovell, Pardini, Collins, & Fu, 2006).

That said, the use of these baseline neuropsychological tests is rather new, so data are still lacking (Duff, 2009) and there are on-going debates about the sensitivity of the existing measures for making return-to-play decisions alone (e.g., Broglio, Pontifex, O’Connor, & Hillman, 2009).

Using results from neuropsychological tests and adapting return to play guidelines to meet the needs of the pediatric concussed athlete can be beneficial in creating an individualized management plan. Currently, both baseline assessments and return to play guidelines are being used at the high school level. In the future, there will likely be a push to implement these protocols in elementary and junior-high schools (Duff, 2009).
Implications from TBI literature

In addition to relying on research in the area of sports-related concussion, management guidelines for pediatric concussion are also based on protocols for assessment and management of traumatic brain injuries (TBI) in general.

The evaluation process of a child following a concussion should include both formal and informal assessments of cognitive-communication disorder. Very few standardized tests specific to TBI exist for the pediatric population; however, standardized assessments used to identify general cognitive functioning and cognitive-communication disorders can be useful for concussed students. These tests can provide an expected or “typical” level of communication or cognition for a concussed student’s age. Depending on a student’s deficits, more specific tests may be necessary. Under the auspices of the Academy of Neurological Communication Sciences and Disorders, Turkstra and colleagues distributed a survey to examine assessment tools that practicing SLPs routinely use when working with individuals with TBI (Turkstra et al., 2005). The authors summarized the survey results, test publishers and distributors, test manuals, and published literature and expert opinions, providing a list of tests that are being used for evaluation and assessment of communication ability for individuals with TBI. Tests that were found to adequately evaluate individuals following TBI include American Speech Language Hearing Association Functional Assessment of Communication Skills in Adults (ASHA-FACS), Behavior Rating Inventory of Executive Function (BRIEF), Communication Activities of Daily Living, Second Edition (CADL-2), Functional Independence Measure (FIM), Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), Test of Language Competence – Extended (TLC-
E), and Western Aphasia Battery (WAB); however, these tests are not without limitations. The authors suggest that most standardized tests are limited, as they fail to recognize all of the deficits for individuals with cognitive-communication disorders after TBI (Turkstra et al., 2005).

Informal assessments are useful and an important part of the evaluation and assessment process. Informal evaluations such as observations of a student can provide information regarding how well a student is functioning in the classroom or social situations: “Informal observation or simulation of situations allows the clinician to propose workable solutions to the problems a youngster is likely to encounter” (Blosser & DePompei, 1994, p. 84). This would be helpful during assessment, as standardized tests do not provide a snapshot of an individual’s ability to function in the classroom or in the real world (Benton, 1991; Bigler, 1988; Crepéau, Scherzer, Belleville, & Desmarais, 1997). Additionally, executive function deficits like distractibility, social disinhibition, and impulsiveness do not always become evident from results of standardized test results (Benton, 1991; Bigler, 1988; Ylvisaker & Gioia, 1998). Informal measures and observations may be necessary to identify these behaviors and deficits.

Little research exists for treatment of concussion; consequently, clinicians rely and adapt intervention techniques for mild TBI. Interventions for mTBI can be divided into three categories: pharmacotherapy, cognitive rehabilitation, and patient education.

One area of research has focused on the use of pharmacological interventions to treat symptoms associated with mTBI. Four studies evaluated the use of amitriptyline, an anti-depressant, as a treatment for depression and headaches following a mild head injury (Dinan & Mobayed, 1992; Saran, 1985; Saran, 1988; Tyler, McNeely, & Dick, 1980).
The drug regimen varied between studies, making it difficult to derive a conclusive statement on its effect (Comper et al., 2005). Additionally, the use of corticosteroids has been studied based on the presumed ability to reduce inflammation. A systematic review of randomized controlled trials in individuals with TBI revealed considerable uncertainty in their effects (Alberson & Roberts, 1997). Research has also evaluated the role of methylphenidate in children and adults to treat deficits of attention and speed of processing following a TBI (Kaelin, Cifu, & Matthies, 1996; Williams, Douglas Ris, Ayyangar, Schefft, & Berch, 1998; Whyte et al., 2004; Mahalick et al., 1998). The results of these studies are inconsistent. While some suggest that methylphenidate can improve memory, attention, concentration, and processing (Whyte et al., 2004), Williams and colleagues (1998) found no significant effect following the use of the medication. There is a lack of solid evidence that drug treatments are effective for reducing one or more symptoms of mTBI, as many pharmacotherapy studies provided inconsistent results (Comper et al., 2005).

A second area of research has examined the use of cognitive rehabilitation interventions to improve attention, memory, executive function, and cognitive processing following mTBI. Some research efforts have focused on improving working memory via competing task activities (i.e., taking directions over the phone while figuring out route on map) (Cicerone, 2002; Serino, Ciaramelli, & Santantonio, 2007). Subjects demonstrated improvements on measures of working memory and attention; however, it is unclear whether improved performance in a laboratory setting translates to a functional recovery of cognition in the real-world (Comper et al., 2005). Additionally, Cicerone and colleagues (1996) created a neuropsychological rehabilitation program, tailoring
treatment for each patient to meet individual needs. The protocol included “both ‘paper-and-pencil’ and ‘real-life’ activities aimed at improving their ability to focus and sustain attention, maintain task performance in the presence of background noise and distractions, and shift the priority of attention among competing stimuli or tasks” (Cicerone et al., 1996, p. 280). Fifty percent of subjects exhibited a good outcome while the other 50% exhibited a poor outcome. These results show that the good outcome group had greater improvement on neuropsychological measures of cognitive function compared to the poor outcome treatment group, demonstrating the variability in recovery following TBI (Comper et al., 2005). Other research in the area of cognitive rehabilitation has focused on “memory training” (Helmick, 2010). Studies have shown that the use of repetitive memory drills is ineffective (Rees, Marshall, Hartridge, Mackie, & Weiser, 2007; Schutz & Trainor, 2007). The research of Kashel and colleagues demonstrates that the use of mnemonics is effective for improving memory for individuals with mTBI and effectiveness decreases as injury severity increases (Kashel et al., 2002). Research has also shown external aids (i.e., memory notebook, schedules, written reminders) can be used to serve as a way to compensate, improving everyday memory function in individuals with TBI (Sohlberg et al., 2007). Furthermore, Mark Ylvisaker and colleagues proposed a functional everyday approach to cognitive rehabilitation (Ylvisaker, Szekeres, & Haarbauer-Krupa, 1998). They outline necessary supports and strategies to teach individuals after TBI of all severity types to successfully complete and understand activities of daily living, other everyday routines, play, perception, general organization schemas, and language. Ylvisaker and colleagues argue that integrating routines and real-world activities in cognitive rehabilitation is a more
realistic approach to intervention and promotes generalization. Below are some of the cognitive supports that Ylvisaker and colleagues suggest increase independent performance of activities of daily living.

- Generate consistent daily routines both in the hospital and at home
- Ensure consistent location of every day items (e.g., clothes, bathroom items, eating utensils)
- Label closets, drawers, containers, etc. with helpful photographs, symbols, or words, allowing the child to know where to look for needed items
- Provided useful external organizers (i.e., a picture schedule) so the child can independently guide himself or herself through the activity or day.
- Have photographs available to orient the child to the unfamiliar people.
- Encourage the child to observe peer models and use peers as coaches if this is helpful for the child.
- Gradually reduce support as the child’s competence improves.

(adapted from Ylvisaker, Szekeres, & Haarbauer-Krupa, 1998, p. 197)

The TBI literature suggests that rest is warranted in the initial period of recovery; however, education of the individual and family is also important during this time (Ylvisaker et al., 1995; Waaland, 1998; Kirkwood et al., 2008). Ponsford and colleagues studied the effect of information booklets about symptoms and what to expect after the injury for children and their families following a mTBI. In this controlled study, two mTBI groups were studied and compared to 2 control groups of children with minor injuries that did not include the head. One mTBI group received ED treatment and the information booklet while the other mTBI group only received ED treatment. Results revealed that providing the information booklet early in the treatment period minimized
stress and lowered incidence of ongoing problems (Ponsford et al., 2001). A clear understanding of the nature and typical recovery associated with the injury has been shown to improve recovery rates (Ponsford et al., 2001; Kirkwood et al., 2008). Caregivers should be educated on warning signs and be able to take action in the case of a medical emergency (Hux & Hacksley, 1996). The child’s symptoms and cognitive status should be monitored and evaluated frequently in order to track recovery.

Once asymptomatic and medical clearance is given, the child can return to school and activities. Upon initially returning to school after experiencing a TBI, a student may require compensatory strategies in order to succeed. Examples of these include extending test time and assignment deadlines, providing a copy of notes, using visual or auditory cues to gain attention, preferential classroom seating, and providing step-by-step instructions (Hux & Hacksley, 1996; McGrath, 2010). These modifications aim to lessen visual, concentration, attentional, and other demands on the student. The guidelines proposed for management of TBI can be adapted to meet the individual needs of a concussed child.

The Problem

Concussion management is considered the fastest growing sub-discipline of neuropsychology and the literature of concussion management is growing exponentially. In communication sciences and disorders, the role of the SLP in concussion management is unclear. The Individuals with Disabilities Education Act (IDEA) is a federal law that ensures special education services for students with disabilities and traumatic brain injury is included as an official educational disability (IDEA, 1990). Under this law, individuals who have sustained a brain injury qualify for special education services (e.g., speech-
Furthermore, both the American-Speech-Hearing-Association Scope of Practice (2007) and the American-Speech-Hearing-Association position statement on cognitive-communication disorders (2005) state that SLPs are not only qualified but also required to provide services to individuals following a head injury. The roles of the SLP in regards to TBI include identification, assessment, intervention, counseling, collaboration, case management, education, prevention, and advocacy (ASHA, 2005). The scope of practice states that speech pathologists should also play a role in prevention, advocacy, and education in addition to providing clinical services. Duff (2009) argued that SLPs are the most qualified to meet the demands of detecting and managing concussion in school aged individuals given their knowledge in cognitive-communication disorders, administration of standardized testing, and clinical decision-making, particularly in schools where there is not a staff neuropsychologist. Salvatore and Fjordback (2011) agree, stating that school based SLPs are the best suited to provide these services, as they are “strategically located to care for and monitor the neurocommunication and academic progress” of concussed students.

Despite these calls that SLPs should contribute to concussion assessment and management, numerous studies have identified that educators and SLPs feel unprepared and lack self-confidence to deliver services to individuals with TBI (Blosser & DePompei, 1991; Duff, Proctor, & Haley, 2002; Frank, Redmond, Ruediger, & Scott, 1997; Hux, Walker, & Sanger, 1996; McGrane & Cascella, 2000). With regard to SLPs, the lack of preparedness has been linked to a minimal amount of coursework in cognition (Blosser & DePompei, 1991; Russell, 1993) and lack of supervised clinical experience in graduate training programs (Duff et al., 2002). Similarly, in a study of 78 Illinois school-
based SLPs, Duff and colleagues found that SLPs do not feel qualified or prepared to provide service to students with TBI, to serve on an interdisciplinary brain injury team, or to educate other school personnel and student athletes about the consequences and prevention of concussion although they stated that doing so was within their scope of practice and a role that SLPs should embrace (Duff, Graf, & Benson, 2003). While it seems clear that the range of cognitive deficits possible following a concussion could interfere with language and communication, placing them on the caseload of the school speech-language pathologist (e.g., Russell, 1993), the role of SLPs in concussion management and current practices for school aged children with concussion has not been described.

