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Social Cognitive Functioning and Social Competence in Children and Adolescents with Spina Bifida and Hydrocephalus: Social Cognitive Neuroscience As a Model

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SOCIAL COGNITIVE FUNCTIONING AND SOCIAL COMPETENCE IN CHILDREN AND ADOLESCENTS WITH SPINA BIFIDA AND HYDROCEPHALUS: SOCIAL COGNITIVE NEUROSCIENCE AS A MODEL

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TABLE OF CONTENTS

ACKNOWLDGEMENTS iii

LIST OF TABLES viii

LIST OF FIGURES x

ABSTRACT xi

CHAPTER I: INTRODUCTION 1

CHAPTER II: REVIEW OF RELEVANT LITERATURE 7
Spina Bifida 7
Orthopedic and peripheral features 9
Neurological features 10
Neuropsychological implications 14
Additional cognitive constructs of interest 21
Predictors of Functional Outcomes in Spina Bifida 23
Defining Social Competence 26
Components of Social Competence and their Link to Neuropsychological Functioning 29
Social Competence in the Context of Chronic Illness 33
Social Cognitive Neuroscience as a Basis for Understanding Social Competence 37
Developmental Considerations 41
Rationale for the Current Study 43
Hypotheses 46
Social cognitive functioning 46
Predictors of social cognitive functioning 46
Social cognitive impairment and social outcomes 47
Self-awareness/monitoring considerations 47
Developmental considerations 48
Social cognition as a mediator 49

CHAPTER III: METHOD 50
Participant Recruitment 50
Inclusion/Exclusion Criteria 51
Participant Demographics 52
Design and Procedure 53
Neuropsychological Measures 58
General intellectual ability 58
Nonliteral language, inference making skills, and pragmatic judgment 59
Emotion recognition 60

Measures of Social Competence 61
Self-report measures of social skills 61
Self-report measures of social performance 62
Self-report measures of social adjustment 63
Audiotaped interview measures of social skills 63

CHAPTER IV: RESULTS 67
Preliminary Analyses 67
Study Hypotheses 71
Social cognitive features of spina bifida 71
Predictors of social cognitive abilities 72
Social cognition and social outcomes 75
Developmental considerations: Age as a moderator 85
Relationship between illness severity, social cognition, and social competence 95

CHAPTER V: DISCUSSION 99
Hypotheses 101
Social Cognitive Features of Spina Bifida 101
Predictors of Social Cognitive Abilities 102
Social Cognitive Correlates of Social Competence: Objective Report 108
Social Cognitive Correlates of Social Competence: Subjective Report 116
Developmental Considerations 119
Social Cognition as a Mediator 124
Study Limitations 126
Clinical Implications of the Current Study 130
Future Directions 133

REFERENCES 140

VITA 160

LIST OF TABLES

Table 1. Links Between Brain Structures and Social-Affective and Cognitive-Executive Processes 40

Table 2. Participant Demographics 55

Table 3. Measures Used to Assess Relevant Constructs 69

Table 4. Alpha Coefficients for Questionnaire Measures of Social Competence 70

Table 5. Comparison of Study Sample to the Normal Population on Measures of Social Cognition 71

Table 6. Regression Results for Prediction of Social Cognition Variables from Number of Shunt Surgeries 73

Table 7. Lesion Level Group Differences on Measures of Social Cognition 75

Table 8. Regression Results for Prediction of Social Outcomes from Social Cognition: Parent and Teacher Report of the Dependent Variable 78

Table 9. Regression Results for Prediction of Social Outcomes from Social Cognition: SGPS-RE as the Dependent Variable 80

Table 10. Curvilinear Regression Results for Prediction of Child-Reported Social Performance from Social Cognition 82

Table 11. Curvilinear Regression Results for Prediction of Child-Reported Social Acceptance from Social Cognition 84

Table 12. Multiple Regression Results for Interactions between Nonliteral Language and Moderator Variable Age as Predictors of Social Competence Variables 88

Table 13. Multiple Regression Results for Interactions between Inference Making Skills and Moderator Variable Age as Predictors of Social Competence Variables 9

Table 14. Multiple Regression Results for Interactions between Pragmatic Judgment and Moderator Variable Age as Predictors of Social Competence Variables 92

Table 15. Multiple Regression Results for Interactions between Emotion Recognition and Moderator Variable Age as Predictors of Social Competence Variables 95

LIST OF FIGURES

Figure 1. Chiari II Malformation 11

Figure 2. Brain Regions of Interest 13

Figure 3. Yeates' Heuristic Model 30

ABSTRACT

The purpose of the current study was to examine social cognition in children with spina bifida and congenital hydrocephalus (SBH) and to determine whether deficits in these domains are associated with poor social competence, utilizing concepts from social cognitive neuroscience. To build upon extant literature, multi-method assessments, multi-informant data, and a developmental, biopsychosocial perspective were utilized. Distinct aspects of social competence, as defined by social performance, social skills, and social adjustment, were considered.

The current study was designed to investigate: (1) differences in social cognition between children and adolescents with SBH and the general population, (2) potential neuroanatomical predictors of social cognition for children and adolescents with SBH, (3) whether measures of social cognition are useful in predicting social competence in children and adolescents with SBH, and (4) whether developmental factors (i.e., age) need to be considered when addressing the association between social cognition and social competence in these children. Findings suggest that children and adolescent with SBH perform at a lower level of social cognitive functioning than typically developing youngsters. In addition, there is evidence that these impairments in social cognition are associated with poor social functioning. The findings vary based on the individual social cognitive and social competence variables of interest. Implications for future research efforts and clinical intervention are discussed.

CHAPTER I

INTRODUCTION

Due to significant enhancements in medical care, children with chronic illnesses are benefitting from improved medical prognosis and longevity. Therefore, many more children with chronic illnesses are living into adolescence and adulthood. These changes highlight the importance of further research focused on the developmental outcomes of these children. Given that social relationships become increasingly important as children enter school, social outcomes for children and adolescents with chronic illnesses is an area of research that demands further attention.

The literature on typically developing children emphasizes the importance of associations between early peer relationships and later adjustment. Specifically, children who are rejected by or isolated from their peers are at risk for a variety of poor psychosocial outcomes, including internalizing and externalizing symptoms, low self-esteem, and loneliness (Hartup, 1983; Ladd & Troop-Gordon, 2003; Parker & Asher, 1987). Successful friendships, however, have been shown to facilitate the learning of behavioral and social norms and self-monitoring skills necessary for the continuance of appropriate social interactions (Parker & Gottman, 1989). Additional research has pointed towards the important role that social competence and interpersonal skills play in fostering the development of independent adult functioning (Spirito, DeLawyer, & Stark, 1991).

Research has indicated that children with chronic illnesses are at increased risk for psychosocial maladjustment compared to their healthy peers (Blum, Resnick, Nelson, & St. Germaine, 1991; Lavigne & Faier-Routman, 1992; Morris et al., 1997; Walander & Varni, 1998). As such, it is important to specifically explore the effects of peer relationships and social competence on functional outcomes in children with chronic illnesses. In addition, to better address any negative functional outcomes, it is necessary to understand the factors that result in poor social outcomes.

The purpose of this study is to examine specific factors (i.e., social cognitive functioning) that may contribute to poor social outcomes in children with spina bifida. Social competence is believed to play an integral role in the development of children with spina bifida (La Greca, 1990). In particular, social competence and positive peer interactions could potentially enhance self-esteem, in addition to coping with a chronic condition, thereby leading to better psychosocial outcomes (Nassau & Drotar, 1997). The presence of a chronic illness, however, presents many challenges that impede optimal social interactions. For example, demanding medical regimens and physical limitations interfere with a child's ability to interact with their peers in a normative fashion, thereby putting them at risk for poor social competence compared to their healthy peers (Kokkonen, Kokkonen, & Moilanen, 2001; Nassau & Drotar, 1997).

The presence of a chronic illness that is characterized by neurological insult presents further challenges that could negatively impact social functioning. Disruptions in brain structure development can lead to impairments in cognition that are key contributors to successful social functioning (Yeates et al., 2007). These cognitive deficits, in addition to other challenges faced by children with chronic illnesses, only heighten the risk for poor psychosocial outcomes. The field of social cognitive neuroscience can provide a useful perspective on the social impact of childhood brain disorder, such as congenital hydrocephalus. In particular it calls for an integrative analysis of the social difficulties arising from neurological insults (Cacioppo, Berntson, Sheridan, & McClintock, 2000; Moss & Damasio, 2001; Ochsner & Lieberman, 2001). Using a heuristic model proposed by Yeates and colleagues (2007), the current study will utilize concepts of social cognitive neuroscience to better understand how neurological insults resulting from spina bifida with congenital hydrocephalus affect social cognitive functioning and, ultimately, social competence. Yeates and colleagues argue that childhood brain injuries result in neurological deficits that can affect cognitive functioning. In particular, they provide evidence that these early insults have implications for the cognitive skills required for effective social information processing and social problem solving, ultimately hindering social competence.

Based on their example of childhood traumatic brain injury (TBI) and social outcomes, Yeates et al. (2007) suggest that future research in the area of childhood brain disorder follow a similar model that examines the relationship between neural substrates and their cognitive-executive processes, social problem solving, and social adjustment, peer interactions and relationships. Given that children with spina bifida with congenital hydrocephalus (SBH) are subject to neurological insults prior to birth (McLone & Ito, 1998) and also tend to express difficulty with social competence (Borjeson & Lagergren, 1990; Holmbeck et al., 2003; Lord, Varzos, Behrman, Wicks, & Wicks, 1990), utilizing

Yeates' heuristic would allow researchers to better understand the cognitive processes that may explain these social deficits.

In addition to utilizing Yeates' heuristic to understand the effects of childhood brain injury on social outcomes in children and adolescents with SBH, a developmental approach will be taken in the current study. Given that certain brain structures undergo gradual development, particularly those associated with social behavior, it is important to recognize that age plays a salient role in determining when social cognitive processes are expected to come on line. As social demands increase (i.e., early to mid adolescence), the neurological and cognitive deficits seen in children with SBH are likely to become more apparent or pronounced.

The present investigation includes a sample of children and adolescents with spina bifida, a congenital birth defect in which the neural tube fails to close completely during gestation, resulting in a lesion on the spine (Blum, 1991; McLone & Ito, 1998; Wills, 1993). The presentation and impact of spina bifida varies depending on the level of the lesion on the spine, in addition to other medical and neurological complications (McLone & Ito, 1998). Physical problems associated with spina bifida include limited mobility, neurogenic bowel and bladder incontinence, and neurological deficits (i.e., hydrocephalus), putting these children at risk for constrained involvement in social activities, social isolation due to appearing different from their normally developing peers, and cognitive/neuropsychological dysfunction.

By incorporating a social cognitive neuroscience perspective on how neurological insults impact neurocognitive functioning and, ultimately, predict social outcomes, the present study will add to the extant literature on social competence in children and adolescents with spina bifida. In addition, developmental aspects of social functioning and neurological structure will be considered. The current study addresses the following questions: (1) How is socially-relevant neuropsychological functioning associated with social competence in children and adolescents with spina bifida? (2) After controlling for features that may influence social outcomes (i.e., cognitive functioning/IQ, lesion level, and number of shunt revisions), does the association between social cognition and social outcomes vary as a function of age for children and adolescents with spina bifida and hydrocephalus?

In the literature review that follows, the aforementioned concepts and their importance to children and adolescents with SBH will be introduced. First, more information about spina bifida and the orthopedic and medical features associated with this chronic condition will be provided. Second, the neurological and neuropsychological features of SBH will be discussed, followed by a review of characteristics of SBH that have been shown to affect social and cognitive outcomes for these children and adolescents. Third, the construct of social competence will be defined and its components discussed, followed by a review of existing research on social competence in the context of a chronic illness or physical disability, specifically SBH. A discussion of social cognitive neuroscience as a basis for understanding social competence will then presented. Based upon this literature, the rationale for examining the association between social-cognitive processes and social competence outcomes in children and adolescents with spina bifida and neurological deficits (i.e., hydrocephalus) will be provided. Finally, several hypotheses for the current study will be proposed.

A greater understanding of the neuropsychological deficits commonly seen in children and adolescents with spina bifida will better elucidate the real world implications of these deficits on functional outcomes, particularly social competence. More information about the specific neuropsychological deficits that are linked to poor social outcomes in these children will inform caregivers and medical professionals of the specific cognitive domains that warrant assessment in these children. Rehabilitation methods that target improvement in such domains will ultimately assist these children in acquiring the skills necessary for successful social interactions, thereby enhancing quality of life.