**Purpose of the Study**

The goals of the current survey study are: 1) to determine and characterize the current knowledge of pediatric concussion in school SLPs including the causes, symptoms, and neuropathophysiology of concussion, the effects of age, sex and multiple injuries on concussion recovery, and the impact of concussion on cognition, communication, social and academic performance; 2) to determine and characterize the current management practices for concussed students by school SLPs including obtaining information about the number of students with concussion on their caseload, assessment and treatment procedures used for this population, frequency of follow-up or monitoring services of concussed students, and role in concussion education and prevention. The results promise to offer insights about current practice, may lead to more targeted education opportunities for practicing SLPs, identification of future research needs, and
may ultimately improve the quality of service delivery to students recovering from concussion.
<table>
<thead>
<tr>
<th>Grade</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 Concussion</td>
<td>Temporary confusion</td>
</tr>
<tr>
<td></td>
<td>No loss of consciousness</td>
</tr>
<tr>
<td></td>
<td>Resolution of symptoms within 15 minutes</td>
</tr>
<tr>
<td>Grade 2 Concussion</td>
<td>Temporary confusion</td>
</tr>
<tr>
<td></td>
<td>No loss of consciousness</td>
</tr>
<tr>
<td></td>
<td>Symptoms last for more than 15 minutes</td>
</tr>
<tr>
<td>Grade 3 Concussion</td>
<td>Loss of consciousness (brief or prolonged)</td>
</tr>
</tbody>
</table>

Cascade Following Concussion
CHAPTER II
METHODS

Survey Development

A survey consisting of 65 items was developed and served as the basis for data collection (see Appendix A). The questions on the survey focused on knowledge and current management of children with concussion. Survey items addressed seven areas: professional background information, concussion knowledge and terminology, referral, assessment, management, follow-up and/or monitoring, and respondents’ education and experiences with TBI and concussion. Survey questions were a mix of multiple choice, fill-in, yes/no, and Likert-type scale formats. A 5-point scale accompanied all Likert-type items, ranging from “strongly agree” to “strongly disagree” with a midpoint response of “uncertain.”

Professional background items included four questions concerning the respondents’ education and current employment. Concussion knowledge and terminology was divided into three parts: (a) 18 statements concerning epidemiology, characteristics, behaviors, assessment, and treatment procedures of concussed students to which respondents indicated their level of agreement on a 5 point Likert scale; and (b) 10 terms associated with concussion and TBI to which respondents indicated whether or not they were capable of providing definitions by answering yes or no. The content for the concussion knowledge section was established by reviewing literature on concussion.

Items included in the referral section focused on whether or not respondents were notified when students sustain a concussion at or away from school. If they responded
YES, respondents were asked to answer questions about number of referrals and notification procedures in their work setting. If they responded NO, respondents were asked questions about who is notified at the school and whether or not they believed SLPs should be notified.

In the assessment section, respondents were asked to list formal and informal assessments and to indicate which areas should be assessed for concussed students. Respondents also indicated whether or not they had ever provided assessment for a concussed student. In the management section, items were divided into 6 sections: (a) one yes/no item on whether or not respondents provided treatment for a concussed student; (b) one multiple choice item on length of treatment for a concussed student; (c) one item in which respondents indicated areas targeted in treatment of concussed students; (d) one item in which respondents listed classroom accommodations for concussed students; (e) 2 yes/no items about promoting education and awareness on concussion; and (f) 8 yes/no items concerning readiness and opinions of respondents’ ability to provide service to students with concussion. The section on follow-up and/or monitoring procedures addressed current practices for reassessment and follow-up of concussed students. For these three sections of the survey (assessment, management, and follow-up and/or monitoring), respondents were instructed to answer the questions based on their current practices. If they have never provided services to a concussed student, respondents were asked to answer the question based on how they would approach the situation.

Respondent’s education and experiences with TBI and concussion contained four sections: (a) one item detailing specific training related to concussion; (b) one item detailing specific training related to TBI; (c) one item in which respondents indicated
whether or not they ever provided services in a medically-based setting; and (d) one item detailing if their school district has a head injury team.

Development of the survey occurred over two stages. First, the initial survey was developed to assess knowledge and information across the seven aforementioned areas. The form and content of the survey drew heavily from previous studies of traumatic brain injury (e.g., Duff, Proctor, & Haley, 2002; Duff et al., 2003; Hux, Walker, & Sanger, 1996). Second, the survey was distributed to 4 practicing speech language pathologists and 4 graduate students for review to determine face validity. Changes to the wording of questions to resolve ambiguity and to the general organization of the survey, as well as removal of any redundant questions, were completed.

Participants

A total of 1000 surveys were sent to practicing school speech language pathologists across 10 states: Minnesota, Wisconsin, New York, Massachusetts, Georgia, Florida, Texas, Tennessee, California, and Arizona. Using data from the 2010 Schools Survey report (ASHA, 2010), 10 states were selected that: a) represent diverse geographical regions of the US, and b) represent the density of speech language pathologists practicing in various geographic areas (e.g., highest percentage of speech language pathologists working in the South (~30%); smallest in the West (~18%)).

The names and addresses of the participants were obtained from the American Speech-Language-Hearing Association. For each state, a mailing list of 100 randomized speech language pathologists self-designated as working in elementary, middle/junior high, and/or high school was obtained.
Each person on the list was mailed a cover letter explaining the nature of the survey, a survey, and a self-addressed, stamped return envelope. The survey was a 7-page booklet, stapled twice at the seam. It contained print on both sides of each page except the last page of the booklet was left blank. The first page of the survey was a cover page containing the title of the survey and the authors’ names. The second page contained the cover letter stating the purpose of the study and directions for completing the survey (See Appendix B). Pages three through seven contained the survey. A blank page was included at the end of the survey to allow respondents room to write any additional comments. To track the number of surveys returned from each state, while protecting anonymity, each state was assigned a color on which the surveys were printed (e.g., New York surveys were printed on green paper; Florida surveys were printed on gray paper).

The speech language pathologists were asked to complete the survey at their earliest convenience and return it with the enclosed self-addressed envelope. Prospective participants were informed that the survey would take less than 20 minutes to complete and participation was entirely voluntary. Informants were assured their responses would only be reported as group responses and that neither individual names nor the name of the facility where they were employed would be used at any time, either in the data processing or in reporting the results. About two weeks after mailing the original invitations to participate, reminder postcards (see Appendix C) were mailed to all 1000 individuals, encouraging the speech language pathologists to complete and return the survey.
Data Analysis

The sample size varied across questions on the survey, as not all respondents answered all questions. Most of the survey data was treated descriptively. The survey contained 18 statements concerning epidemiology, characteristics, behaviors, assessment, and treatment procedures of concussed students to which respondents indicated their level of agreement on a 5 point Likert scale. Responses were collapsed to provide general indication of agreement or disagreement with a given statement. Responses strongly agree and agree as well as strongly disagree and disagree were combined for the purpose of data analysis.
CHAPTER III

RESULTS

Response Rate

One thousand surveys were mailed to practicing school speech-language pathologists across 10 states: Minnesota, Wisconsin, New York, Massachusetts, Georgia, Florida, Texas, Tennessee, California, and Arizona. A total of 280 surveys were returned, which is a 28% response rate. The number of responses from the 10 states ranged from a low of 20 (New York) to a high of 37 (Minnesota) (M = 27.2; SD = 5.2).

A total of 272 surveys were used for data analysis. Of the 280 returned, 8 surveys were not used in data analysis either because respondent indicated they had never worked in a school setting or the survey was returned blank. In the following sections, data will be reported within the following seven areas: education and experiences, concussion knowledge, referral, assessment, management, follow-up and monitoring, and concussion education and prevention. The number of respondents varies from question to question as not all respondents answered all questions.

Education and Experiences

The number of years respondents worked as a speech-language pathologist at the time of completing the survey ranged from 2 to 43 years (M = 16.5; SD = 9.51). The overwhelming majority of respondents held a master’s degree (97.77%; n = 263/269) while 1.49% (4/269) held a doctoral degree, and less than one percent held only a bachelor’s degree (n = 2/269). The majority of respondents worked in elementary schools (70.8%; n = 245/332). About eighteen percent (n = 60/332) worked at a junior high or
middle school and 11.1% (n = 37/332) worked at a high school. Over half (61.3%; n = 160/261) of respondents reported full-time employment at a single school while 38.7% (n = 101/261) of respondents provided services at more than one school. Respondents indicated that few schools or school districts in the states surveyed have interdisciplinary brain injury teams (10.6%; n = 27/255). Of the schools with brain injury teams, 29.6% (n = 8/27) of respondents participate on the team. Although we were specifically interested in the concussion management practices in the schools, it is interesting to note that over half of the respondents (57.1%; n = 153/268) have previously provided services in a medically-based setting (e.g., hospital). Table 2 reports the demographic information of the survey respondents.

Only 21.2% (n = 56/264) of respondents had specific training related to concussion, and less than half of respondents with this training (41.2%; n = 14/34) completed clinical practica with concussed individuals. Of those respondents who indicated receiving training in concussion, 41.1% (n = 23/56) did so as part of continuing education, 33.9% (n = 19/56) did so as part of their undergraduate or graduate school training, and 25% (n = 14/56) received both college and continuing education training. Some differences in concussion training emerged among the states sampled (see Table 3). Arizona had the most respondents who reported having concussion training (38.7%; n = 12/31) while New York, with 15.8% of respondents (n = 3/19), had the fewest number of respondents who reported concussion training. The source of concussion training was variable across states. Over two-thirds of respondents from California, Texas, Tennessee, and Florida reportedly received concussion training as part of college coursework. Over
two thirds of respondents from New York, Massachusetts, Wisconsin, and Arizona received concussion training through continuing education.

While the number of respondents receiving training specific to concussion was low, the majority of respondents had received more general training in TBI. Over 80% of respondents had training related to TBI (83.8%; n = 222/265), and 73.1% (n = 136/186) performed clinical practica with TBI patients. Similar to the data on concussion training there was considerable variability among the states. California had the most respondents reporting TBI training (92.9%; n = 26/28) while Florida had the fewest respondents reporting TBI training (70.8%; n = 17/24). The source of TBI training was more consistent across respondents, as over 70% of respondents from all states received TBI training as part of college coursework.

**Concussion Knowledge**

The survey contained 18 statements concerning epidemiology, characteristics, behaviors, assessment, and treatment procedures of concussed students to which respondents indicated their level of agreement. Over 80% of respondents correctly disagreed that loss of consciousness is required for a diagnosis of concussion. Additionally, over 80% correctly agreed that a concussion is a brain injury, a concussed individual is more vulnerable for a subsequent injury, concussion can affect academic performance, physical rest is important for recovery, concussions can occur in any recreational sport or activity, and repeated concussions can cause long-term damage if the brain does not recover between injuries. Some uncertainty emerged for several of the statements. Over 20% of respondents were uncertain if children show better concussion recovery than adults, signs and symptoms of concussion overlap symptoms of other
disorders, concussed students are eligible for educational accommodations, recovery is complete when the individual is asymptomatic, and multiple concussions are required to observe long-term cognitive deficits. Over 35% of respondents were unsure if cognitive rest is important for recovery, individual baseline neuropsychological testing is part of concussion prevention and management, and concussions result in structural damage visible on MRI or CAT scans. The most uncertainty existed for respondents (74.8%; n = 202/270) concerning whether or not males show better recovery from concussion than females. Concussion knowledge of respondents is displayed in Table 5.