CHAPTER II

REVIEW OF RELEVANT LITERATURE

Spina Bifida

Spina bifida is the most common malformation of the central nervous system, occurring in about 18 of every one hundred thousand live births in the United States (Centers for Disease Control and Prevention, 2008). The cause of spina bifida remains a mystery to the medical community. Researchers currently believe there is no single etiology, but rather a combination of factors that contribute to the development of spina bifida, including genetic influences, environmental toxins, and nutritional deficiencies (e.g., folic acid) (Lemire, 1988; McLone & Ito, 1998; Wills, 1993).

Prevalence rates of spina bifida vary substantially around the world. The highest rates of spina bifida occur in the United Kingdom, where neural tube defects have been estimated to affect as many as 4.13 per 1,000 pregnancies. Within the United States, 6,000 children are born with spina bifida annually. Rates range from as low as 0.1 to 0.4 per 1,000 live births among African Americans to approximately 1 in every 1,000 live births among European Americans (Fletcher, Dennis, & Northrup, 2000; Lemire, 1988). The most complex and severe form of spina bifida is called myelomeningocele (MM). It is the most prevalent form of spina bifida, accounting for 90% of cases (Norman, McGillivray, Kalovsek, Hill, & Poskitt, 1995).

Spina bifida begins 21-36 days after conception, often before a woman becomes aware she is pregnant. It is during this stage of pregnancy that the embryo's central nervous system begins to develop through the formation of the neural tube. In typical neural development, a flat group of cells begins to migrate inward, recessing into the embryo and forming a tube. Starting in the center of the embryo's back and processing downward, the tube seals in a "zipping" fashion. The upper part of the neural tube forms into the brain, while the lower part becomes the spinal cord and is soon covered by skin, muscle, and bone. Spina bifida occurs when there is a disruption in the fusion of the neural tube, resulting in an opening in the spine.

In the more common version of spina bifida, myelomeningocele, an opening is left near the base of the spine where fusion was not complete. The bones of the vertebral column fail to fuse in the posterior midline, resulting in a protrusion of the spinal cord, meninges, parenchyma, and nerve roots through the defect in the spine (Barkovich, 1995; Menkes & Till, 1995), called a myelomeningocele. In a milder variant of the condition, lipomeningocele, a lipoma, or fatty tumor, protrudes from the spine (Bruner et al., 1999; Children's National Medical Center, 1995; McLone & Ito, 1998).

Once the neural tube fails to fully close, the open portion of spinal cord is left unprotected through the remainder of prenatal development. Before birth, the womb and amniotic fluid protect the exposed nerves. After delivery, however, the infant becomes vulnerable to infection and further damage. As such, the majority of children born with spina bifida undergo surgery within 24 to 72 hours of birth in order to place the spine in a normal position and close the back (Children's National Medical Center, 1995).

Although post-natal surgery minimizes further damage to the infant with spina bifida, it does not correct many of the complications associated with incomplete formation of the central and peripheral nervous system. As a result, these children face a number of serious medical and developmental challenges.

Orthopedic and peripheral features. The degree of impairment experienced by a child with spina bifida corresponds roughly with the level of the spine at which fusion of the neural tube failed and the myelomeningocele occurred. Spina bifida may occur at any level along the spine, including the base of the skull, the thoracic region (T1-T12) in the upper back, the lumbar region (L1-L5) near the middle of the back or waist, or the sacral region (S1-S4) at the base of the spine. Most children with spina bifida have lesions in the lumbar region (Wills, 1993). Damage to the spina at the site of the myelomeningocele interrupts the transmission of motor and sensory information at and below the lesion level. As such, higher lesions are associated with more significant orthopedic and peripheral nervous system damage than lower lesions (Rintoul et al., 2002; Wills, 1993).

The most common sensory and motor impairments associated with spina bifida are difficulties with bladder and bowel control, ambulation difficulties, and skin infections due to pressure sores or burns (Children’s National Medical Center, 1995; McLone & Ito, 1998). Because the nerves regulating bladder and bowel functions are located at the lower end of the spine, these functions are lost in nearly all children born with spina bifida (McLone & Ito, 1998). Motor and sensory nerves that project to and from the feet, ankles, and lower legs are also commonly damaged, resulting in sensory loss and paralysis in the affected regions. Therefore, most individuals with spina bifida experience some degree of ambulation impairment. Ambulation is typically accomplished with assistance from wheelchairs, braces, or orthoses (McLone & Ito, 1998).

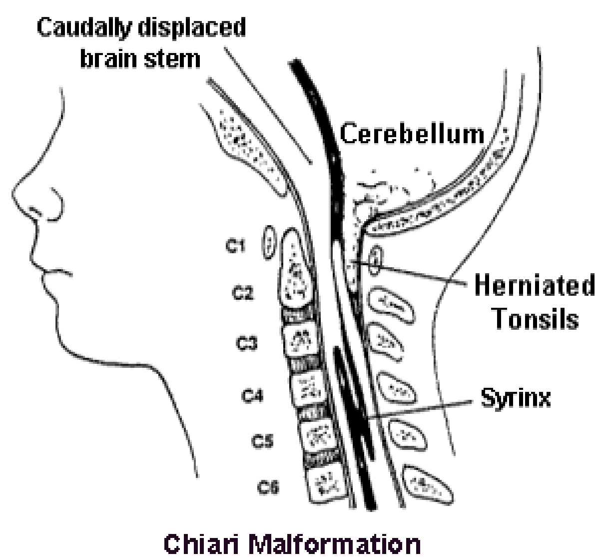
In addition to sensory and motor difficulties, which arise directly from disrupted peripheral nervous system communication, spina bifida is associated with a variety of other orthopedic complications. Some of the additional problems commonly seen in spina bifida include scoliosis, kyphosis, and heightened vulnerability to bone fractures (McLone & Ito, 1998).

Neurological features. In addition to the aforementioned orthopedic and peripheral feature, spina bifida is associated with specific brain abnormalities. The most common neurological complication associated with spina bifida is hydrocephalus, which occurs in approximately 80 to 90% of those who undergo surgical myelomeningocele repair (Dennis, Barnes, & Hetherington, 1999; Fletcher et al., 2000; Lemire, 1988; Rintoul et al., 2002).

In spina bifida myelomeningocele, hydrocephalus is caused by a specific neuroanatomical deficit known as the Arnold-Chiari II malformation (Barkovich, 1995; McCullough, 1990). This malformation involves the herniation of the hindbrain and cerebellar tonsils through an opening at the base of the skull called the foramen magnum. The lower portion of the brain is forced through this opening and pushed into the spinal canal, resulting in compression of the brain and obstruction of ventricular flow in the third and/or fourth ventricles (See Figure 1; Bruner et al., 1999; Fletcher et al., 2000;

McLone & Ito, 1998). The result of this obstruction is the accumulation of cerebrospinal fluid (CSF) in the ventricles, which in turn causes ventricular enlargement. This ultimately causes a reduction in cortical volume. Although mild hydrocephalus is present in most children with spina bifida at birth, it can worsen following surgical repair of the myelomeningocele because closure of the lesion eliminates a drainage pathway for cerebrospinal fluid. Within days or weeks of the surgery, placement of a ventricular shunt, which redirects the fluid from the ventricle to another body cavity where it can be absorbed (i.e., the peritoneum in the abdominal region) is often necessary for the relief of the increasing pressure on the brain (Chumas, Tyagi, & Livingston, 2001; Fletcher et al., 2000; McLone & Ito, 1998; Toporek & Robinson, 1999).

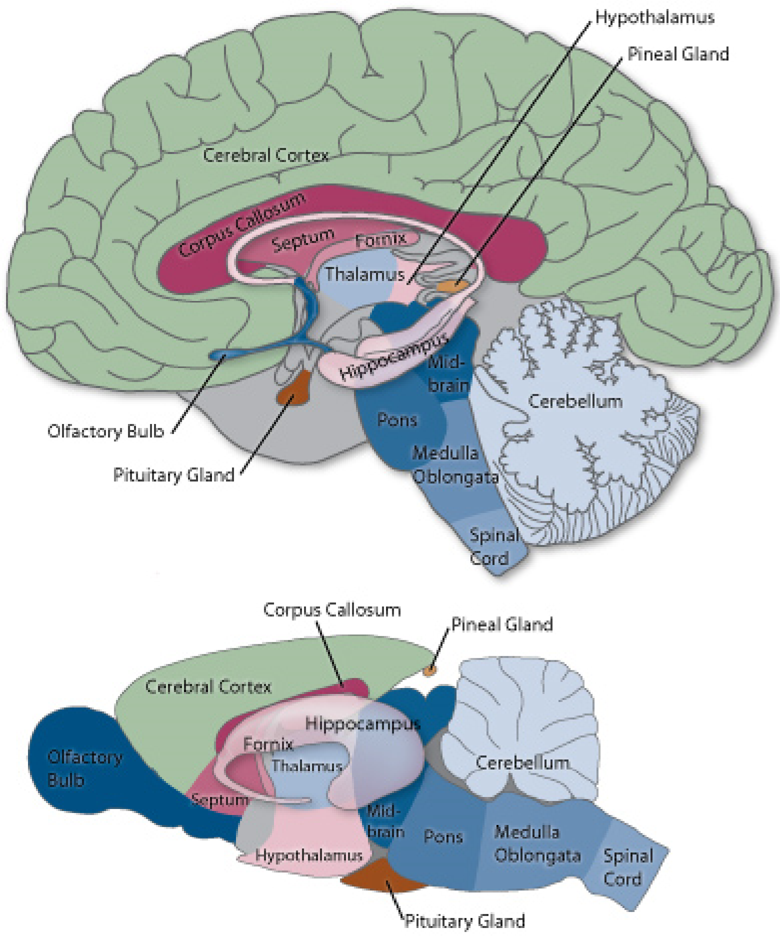
Figure 1. Chiari II Malformation



The impact of an enlarged ventricular system on the developing brain is complex. Hydrocephalus produces increased intraventricular pressure that leads to expansion of the ventricles and ultimate displacement of adjacent brain structures. In particular, the third and fourth ventricles tend to expand in a posterior-to-anterior direction, thereby affecting the nearby white matter tracts. The mechanical distortion of the brain, combined with impaired cerebral blood flow and changes in metabolism and neurotransmission, has been implicated in the brain's structural and functional alterations. Specifically, hydrocephalus can result in axonal degeneration; compression of extracellular spaces believed to effect neurochemical transmission; dysplasia of the corpus callossum; stretching of the periventricular white matter; disruption of normal myelination; damage to the optic tracts; reduced blood flow to the frontal lobes; compression of the cortex; and reduction in the thickness of the cortical mantle, particularly in posterior regions (Barkovich, 1995; Del Bigio, 1993; Fletcher, McCauley, et al., 1996; Hannay, 2000; Braun et al., 1997; Caner et al., 1993; Catalan et al., 1994; Del Bigio, 1993; Tashiro & Drake, 1998).

In addition to hydrocephalus, children with spina bifida are at increased risk for higher rates of other neurological abnormalities including numerous unusually small gyri on the surface of the brain (polymicrogyria), malformation of the corpus callosum, aqueductal stenosis (blockage of the channel between ventricles that can lead to hydrocephalus), beaking of the tectum (a malformation of the dorsal portion of the midbrain positively correlated with abnormal eye movements), abnormalities of the posterior fossa (the compartment in the back of the skull where the brain normally joins to the spinal cord), and other abnormalities (Fletcher, Bohan, et al., 1992; Fletcher et al., 2000; Lemire, 1988; Wills, 1993). (See Figure 2 for these brain regions.)

Figure 2. Brain Regions of Interest



In summary, spina bifida is clearly an early onset disorder with associated central nervous system (CNS) difficulties beyond the level of the lesion. The most common and significant neurological abnormality associated with spina bifida myelomeningocele is hydrocephalus. It impacts the majority of individuals with this condition. The hydrocephalus leads to stretching and thinning of the cortex, especially in posterior regions and the corpus callosum. As such, spina bifida myelomeningocele with hydrocephalus (SBH) represents a complicated series of neural insults that begins prior to birth, with persisting effects on development, including problems in the orthopedic, cognitive, and behavioral domains (Anderson, 1975; Fletcher et al., 2000; Fletcher et al., 2004; Wills, 1993).

The section that follows discusses the cognitive and behavioral implications of the aforementioned neuroanatomical features.

Neuropsychological implications. Recent research of children and adults with SBH typically indicated a pattern of intelligence in the low average to average range (Friedrich, Lovejoy, Shaffer, Shurtleff, & Beilke, 1991; Holler, Fennell, Crosson, Boggs, & Mickle, 1995; Hommet et al., 1999; Wills, Holmbeck, Dillon, & McLone, 1990). In addition, most studies suggest that intellectual ability remains stable across the life span in this population.

Further examination of intellectual ability in children with SBH reveals that their verbal skills are typically more developed than non-verbal problem-solving skills (Brookshire et al., 1995; Donders, Rourke, & Canady, 1991; Fletcher et al., 2000; Riddle, Morton, Sampson, Vachha, & Adams, 2005). This difference is often small and is not a consistent finding in studies of children with spina bifida and congenital hydrocephalus (e.g., Friedrich, et al., 1991; Hommet et al., 1999). Wills (1993) suggested that the inconsistency of this finding might be due to the use of samples with hydrocephalus of mixed etiologies. Whereas children with SBH may exhibit deficits in upper motor functioning that could impact performance on measures of Performance IQ (PIQ), those children with other sources of hydrocephalus may demonstrate no impairments in this domain. As such, impairment in PIQ is minimized for these children (Hommet et al., 1999).

Hydrocephalus is associated with a variety of cognitive deficits. Although several reports suggest a normal or low-average intelligence in children with hydrocephalus, this does not necessarily mean the absence of neuropsychological deficits (Berker, Goldstein, Lorber, Priestley, & Smith, 1992; Prigatano, Zeiner, Pollay, & Kaplan, 1983). The academic difficulties present in these children, (i.e., mathematics skills being less developed than reading skills; Barnes et al., 2002), for example, may be associated with cognitive deficits that are not properly measured by standard measures of IQ (Prigatano et al., 1983).

There is much evidence to suggest reduced efficiency of complex visuospatial abilities in children with SBH (Dennis, Fletcher, Rogers, Hetherington, & Francis, 2002; Dennis, Rogers, & Barnes, 2001; Donders, Canady, & Rourke, 1990; Fletcher, Francis, et al., 1992; Fletcher, McCauley, et al., 1996; Prigatano et al., 1983). In part, these impairments appear to be due to occulomotor difficulties, such as poor visual tracking and strabismus, caused by compressed or malformed cranial nerves (Wills, 1993).

Additionally, it has been suggested that these visuospatial deficits are a reflection of damage done to the posterior regions of the brain due to the posterior-to-anterior expansion of the ventricles seen with congenital hydrocephalus (Dennis et al., 1981; Donders et al., 1991; Fletcher, McCauley, et al., 1996).

In addition to visuospatial difficulties, children and adolescents with spina bifida have clear motor and sensory deficits resulting from the original spinal lesion and subsequent nerve damage. These insults impact ambulation and other motor functions in the lower extremities of individuals with spina bifida. Those with hydrocephalus, in particular, demonstrate abnormal hand functioning (Fletcher, McCauley, et al., 1996; Hetherington & Dennis, 1999; Holler et al., 1995; Wills, 1993). Poor performance on gross and fine motor function and bimanual motor function in children with SBH has been attributed to the neurological insults that occur as a result of hydrocephalus (Matarò, Junque, Poca, & Sahuquillo, 2001).

There is also information to suggest deficits in attention in children and adolescents with SBH. Parents and teachers commonly observe that children with SBH have difficulties focusing and sustaining attention. Many children with shunted hydrocephalus receive stimulant medications for these attentional problems. What little research has been conducted in this area supports the above anecdotal evidence. In particular, children with SBH have shown difficulty with tasks that require sustained visual attention (Snow, 1999; Wills, 1993), and with focusing and shifting attention, compared to those with attention deficit disorder and normal controls (Brewer, Fletcher, Hisock, & Davidson, 2001). Dennis, Edelstein, Copeland, et al. (2005) and Dennis, Edelstein, Frederick, et al. (2005) also found that, relative to controls, children with SBH engaged and disengaged from stimuli more slowly, which is consistent with impairments in the ability to shift attention.

The deficits in focusing, engaging, and shifting attention are hypothesized to be under the control of attention systems controlled with the posterior regions of the brain (Dennis, Edelstein, Copeland, et al., 2005). It is well-known that the ventricles in children with SBH expand in a posterior-to-anterior direction as CSF accumulates (Raimondi, 1994). As such, these studies implicating the posterior system in the attention deficits in these children are consistent with the fact that the posterior regions of the brain are especially susceptible to damage in this population.

The few studies examining memory features in children with SBH have offered mixed results. Some authors have found verbal and visual memory impairments (Fletcher, Francis, et al., 1992; Holler et al., 1995; Hommet et al., 1999; Mammarella, Cornoldi, & Donadello, 2003; Prigatano et al., 1983; Scott et al., 1998), whereas others have not (Donders et al., 1991).

Although there have been relatively few studies investigating executive functions in children with spina bifida and hydrocephalus, there has been a more recent interest in further examining these higher order cognitive abilities in this population. While damage to the prefrontal cortex often results in executive impairment, executive dysfunction does not imply damage exclusively to the frontal lobes. Deficits in these higher order cognitive functions can also result from damage to other brain areas which leave the frontal lobes intact but inaccessible. For example, damage to the frontal-subcortical white matter circuits, which commonly occurs as a result of congenital hydrocephalus, can disrupt communication between the prefrontal cortex and other areas of the brain, resulting in executive dysfunction (Denckla, 1996; Fletcher, Brookshire, et al., 1996). As such, it is clear that executive dysfunction is a potential outcome for children with SBH.

Executive functioning is a term used to describe higher-ordered cognitive processes, such as creative thinking, problem solving, and planning behavior. In addition to the cognitive aspect of executive functioning, researchers and practitioners also recognize an observable behavioral component to executive functioning. Problem solving, planning, and organization skills are often suggested as outward behavioral aspects of executive functioning (Brocki & Bohlin, 2004; Gioia, Isquith, Guy, & Kenworthy, 2000). Disinhibited, impulsive, and poorly regulated behavior is generally thought to reflect deficits in executive functioning (Eslinger, 1996) and elucidates the fact that there is a social component to executive functioning.

In her 1993 review, Wills found some evidence of social impairment in children with spina bifida that appeared to be associated with behavioral dysregulation and impaired self-awareness. More recently, researchers have found evidence to suggest that children with spina bifida exhibit some difficulties with adaptive problem-solving and deficits in cognitive flexibility (see Fletcher, Brookshire, et al., 1996; Snow, 1999). Fletcher, Brookshire, and colleagues (1996), in particular, found that those children with SBH display poorer conceptualization and strategizing abilities than those without hydrocephalus. Others have found evidence of observable deficits in executive functioning in adolescents with SBH (Mahone, Zabel, Levey, Verda, & Kinsman, 2002), indicating problems with initiation, working memory, planning/organization, self-monitoring, metacognition, and emotional control relative to controls. These results, however, have been challenging to replicate. As a result, the full range of executive deficits associated with SBH remains unclear.

Of particular interest for the current study is the verbal profile of those with SBH. In general, children with spina bifida usually acquire speech at the same rate as typically developing children, and verbal abilities in these children appear to be relatively preserved (Wills, 1993). Closer examination of these “preserved” verbal abilities, however, has highlighted deficits in verbal learning (Yeates, Enrile, Loss, Blumenstein, & Delis, 1995) and speech fluency and articulation (Holler et al., 1995; Huber-Okrainec, Dennis, Brettschneider, & Spiegler, 2002).

Despite the fact that the form and content of language are often intact, children with SBH commonly demonstrate difficulties with pragmatic components of language, particularly in oral discourse (Brewer, et al., 2001; Dennis, Jacennik, & Barnes, 1994; Vachha & Adams, 2002). In particular, some children with SBH manifest the “cocktail party syndrome,” which is characterized by hyperverbal behavior with good articulation and vocabulary above the apparent mental level (Hurley, Dorman, Laatsch, Bell, & D’Avignon, 1990). Despite these apparent strengths, this type of speech is ultimately of shallow intellect and characterized by poor social and academic skills. Additionally, tangential language irrelevant to the conversation, excessive use of stereotypic phrases (i.e., use of jargon and clichés), over familiarity of manner, and verbal perseveration are characteristic. Because children with SBH are frequently charismatic and talkative

(Hurley, et al., 1990), caregivers often underestimate the severity of their cognitive impairments (Mahone & Bernstein, 1993). Since relatively preserved verbal skills are usually sufficient to meet the early demands of the academic environment, they are initially placed in traditional classroom settings with children of the same chronological age.

The hyperverbalization characteristic of cocktail party syndrome is also often considered to be an executive deficit insofar as it exemplifies behavioral dysregulation and poor social judgment. With age-related increases in social and academic expectations, organizational deficits become more apparent (Bernstein, 2000). As such, these children appear to be increasingly off-track developmentally in comparison to their peers as environmental demands increase. Elements of this behavior may also be understood in terms of impairments in pragmatic aspects of language (e.g., conversational rules enjoining speakers to be brief, take turns speaking, and stick to the topic). Additionally, an inability to regulate language as a function of context is also apparent (i.e., understanding nuances of body language and differences between formal and informal situations). Some authors have suggested that disruption of cortical association fibers secondary to hydrocephalus may result in hyperverbal speech (Donders et al., 1990; Emery & Svitok, 1968; Fletcher & Levine, 1988; Stark, 1977). Consistent with this possibility, Hurley et al. (1990) note that right hemisphere lesions caused by shunting may be responsible for deficits in comprehension of tone and emotion in language. This, in conjunction with deficits in executive functioning, may contribute to the cocktail party syndrome.

Additional cognitive constructs of interest. Given the above discussion of "cocktail party syndrome" and how it seemingly impacts social interactions and functioning, the current study will examine cognitive skills that are likely to impact verbal interactions and, subsequently, social competence. These constructs are discussed in the following section.

Language pragmatics, inference making skills, and nonliteral language. Language pragmatics is a neuropsychological construct that refers to a set of sociolinguistic rules related to the ability to use language in a social and communicative manner (Carrow-Woolfolk, 1999; Owens, 1988). Children with such skills are able to readily understand and utilize specific types of language given the social context at hand. In addition, they are more likely to know when and how to modify language accordingly (e.g., in informal vs. formal situations).

Inference making skills refer to the ability to makes inferences and extract meaning when reading or listening to a story. Moreover, the ability to understand nonliteral language also falls within this set of skills. A child who does not have adequate inferential making skills has difficulty understanding the meaning of a story (i.e., meaning construction). It appears that children with spina bifida have deficits in language pragmatics and inference making skills (Barnes & Dennis, 1998; Cull & Wyke, 1984); however, little research has examined these neuropsychological features and the resulting functional consequences for these children and adolescents. The ability to utilize language appropriately given contextual clues and infer meaning from verbal interactions that may not be literal in nature can be clearly seen as skills necessary to effectively navigate social interactions. Deficits in these neuropsychological domains may contribute to the aforementioned "cocktail party syndrome," which is characterized by an inability to effectively engage in a back-and-forth conversation due to a lack of understanding the state of mind of others. As such, it follows that they are likely key components to social competence. The connection between these neuropsychological constructs and social outcomes will be discussed in sections to follow.

Emotion recognition. Emotion recognition is a neuropsychological construct that refers to the ability to interpret the emotions or mental states of others based on static or dynamic facial expressions or from verbal cues (e.g., tone; See Golan, Baron-Cohen, Hill, & Rutherford, 2007). The ability to read facial expressions and interpret mood from verbal intonation and extract cues from them about social behavior is an important component for adequate social interaction (Gnepp, 1983). To process social information accurately and to be able to respond to situations in socially appropriate ways, individuals must read the affective states of others (Boyatzis & Satyaprasad, 1994). The construct of emotion recognition has received little attention in the study of children with spina bifida. However, it is likely to be a skill that has implications for successful social interactions for this population. There is some evidence that children and adolescents with spina bifida are at greater risk for nonverbal learning disabilities than their normally developing peers (Yeates, Loss, Colvin, & Enrile, (2003). Given that children with nonverbal learning disabilities have been found to be impaired in their ability to readily and accurately perceive emotion from facial expressions (Rourke et al., 2002; Zillmer &

Spiers, 2001), it is likely that those with spina bifida will exhibit similar deficits in emotion recognition.