Overall, TBI training did not appear to significantly impact on respondents’ concussion knowledge. TBI training was defined as undergraduate or graduate coursework and/or continuing education such as inservices, workshops, conferences, and seminars. Responses to concussion knowledge questions were similar for individuals with and without TBI training. The responses of the entire group were similar to those of individuals with TBI training. Table 6 displays the influence of TBI training on respondents’ concussion knowledge.

In contrast, concussion training increased respondents’ concussion knowledge across most areas. Concussion training was defined as undergraduate or graduate coursework and/or continuing education such as inservices, workshops, conferences, or seminars. Ninety-one percent of respondents (n = 50/55) with concussion training agreed that signs and symptoms of concussion can overlap with those of other disorders compared to only 70% of respondents without concussion training. Over 70% of respondents (72.7%; n = 40/55) with concussion training agreed that concussed students are eligible for accommodations such as specialized instruction or other educational
accommodations. Similar to the group as a whole, respondents with concussion training remained unsure if cognitive rest is important for recovery (30.9%; n = 17/55), if concussions result in structural damage visible on CT or MRI scans (29.6%; n = 16/54), if males show better recovery than females (70.9%; n = 39/55), and if children show better recovery than adults (25.5%; n = 14/55). Table 7 displays the influence of concussion training on respondents’ concussion knowledge.

Survey respondents were asked to give a yes/no response on their ability to define ten words associated with concussion and TBI. Over 70% of respondents indicated an inability to define the following terms: second impact syndrome, diffuse axonal injury, and anterograde amnesia. On the other hand, at least 75% of respondents believed they could define post-traumatic amnesia, executive functioning, and consciousness. Respondents were divided on their perceived ability to define Glasgow Coma Scale, lability, confabulation, and retrograde amnesia. Table 8 shows results of this section.

**Referral**

Only 11.7% (n = 31/265) of respondents indicated that they are notified when a student in their school sustains a concussion at or away from school. Of the respondents who are not notified, 80.6% (n = 129/160) believe they should be notified when a student sustains a concussion at or away from school. Only 34.6% (n = 56/162) indicated knowing which school personnel are notified when a student has a concussion. Respondents reported that the school nurse (n=49/96; 51%), administrators (n=17/96; 18%), and teachers (n=17/96; 18%) are the ones notified when a student sustains a concussion at or away from school.
Of those who are notified when a student sustains a concussion, the majority reported receiving 1-5 referrals per year (95.2%; n=20/21) and one respondent indicated receiving 5-15 referrals per year (4.8%; n=1/21). Respondents indicated that it is the parent (n=20/65; 31%), teacher (n=18/65; 28%), or school nurse (n=15/65; 23%) who notifies the SLP when a student sustains a concussion. These referrals are typically received within 1-7 days of the injury (54.6%; n=12/22). Figure 2 displays the amount of time after the injuries SLPs receive a referral.

**Assessment**

Respondents were asked to indicate which areas should be assessed for concussed students. Respondents provided 41 unique areas to assess (357 total responses). Table 9 shows the most commonly reported areas. Areas of assessment receiving less than 2% of responses were not included in the table. Expressive language was the most frequently reported area to assess (21.3%; n = 76/357) followed by receptive language (20.7%; n = 74/357) and memory (9.8%; n = 35/357). A small percentage of responses (2.2%; n = 8/357) indicated uncertainty of which area(s) to target in assessment.

Less than ten percent of respondents (6.4%; n = 17/270) have assessed a concussed student. Respondents provided 55 unique responses (326 total responses) when asked to indicate a formal assessment used to evaluate concussed students. Table 10 presents the most common formal assessment tools respondents do or would use to evaluate concussed students. Formal assessments that received less than 2% of the total responses were not included in this table (see Appendix C for all assessments suggested by survey respondents). The Clinical Evaluation of Language Fundamentals (CELF) was the most frequently reported formal assessment tool (17.5%; n = 57/326) followed by the
Comprehensive Assessment of Spoken Language (CASL) (5.5%; n = 18/326) and the Expressive One-Word Picture Vocabulary Test (EOWPVT) (4.3%; n = 14/326). Nearly a quarter of the responses (22.4%; n = 73/326) were not specific formal assessment tools but rather described a test category such as a language assessment or memory assessment. Seven percent (n=23/326) of responses indicated they were unsure or would need to research for a proper formal assessment. A small percentage of responses (4%; n = 12/326) indicated that someone else in the school or district would do the assessment.

Respondents were also asked to indicate informal assessment tools or measures used for concussed students. Respondents provided 53 unique responses (349 total responses). Table 11 presents the most frequently reported informal assessment tools and measures. Informal assessments and measures that received less than 2% of responses were not included in the table. See Appendix D for a full list of informal assessments. A parent, teacher, or coach interview following a concussion was the most commonly reported informal assessment (14%; n = 49/349) followed by classroom observation (12.6%; n = 44/349) and language sample (10.6%; n = 37/349). Three percent (n = 12/349) reported uncertainty as to what formal assessment to use.

Management

Less than ten percent of respondents (9.7%; n = 26/267) indicated experience providing services for a student with a concussion. Respondents provided 51 unique areas to target in treatment (320 total responses). Table 12 displays the most commonly reported areas to target when treating concussed students. Memory was the most frequent response (14.7%; n = 47/320) followed by expressive language (9.1%; n = 29/320) and word retrieval (7.5%; n = 24/320). Five percent of responses (n = 16/320)
indicated that any deficit area would be treated and 4.7% (n = 15/320) stated uncertainty as to which area to target in treatment of concussed students.

Respondents were asked how long a concussed student would stay on the caseload to receive treatment. The most common treatment durations were 1-3 months (24.4%; n = 19/78), 4-6 months (20.5%; n = 16/78), and more than a year (25.6%; n = 20/78). Figure 3 displays the length of treatment for concussed students.

When asked to list classroom accommodations for concussed students, respondents provided 42 unique strategies and modifications (451 total responses). The most common classroom accommodation is extended time for work and tests (13.7%; n = 62/451) followed by repetition of directions/questions (10.6%; n = 48/451) and more visual cues/aids (10%; n = 45/452). About 2% of respondents (n= 10/451) indicated uncertainty of appropriate classroom accommodations and another 2% (n = 9/451) stated that accommodation would depend on student need(s). Two respondents (less than 1%) indicated they would use the same accommodations provided to students with learning disabilities, specific language impairments, or attention deficit hyperactivity disorder. One respondent revealed that special education develops accommodations and another respondent said no accommodations are needed for concussed students.

The survey contained two yes/no items about promoting education and awareness on concussion. Few respondents (4.9%; n = 11/223) have disseminated information regarding concussion, symptoms, and what to expect from the injury to coaches, teachers, parents, and students and even fewer (0.9%; n = 2/223) have provided an inservice to coaches, teachers, or students regarding prevention of concussion.
Eight survey questions aimed to determine respondents’ readiness and opinions on providing services to concussed students. Over half of the respondents (67%; n = 146/218) felt uncertain that treatment for concussed students is effective. Many respondents (68.5%; n = 152/222) do not consider themselves to be the most knowledgeable resource among school personnel for information on concussion. When asked if they were aware of institutional (state; school district) documentation that defines what services should be provided by school SLPs, 52.9% (n = 120/227) indicated no while another 13.2% (n = 30/227) responded they were uncertain. When asked if it is an SLP’s responsibility to provide intervention to concussed students in the school setting, a majority of respondents were uncertain (60.7%; n = 136/224) and (30.4%; n = 68/224) indicted yes. While 8.9% (n = 20/224) indicated they did not feel it is an SLP’s responsibility to provide intervention to concussed students in the school setting, 62.2% (n = 140/225) of respondents believe it is within an SLP’s scope of practice to provide treatment to concussed students in the school setting and 34.7% (n = 78/225) were uncertain. A third of respondents (31.3%; n = 71/227) thought that colleagues and school administrators believe that concussion intervention has education relevance. When asked if the school district has concussion management procedures, protocols, and guidelines to assist SLPs working in the school, 54.1% (n = 124/229) of respondents said no while 41.9% (n = 96/229) were uncertain. The final question in this section asked if respondents were confident in their ability to provide treatment to concussed students. Only 21.8% (n = 49/225) felt confident in their abilities while 43.1%(n = 97/225) were not confident and 35.1% (n = 79/225) were uncertain.
Follow-up and Monitoring

Respondents were asked several questions regarding follow-up and/or monitoring procedures of concussed students. Many respondents (70.4%; n = 159/226) indicated that they do or would reassess students at regular intervals if they were not impaired at initial evaluation following a concussion. The most typical timeframe for reassessment was once a month (39.6%; n = 57/144) or every six months (34.7%; n = 50/144). Sixteen percent (n = 21/144) reassess students once a week while 12% (n = 16/144) reassess students once a month. When asked if they routinely follow concussed students after discharge, 61.3% (n = 138/225) of respondents reported they do or would. The most common interval of follow-up was once a month (39.7%; n = 50/126) and every six months (38.1%; n = 48/126). The last question in this section asked when respondents typically terminate follow-up. The most frequently response was after 12 months (43%; n = 73/168). Figure 4 displays the results from this question.
Table 2 Respondents’ Education and Experiences

**Number of Years as Practicing Speech Language Pathologists (n = 271)**

<table>
<thead>
<tr>
<th>Years as Practicing SLP</th>
<th>Number of Respondents</th>
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<tbody>
<tr>
<td>Less than a year</td>
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<tr>
<td>1-5 years</td>
<td>23 (8.5%)</td>
</tr>
<tr>
<td>6-10 years</td>
<td>71 (26.2%)</td>
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<td>11-15 years</td>
<td>52 (19.2%)</td>
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<td>16-20 years</td>
<td>36 (13.3%)</td>
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<tr>
<td>21-30 years</td>
<td>66 (24.3%)</td>
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<tr>
<td>More than 31 years</td>
<td>23 (8.5%)</td>
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**Highest Degree Earned (n = 269)**

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<tr>
<th>Degree</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor’s Degree</td>
<td>2 (0.7%)</td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>263 (97.7%)</td>
</tr>
<tr>
<td>Doctoral Degree</td>
<td>4 (1.5%)</td>
</tr>
</tbody>
</table>

**Current Employment Setting (n = 332)**

<table>
<thead>
<tr>
<th>Employment Setting</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary School</td>
<td>245 (70.8%)</td>
</tr>
<tr>
<td>Junior High/Middle School</td>
<td>60 (18.1%)</td>
</tr>
<tr>
<td>High School</td>
<td>37 (11.1%)</td>
</tr>
</tbody>
</table>

**Employed Full-Time in One School (n = 261)**

<table>
<thead>
<tr>
<th>Employment Status</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>160 (61.3%)</td>
</tr>
<tr>
<td>No</td>
<td>101 (38.7%)</td>
</tr>
</tbody>
</table>

* Some respondents work in more than one setting

---

Table 3 Percentage of Respondents with Concussion Training and the Source of Training (n = 264)