As with language pragmatics and inference making skills, deficits in emotion recognition can clearly impede success in social interactions. Dennis and Barnes (1993) found that children with spina bifida had difficulty forming speech acts to reflect the perceived beliefs, plans, and intentions of a speaker with whom they were engaged in conversation. This lack of foresight may be reflective of the inability of these children to effectively assess facial expressions, body language, and verbal cues (i.e., tone of voice), ultimately contributing to the aforementioned "cocktail party syndrome." As such, it is important to further examine emotion recognition abilities in this population.

Predictors of Functional Outcomes in Spina Bifida

Functional outcomes refer to one's ability to perform activities relevant to daily life including physical, social, and personal activities (Drotar, 1998). Although the reasons for functional impairment in spina bifida are not well understood, studies investigating the predictors and correlates of adjustment provide some information about the features of spina bifida that impact adaptive functioning. Several studies have found shunt status to be a consistent predictor of adaptive outcomes in children and adolescents with spina bifida. In general, those with shunted hydrocephalus seem to have greater impairment in cognitive and social domains than either those without hydrocephalus or those with arrested hydrocephalus who never required shunting. For example, Hommeyer, Holmbeck, Wills, and Coers (1999) found that children with shunts reported more attention problems relative to unshunted children with spina bifida. Additionally, Bier, Morales, Liebling, Geddes, and Kim (1997) found a relationship between number of shunt revisions and nonverbal intellectual functioning, such that the number of shunt surgeries accounted for almost one third of the variance in their nonverbal intelligence.

Spinal lesion level has also been considered to be an important predictor of outcomes in spina bifida. In one study (Bier et al., 1997) lesion level accounted for one quarter of the variance in general intellectual functioning in their sample of children with spina bifida, with higher lesion level predicting lower scores. Hommeyer et al. (1999) found that children with lower lesion levels participated in more activities than children with higher-level lesions, perhaps indicating that lesion level is a predictor of social competence. Not all studies, however, show consistently better outcomes for children with lower lesion levels. Some studies have reported lesion levels to be positively associated with global self worth and self esteem in physical appearance, such that children with greater cognitive and physical impairments had higher self esteem than those with milder disabilities (Minchom et al., 1995). This counterintuitive phenomenon has been referred to as the "marginality hypothesis" (Bruhnm, Hampton, & Chandler, 1971; McArney, Pless, Satterwhite, & Friedman, 1974; Pless & Pinkerton, 1975), which theorizes that children with less severe forms of disability show more psychosocial impairment because they find it difficult to fit in with typically developing peers but do not necessarily identify with or relate to more severely disabled children (Holmbeck & Faier-Routman, 1995; Minchom et al., 1995). This may result in children with lower-level lesions perceiving themselves as having fewer friends than those with worse condition severity.

The aforementioned study findings suggest that shunt status and lesion level contribute to the prediction of cognitive and adaptive functioning and the psychosocial adjustment of children with spina bifida. Children with more complications related to hydrocephalus and higher lesion levels tend to exhibit more intellectual and social impairment (but less awareness of their social pitfalls) relative to children with more mild and uncomplicated cases of spina bifida. The specific cognitive sequelae of hydrocephalus that predict social and functional difficulties have yet to be clarified. Fletcher, Brookshire, et al. (1996) suggest that the neurological complications associated with spina bifida contribute to impaired "higher order" cognitive functions, such as executive functioning and attention, which in turn predict functional outcomes above and beyond general intellectual ability. Landry, Robinson, Copeland, and Garner (1993) likewise reasoned that children who show deficits in planning, sequencing, and problem-solving (i.e., executive functions) may have difficulty identifying and demonstrating a flexible set of social behaviors necessary for successfully navigating diverse social situations.

The link between executive functions and social competence is suggested by researchers who reason that higher order cognitive skills are prerequisites for appropriately traversing the social world (see Landry et al., 1993). However, this theory has not been tested thoroughly. In a recent study, Rose and Holmbeck (2007) compared adolescents with spina bifida and a matched comparison group. They found clear differences between groups on measures of attention and executive functioning, even when controlling for intellectual ability. They suggested that the effects of hydrocephalus and/or shunt surgery were major factors in the group differences. In addition, performances on measures of attention and executive function were found to predict social adjustment, such that poor performance was associated with impaired social competence.

In the section that follows, the construct of social competence will be discussed. Since successful social interactions require that individuals be able to readily interpret the desires and intentions of others, it follows that certain cognitive skills must be developed. While executive and attentional skills have been shown to affect social functioning (see above), it is possible that there are very specific cognitive abilities that inform social competence. In particular, inference making skills, language pragmatics, and emotion recognition require that one is able to appropriately assess subtleties of social interactions and respond in a manner that suggests sociability. As such, further exploration of these cognitive domains and their association with social skills in children with spina bifida is warranted.

Defining Social Competence

Researchers have offered many definitions of social competence. Most have suggested that social competence involves how effectively a person functions as an individual in dyadic relationships and in groups (Bukowski, Rubin, & Parker, 2001). Rubin and Rose-Krasnor (1992) have defined social competence as the ability to achieve personal goals in social interaction while simultaneously maintaining positive relationships with others over time and across situations. This definition implies that both individual and social goals are important aspects of social competence.

Cavell (1990) proposed a tri-component model of social competence in an attempt to reconcile disparate views of the construct (see Hops, 1983; McConnel & Odom, 1986; McFall, 1982). The subcomponents, social adjustment, social performance, and social skills were meant to simplify past attempts at operationalizing social competence. Additionally, Cavell presented his model as hierarchical, with social adjustment as the ultimate goal. Social skills refers to specific abilities that enable one to perform competently within social tasks. These skills allow for a sequence of functions: stimulus encoding (ability to effectively perceive and interpret social situations), decision making (ability to propose and justify an action and evaluate its impact on others' feelings), and response enactment (ability to generate the proper sequence of behaviors and make adjustments in accordance with peer feedback; Dodge & Murphy, 1984; McFall, 1982).

The second component of Cavell's (1990) model, social performance, refers to children's actual behavior in social interactions and whether their responses are effective both in achieving their own goals and in maintaining positive relationships. Finally, social adjustment reflects the extent to which individuals are currently achieving socially desirable and developmentally appropriate goals. Social adjustment includes not only the quality of the child's relationships as perceived by others (i.e., parents and teachers), but also the child's self-perception of loneliness, social support, or social self-esteem.

Rubin, Bukowki, and Parker (2006) have suggested that the study of social competence must primarily recognize that children bring certain individual characteristics into their interactions with others. These characteristics, which compromise social intelligence, include (1) the ability to regulate emotion; (2) ways of thinking about how to solve social problems; (3) a repertoire of means to achieve social goals; (4) the capacity to predict the consequences of strategies chosen to navigate interactions and meet social goals, for both the self and others; and (5) thoughts and feelings about the self's ability to have successful social interactions. This so called social intelligence implies that social competence is determined, in part, by a set of cognitive skills. Children's social interactions depend not only on these individual characteristics, but also on the characteristics and behaviors of those with whom they are involved. Ultimately, these interactions give rise to longer term relationships (i.e., friendships), which have distinct properties, such as closeness and commitment.

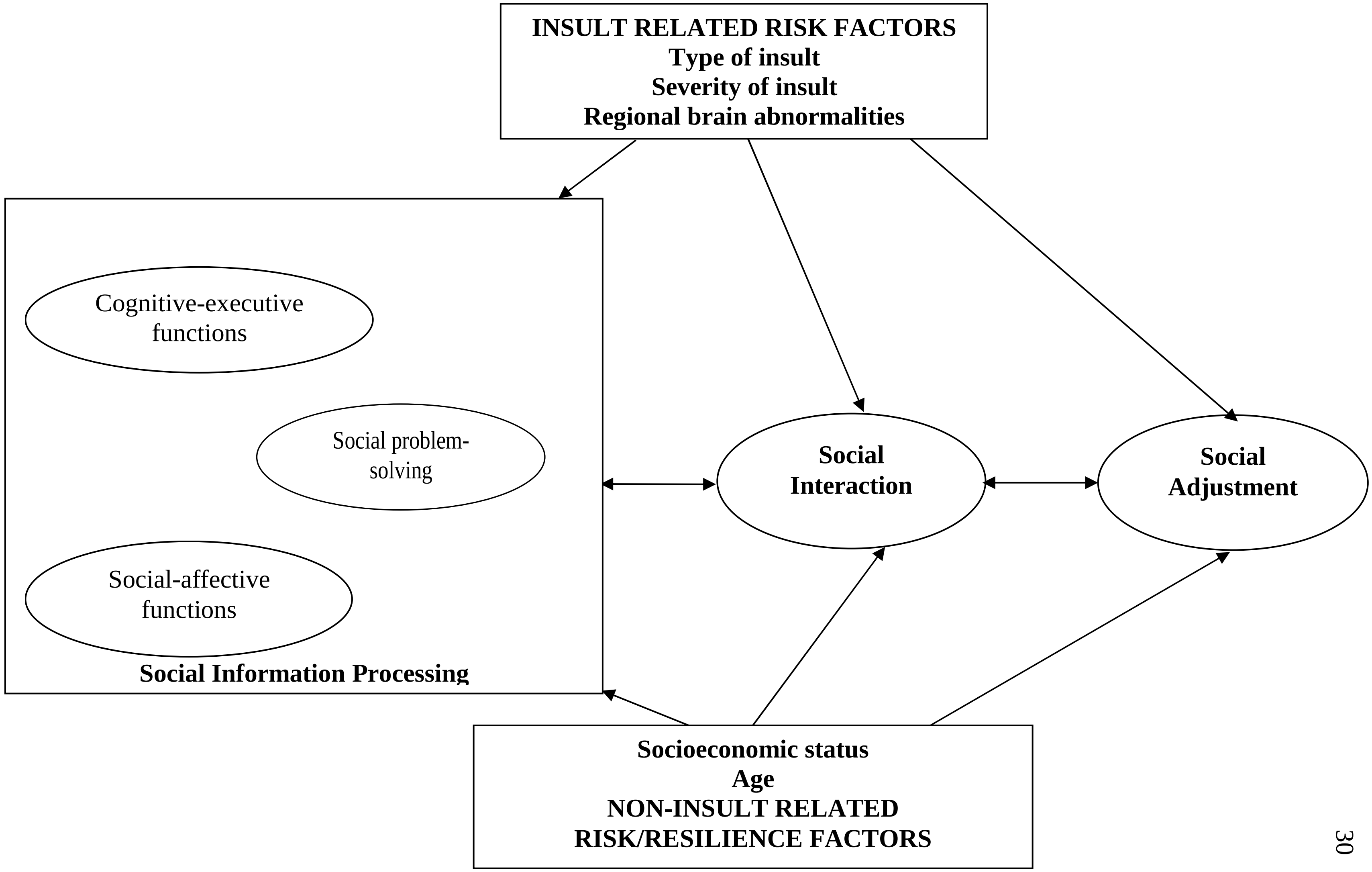
In their attempt to better understand social outcomes in childhood brain disorder, Yeates et al. (2007) drew from research in developmental psychology/psychopathology to better understand the various aspects that inform social competence. Utilizing traumatic brain injury (TBI) as an example, Yeates and colleagues discuss how a childhood brain disorder can give rise to significant social problems. Specifically, they discuss how the focal lesions that are typically associated with TBI (frontal and anterior temporal regions) are found in locations implicated as the neural substrates of social information processing and regulation of social behavior (Adolphs, 2001; Grady & Kneightley, 2002). In addition, they present a review of the literature indicating that children with severe TBI are less skilled at social problem solving and are rated as less socially competent than children who have not experienced chronic illness or injuries involving the brain (Janusz, Kirkwood, Yeates, & Taylor, 2002; Taylor et al., 2002; Yeates et al., 2002).

Yeates and colleague's heuristic model (see Figure 3) can effectively be utilized to elucidate the links between neurological insults, their subsequent neuropsychological deficits. An examination of these constructs within such a framework ultimately provides a better understanding of how deficits in the areas of social skills, interactions, and social adjustment are linked to social maladaptation. The section that follows discusses the links between the specific components of social competence and neuropsychological functioning.