<table>
<thead>
<tr>
<th>State</th>
<th>Concussion Training</th>
<th>College</th>
<th>Continuing Education</th>
<th>Both College and Continuing Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZ (n = 31)</td>
<td>38.7%</td>
<td>8.3%</td>
<td>58.3%</td>
<td>33.3%</td>
</tr>
<tr>
<td>CA (n = 27)</td>
<td>25.9%</td>
<td>71.4%</td>
<td>28.6%</td>
<td>0.0%</td>
</tr>
<tr>
<td>FL (n = 25)</td>
<td>16.0%</td>
<td>50.0%</td>
<td>25.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>GA (n = 23)</td>
<td>8.7%</td>
<td>50.0%</td>
<td>50.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>MA (n = 22)</td>
<td>18.2%</td>
<td>0.0%</td>
<td>75.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>MN (n = 37)</td>
<td>21.6%</td>
<td>37.5%</td>
<td>37.5%</td>
<td>25.0%</td>
</tr>
<tr>
<td>NY (n = 19)</td>
<td>15.8%</td>
<td>33.3%</td>
<td>66.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>TN (n = 25)</td>
<td>20.0%</td>
<td>20.0%</td>
<td>20.0%</td>
<td>60.0%</td>
</tr>
<tr>
<td>TX (n = 23)</td>
<td>17.4%</td>
<td>75.0%</td>
<td>0.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>WI (n = 32)</td>
<td>21.9%</td>
<td>28.6%</td>
<td>42.9%</td>
<td>28.6%</td>
</tr>
<tr>
<td>TOTAL (n = 264)</td>
<td>21.2%</td>
<td>33.9%</td>
<td>41.1%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Table 4 Percentage of Respondents with TBI Training and the Source of TBI Training (n = 265)

<table>
<thead>
<tr>
<th>State</th>
<th>TBI Training</th>
<th>College</th>
<th>Continuing Education</th>
<th>Both College and Continuing Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZ (n = 31)</td>
<td>83.9%</td>
<td>23.1%</td>
<td>26.9%</td>
<td>50.0%</td>
</tr>
<tr>
<td>CA (n = 28)</td>
<td>92.9%</td>
<td>30.8%</td>
<td>3.8%</td>
<td>65.4%</td>
</tr>
<tr>
<td>FL (n = 24)</td>
<td>70.8%</td>
<td>17.6%</td>
<td>23.5%</td>
<td>58.8%</td>
</tr>
<tr>
<td>GA (n = 23)</td>
<td>91.3%</td>
<td>42.9%</td>
<td>14.3%</td>
<td>38.1%</td>
</tr>
<tr>
<td>MA (n = 23)</td>
<td>78.3%</td>
<td>50.0%</td>
<td>5.6%</td>
<td>44.4%</td>
</tr>
<tr>
<td>MN (n = 36)</td>
<td>88.9%</td>
<td>56.3%</td>
<td>3.1%</td>
<td>40.6%</td>
</tr>
<tr>
<td>NY (n = 20)</td>
<td>85.0%</td>
<td>52.9%</td>
<td>11.8%</td>
<td>35.3%</td>
</tr>
<tr>
<td>TN (n = 25)</td>
<td>84.0%</td>
<td>42.9%</td>
<td>9.5%</td>
<td>47.6%</td>
</tr>
<tr>
<td>TX (n = 23)</td>
<td>82.6%</td>
<td>31.6%</td>
<td>21.1%</td>
<td>42.1%</td>
</tr>
<tr>
<td>WI (n = 32)</td>
<td>78.1%</td>
<td>48.0%</td>
<td>12.0%</td>
<td>36.0%</td>
</tr>
<tr>
<td>TOTAL (n = 265)</td>
<td>83.8%</td>
<td>40.6%</td>
<td>12.8%</td>
<td>46.6%</td>
</tr>
</tbody>
</table>

Table 5 Concussion Knowledge of Respondents

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of consciousness is required for a diagnosis of concussion. (n = 271)</td>
<td>7.38%</td>
<td>12.55%</td>
<td>80.07%</td>
</tr>
<tr>
<td>A concussion is a brain injury. (n = 271)</td>
<td>92.62%</td>
<td>4.80%</td>
<td>2.58%</td>
</tr>
<tr>
<td>Children show better recovery from concussion than older individuals. (n = 271)</td>
<td>61.03%</td>
<td>31.25%</td>
<td>7.72%</td>
</tr>
<tr>
<td>The signs and symptoms of concussion can overlap with symptoms of other disorders such as depression, anxiety, and attention-deficit disorder. (n = 272)</td>
<td>75.00%</td>
<td>21.69%</td>
<td>3.31%</td>
</tr>
<tr>
<td>Recovery from a concussion is complete when the individual is asymptomatic. (n = 272)</td>
<td>5.88%</td>
<td>21.69%</td>
<td>72.43%</td>
</tr>
<tr>
<td>Concussion makes an individual more vulnerable for a subsequent injury. (n = 272)</td>
<td>80.15%</td>
<td>14.71%</td>
<td>5.15%</td>
</tr>
<tr>
<td>Concussion can affect academic performance. (n = 272)</td>
<td>96.32%</td>
<td>3.31%</td>
<td>0.37%</td>
</tr>
<tr>
<td>Cognitive rest is important for recovery from a concussion. (n = 272)</td>
<td>44.85%</td>
<td>36.03%</td>
<td>19.12%</td>
</tr>
<tr>
<td>Physical rest is important for recovery from a concussion. (n = 270)</td>
<td>89.26%</td>
<td>8.52%</td>
<td>2.22%</td>
</tr>
<tr>
<td>A standardized protocol, or return to play guidelines, is important for determining when a student returns to competitive play. (n = 269)</td>
<td>81.41%</td>
<td>15.24%</td>
<td>3.35%</td>
</tr>
<tr>
<td>Males show better recovery from concussion than females. (n = 270)</td>
<td>1.11%</td>
<td>74.81%</td>
<td>24.07%</td>
</tr>
<tr>
<td>Individualized baseline neuropsychological testing for student athletes is part of concussion prevention and management. (n = 269)</td>
<td>37.17%</td>
<td>47.96%</td>
<td>14.87%</td>
</tr>
<tr>
<td>Concussed students are eligible for accommodations such as specialized instruction or other educational accommodations. (n = 270)</td>
<td>53.33%</td>
<td>32.96%</td>
<td>13.7%</td>
</tr>
<tr>
<td>Concussions result in structural damage that is visible on CT or MRI scans. (n = 267)</td>
<td>29.21%</td>
<td>43.45%</td>
<td>27.34%</td>
</tr>
<tr>
<td>Multiple concussions are required to observe long-term cognitive deficits. (n = 268)</td>
<td>8.58%</td>
<td>23.51%</td>
<td>69.91%</td>
</tr>
<tr>
<td>Concussions can occur in individual or group recreational sport or activity. (n = 268)</td>
<td>98.88%</td>
<td>1.12%</td>
<td>0%</td>
</tr>
<tr>
<td>A repeated concussion that occurs before the brain recovers from the first can slow recovery or increase the likelihood of having long-term problems. (n = 268)</td>
<td>94.40%</td>
<td>5.22%</td>
<td>0.37%</td>
</tr>
<tr>
<td>Statement</td>
<td>Training</td>
<td></td>
<td>Training</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>----------</td>
<td>-------------</td>
<td>----------</td>
</tr>
<tr>
<td>Loss of consciousness is required for a diagnosis of concussion.</td>
<td>7.3%</td>
<td>14.7%</td>
<td>78.0%</td>
</tr>
<tr>
<td>A concussion is a brain injury.</td>
<td>92.8%</td>
<td>4.5%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Children show better recovery from concussion than older individuals.</td>
<td>60.6%</td>
<td>31.2%</td>
<td>8.1%</td>
</tr>
<tr>
<td>The signs and symptoms of concussion can overlap with symptoms of other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>disorders such as depression, anxiety, and attention-deficit disorder.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery from a concussion is complete when the individual is asymptomatic.</td>
<td>75.1%</td>
<td>21.7%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Concussion makes an individual more vulnerable for a subsequent injury.</td>
<td>5.5%</td>
<td>21.0%</td>
<td>73.5%</td>
</tr>
<tr>
<td>Concussion can affect academic performance.</td>
<td>81.1%</td>
<td>13.1%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Cognitive rest is important for recovery from a concussion.</td>
<td>95.9%</td>
<td>3.6%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Physical rest is important for recovery from a concussion.</td>
<td>45.5%</td>
<td>36.8%</td>
<td>17.7%</td>
</tr>
<tr>
<td>A standardized protocol, or return to play guidelines, is important for</td>
<td>81.0%</td>
<td>15.4%</td>
<td>3.6%</td>
</tr>
<tr>
<td>determining when a student returns to competitive play.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males show better recovery from concussion than females.</td>
<td>89.6%</td>
<td>7.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Individualized baseline neuropsychological testing for student athletes is part of concussion prevention and management.</td>
<td>0.9%</td>
<td>75.3%</td>
<td>23.7%</td>
</tr>
<tr>
<td>Concussed students are eligible for accommodations such as specialized</td>
<td>37.9%</td>
<td>47.0%</td>
<td>15.1%</td>
</tr>
<tr>
<td>instruction or other educational accommodations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concussions result in structural damage that is visible on CT or MRI scans.</td>
<td>53.9%</td>
<td>32.0%</td>
<td>14.2%</td>
</tr>
<tr>
<td>Multiple concussions are required to observe long-term cognitive deficits.</td>
<td>30.3%</td>
<td>42.2%</td>
<td>27.5%</td>
</tr>
<tr>
<td>Concussions can occur in individual or group recreational sport or activity.</td>
<td>10.1%</td>
<td>22.6%</td>
<td>67.3%</td>
</tr>
<tr>
<td>A repeated concussion that occurs before the brain recovers from the first can slow recovery or increase the likelihood of having long-term problems.</td>
<td>98.6%</td>
<td>1.4%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>93.2%</td>
<td>6.4%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
Table 7 Influence of Concussion Training on Respondents’ Concussion Knowledge