Components of Social Competence and their Link to Neuropsychological Functioning

As mentioned above, social skills are individual characteristics that contribute to the determination of social competence. Social information processing, in particular, has been considered a key component of social skills and a critical determinant of social competence (Crick & Dodge, 1994; Rubin & Krasnor, 1986). Social information processing is conceptualized as a series of distinct mental steps that children implement when faced with a social situation. Crick and Dodge (1994) proposed that children enter social situations with a set of biologically limited capabilities, in addition to memories of past experiences. When faced with external cues, their behavioral response is a function of how they process those cues in light of their capabilities. The six mental steps proposed by Crick and Dodge include (1) encoding of external and internal cues, (2) interpretation and mental representation of those cues, (3) clarification or selection of a goal, (4) response access or construction, (5) response decision, and (6) behavioral enactment. Essentially, a child is faced with the tasks of interpreting cues/social

Figure 3. Yeates' Heuristic Model



situations, clarifying for goals both for themselves and others, generating alternative responses when expected outcomes are not experienced (i.e., troubleshooting), selecting and implementing responses, and evaluating the outcome. Researchers often assess social problem solving by asking children to reflect on and answer questions about hypothetical social dilemmas (Dodge, Laird, Lochman, & Zelli, 2002).

Recently, theorists have begun to recognize that social information processing is dependent on other cognitive and affective factors. Specifically, researchers have highlighted the important role that language pragmatics, inference making, executive function, attention and emotion recognition play in social interactions (Dodge et al., 2002; Guralnick, 1999; Lemerise & Arsenio, 2000). Children who have deficits in these cognitive domains are at risk for impaired social functioning and peer rejection. In particular, appropriate executive and attentional skills give rise to mental flexibility, the ability to inhibit inappropriate behaviors, focused attention, and employment of working memory skills. Children who lack these skills are likely to appear impulsive and unable to maintain socially appropriate interactions. Likewise, the ability to make inferences about both nonverbal and verbal cues in social conversation and to correctly identify and respond to the emotions of others plays a significant role in the determination of social competence. Without these skills, children appear socially insensitive and unskilled. Such awkward behavior leaves them at risk for peer rejection (Kavale & Forness, 1996; Semrud-Clikeman & Hynd, 1991; Zillmer & Spiers, 2001). Proper development of these cognitive skills is necessary for one to successfully navigate social interactions and maintain peer relationships (Bellanti & Bierman, 2000; Semrud-Clikeman & Hynd, 1991).

Social skills inform social performance, such that these abilities determine whether or not interactions in which children are involved are successful. Research indicates that the behaviors exhibited by children in social situations depend on the nature of the interaction and the children's relationship with the individual in questions (Parker, Rubin, Erath, Wojslawowicz, & Buskirk, 2006; Rubin, Wojslawowicz, Rose-Krasnor, Booth-LaForce, & Burgess, 2006). The ability to display flexible social behaviors across different contexts and relationships is considered a hallmark of social competence (Rose-Krasnor, 1997; Rubin, Booth, Krasnor, & Mills, 1995). Direct observational protocols are generally required to assess social performance (Bierman, 2004; Rubin, Bukowski, et al., 2006). When assessing social performance, three broad behavioral tendencies are generally focused upon: (1) moving towards others (i.e., affiliative behavior), (2) moving against others (i.e., aggressive behavior), and (3) moving away from others (i.e., socially withdrawn behavior).

Finally, social adjustment can be assessed when children put to use their social skills in social interactions. Since social competence incorporates both individual and social goals (see above), it is important to consider the perspective from which social adjustment is evaluated. Perspectives of the self and others (i.e., parents, teachers, peers) may not be congruent, particularly for children who lack awareness of their own deficits. This may be the case for those children with brain disorders who tend to evaluate their social adjustment more positively than do others (Prigatano, 1991; Prigatano, Altman, & O'Brien, 1990).

Recent models of social competence have acknowledged that there are various risk and resilience factors that can promote or hinder social development (Guralnick, 1999; Masten et al., 1999). Factors intrinsic to the child, such as neurological dysfunction and acquired brain injury, can be conceptualized as risk factors that increase the likelihood of deficits in social information processing, atypical social interaction, and poor social adjustment (Janusz et al., 2002; Warschausky, Cohen, Parker, Levendosky, & Okun, 1997). As such, children with spina bifida and hydrocephalus are at risk for difficulties with cognitive domains important in social cognition (i.e., attention and executive functioning), and therefore more likely to express impairments in social competence.

Social Competence in the Context of Chronic Illness

In addition to the aforementioned cognitive difficulties, children and adolescents also have unique experiences and challenges that are not readily captured by formal testing. Of particular interest for the current study is that children with spina bifida are more likely to encounter psychopathology than others their age. Specifically, they demonstrate higher rates of internalizing behavior, conduct problems, and psychiatric diagnoses than the general public, along with a tendency to experience more problems with social relationships and autonomy development (Ammerman, Van Hasselt, Hersen, & Moore, 1989; Holmbeck et al., 2003; Landry et al., 1993). While the reasons for these interpersonal and emotional difficulties are unclear, recent research has attempted to better understand such outcomes in these children and adolescents. Hommeyer and colleagues (1999) suggest that condition severity predicts a child's cognitive and physical competence, which in turn predicts the child's social and emotional adjustment (e.g., social competence).

The presence of a chronic illness, such as spina bifida, can affect social competence in a variety of ways. Physical limitations, required lifestyle modifications, and the need for adherence to often intense medical regimens can reduce peer contact for children and adolescents who live with chronic illnesses (La Greca, 1990; Nassau & Drotar, 1995). Additionally, children with chronic illnesses face social challenges that are disparate from their typically developing peers, such as differences in physical appearance and ability, the stigma of having a disability, and the need to explain their condition. Finally, the cognitive impairments associated with certain conditions may also interfere with social competence (Nassau & Drotar, 1997). Holler et al. (1995) noted that social and adaptive functions were more impaired in older children with spina bifida and hydrocephalus than a younger cohort. They hypothesized that, as social demands become more complex over time, children with spina bifida find it increasingly challenging to keep up with their peers. Given this hypothesis, it is possible that deficits in cognitive functioning, such as executive dysfunction, attentional problems and impaired skills required for successful social interactions, are associated with poor social outcomes for these children.

Research investigating pediatric populations has focused almost exclusively on social adjustment, with very little attention given to social skills or performance. The risk of poor social adjustment in children with chronic illnesses, including those with spina bifida, has been addressed by numerous investigators. Specifically, children with spina bifida have been shown to be perceived as socially immature compared to their peers (Holmbeck et al., 2003) and report experiencing more feelings of loneliness and isolation than their typically developing peers (Borjeson & Lagergren, 1990; Lord et al., 1990). Although adolescents with spina bifida perceive friendships as important to them, they also report limited interaction with peers outside of school settings (Blum et al., 1991; Borjeson & Lagergren, 1990; Holmbeck et al., 2003). For teens with spina bifida, the social consequences of their illness (i.e., inability to engage in activities with others, stigma associated with their disability, and lack of social acceptance) are often perceived as the most difficult aspects of having a chronic illness (Borjeson & Lagergren, 1990; Zurmohle et al., 1997). There is also some evidence that these differences in social adjustment persist over time (i.e., into adulthood). For example, Kokkonen and colleagues (2001) found that youth with chronic illnesses displayed social immaturity compared to their typically developing peers in terms of employment status, independence from their families, and sexual relationships.

It is important to recognize that a proportion of children and adolescents with chronic illnesses experience positive social adjustment. Some studies failed to find differences between social adjustment of chronically ill children and their healthy peers. Meijer, Sinnema, Bijstra, Mellenbergh, and Wolters (2000), for example, found that a sample of children living with various chronic conditions did not differ from normative data on healthy children in terms of social activities and social self-esteem. Studies examining other aspects of social competence (i.e., social skills and social performance) are much less common. Two studies assessing social skills of children with spina bifida did not reveal group differences with respect to verbal (i.e., speech duration) and nonverbal (i.e., eye contact) social skills (Ammerman et al., 1989; Van Hasselt, Ammerman, Hersen, Reigel, & Rowley, 1991). It is important to consider the possibility that small sample sizes or the selection of a higher functioning sample in these studies may have affected the findings. Findings regarding differences in social performance between healthy children and those with chronic illnesses have been mixed. Whereas Kapp-Simon and McGuire (1997) found that children with craniofacial conditions were less likely to approach their peers or initiate and engage in conversation with them, another study found that children with asthma and diabetes were not perceived to differ from their healthy peers in terms of positive peer interactions (Nassau & Drotar, 1995). However, it is important to recognize the major differences between the chronically ill children sampled in the two studies. The former includes children with obvious physical differences, whereas those with asthma and diabetes can more readily keep their medical issues from becoming public knowledge. As such, it is not surprising that the children with craniofacial conditions appeared more impaired in their social performance.

In sum, knowledge of social competence in children with chronic illness is mostly based on studies of social adjustment. These studies indicate that although children with chronic illness are at risk for social maladjustment, a significant range of functioning is seen. Despite these findings, there is a paucity of literature focusing on factors that can be considered risk factors for social maladjustment in these children. Also, little is known about the social skills and performance of children with chronic illness. The current study will examine all three components of social competence and explore neurocognitive characteristics of children and adolescents with spina bifida that are hypothesized to be associated with these social outcomes. In particular, neurocognitive characteristics common in children with spina bifida and hydrocephalus (see above) will be examined as predictors of social competence. Specifically, cognitive functions that are associated with social functioning will be highlighted. The section that follows will discuss how the field of social cognitive neuroscience provides a heuristic for understanding how brain structure and function affect children's social development, particularly for those with compromised neurological and neuropsychological functioning.

Social Cognitive Neuroscience as a Basis for Understanding Social Competence

The field of social cognitive neuroscience provides a basis for integrating knowledge about brain structure and function and children's social development. The field promotes integrative studies of the links between brain, emotion and cognition, and social behavior (Brothers, 1990; Cacioppo et al., 2000; Moss & Damasio, 2001; Ochsner & Lieberman, 2001; Posner, Rothbart, & Gerardi-Caulton, 2001). The growing literature in social cognitive neuroscience indicates social-cognitive processes are dependent on a distributed network of interdependent brain regions that become integrated over the course of social development (Adolphs, 2001; Grady & Kneightley, 2002; Johnson et al., 2005). As such, a single process cannot be linked to any single structure. Moreover, a single structure can be involved in several processes. It becomes clear that abnormalities in any brain structure can contribute to disruption in cognitive processes that lead to social deficits.

Despite the fact that a single structure is unlikely to explain deficits in social cognition, many brain regions have been found to play especially important roles in specific processes. For example, the anterior cingulate and ventromedial, orbital, and dorsolateral prefrontal cortex are brain structures that appear to play an important role in aspects of social cognition, such as theory of mind (i.e., understanding the mental states of others) and emotional regulation (Allman, Hakeem, Erwin, Nimchinsky, & Hof, 2001; Amodio & Frith, 2006; Frith & Frith, 2001; Gallagher & Frith, 2003; Mah, Arnold, & Grafman, 2004; Siegal & Varley, 2002). Table 1 (Yeates et al., 2007) summarizes the links between brain regions and specific social-cognitive and affective processes that have been the focus of recent research. It is clear that most brain regions are involved in multiple functions, and most functions draw on multiple brain structures. It is also important to recognize that the brain regions listed in Table 1 follow predictable developmental sequences that relate to social development and that can be impaired or disrupted by childhood brain disorders (Johnson et al., 2005). Of particular interest, the brain regions known to regulate cognitive-executive processes appear to overlap considerably with those areas implicated in social cognition.

Yeates and colleagues (2007) suggested that cognitive-executive functions reflect aspects of social information processing that are linked to a network of specific brain regions (Adolphs, 2001; Grady & Kneightley, 2002). In addition, these cognitive-executive processes represent the latent knowledge (i.e., stable individual characteristics) that has been described in recent models of social competence (see Dodge et al., 2002; Guralnick, 1999; Lemerise & Arsenio, 2000). By focusing on cognitive and emotional processes, the field of social cognitive neuroscience provides a much needed link between knowledge regarding the brain substrates of social behavior and developmental models of social competence.