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of consciousness is required for a diagnosis of concussion.</td>
<td>3.6%</td>
<td>14.5%</td>
<td>81.8%</td>
<td>8.1%</td>
<td>11.5%</td>
<td>80.4%</td>
</tr>
<tr>
<td>A concussion is a brain injury.</td>
<td>98.2%</td>
<td>1.8%</td>
<td>0.0%</td>
<td>91.4%</td>
<td>5.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Children show better recovery from concussion than older individuals.</td>
<td>58.2%</td>
<td>25.5%</td>
<td>16.4%</td>
<td>61.0%</td>
<td>33.3%</td>
<td>5.7%</td>
</tr>
<tr>
<td>The signs and symptoms of concussion can overlap with symptoms of other disorders such as depression, anxiety, and attention deficit disorder.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery from a concussion is complete when the individual is asymptomatic.</td>
<td>90.9%</td>
<td>9.1%</td>
<td>0.0%</td>
<td>70.5%</td>
<td>25.2%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Concussion makes an individual more vulnerable for a subsequent injury.</td>
<td>5.5%</td>
<td>14.5%</td>
<td>80.0%</td>
<td>6.2%</td>
<td>23.3%</td>
<td>70.5%</td>
</tr>
<tr>
<td>Concussion can affect academic performance.</td>
<td>90.9%</td>
<td>7.3%</td>
<td>1.8%</td>
<td>77.1%</td>
<td>16.7%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Cognitive rest is important for recovery from a concussion.</td>
<td>100.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>95.2%</td>
<td>4.3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Physical rest is important for recovery from a concussion.</td>
<td>54.5%</td>
<td>30.9%</td>
<td>14.5%</td>
<td>42.4%</td>
<td>37.6%</td>
<td>20.0%</td>
</tr>
<tr>
<td>A standardized protocol, or return to play guidelines, is important for determining when a student returns to competitive play.</td>
<td>81.8%</td>
<td>12.7%</td>
<td>5.5%</td>
<td>81.7%</td>
<td>15.4%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Males show better recovery from concussion than females.</td>
<td>94.5%</td>
<td>3.6%</td>
<td>1.8%</td>
<td>88.0%</td>
<td>9.6%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Individualized baseline neuropsychological testing for student athletes is part of concussion prevention and management.</td>
<td>1.8%</td>
<td>70.9%</td>
<td>27.3%</td>
<td>1.0%</td>
<td>76.1%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Concussed students are eligible for accommodations such as specialized instruction or other educational accommodations.</td>
<td>38.2%</td>
<td>41.8%</td>
<td>20.0%</td>
<td>35.6%</td>
<td>50.5%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Concussions result in structural damage that is visible on CT or MRI scans.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple concussions are required to observe long-term cognitive deficits.</td>
<td>72.7%</td>
<td>16.4%</td>
<td>10.9%</td>
<td>47.4%</td>
<td>37.8%</td>
<td>14.8%</td>
</tr>
<tr>
<td>Concussions can occur in individual or group recreational sport or activity.</td>
<td>29.6%</td>
<td>29.6%</td>
<td>40.7%</td>
<td>28.5%</td>
<td>46.9%</td>
<td>24.6%</td>
</tr>
<tr>
<td>A repeated concussion that occurs before the brain recovers from the first can slow recovery or increase the likelihood of having long-term problems.</td>
<td>1.9%</td>
<td>11.1%</td>
<td>87.0%</td>
<td>10.6%</td>
<td>25.5%</td>
<td>63.9%</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>98.6%</td>
<td>1.4%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Table 8 Perceived Ability to Define Concussion and TBI Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Functioning (n = 267)</td>
<td>94.01%</td>
<td>5.99%</td>
</tr>
<tr>
<td>Consciousness (n = 266)</td>
<td>93.61%</td>
<td>6.39%</td>
</tr>
<tr>
<td>Post-traumatic Amnesia (n=269)</td>
<td>79.55%</td>
<td>20.45%</td>
</tr>
<tr>
<td>Lability (n=266)</td>
<td>59.02%</td>
<td>40.98%</td>
</tr>
<tr>
<td>Glasgow Coma Scale (n=268)</td>
<td>57.84%</td>
<td>42.16%</td>
</tr>
<tr>
<td>Retrograde Amnesia (n = 266)</td>
<td>48.50%</td>
<td>51.50%</td>
</tr>
<tr>
<td>Confabulation (n = 265)</td>
<td>41.51%</td>
<td>58.49%</td>
</tr>
<tr>
<td>Second Impact Syndrome (n=266)</td>
<td>27.44%</td>
<td>72.56%</td>
</tr>
<tr>
<td>Anterograde Amnesia (n = 266)</td>
<td>27.07%</td>
<td>72.93%</td>
</tr>
<tr>
<td>Diffuse Axonal Injury (n=268)</td>
<td>20.15%</td>
<td>79.85%</td>
</tr>
</tbody>
</table>

Table 9 Areas to Assess in Concussed Students (n = 357)

<table>
<thead>
<tr>
<th>Area</th>
<th>Percent of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressive language</td>
<td>21.3%</td>
</tr>
<tr>
<td>Receptive language</td>
<td>20.7%</td>
</tr>
<tr>
<td>Memory</td>
<td>9.8%</td>
</tr>
<tr>
<td>Pragmatics</td>
<td>7.0%</td>
</tr>
<tr>
<td>Word retrieval</td>
<td>4.2%</td>
</tr>
<tr>
<td>Problem solving</td>
<td>3.9%</td>
</tr>
<tr>
<td>Executive functioning</td>
<td>3.6%</td>
</tr>
<tr>
<td>Auditory processing</td>
<td>3.4%</td>
</tr>
<tr>
<td>Language</td>
<td>2.5%</td>
</tr>
<tr>
<td>Attention</td>
<td>2.2%</td>
</tr>
<tr>
<td>Comprehension</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

Table 10 Common Formal Assessments (n = 326)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Percent of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Evaluation of Language Fundamentals (CELF)</td>
<td>17.5%</td>
</tr>
<tr>
<td>Comprehensive Assessment of Spoken Language (CASL)</td>
<td>5.5%</td>
</tr>
<tr>
<td>Expressive One-Word Picture Vocabulary Test (EOWPVT)</td>
<td>4.3%</td>
</tr>
<tr>
<td>Test of Auditory Processing Skills (TAPS)</td>
<td>3.4%</td>
</tr>
<tr>
<td>Peabody Picture vocabulary Test (PPVT)</td>
<td>3.1%</td>
</tr>
<tr>
<td>Receptive One Word Picture Vocabulary Test (ROWPVT)</td>
<td>2.8%</td>
</tr>
<tr>
<td>Test of Language Development (TOOLD)</td>
<td>2.8%</td>
</tr>
<tr>
<td>Test of Problem Solving (TOPS)</td>
<td>2.5%</td>
</tr>
<tr>
<td>Oral and Written Language Scale (OWLS)</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
Table 11 Common Informal Assessments and Measures (n = 349)

<table>
<thead>
<tr>
<th>Informal Assessment</th>
<th>Percent of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent, teacher, or coach interview</td>
<td>14.0%</td>
</tr>
<tr>
<td>Classroom observation</td>
<td>12.6%</td>
</tr>
<tr>
<td>Language sample</td>
<td>10.6%</td>
</tr>
<tr>
<td>Student interview</td>
<td>8.9%</td>
</tr>
<tr>
<td>Short term memory</td>
<td>4.3%</td>
</tr>
<tr>
<td>Playground/sports/social setting observation</td>
<td>3.7%</td>
</tr>
<tr>
<td>Naming tasks</td>
<td>3.4%</td>
</tr>
<tr>
<td>Answers questions appropriately about self/events</td>
<td>3.2%</td>
</tr>
<tr>
<td>Compare academic performance before and after</td>
<td>2.9%</td>
</tr>
<tr>
<td>Ability to follow directions</td>
<td>2.3%</td>
</tr>
<tr>
<td>Conversational sample</td>
<td>2.3%</td>
</tr>
<tr>
<td>Orientation</td>
<td>2.3%</td>
</tr>
<tr>
<td>Pragmatic assessment</td>
<td>2.3%</td>
</tr>
<tr>
<td>Long-term memory</td>
<td>2.0%</td>
</tr>
<tr>
<td>Problem solving</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

Table 12 Common Areas Targeted in Treatment (n = 320)

<table>
<thead>
<tr>
<th>Area</th>
<th>Percent of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>14.7%</td>
</tr>
<tr>
<td>Expressive language</td>
<td>9.1%</td>
</tr>
<tr>
<td>Word retrieval</td>
<td>7.5%</td>
</tr>
<tr>
<td>Executive functioning</td>
<td>5.9%</td>
</tr>
<tr>
<td>Receptive language</td>
<td>5.6%</td>
</tr>
<tr>
<td>Auditory processing skills</td>
<td>5.3%</td>
</tr>
<tr>
<td>Pragmatics</td>
<td>5.3%</td>
</tr>
<tr>
<td>Organization</td>
<td>5.0%</td>
</tr>
<tr>
<td>Problem solving</td>
<td>3.8%</td>
</tr>
<tr>
<td>Attention</td>
<td>2.8%</td>
</tr>
<tr>
<td>Compensatory strategies</td>
<td>2.8%</td>
</tr>
<tr>
<td>Comprehension</td>
<td>2.8%</td>
</tr>
<tr>
<td>Language</td>
<td>2.5%</td>
</tr>
</tbody>
</table>
Table 13 Classroom Accommodations (n = 451)

<table>
<thead>
<tr>
<th>Accommodation</th>
<th>Percent of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended time for work/tests</td>
<td>13.7%</td>
</tr>
<tr>
<td>Directions/questions repeated</td>
<td>10.6%</td>
</tr>
<tr>
<td>More visual cues/aids (schedules, word bank, assignments written out)</td>
<td>10.0%</td>
</tr>
<tr>
<td>Preferential seating</td>
<td>9.1%</td>
</tr>
<tr>
<td>Modified workload</td>
<td>8.4%</td>
</tr>
<tr>
<td>Note taking help/study guides/desk copy of board work</td>
<td>6.4%</td>
</tr>
<tr>
<td>Breaks throughout the day</td>
<td>4.7%</td>
</tr>
<tr>
<td>Teacher checks for student understanding</td>
<td>4.2%</td>
</tr>
<tr>
<td>Allow additional response/processing time</td>
<td>3.8%</td>
</tr>
<tr>
<td>Assistance with organization</td>
<td>3.1%</td>
</tr>
<tr>
<td>Minimal distractions</td>
<td>2.7%</td>
</tr>
<tr>
<td>Peer buddy</td>
<td>2.7%</td>
</tr>
<tr>
<td>Preview and review of material</td>
<td>2.4%</td>
</tr>
<tr>
<td>Uncertain</td>
<td>2.2%</td>
</tr>
<tr>
<td>Depends on needs</td>
<td>2.0%</td>
</tr>
<tr>
<td>Quiet location for test</td>
<td>2.0%</td>
</tr>
<tr>
<td>Chunk information into smaller bits/breakdown tasks</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

Figure 2 Amount of Time After Injury SLPS receive Concussion Referral (n = 22)
Figure 3 Length of Treatment for Concussed Students (n=78)

Figure 4 Termination and Follow-up
CHAPTER IV
DISCUSSION

Pediatric concussion is a growing public health issue. A mild brain injury like a concussion can result in cognitive communication disorders and negatively impact academic and social success (Duff, 2009; Fjordbak, 2011; Hux & Hacksley, 1996; Salvatore, & Fjordbak, 2011). Following a concussion, individuals may experience deficits in cognitive processes, interfering with language use and placing them on the caseload of the school speech-language pathologist (Russell, 1993). These deficits demand additional clinical and/or educational services, making it imperative that speech-language pathologists are properly informed on how to detect and manage individuals with concussion.

The purposes of the present study were to: 1.) determine pediatric concussion knowledge of school SLPs, and 2.) examine the current management practices of pediatric concussion by school SLPs. To establish current knowledge and practices of pediatric concussion, a survey was created and disseminated to 1000 school-based SLPs across the country.

Concussion Knowledge and Experiences

In the present study, only 21% of respondents indicated they had received concussion training either in school coursework or continuing education while 80% indicated they had received TBI training more broadly. This discrepancy could be because some respondents may not have realized that concussion is a type of mTBI or college courses and continuing education are not including concussion (or mTBI) with general TBI material. There may also be confusion because of inconsistencies in
terminology in the literature, as there is debate as to whether concussion should be considered part of mTBI or if it is a brain injury that falls short of being a mTBI (Carroll, Cassidy, Holm, Kraus, & Coronado, 2004; McCrory et al., 2009). In a similar study to the one here by Hux, Walker, and Sanger (1996), approximately half (52.2%) of survey respondents reported specific training related to TBI (Hux, Walker, & Sanger, 1996). That 80% of respondents in the current study reported receiving TBI training represents a significant increase in SLPs receiving TBI training from previous work. This indicates a positive trend across SLPs as a group; however, there is considerable variability across states sampled. For example, California had the most respondents who reported concussion training (92.9%) while Florida had the fewest number of respondents who indicated concussion training (70.8%) Moreover, should this trend continue across all state, it may also lead to more training and education of concussion. Yet, while it is refreshing to see an increase in the percentage of SLPs receiving specific training in TBI, either through graduate coursework or continuing education, the results here suggest that 20% of school SLPs have little to no training in this area despite the fact that brain injury related services are in the ASHA scope of practice. Cognitive communication disorders entered into the SLP’s scope of practice within the past 20 years, and it is important to point out that 32.8% of respondents in the current study have been practicing for 21+ years. This indicates that some respondents who have been in the field the longest have received TBI training at some point in their career.