Because of the neurological insults that result from childhood brain disorder, it is important to understand the neuropsychological and functional implications for these children. The timing of the brain injury also becomes important because of the developmental changes that occur in certain brain regions. In regards to social behavior, this is particularly salient because the brain regions implicated are subject to change with age. Moreover, this brain maturation process correlates with increases in the child's capacity for social information processing and the capability of more complex social behaviors (Dennis, 2006; Paus, 2005; Stuss & Anderson, 2004). For children with congenital brain disorders, such as spina bifida and hydrocephalus, the effects of neurological development on social cognitive outcomes are particularly important to better understand. Given that children with SBH incur neurological insults while still in utero, it follows that disruptions in the multiple structures that contribute to social cognitive processes are possible and likely. As mentioned above, the regions involved in cognitive functions related to social competence follow predictable developmental sequences (Yeates et al., 2007). Since hydrocephalus in spina bifida impacts brain development early on, it follows that this sequence is likely altered in some significant way for these children and adolescents. The next section specifically addresses

Table 1. Links Between Brain Structures and Social-Affective and Cognitive-Executive Processes

Brain Structure	Social-affective and cognitive-executive function
Somatosensory cortices	Representation of emotional response Viewing the actions of others
Fusiform gyrus	Face perception
Superior temporal gyrus	Representation of perceived action Face perception Perception of gaze direction and biological motion
Amygdala	Motivational evaluation Self regulation Emotional processing Gaze discrimination Linking internal somatic states & external stimuli
Ventral striatum	Motivational evaluation Self regulation Linking internal somatic states & external stimuli
Hippocampus and temporal poles	Modulation of cognition Memory for personal experiences Emotional memory retrieval
Basal forebrain	Modulation of cognition
Cingulate cortex	Modulation of cognition Error monitoring Emotion processing Theory of mind
Orbitofrontal cortex	Motivational evaluation Self regulation Theory of mind
Medial frontal cortex	Theory of mind Action monitoring Emotional regulation Emotional responses to socially relevant stimuli Monitoring outcomes associated with punishment & reward
Dorsolateral frontal cortex	Cognitive executive functions Working memory

developmental issues that ought to be taken into consideration when understanding brain structure and function and social outcomes for compromised children and adolescents, such as those with SBH. In addition, a discussion of the gradual development of social cognitive abilities during childhood and adolescence will be provided.

Developmental Considerations

The anterior regions of the brain that are associated with social behavior undergo gradual development. Development of the frontal cortex, in particular, is not complete until around puberty (Klingberg, Vaidya, Gabrieli, Moseley, & Hedehus, 1999). Additionally, the prefrontal cortex is not fully myelinated until mid-to-late adolescence (Giedd et al., 1999; Klingberg et al., 1999; & Sowell et al., 1999). Recent longitudinal studies of cortical gray matter development have shown that higher order association cortices mature only after lower order somatosensory and visual cortices (Gogtay et al., 2004). Within the frontal lobes, maturation proceeds in a back-to-front direction, beginning in the precentral gyrus and spreading anteriorly, with the prefrontal cortex developing last.

The direction of developmental maturation is reminiscent of the effect that spina bifida-related hydrocephalus has on neurological structures. Specifically, congenital hydrocephalus results in expansion on the third and fourth ventricles in a posterior-to-anterior (back-to-front) direction, affecting the nearby white matter tracts. As such, hydrocephalus may inhibit appropriate development of the frontal lobes since more anterior structures are being attended to much later than which is appropriate. Given that being born with SBH infers abnormalities in brain structure, it is important to recognize that disruptions in further brain development are possible, if not likely. As mentioned above, spina bifida-related hydrocephalus results in ventricular enlargement, and decreased cortical volume (Fletcher et al., 2000). Though this is repaired with surgical shunt placement, possible damage to several brain structures has already occurred because of the displacement of brain structures, including axonal degeneration, stretching of the periventricular white matter, disruption of normal myelination, and reduced blood flow to the frontal lobes (Barkovich, 1995; Braun et al., 1997; Caner et al., 1993; Catalan et al., 1994; Del Bigio, 1993; Hannay, 2000; Tashiro & Drake, 1998). It is clear that this early onset disorder has persisting effects on brain development, which can ultimately impact cognitive and social development (Fletcher et al., 2004; Wills, 1993).

In addition to structural issues, it is important to understand that social information processing also shows developmental changes that are likely related to brain development (Anderson, Levin, & Jacobs, 2002; Diamond, 2002). The executive functions involved in social behavior, such as inhibitory control and working memory, develop gradually. For instance, during the preschool years, children become more able to delay their responses to stimuli (Diamond & Taylor, 1996; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). Such behavior enables them to achieve developmentally appropriate social interactions.

For typically developing children, the ability to understand nonliteral language (i.e., irony, deceptive praise, and sarcasm), follows a protracted course of development that becomes well-established by early adolescence (Winner, 1988). For children with spina bifida, difficulty in this domain may not become apparent until children become older (i.e., middle childhood), when social demands increase (Bernstein, 2000).

Pragmatic aspects of language, such as following conversational rules that allow a back-and-forth discussion attending to the desires and intentions of all parties, are generally acquired in early childhood by normally developing children. Children and adolescents with spina bifida who are unable to adequately assess and understand the context in which language occurs can ultimately appear less socially skilled and have fewer successful social interactions.

With time, children are able to utilize their growing problem-solving skills to think reflectively about more complex social dilemmas. This allows for more successful social outcomes (i.e., social competence; Crick & Dodge, 1994; Dodge et al., 2002). In addition to the development of social information processing, social behaviors become more diverse, complex, and integrated with increasing age (Rubin, Bukowski, et al., 2006). Interactions and relationships become more meaningful and multifaceted, reflecting their developing cognitive abilities. Based on the aforementioned developmental hurdles faced by children with spina bifida and congenital hydrocephalus, these social milestones are clearly more difficult to attain. As such, age becomes an important feature when exploring social outcomes in this population.

Rationale for the Current Study

Despite the evidence that children and adolescents with spina bifida display less social competence than their normally developing peers and the knowledge that cognitive skills impact functional outcomes in this domain, little is known about the specific cognitive deficits characteristic of spina bifida and congenital hydrocephalus that affect social competence. Most studies that explore social outcomes in children and adolescents with SBH focus on measures of attention and broad measures of executive functioning. However, there are other neuropsychological constructs that assess skills that inform social competence more accurately. In particular, the development of pragmatic judgment of language and inference making skills is important when attempting to successfully traverse social situations. These social cognitive abilities are required for understanding the nuances of social interactions, such as being able to interact appropriately given contextual clues and infer meaning from nonliteral aspects of language (e.g., sarcasm, intonation). Given the evidence that children with spina bifida have deficits in pragmatic judgment of language and inference making skills (Barnes & Dennis, 1998; Cull & Wyke, 1984), it follows that this population would demonstrate impairment in social functioning. In addition, the ability to engage in a socially appropriate manner often requires that one be able to read the affective states of others without explicit verbal cues (emotion recognition; Boyatzis & Satyaprasad, 1994). Those with nonverbal learning disabilities often exhibit impairments in this domain (Rourke et al., 2002; Zillmer & Spiers, 2001). The evidence that children and adolescents with spina bifida are at greater risk for nonverbal learning disabilities (Yeates et al., 2003) suggests that this population also displays deficits in emotion recognition, leading to difficulties engaging with others in socially appropriate ways.

If the specific social-cognitive deficits associated with spina bifida were understood in greater detail, or if a “profile” of the typical deficits and associated outcomes were developed, then children and adolescents with spina bifida could be tested and provided with remedial services early in development, before they begin to lag behind peers. The aforementioned social cognitive constructs of interest contribute to social difficulties commonly associated with spina bifida by affecting a child's ability to interact with others in a manner that is socially acceptable. If specific domains of socio-cognitive functioning were identified, it might be possible to design more targeted cognitive remedial techniques for this population.

To address the need for a more comprehensive understanding of how socio-cognitive abilities affect social outcomes of children and adolescents with SBH, the current study will explore whether or not measures of language pragmatic, emotion recognition, and inference making are associated with social competence and its components. The study has three objectives: (1) to provide a profile of socio-cognitive features present in a sample of children and adolescents with SBH; (2) to identify the clinical characteristics (e.g., number of shunt revisions, and lesion level) associated with deficits in nonliteral language, inference making skills, pragmatic judgment, and emotion recognition in spina bifida; and (3) to examine the importance of the aforementioned socio-cognitive abilities in predicting social competence outcomes. It is hoped that the results of this study will provide a more comprehensive picture of neuropsychological functioning and its outcomes in children and adolescents with SBH to guide future research, diagnostic decision-making, and intervention.

Hypotheses

Social cognitive functioning. Based on previous literature, it is expected that children and adolescents with spina bifida and hydrocephalus will demonstrate difficulty on neuropsychological measures of social cognition.

1. It is expected that children and adolescents with spina bifida and hydrocephalus will perform significantly lower than the general population on neuropsychological measures of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition.

Predictors of social cognitive functioning. Some studies have demonstrated a link between neurological status/condition severity indicators (e.g., shunt status) and a variety of cognitive and functional outcomes (Holmbeck & Faier-Routman, 1995; Hommeyer et al., 1999). It is expected that these features will also be associated with deficits in social cognitive functioning. Two severity indices (number of shunt surgeries and lesion level) will be examined because they are expected to affect variables of interest in distinct ways. Shunt surgeries affect the brain directly, and are, therefore, expected to impact areas that inform cognitive abilities (the independent variable). Lesion level, on the other hand, affects physical functioning (e.g., mobility, bladder control). These factors have been shown to be associated with social functioning (the dependent variable). Hommeyer et al. (1999), for example, found that children with lower lesion levels participated in more activities than children with higher-level lesions, perhaps indicating that lesion level is a predictor of social competence. The following hypotheses are offered with respect to prediction of neurocognitive ability.

2. It is hypothesized that the number of shunt surgeries will be positively related to the degree of impairment in social cognitive domains of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition.
3. It is also hypothesized that lesion level will be negatively associated with social cognitive functioning, such that higher lesion levels will predict worse performance on measures of social cognitive domains of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition.

Social cognitive impairment and social outcomes. Based on Yeates and colleagues' (2007) heuristic, it is expected that performance on neuropsychological measures of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition will predict social competence (i.e., social skills, performance, and adjustment) in children and adolescents with spina bifida and hydrocephalus. The following specific results are expected.

4. It is expected that performance on neuropsychological measures of social cognition will be positively associated with objective (i.e., parent report, teacher report, and SGPS-RE) measures of social competence.

Self-awareness/monitoring considerations. Based on the findings of Minchom et al. (1995) that children and adolescents who are more cognitively impaired tend to report higher self-competency than those who are less impaired and more aware of their deficits, and because those with impaired social cognitive abilities might be less capable of monitoring their own social behavior and understanding its impact on others, a separate hypothesis will address child-report of social competence. In addition, those children with high scores on measures of social cognition are expected to report high scores on social competence. Based on the marginality hypothesis, the children and adolescents who struggle with social competence are those who are aware of their abilities (i.e. not severely impaired), yet are not functioning at the same level as their normally developing peers. The following hypothesis is offered:

5. A curvilinear relationship is expected to be found between performance on neuropsychological measures of social cognition and subjective (i.e. self-reported) measures of social competence, such that poor performance on social cognition will be associated with better self-reported social competence and high scores on social cognition to be associated with better scores on self-reported social competence. This hypothesis suggests that those who are neither severely impaired nor functioning at the same level as normally developing peers rate themselves as not having good social competence.

Developmental considerations. As previously noted, brain structures associated with social behavior undergo gradual development. In addition, the cognitive abilities necessary for adequate social competence develop over the course of early- to mid-adolescence, making the neurological and cognitive deficits seen in those with spina bifida more apparent as they get older. As such, the following hypothesis is offered.

6. The association between neuropsychological measures of social cognition and social competence will be stronger as children with spina bifida and hydrocephalus become older.

Social cognition as a mediator. Hydrocephalus and shunt placement to treat hydrocephalus may be associated with a greater degree of cognitive impairment, including problems in the areas of planning, attention, and working memory (Brewer, et al., 2001; Charney, 1992; Brown et al., 2008; Rose & Holmbeck, 2007; Tarazi, Zabel, & Mahone, 2008). These cognitive and executive function deficits are hypothesized to mediate the relation between SB status and social adjustment (Rose & Holmbeck, 2007). Given the above discussion of social cognitive constructs and their connection to social competence outcomes, it is expected that they will likewise mediate the relationship between illness severity and social outcomes. The following hypothesis is offered:

7. It is predicted that social cognition will mediate the relationship between illness severity and social outcomes. In particular, illness severity is expected to be negatively associated with social cognition and, in turn, this level of social cognition will be positively associated with social outcomes/functioning.