Consistent with low levels of formal concussion training, only 41.2% (n = 14/34) of respondents indicated that they performed clinical practica with concussed individuals while 73% of the 186 who responded had preformed clinical practica with TBI patients.
In a similar survey study of hospital and rehabilitation center based SLPs, Duff, Proctor, and Haley (2002) found that 46% of respondents had clinical practicum experience with individuals with mTBI and 54% reported no such experience. A lack of graduate coursework in TBI, and cognition more generally, and clinical training experiences have been linked to the lack of preparedness of SLPs working with individuals with TBI (Blosser & DePompei, 1991; Duff et al., 2002; Russell, 1993). The results of this survey suggest that these same challenges remain in the area of concussion and represent a barrier to the delivery of speech language pathology services delivery in the schools.

Increasing coursework in the area of TBI is challenging. Courses dedicated to TBI are seldom required in speech language pathology curricula. When programs do have TBI in the curriculum it is most often an elective, enrolled overwhelming by students who want to work in adult neurogenics. Increased recognition among academic advisors that students preparing to work in the schools also need TBI training (i.e., TBI is most prevalent in pediatric populations (infants, 14-25 years olds) may encourage more students to seek TBI coursework and training as part of their graduate training. Ideally, coursework in this area should be mandatory for all students in order to increase the services for individuals with brain injuries; however, school curricula are already so full, it would be a challenge to make this a graduation requirement. In addition, creating continuing education opportunities that offer information on TBI with a concentration on concussion in local school districts will increase the access school based SLPs to information on best practices in serving concussed students.

The current study suggests that SLPs have some accurate and some inaccurate knowledge regarding concussion. General TBI training (not specific to concussion) did
not appear to impact respondents’ concussion knowledge. Responses were similar for individuals with and without TBI training, as well as for the entire group compared with individuals with TBI training. While this seems counterintuitive, it is possible that concussion may not always be covered in general TBI training, as college courses or continuing education materials may focus on more severe brain injuries. Also, concussion awareness and what we know about the injury has increased significantly in recent years, as has the amount of attention it receives, so individuals who received general TBI training over 5-10 years ago may not be aware of newer concussion facts.

Training specific to concussion, did appear to increase respondents’ concussion knowledge in some areas. Ninety-one percent of respondents with concussion training agreed that signs and symptoms of concussion can overlap with those of other disorders, which is a 15% increase from the group of respondents as a whole. A 25.3% increase in agreement with the following statement was also noted with respondents with concussion training: concussed students are eligible for accommodations such as specialized instruction or other educational accommodations.

The majority of respondents understand that a concussion is a brain injury; however, almost 30% of total respondents believe that a concussion can result in structural damage that is visible on CT or MRI scans. Approximately 30% of respondents with concussion training and TBI training believe this as well. Hux and colleagues found this to be a common misconception of SLPs as well (Hux, Walker, & Sanger, 1996). When an individual sustains a concussions, diffuse axonal damage occurs in the brain; however, this injury does not appear on clinical CT or MRI scans (Kay, 1986; Kirkwood et al., 2006; McCrory et al., 2009).
Over 60% of respondents indicated that children show better recovery from concussion than adults. Most respondents with TBI and/or concussion training believed this statement as well and is most likely related to the long-standing idea that children’s brains are “more plastic” than adult brains. The Kennard principle (Kennard, 1936) suggests that children’s brains are more adaptive after brain damage than an adult brain due to neuroplasticity. This view has been challenged by numerous studies that have shown children are more vulnerable than adults to the diffuse damage of traumatic brain injuries (Anderson et al., 1997; Levin, Song, Ewing-Cobbs, Chapman & Mendelsohn, 2001; Webb, Rose, Johnson, & Attree, 1996). Results of other studies show that outcomes from focal injuries early in life can also be poorer in children than in adults (Anderson, Barrash, Bechara, & Tranel, 2006; Anderson et al., 2005; Ewing-Cobbs, Barnes & Fletcher, 2003). The notion that children are more vulnerable than adults to the effects of brain injury is also evident in the concussion literature as a more conservative management of pediatric concussion is often stressed in the literature (Kirkwood et al., 2006; Aubry et al., 2002).

Over 80% of survey respondents expressed the importance of using standardized protocols like return to play guidelines for individuals with concussion. Return to play protocols can be helpful in guiding concussion management, but should be used with caution. Concussion management should be individualized rather than a "one size fits all" protocol (Collins & Hawn, 2002). Management of concussion should account for factors such as age and sex that the literature has shown to impact recovery. Almost half of respondents were uncertain regarding the use of individualized baseline testing for the management of pediatric concussion. This uncertainty may stem from the fact that
protocols like ImPACT are more common in high school and college settings. While there is some controversy regarding the sensitivity of baseline neuropsychological testing (e.g., Broglio et al., 2009), school SLPs should still become familiar with this type of assessment as they are likely going to be used in elementary schools in the future (Duff, 2009). Baseline testing in concussion management allows for monitoring of an individual's status following a concussion and aligns with the suggested individualized approach to management.

In addition, respondents’ abilities to define words associated with concussion and TBI also demonstrated inadequate knowledge or uncertainty. For instance, over 70% of all respondents indicated they could not define second impact syndrome, diffuse axonal injury, and anterograde amnesia. These results demonstrate that fundamental gaps in basic knowledge exist.

Overall, SLPs in the current study indicate uncertainty as well as some misconceptions in some aspects of concussion knowledge. The results of the present study suggest that current concussion training alone may not be sufficient, as even some respondents who had TBI or concussion training had uncertainties and misconceptions. This may be due to the quality or specificity of information presented in concussion training or the inconsistencies that exist in the literature (i.e., terminology, sex differences). It may also be due to a lag in transfer of concussion and brain injury knowledge, as these areas are rapidly changing. This all points to the need for increased training in pediatric TBI and concussion, in addition to the need for SLPs to stay up to date with concussion and TBI literature. These suggestions are consist with previous studies that have looked at brain injury knowledge of SLPs (Hux, Walker, & Sanger,
demonstrating the lack of TBI knowledge is a consistent problem in the field of speech language pathology.

Referral

In general, SLPs in the present study are not receiving referrals to treat children with concussion. In the present study, only about 12% of respondents indicated that they were notified when a student sustains a concussion. Similarly, in a survey of 78 Illinois school SLPs, Duff et al. (2003) found that only 6% of respondents were informed when a student experienced a sports-related head injury. Moreover, of the all the respondents in the present study who receive referrals for concussion, 95.2% (n = 20/21) of respondents receive 1-5 referrals per year while 4.8% (n = 1/21) of respondents receive 5-15 referrals per year. Given the statistics on concussion, this seems to suggest a gap in identification of concussed students. Although the samples are small, these findings appear to suggest a persistent lack of communication between SLPs and other stakeholders (e.g., teachers, coaches, administrators, parents).

Indeed, approximately 35% of respondents indicated knowing which school personnel are notified when a student has a concussion, and these individuals most frequently included the school nurse, administrators, and teachers. While a school nurse may have appropriate concussion knowledge, administrators and teachers are not trained to monitor and manage concussion. Because a concussion can result in cognitive-communication deficits that impact both academic and social success, qualified personnel like speech-language pathologists should be notified. Moreover, a head injury team at a school can assist in the prevention and management of brain injuries like concussion. The current study found that approximately 10% of schools or districts respondents work
in have head injury teams. Of the 27 respondents that indicated the presence of a head injury team, only 30% were part of the team.

One reason SLPs may not be notified or participate on head injury teams could be a lack of knowledge and understanding of the role SLPs play in TBI and concussion. This calls for SLPs to advocate for their role and educate school personnel on the full scope of their abilities. Another reason SLPs may not be notified could be a lack of communication between school personnel. This warrants the use of enhanced procedures such as a district or school implemented head injury protocol including specifications of who to notify when a student sustains a head injury to improve communication among school personnel. Once awareness is increased, school SLPs could be vital members of the concussion management team.

Perhaps the most surprising finding in this study was that of SLPs who are not notified when a student has had a concussion, 20% do not believe they should be notified and 1% believes it depends on the situation. This is particularly striking since of this 21% of respondents, 91% of them indicated that a concussion is a brain injury. This may reflect a misunderstanding of the roles of a school SLP. Brain injury falls within the SLP’s scope of practice, which is why SLP’s should be notified when a student sustains a concussion. In general, given the prevalence of concussion, we would expect to see more concussed students identified and receiving services from school based SLPs.

**Assessment**

Following a concussion, individuals may experience deficits in cognition (e.g., attention, memory, executive function, processing) and communication (CDC, 2003; Halstead & Walter, 2010). While respondents in the present study reported memory and
pragmatics as two of the top four areas to assess after a concussion, basic language abilities such as expressive and receptive language were the two top most frequent areas of assessment. From this study, it appears that SLPs are focusing mainly on basic language deficits following a concussion rather than areas of cognition that may underlie a disruption. However, even in severe cases of brain injury, only about one third of survivors display basic language deficits like aphasia, while the majority display motor speech and/or cognitive-communication deficits (Sarno, 1980; Sarno, Buonaguro, & Levita, 1986). In addition, only 3.6% of responses suggested executive function as an area to be assessed. This is surprising given the strong link between executive function deficits following a mTBI such as concussion (CDC, 2003; Halstead & Walter, 2010), and executive function and other cognitive processes should be the focus of assessment following a concussion.

Similarly, the present study found the formal assessments used to assess concussions are not appropriate for pediatric TBI. The most common assessment suggested by SLPs in the current study was the Clinical Evaluation of Language Fundamentals (CELF) with 17.5% of respondents reporting its use. A previous study examined the use of the CELF-3 for identifying language disorders in adolescents with TBI and found it was not sensitive to the detection of cognitive impairments that would impact communication ability. The test was able to identify individuals with previous diagnoses of language impairment but not individuals with verbal information processing impairments. The CELF-3 also does not identify strengths and weaknesses (Turkstra, 1999). While the tests mentioned by SLPs in the current study may not be sensitive to
cognitive communication deficits, this may be due to the paucity of formal assessment tools for pediatric TBI.

Formal assessments recommended for the pediatric TBI population for their specificity and sensitivity to detecting deficits include the Woodcock Johnson Tests of Psycholinguistic Abilities and Behavior Rating Inventory of Executive Function (BRIEF) (Turkstra et al., 2005). The Woodcock Johnson III Tests of Cognitive Abilities was standardized on over 8000 healthy subjects ranging from age 2 to 90. It can be useful for identifying deficits after TBI as it measures intellectual activity and academic achievement; however, it does not provide norms for individuals after a TBI (Turkstra et al., 2005). The BRIEF is a questionnaire for parents and teachers to complete based on a student’s behavior in home and school environments. This test assesses executive function and is designed for TBI, LD, attentional disorders, depression, and other disorders. It was standardized on males and females ages 5 to 18 (Turkstra et al., 2005). The findings of the current study support the need for more formal assessment tools to identify deficits after pediatric TBI and concussion, as well as better education regarding the use of existing tools.