CHAPTER III

METHOD

Participant Recruitment

Recruitment was conducted for a larger longitudinal study under the direction of Dr. Grayson Holmbeck. Families with children who had spina bifida myelomeningocele were recruited from four primary sources: (1) a children's hospital, (2) the Spina Bifida Association of Illinois, (3) a pediatric hospital for disabilities, and (4) a university-based medical center. Eligible families from the children's hospital and spina bifida association were identified. Recruitment letters were then sent out to families and/or contact was initiated via telephone. In addition, in-clinic recruitment was conducted by trained research assistants at both the children's hospital and hospital for disabilities. Eligible participants were identified with the help of a nurse coordinator, and families were provided information about the study. Follow-up phone calls were made within a week to schedule the first home visit. There were 467 nonoverlapping names from the four sources. Out of the 467 potential participants, 26 families lived greater than 300 miles from the laboratory, 71 declined to participate, 50 could not be reached due to invalid addresses and/or phone numbers, 67 children were out of the age range (either younger than 8 or older than 16) during the recruitment period, 49 did not have a diagnosis of spina bifida, 2 were deceased, and 74 were excluded for miscellaneous reasons (e.g, child cognitively impaired). 140 families remained. A comparison of participating children with children from families that declined to participate (*n* = 71) revealed no differences with respect to lesion type of spina bifida (χ^2 (1) = 2.173, p>.05), shunt status (χ^2 (1) = .258, p>.05), or occurrence of shunt infections (χ^2 (1) = .000, p >.05). For the purposes of the current study, only those with spina bifida with hydrocephalus (SBH) were included (*n* = 108).

Peers were recruited on or before the first home visit with the target family. Parents and children were asked to determine a peer suitable for involvement in the study. To be eligible for inclusion in the study, peers had to be 6-17 years of age at Time 1, and either English- or Spanish-speaking. In addition, efforts were made to recruit peers who were within 2 years of the target child's age. While target families were encouraged to identify a peer who was unrelated, cousins were included as a last resort option in some cases. For the current study, only those children who identified non-related peers were included. Guidelines were provided to the parents for how to contact the peer's family. A second home visit was then scheduled. Once the target child's parent spoke with the peer's parent, a research assistant obtained the peer's contact information and mailed out consent forms and made phone contact to go over the details of the study. Peers were successfully recruited for 82% of the families in the current study.

Inclusion/Exclusion Criteria

In order to be included in the current study, participants needed to present with a diagnosis of spina bifida myelomeningocele, lipomeningocele, or myelocystocele with hydrocephalus. Involvement of at least one primary custodial caregiver was necessary for inclusion. Upon the first home visit, participants were 8-15 years of age and spoke either English or Spanish.

Children/adolescents were excluded from the current study if they did not have spina bifida with hydrocephalus (SBH). Any comorbid health conditions also rendered them ineligible for study involvement. All children/adolescents who lived more than 300 miles from Chicago were excluded.

Participant Demographics

Children were 8 to 15-years old at recruitment, with the following distribution: 28 were 8 or 9 years old, 22 were 10 or 11 years old, 29 were 12 or 13 years old, and 29 were 14 or 15 years old. Thus, the sample is relatively evenly distributed across these 4 age groupings. With respect to other demographics, it can be seen in Table 1 that there are equivalent numbers of males (n = 54) and females and the sample is roughly half White/Caucasian (52.8%), with a large percentage of Latino/Hispanic families (28.7%), and 18.5% from other ethnic groups (i.e., African American). With respect to SES, the sample demonstrates considerable variability around a mean Hollingshead (1975) rating of 39.

Medical chart review and maternal report provided information on a number of condition parameter variables for the entire sample of target children (n = 140): (1) *spinal lesion level*: 18.7% sacral, 65.7% lumbosacral or lumbar, 15.6% thoracic, (2) *spina bifida type*: 87.7% myelomeningocele, 9.4% lipomeningocele, 2.9% other, (3) *shunt status*: 78.3% shunt, (4) *hydrocephalus status*: 78.3% with hydrocephalus, (5) *total number of shunt surgeries* (not including original shunt placement): M = 3.167; SD = 5.088. For each of these variables, when maternal report was not available, paternal report was then examined. A composite of parent and medical chart report was created for each variable. In instances in which parent and medical chart report were inconsistent, parent-report was given priority. An overall severity score was computed for each participant and based on the Gross Motor Function Classification System (GMFCS; Palisano et al., 1997), with scores ranging from 1 to 4 (higher scores index higher levels of severity). This score provides a classification for the child's present abilities and limitations in gross motor functioning.

For the purpose of the current study, only those children and adolescents with spina bifida with hydrocephalus (SBH) were included. For those children and adolescents included in the current study analyses (n = 108), lesion level break-down was as follows: 18.1% sacral, 65.7% lumbosacral or lumbar, 16.2% thoracic. All participants had spina bifida myelomeningocele (n = 108). Participant demographics can be seen in Table 2.

Data collection for the larger study has occurred every two years. At the time of the current study, only the first wave of data was completely collected, hereby denoted Time 1.

Design and Procedure

Standard Institutional Review Board (IRB) procedures were carried out for the larger longitudinal study and approval was granted. Trained graduate and undergraduate research assistants conducted data collection. Data collection occurred in the families' homes over the course of two home visits (HVs) and took about three to four hours to complete. Families were paid at each visit: $50 for home visit 1 (HV1) and $100 for home visit 2 (HV2). Peers were paid $50 for their participation at HV2. At the beginning of each visit, the purpose and procedures of the study were reviewed with the family and peer. Parental consent and child assent for both the target child and peer, in addition to medical and teacher release forms, were attained at each visit. Parents and children from the target family were asked to complete a set of questionnaires in separate rooms to ensure privacy. Peers also completed questionnaires. The order of the questionnaires was counterbalanced. These questionnaires were completed in an interview format with Likert scales presented on large cards for all children when needed to enhance understanding. Standardized neuropsychological assessments were also administered to target children over the course of HV1 and HV2 to assess cognitive functioning in a variety of domains.

At HV1, families were also asked to participate in a set of audio and videotaped observational interaction tasks. The families, consisting of the target child and one or more primary caregiver, participated in four structured tasks: (1) an interactive game, (2) discussion of two age-appropriate vignettes, (3) discussion of transferring disease-specific responsibilities to the child, and (4) discussion of conflict issues as rated in paper questionnaires (Smetana, Yau, Restrepo, & Braeges, 1991). The order of the three tasks following the interactive game was counterbalanced. All tasks were coded across interaction style, conflict, affect, control, parental behaviors and collaborative problem solving, and general family atmosphere and impairment. All but the conflict task were designed specifically for the study.

Table 2. Participant Demographics

Variable	*M*	*SD*
Age	11.54	2.45
SES	39.00	15.83
WASI Score	82.09	19.55
Number of shunt revisions	3.17	5.09
Gender	*n*	%
Male	54	50
Female	54	50
Ethnicity		
Caucasian	57	52.8
Hispanic	31	28.7
Other	20	18.5
Lesion level		
Sacral	19	18.1
Lumbosacral/Lumbar	69	65.7
Thoracic	17	16.2

NOTE: There was missing data for spina bifida type, lesion level, shunt status, and hydrocephalus status variables. Frequencies represent the valid percent rates.

For the interactive board game, the family was presented with a game that was purchased in a local toy department. The family was provided rules for how to play and given enough time to complete the game.

For the vignette task, the family was provided with two age-appropriate social situations, one of which specifically targeted issues related to spina bifida. After reading each short story, the family was requested to read and respond to 7 questions (i.e., What are good ways to handle the situation?; If something like this were to happen to you in the future, what would you do?) The goal given by the research assistant was for the family to work together to answer the questions. The family was given 10 minutes to discuss both vignettes and respond to the questions provided.

For the transfer of responsibility task, the family was asked to identify one spina bifida related responsibility that was managed by the parents at the time of the HV but for which the child would have to take responsibility in the future. After identifying a responsibility, the family was asked to discuss how the transfer of responsibility would take place and how they would know when successful transferred had occurred. Families were encouraged to identify a spina bifida-related responsibility, but were told that they could come up with any responsibility that would need to be transferred from the parent to the child/adolescent if they could not think of a responsibility related to spina bifida. The family was given 5 minutes to discuss the topic and a piece of paper to record their answers. If they finished discussing the topic before time was up, they were instructed to discuss a second topic in the same manner.

For the conflict task, the Parent-Adolescent Conflict Scale (PAC; Robin & Foster, 1989) was first completed by each family member and then examined and coded by a research assistant. Scores were computed for each item by multiplying conflict frequency by intensity. Items with the five highest scores across respondents were selected for the conflict task and were presented on laminated cards to the family. The family was requested to come to a consensus on which 3 of the 5 issues to discuss. Once this was accomplished, the family was given 10 minutes to discuss the 3 issues, with the goal of incorporating the viewpoints of all family members. The observational procedure was based on one established by Smetana et al. (1991).

At HV2, the target child and his/her peer were asked to participate in a set of audio and videotaped observational interaction tasks. The children/adolescents participated in four structured tasks: (1) a toy-ranking activity, (2) discussion of an unfamiliar object, (3) discussion and planning of an adventure, and (4) discussion of social conflicts. The order of the four tasks was counterbalanced. All tasks were coded across interaction style, conflict, affect, control, collaborative problem solving, and general friendship atmosphere and impairment. These four tasks were designed specifically for the study.

For the toy-ranking activity, the children where presented with 5 toys that were purchased in a local toy department. They were then asked to spend 5 minutes working together to rank the toys in order of preferences. The goal of the task was to elicit collaboration in determining preference.

For the discussion of an unfamiliar object, children/adolescents were presented with an object that was not easily identified. They were then asked to work together to determine a name and use for the object. It was also suggested that the children create a commercial for their new object. If either child knew the actual use of the object, they were asked to come up with a new use. Children were given 5 minutes to discuss uses and names for their object.

For the Plan and Adventure task, the children were asked to come up with an adventure they would like to go on together. Once the activity was decided upon, the children/adolescents were instructed to discuss details of the trip, including what they would bring with them, how they would arrive at the location in question, and things that they would do together. They were also provided paper and colored pencils to draw a scene from the adventure. Children were given 5 minutes to come up with and discuss their adventure.

For the discussion of social conflicts task, the children were each asked to think of a time when they were either upset by a friend or caused a friend to become upset. After each describing the scenario, the target and peer were instructed to discuss (1) how the situation made them feel, (2) how they would have felt if they were in each other's position, and (3) alternative reactions to the upsetting situations. Children were given 5 minutes to discuss their examples of social conflict.

The specific measures utilized for the current study are described in greater detail in the following section.

Neuropsychological Measures

General intellectual ability. The Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) is an abbreviated measure of intellectual functioning including both performance and verbal domains that is frequently used to provide IQ. For the purposes of the current study, the Vocabulary and Matrix Reasoning subtests were administered to obtain a full-scale IQ. The vocabulary subtest is a 42-item task that measures expressive vocabulary, verbal knowledge, and fund of information. In addition, it is a good measure of crystallized intelligence and general intelligence (*g*). Items 1-4 require the examinee to name pictures. Items 5-42 are orally and visually presented words which the examinee defines. The matrix reasoning subtest is a series of 35 incomplete gridded patterns that the examinee completes by pointing to or stating the number of the correct response from five possible choices. Matrix Reasoning is a measure of nonverbal fluid reasoning and general intellectual ability. The WASI was nationally standardized on 2,245 individuals ages 6-89. For the vocabulary and matrix reasoning subtests, the average reliability coefficient for children 6-16 years old were found to be .89 and .92, respectively.

Nonliteral language, inference making skills, and pragmatic judgment. The Comprehensive Assessment of Spoken Language (CASL; Carow-Woolfolk, 1999) is a norm-referenced oral language assessment battery of tests for children and young adults aged 3 through 21 years. Three subtests were administered to children and adolescents to assess nonliteral language, inference making skills, pragmatic judgment. The Supralinguistic subtests include Nonliteral Language and Inference, which measure comprehension of complex language in which meaning is not directly available from lexical or grammatical information. The Pragmatic Judgment subtest measures awareness of the appropriateness of language in relation to the context in which it is used and the ability to modify language to the situation. On all three subtests, of the CASL, higher scores indicated better performance. Of particular note for the current study is the fact that there was a good deal of missing data for all three subtests of the CASL (Nonliteral Language n = 89; Inference n = 89; Pragmatic Judgment n = 90). This missing date was due to three factors. First, the CASL was the final measure administered at HV2 and children were often too fatigued to continue. In some cases, parents requested that the visit be terminated. Often, the family was unwilling to schedule a third home visit to complete testing. Secondly, the total sample in the current study reflects the number of children/families who completed an HV1, despite efforts to schedule a second home visit with all children. Given that the CASL was administered at HV2, there was no data collected for the children who only completed HV1. Finally, the CASL proved to be difficult for those participants who had relatively more cognitive difficulties. The CASL required that the child understand and respond to more complex verbal instructions. For some participants, the inability to engage verbally prevented the research assistant from administering the subtests from the CASL.

Emotion recognition. The Diagnostic Analysis of Nonverbal Accuracy 2 (DANVA2; Nowicki, 2003) was administered to children and adolescents to assess ability to infer emotion, desire, and intention of others based on nonverbal cues and nuances of language (i.e., tone). Three subtests were administered. The Child Facial Expression Subtest consists of 24 photographs of child facial expressions; 12 female and 12 male showing an equal number of high and low intensity happy, sad, angry and fearful faces. The subtest has good internal consistency, with coefficient alphas ranging from .69 to .81.

The Child Paralanguage Subtest is a revision of the original child voices test and includes stimuli differing by intensity. The measure consists of 32 voice trials, with an equal number of male and female voices for each of the four high and four low intensity trials of each emotion. Scores have shown to be internally consistent for eight-year-old (α = .74) and ten-year-old (α = .76) children.

Finally, the Adult Posture Test for Children is a brief version of the 40-item Adult Posture Test. It consists of 16 photographs of adults portraying happy, sad, angry and fearful emotions with their faces blacked out. There are an equal number of male and female pictures, as well as high and low intensities in both standing and seated postures. Internal consistency data for the Adult Posture Test revealed a Cronbach's coefficient alpha of .68 for adolescents and adults ranging in age from 14-48. Reliability and validity data for the child version are not available. All three subtests of the DANVA2 were used for the current study, and higher scores indicated better performance.

Measures of Social Competence

To assess the three subcomponents of social competence, social skills, social performance, and social adjustment (Cavell, 1990), various self-report and observational measures were completed. This allowed for the perspective of both the target child and observers (i.e., parents and teachers) to be considered.

Self-report measures of social skills. The Social Skills Rating System (SSRS; Gresham & Elliot, 1990) was completed by mothers, fathers, and teachers to assess the respondent's perspective of the target child's behaviors that are considered essential to social competence and adaptive functioning. It is a standardized, norm-referenced instrument that assesses behaviors that are considered essential to social competence and adaptive functioning. The questionnaire includes parent and teacher forms. Each item asks the respondent to rate how often a child demonstrates the social skill and how important the skill is to the child's development. Teachers and parents were only asked to rate how often the child engages in the behavior, from "0 = never" to "1 = sometimes" to "2 = very often." The SSRS also has different versions for different age groups. Given the age range at Time 1, the elementary level versions (grades K through 6) were used in this study. Subscales fall into the domains of social skills and problematic behaviors. Only the social skills subscales were used in this study since problem behaviors are assessed using other questionnaires (e.g., CBCL). The subscales of social behavior include cooperation, assertion, self-control, and responsibility (parent only). The SSRS has shown adequate to good internal consistency across forms (α = .51; Gresham & Elliot, 1990). Coefficient alphas for the social skills subscales ranged from .86 to .94 for the teacher form and .65 to .87 for the parent form (Gresham & Elliot). The parent form consisted of 38 items and the teacher form consisted of 30 items. Higher scores on parent and teacher report of the SSRS indicated better social skills for the target child.

Self-report measures of social performance. The Children's Self Efficacy for Peer Interaction Scale (CSPI; Wheeler, & Ladd, 1982) was completed by target children to assess children's perceived self-efficacy in social situations. The scale consists of 22 items describing peer interactions clustered into two groups: conflict and non-conflict. Each item describes a social situation (e.g., "Some kids want to play a game"), and is followed by an incomplete statement requiring the subject to evaluate his or her ability to perform a verbal persuasive skill (e.g., "Asking them if you can play is __________ for you"). For each item, the subject circles one of four choices: very hard, hard, easy, or very easy. The test-retest reliability of the CSPI is .90 for boys and .80 for girls. Internal consistency for the total scale is high, with α = .85 for elementary school children (Wheeler & Ladd, 1982). For the current study, four items were dropped (numbers 15, 16, 18, and 20 from the original scale) because the wording (e.g., "using your play area") was age-inappropriate. Higher scores on this measure indicated better social performance.

Self-report measures of social adjustment. The Social Acceptance subscale of the Self-Perception Profile for Children (SPPC; Harter, 1985) was completed by target children to assess social acceptance by peers. For each of the six items, the child is presented with two statements which can describe a child (e.g., "Some kids find it *hard* to make friends BUT other kids find it's pretty *easy* to make friends"). The reporter identifies which statement best describes the child, and then decides if the statement is "really true" for that child or "sort of true" for that child. Previous research (Holmbeck et al., 2003) has shown alpha coefficients to range from .67 to .93 in families of children with spina bifida.

The parent and teacher versions of this measure contain 3 items and were completed by parents and teachers, respectively, to assess their perspective of the target child's social acceptance. These versions have demonstrated adequate psychometric properties (Cole, Gondoli, & Peeke, 1998). Higher scores on these measures indicated better social adjustment for the target child.

Audiotaped interview measures of social skills. In addition to paper measures, both target children were asked to participate in three short audio-recorded interviews about friendships and peer relationships. Interviews were privately conducted with a research assistant. Questions addressed social problem-solving, the child's general social interactions, and the child's relationships with his/her participating friend.

The Social Goals and Problem Solving-Rejection Expectations Scale (SGPS-RE) was completed by children and adolescents with spina bifida as a means to assess the ability to interpret social situations and respond appropriately given contextual cues (i.e., social information processing). This is a key component of social skills and, as such, a critical determinant of social competence (Crick & Dodge, 1994; Rubin & Krasnor, 1986). The SGPS-RE presents the respondent with a social problem and asks the child to predict how likely another child would offer to help and how likely the child would seek help from another child, using a 6-point likert-type scale from (1) = Definitely No to (6) = Definitely Yes. Additionally, each vignette asked the child to provide examples of what he/she might say or do in the situation. This scale was adapted from the Rejection Expectations Scale (Pope, 2005) and the Middle School Alternative Solutions Task (AST; Caplan, Weissberg, Bersoff, Ezekowitz, & Wells, 1986). According to personal correspondence with Pope, the Rejection Expectations Scale was adapted from Children's Rejection Sensitivity Questionnaire created by Downey, Lebolt, Rincon, and Freitas (1998), and the short version had a coefficient alpha of .80 (A. Pope, personal communication, March 8, 2005). Items were modified to include spina bifida related topics. At Time 1, the target child's responses to 10 vignettes were recorded by research assistants and later coded in accordance with coding manual guidelines. Six category scales (Content, Probability of Negative Relational Effects, Severity of Negative Effects, Social Skills, Effectiveness, and Planfulness) were created to code the components of each open-ended response given. For the purpose of the current study, the Content, Social Skills, and Effectiveness category scales were utilized. These three category scales assessed important characteristics that contribute to social skills, an essential component of social competence (Cavell, 1990). Inter-rater reliability and scale alphas were calculated to determine the adequacy of each category scale. Adequate agreement between coders was found for each of the three categories utilized for the current study ($r = 0.96$-0.98), allowing for a combined mean score across coders.

Content category. The Content category scale required the observational coders to assess the content provided by the target child in response to each of the 10 vignettes presented. Scores ranged from 0-6 (0 = Irrelevant or Unscorable, 1 = Aggressive, 2 = Passive, 3 = Dependent on others, 4 = Nonconfrontational, 5 = Simple request, 6 = Detailed request), with higher scores indicating more socially complex content and better social competence.

Social Skills category. The Social Skills category assessed the degree of social skill and social maturity evidenced by the response. A high score on this category required an explicit reference to wanting to follow social norms or be polite or thoughtful. Social skill was evidenced when the child took into account the person with whom he/she was interacting, and behaved in an appropriate manner. Social skill was also shown when a child acknowledged situational factors and reacted to a scenario in a way that reflected an awareness of self and others. Scores ranged from 0-6 (0 = Unscorable, 1 = Not socially skilled, 2 = Low level of social skill, 3 = Some level of social skill, 4 = Moderate level of social skill, 5 = High level of social skill), with higher scores indicating more socially complex content.

Effectiveness category. The Effectiveness category assessed how well a child's solution was expected to help him/her achieve his/her goal in the social situation. Scores ranged from 1-5 (1 = Not at all effective, 2 = Possibly effective, 3 = Somewhat effective, 4 = Moderately effective, 5 = Highly effective), with higher scores indicating a more effective social solution presented by the child.

CHAPTER IV

RESULTS

Preliminary Analyses

As noted above, 108 children and adolescents with spina bifida with hydrocephalus (SBH) were included in the current study. Mother, father, and teacher report of social competence were assessed for each participant. Sample sizes varied from measure to measure, given that response rates varied. In addition, neuropsychological measures were not completed for all participants. This occurred for two reasons: (1) participant was too cognitively impaired to complete tasks; or (2) family refused participation in the second home visit at which the assessment occurred.

Preliminary correlations were conducted to determine agreement between reporters in an effort to reduce the number of analyses by creating composites, when appropriate. In terms of social adjustment (Harter), adequate agreement was found across mother, father, and teacher report (r = 0.40-0.61), thereby allowing for a composite score to be created. For objective report of social skills (SSRS), there was adequate agreement between mother and father report (r = 0.61); as such, a composite score was created for mother and father report of social skills. Teacher report of social skills was not consistently correlated with either mother or father report, suggesting limited agreement across these reporters. Therefore, subsequent analyses were conducted using separate analyses for parent (mother and father combined) and teacher report of social skills, yielding two scales of objective social skills. Child report of social performance, social adjustment, and social skills were not combined with adult reports, as they were considered to be subjective reports, separate from objective report.

Social skills were additionally evaluated via the Social Goals and Problem Solving-Rejection Expectations Scale (SGPS-RE), an audiotaped interview measure of social problem solving skills. Responses were coded by two trained coders across six categories. For the purpose of this study, the content, social skills, and effectiveness categories were examined. These three categories were considered key components of social skills. Inter-rater reliability and scale alphas were calculated to determine the adequacy of each category scale. Adequate agreement between coders was found for each of the three categories (r = 0.96-0.98), allowing for a combined mean score across coders. While these measures elicited verbal report from the child/adolescent, they are considered to be an objective measure of social skills because performance was assessed and coded by an objective party (see above for coder information). Analyses were run to determine if the three categories of the SGPS-RE were highly correlated. Results indicated that the category scales were, in fact, highly correlated (r = .97=.98). For the purpose of this study, the three scales were not aggregated because they were thought to assess separate components of social competence.

Preliminary analyses were conducted to examine the reliability for questionnaire report of social skills, social adjustment, and social performance. Alpha coefficients for child report of social adjustment (Harter), child report of social performance (CSPI), mother, father, and teacher report social adjustment (Harter composite score), mother and father report of social skills (SSRS composite score), teacher report of social skills (SSRS) were adequate (0.58-0.91), indicating acceptable internal consistency (See Table 3). The methods and reporters used to assess each construct are reported in Table 4.

Table 3. Alpha Coefficients for Questionnaire Measures of Social Competence

Variable	**Mean**	**SD**	**Alpha**
Social Adjustment			
Parent & Teacher Combined Report (Harter)	7.85	1.94	0.675
Child Report (Harter)	17.43	14.02	0.584
Social Skills			
Mother & Father Combined Report	2.50	0.56	0.757
Teacher Report	38.92	9.875	0.908
Social Performance			
Child Report (CSPI)	48.05	8.547	0.810

NOTE: Values listed for observational variables under the “Alpha” column represent Interrater Reliability; SS = Standard Score

Emotion recognition was assed via the DANVA2, which consists of three subtests (faces, paralanguage, and postures). The three subtests were highly correlated (r = 0.58-0.62) and therefore combined to create a composite score of emotion recognition. As such, the number of analyses was reduced, thereby reducing