In addition to a general lack of assessment tools for pediatric TBI, SLPs may not be qualified to administer some assessments designed specifically to measure cognition that may be informative and useful during the assessment process (i.e., neuropsychologists can administer and interpret assessment results from many tests of intelligence and cognition that SLPs can not). This speaks to the importance of multidisciplinary head injury teams to manage individuals with TBI. A team including a neuropsychologist and SLP would offer assessment in basic cognitive abilities
(neuropsychology) and how those deficits impact communication (SLP). This fits into the SLPs role in concussion management, as SLPs can administer and interpret cognitive and behavioral assessments to concussed students; however, this again demonstrates that there is a need for better training of SLPs and development of more sensitive assessment tools for pediatric TBI.

Additionally, informal measures are useful for evaluating how a child is able to function in his/her normal environment and for planning and monitoring intervention (Coelho, Ylvisaker, & Turkstra, 2005). As described above, few formal or standardized tools exist, increasing the clinician’s reliance on informal methods and measures for the evaluation of a student. The top four measures suggested by respondents of the current study include parent, teacher, coach interview, classroom observation, language sample, and student interview. These practices are consistent with recommendations in the literature (Coelho, Ylvisaker, & Turkstra, 2005), as they can provide a whole picture of the student and how he/she is functioning in the environment. It is interesting to note the frequent use of a language sample by respondents, as it highlights the heavy focus on expressive language assessment following a TBI. Clinicians must remember that deficits following a concussion do not always show up right away, demonstrating the necessity of a periodic check/monitoring as part of the assessment and management process, which is reviewed later in the Follow-up and Monitoring section of this chapter.

Management

In the present study, respondents were asked to indicate areas they do or would target in treatment of concussion. The top four responses were memory, expressive language, word retrieval, and executive function. Given that concussion leads to deficits
primarily in cognition, the inclusion of expressive language and word retrieval is surprising; however, slowed processing and confusion, which are common symptoms of concussion, could impact word retrieval. Additionally, 5% of responses indicated uncertainty as to what area should be targeted in treatment.

When the concussed student returns to school, the SLP can support the student’s transition and provide any necessary accommodations. In rare cases of more severe deficits, the SLP can assist in obtaining specialized education services for the student. Respondents were asked to list appropriate classroom accommodations for concussed students and the following were the top four responses: extended time for work/tests, directions/questions repeated, more visual cues/aids, and preferential seating. Each of these appears to be an appropriate strategy for a concussed student. Mark Ylvisaker and colleagues generated a non-exhaustive list of school accommodations and strategies that may need to be considered for students with TBI (Ylvisaker et al., 1995). He lists general categories (i.e., schedule, instructional methods) and specific adaptations under each (i.e., length of instructional sessions, need for task analysis).

Consistent with low levels of concussion training and experience, SLPs expressed a general lack of confidence in concussion treatment and working with concussed students. For example, 67% of respondents indicated uncertainty as to whether or not treatment for concussion is effective, and 61% were uncertain if it is a school SLP’s responsibility to provide services for concussed students. Additionally, only 22% of respondents felt confident in their abilities to provide services to concussed students. These findings are consistent with other studies of SLP’s perceptions of abilities to treat TBI. Hux and colleagues found that most SLPs do not feel qualified to serve as an
individualized educational plan (IEP) manager or to provide academic and cognitive treatment for student survivors of TBI (Hux, Walker, & Sanger, 1996). The combination of uncertainty and inaccurate treatment areas further suggests inadequate and/or lack of proper concussion knowledge.

Follow-up and Monitoring

Consistent with the suggestion that deficits do not always appear immediately following a brain injury, and the individual may not have any difficulties until school or social demands are increased (Savage, 1991), many SLPs appear to understand the need for reassessment and monitoring of students. Hux and colleagues (1996) found that most respondents were aware that a child’s cognitive-communication problems may not arise until several years post injury. The present study revealed similar findings, as 70% of respondents do or would reassess students at regular intervals if not impaired at initial evaluation following a concussion. The most typical timeframe reported in this study for reassessment was once a month or every six months. While frequent reassessment immediately following the injury may be warranted, the child should be continually monitored for years to come, as symptoms or deficits may not appear until the individual experiences increased demands in school, home, or work (Kay, 1986).

Additionally, 61% of respondents indicated they do or would continue to follow concussed students after discharge. Forty-three percent of respondents would terminate follow-up after 12 months and sixteen percent would terminate after 2 or more years. As previously mentioned, it is important to monitor students for any delayed onset of changes or problems following a brain injury, and these long periods of follow-up are encouraging to see.
Role of the SLP

Both the American-Speech-Hearing-Association Scope of Practice (2007) and the position statement on cognitive-communication disorders (2005) make it clear that SLPs are not only qualified but also obligated to provide services to individuals following a head injury. The roles of the SLP in regards to TBI include identification, assessment, intervention, counseling, collaboration, case management, education, prevention, and advocacy (ASHA, 2005). The scope of practice states that speech pathologists should also play a role in prevention, advocacy, and education in addition to providing clinical services. Because concussion is a brain injury, speech language pathologists should be able to contribute to assessment, diagnosis, and treatment process of individuals after sustaining a concussion. Training of SLPs should include both cognition and language, as a disruption or deficit in either of these domains may cause communication impairment.

TBI falls within the umbrella of special education services provided by school personnel like SLPs. The Individuals with Disabilities Education Act (IDEA) is a federal law that ensures special education services for students with disabilities. It was first passed in 1990 and reauthorized in 2004 and recognized traumatic brain injury as an official educational disability:

Traumatic brain injury means an acquired injury to the brain caused by an external physical force, resulting in total or partial functional disability or psychosocial impairment, or both, that adversely affects a child's educational performance. Traumatic brain injury 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. Traumatic brain injury does not apply to brain injuries...
that are congenital or degenerative, or to brain injuries induced by birth trauma. (IDEA, 1990)

This law was reauthorized by Congress in 2004 and continues to be reevaluated to provide the best services for students with disabilities. Furthermore, IDEA states that any child suspected of having a disability, including TBI and concussion, is required to be evaluated free of cost to the parent or caregiver. This evaluation can help determine if there is a disability and if the child qualifies for special services under IDEA.

Furthermore, Section 504 of the Rehabilitation Act may cover students after experiencing a TBI. If students only require accommodations (as opposed to specialized instruction), they may be eligible under the 504 plan. In order to qualify for these services, students must exhibit a physical or mental impairment that limits one major life activity: walking, seeing, hearing, speaking, breathing, learning, reading, writing, doing math calculations, working, caring for oneself, or performing manual tasks (Duff, 2009).

If the need for services is questionable upon the student’s return to school, a response-to-intervention (RTI) model may be put in place by the SLPs, as this allows for support in the least restrictive environment. Deborah Adamczyk explains this approach in the following way:

Initially the RTI team could plan the student's return to school. The SLP and/or health care providers should provide the team with information about signs that may indicate more long-term effects of TBI. If issues arise, other levels of the RTI model could be used to modify instruction and provide accommodations; if that approach does not provide the necessary support, consideration could be made to do a full multidisciplinary assessment. This assessment would determine if the student requires special education services, which would include direct speech/language support as well as any other services, such as learning support, occupational therapy, or other supports (Duff, 2009).
School based SLPs are the suited to provide services for students after a TBI, as they are “strategically located to care for and monitor the neurocommunication and academic progress” of students (Salvatore & Fjordback, 2011; Duff, 2009). The school based SLP can identify concussed students, contribute to the treatment team, support the transition back to school, and increase awareness and prevention of concussion. Increased training and communication between school personnel would maximize the contributions of school SLPs. While SLPs may be best suited, the current study reveals some weaknesses in the SLP’s ability to provide quality services. There is a need to build on the current infrastructure, which in turn would improve SLPs’ knowledge and ultimately services.

**Study Limitations**

The use of a survey for data collection may be criticized for several reasons. The first is that data are based on respondents’ interpretations of questions and answers provided. To minimize this, feedback from practicing SLPs and graduate students was considered during survey development. Additionally, respondents’ self-report may not accurately reflect actual knowledge and practice. The likelihood that responses reflect actual knowledge and practices is increased by the survey’s use of many objective rather than subjective information and because participation was anonymous. Furthermore, survey questions were aimed to typify the “average concussed student;” however, management procedures for every student with a concussion may be different depending on the circumstances.

The current study was also limited by the response rate. The total response rate was 28%. One of the factors for the low response rate may be lack of time to complete
surveys or disinterest in participating in the current study. Another factor could be lack of experience. Some individuals returned the survey blank indicating they had retired or no longer were employed in a school.

**Implications for Future Research**

Despite limitations explained above, this study is the first of its kind, as it provides a snapshot of concussion knowledge and practices of school-based SLPs across the nation and serves as a baseline upon which to make improvements in SLP training and standard of service for concussed students. It is obvious from the results that increased training in pediatric TBI and concussion is needed for school based SLPs. For example, graduate school curricula should consider requiring a course devoted specifically to TBI. If incidence continues at the current rate or grows, school based SLPs could potentially accrue a number of concussed individuals on their caseload. For this reason, SLPs need accurate information and skills for management of pediatric concussion. The results also demonstrate that school SLPs are rarely notified when a student sustains a concussion. School personnel and SLPs should work together to establish improved communication and identification of concussed students. Finally, research directed at identifying and developing sensitive assessments and effective treatments for pediatric concussion is warranted. The literature combined with the results of the present study point toward the paucity of attention in the area of pediatric concussion.
APPENDIX A
SURVEY

A. Background Information
1. How long have you been a practicing speech-language pathologist (SLP)? ________ years

2. What is the highest degree you have earned? (e.g., BA, MS, PhD) ________

3. What is your current employment setting? (check all that apply)
   ___ elementary school
   ___ middle school/junior high school
   ___ high school

4. YES  NO  Do you work full-time in one school?

B. Concussion Knowledge and Terminology
The statements below are generalizations about concussion and do not account for individual differences. For each statement, please indicate your strength of agreement or disagreement with each statement as a generalization. If you are uncertain or do not have enough information to provide an opinion about a given statement, mark “Uncertain.”

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Uncertain</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
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<tbody>
<tr>
<td>SA</td>
<td>A</td>
<td>U</td>
<td>D</td>
<td>SD</td>
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1. SA  A  U  D  SD  Loss of consciousness is required for a diagnosis of concussion.
2. SA  A  U  D  SD  A concussion is a brain injury.
3. SA  A  U  D  SD  Children show better recovery from concussion than older individuals.
4. SA  A  U  D  SD  The signs and symptoms of concussion can overlap with symptoms of other disorders such as depression, anxiety, and attention-deficit disorder.
5. SA  A  U  D  SD  Recovery from a concussion is complete when the individual is asymptomatic.
6. SA  A  U  D  SD  Concussion makes an individual more vulnerable for a subsequent injury.
7. SA  A  U  D  SD  Concussion can affect academic performance.
8. SA  A  U  D  SD  Cognitive rest is important for recovery from a concussion.
9. SA  A  U  D  SD  A standardized protocol, or return to play guidelines, is important for determining when a student returns to competitive play.
10. SA  A  U  D  SD  Physical rest is important for recovery from a concussion.
11. SA  A  U  D  SD  Males show better recovery from concussion than females.
12. SA A U D S D Individualized baseline neuropsychological testing for student athletes is part of concussion prevention and management.

13. SA A U D S D Concussed students are eligible for accommodations such as specialized instruction or other educational accommodations.

14. SA A U D S D Concussions result in structural damage that is visible on CT or MRI scans.

15. SA A U D S D Multiple concussions are required to observe long-term cognitive deficits.

16. SA A U D S D Concussions can occur in individual or group recreational sport or activity.

17. SA A U D S D A repeated concussion that occurs before the brain recovers from the first can slow recovery or increase the likelihood of having long-term problems.

18. Please state two or more frequently observed symptoms of a concussion.

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

19. Can you define the following terms?

<table>
<thead>
<tr>
<th>Term</th>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>Second impact syndrome</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Diffuse axonal injury</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Post-traumatic amnesia</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Glasgow Coma Scale</td>
<td>YES</td>
<td>NO</td>
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<tr>
<td>Executive Functioning</td>
<td>YES</td>
<td>NO</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Term</th>
<th>YES</th>
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<tbody>
<tr>
<td>Lability</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Retrograde amnesia</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Confabulation</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Anterograde amnesia</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Consciousness</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

C. Referral

1. YES NO Are you notified when students sustain a concussion at or away from school?
   If YES, please answer questions 2, 3, and 4.
   If NO, please answer the following questions.
   YES NO Do you think you should be notified?
   YES NO Do you know who is notified?
   If YES, who is notified at your school? ________________

2. How many referrals following concussion do you receive per year?
   ____ 1-5 referrals per year
   ____ 6-15 referrals per year
   ____ more than 15 referrals per year

3. Who notifies you that a student has sustained a concussion? (check all that apply)
   ____ student
   ____ teacher
   ____ school nurse
   ____ coach/athletic trainer
   ____ physician
   ____ other (please specify) ________________

4. Typically, how long after injury do you receive the referral?
D. Assessment
1. YES NO Have you ever provided assessment for a student with a concussion?

If you have worked with a student with a concussion, please answer these questions based on your current practices. If you have not worked with a student with a concussion, please answer based on how you would approach assessment.

2. What formal assessments do you use to evaluate concussed students?

___________________________________________________
___________________________________________________
___________________________________________________

3. What informal measures/assessments do you use to evaluate concussed students?

___________________________________________________
___________________________________________________
___________________________________________________

4. Which areas do you most often assess in concussed students? (e.g., expressive language)

___________________________________________________
___________________________________________________
___________________________________________________

E. Management
1. YES NO Have you ever provided treatment for a student with a concussion?

If you have worked with a student with a concussion, please answer these questions based on your current practices. If you have not worked with a student with a concussion, please answer based on how you would approach assessment.

2. What areas do you most frequently target when treating concussed students?

___________________________________________________
___________________________________________________
___________________________________________________

3. How long do you typically treat concussed students?

___ less than a month  ___ 7-9 months
___ 1-3 months  ___ 10-12 months
___ 4-6 months  ___ more than a year

4. What classroom accommodations need to be made for some concussed students?

___________________________________________________
___________________________________________________
___________________________________________________

5. YES NO Uncertain Do you feel that treatment for concussed students is effective?

6. YES NO Uncertain Do you consider yourself to be the most knowledgeable resource among school personnel for information on concussion?

7. YES NO Uncertain Have you ever provided an inservice to coaches, teachers, or students
regarding prevention of concussion?

8. YES      NO      Uncertain  Do you give literature to students, family members, teachers, and/or coaches regarding concussion, symptoms, and what to expect with this injury?

9. YES      NO      Uncertain  Are you aware of documentation at the state level that defines what services you should provide as a school SLP?

10. YES      NO      Uncertain  Is it an SLP’s responsibility to provide intervention to concussed students in the school setting?

11. YES      NO      Uncertain  Is it within an SLP’s scope of practice to provide treatment to concussed students in the school setting?

12. YES      NO      Uncertain  Do you think your colleagues and school’s administrators believe that concussion intervention has educational relevance?

13. YES      NO      Uncertain  Does your school district have concussion management procedures, protocols, and guidelines to assist SLPs working in the schools?

14. YES      NO      Uncertain  Do you feel confident in your ability to provide treatment to concussed students?

F. Follow-up and/or Monitoring
Please answer these questions based on your current practices. If you have never provided services to a concussed student, please answer based on how you would approach follow-up and monitoring.

1. YES      NO  For students who have sustained a concussion and are not impaired at the time of a speech-language evaluation, do you reassess these students at regular intervals?

   If YES, how often do you reassess the student?
   __________ once a week
   __________ once a month
   __________ every six months
   __________ once a year

2. YES      NO  Do you routinely follow students after discharge?

   If YES, what is your typical interval?
   __________ once a week
   __________ once a month
   __________ every six months
   __________ once a year

3. When do you typically terminate follow-up?

   ____ within 1 month  ____ after 12 months
   ____ within 3 months  ____ after 18 months
   ____ after 6 months  ____ after 2 or more years

G. Speech-Language Pathologist Education and Experiences
1. YES NO Have you had specific training related to concussion?
   If NO, move on to question 2.
   If YES, did the training occur: (check all that apply)
   ________as part of your undergraduate or graduate education (go to A)
   ________through inservices, workshops, conferences, seminars, etc. (go to B)
   A. YES NO Did you perform clinical practica with concussed individuals?
   B. Which categories best describe where you received your training:
      ________poster sessions, technical sessions, miniseminars, or short inservices
      ________half-day or full day conferences such as workshops or seminars
      ________university courses taken after completion of your degree
      ________self-taught (books, websites, peer reviewed journal articles)

2. YES NO Have you had specific training related to TBI?
   If NO, move on to question 3.
   If YES, did the training occur: (check all that apply)
   ________as part of your undergraduate or graduate education (go to A)
   ________through inservices, workshops, conferences, seminars, etc. (go to B)
   A. YES NO Did you perform clinical practica with TBI patients?
   B. Which categories best describe where you received your training:
      ________poster sessions, technical sessions, miniseminars, or short inservices
      ________half-day or full day conferences such as workshops or seminars
      ________university courses taken after completion of your degree
      ________self-taught (books, websites, peer reviewed journal articles)

3. YES NO Have you ever provided services in a medically-based setting?

4. YES NO Does the school or school district in which you work have a head injury team?
   YES NO If YES, are you a part of this team?

Thank you for participating in this study. Please return this survey within the next two weeks in the enclosed pre-addressed stamped envelope.

If there is anything else you would like to tell us about your experience with concussion or concussed students, please use the back of this page. If you are interested in receiving more information about concussion, please provide your contact information.
Dear colleague:

We are currently conducting a research study involving a survey of speech language pathologists to explore current knowledge and management of pediatric concussion. Clinicians working in school settings are invited and encouraged to participate. Your opinions will provide valuable information regarding practice patterns and perceptions within our speech language pathology community. This is a master’s research project conducted by Sarah Stuck at the University of Iowa under the supervision of Dr. Melissa Duff.

If you agree to participate, you can complete the enclosed survey. The survey should take less than 20 minutes to complete. The questions are a combination of multiple choice and open-ended questions, and you are free to skip any questions that you prefer not to answer. Your participation is entirely voluntary.

We ask that you complete the survey in the next two weeks. A follow up postcard will be sent in three weeks as a reminder to return the survey. If you choose not to participate, no further action is required.

After you complete the survey, please return it directly to the University of Iowa. The return postage on the survey is prepaid. All responses to the surveys will be anonymous. It will not be possible to link you to your responses on the survey. We assure you that your responses will be reported only as group responses. Neither your name nor the name of the facility where you are employed will be used at any time, either in the data processing or in reporting the results.

If you have questions about the rights of research subjects, please contact the Human Subjects Office, 105 Hardin Library for Health Sciences, 600 Newton Rd, The University of Iowa, Iowa City, IA 52242-1098, (319) 335-6564, or email irb@uiowa.edu.

Thank you for participating in this study. If you have any questions about this study, please feel free to contact either of us at: sarah-stuck@uiowa.edu or melissa-duff@uiowa.edu.

Sincerely,

Sarah Stuck, BA     Melissa Duff, Ph.D., CCC-SLP
Master’s Student     Assistant Professor
A few weeks ago, you received a survey on pediatric concussion. If you wish to participate in this study, please complete and return the survey in the next few days. If you do not wish to participate, no further action is required.

Thank you for participating in this study.

Sincerely,

Sarah Stuck, BA
Master’s Student
The University of Iowa

Melissa Duff, PhD, CCC-SLP
Assistant Professor
The University of Iowa
APPENDIX D

FORMAL ASSESSMENTS

Clinical Evaluation of Language Fundamentals (CELF)
Comprehensive Assessment of Spoken Language (CASL)
Expressive One-Word Picture Vocabulary Test (EOWPVT)
Test of Auditory Processing Skills (TAPS)
Peabody Picture Vocabulary Test (PPVT)
Receptive One Word Picture Vocabulary Test (ROWPVT)
Test of Language Development (TOLD)
Test of Problem Solving (TOPS)
Oral and Written Language Scale (OWLS)
Expressive Vocabulary Test (EVT)
Listening Comprehension Test (LCT)
Test of Pragmatic Language (TOPL)
Test of Word Finding (TWF)
Preschool Language Scale (PLS)
Language Processing Test (LTP 3)
Mini Mental State Examination (MMSE)
Ross Information Processing Assessment – Second Edition (RIPA - 2)
Token Test
Comprehensive Receptive and Expressive Vocabulary Test (CREVT)
Glasgow Coma Scale (GCS)
Goldman Fristoe Test of Articulation (GFTA)
Scales of Cognitive Ability for Traumatic Brain Injury (SCATBI)
Social Language Development Test
Test for Auditory Comprehension of Language (TACL)
Test of Auditory Reasoning and Processing Skills (TARPS)
Test of Narrative Language (TNL)
Arizona Speech Battery
Attention Processing Test (APT)
Boston Naming Test
Classroom Performance Assessment (CPA)
Cognistat
Comprehensive Test of Phonological Processing (CTOPP)
Functional Communication Profile (FCP-R)
HELP
Illinois Test of Psycholinguistic Abilities (ITPA-3)
Right Brain Inventory
Ross Test of Higher Cognitive Process
SCAN-C Test for Auditory Processing Disorders in Children
Test of Adolescent/Adult Word Finding (TAWF)
Test of Language Competence (TLC)
Test of Semantic Skills (TOSS)
Test of Word Knowledge (TOWK)
Test of Written Language (TOWL)
Wide Range Assessment of Memory and Learning (WRAML)
APPENDIX E

INFORMAL ASSESSMENTS

Parent, teacher, or coach interview
Classroom observation
Language sample
Student interview
Short-term memory
Playground/sports/social setting observation
Naming tasks
Answers questions appropriately about self/events
Compare academic performance before and after
Ability to follow directions
Conversational sample
Orientation
Pragmatic assessment
Long-term memory
Problem solving
Attention
Oral motor evaluation
Academic performance on simple tasks (math facts)
Topic maintenance
Affect
Ask for medical records
Eye contact
Language checklist
Narrative skill analysis
Refer to someone else
Associations
Cognition
Monitor student closely
Reaction time
Story retell
Absurdities
Behavioral assessment
Executive functioning
Explain idioms or plays on words
Intelligence rating
Patient history
Writing sample


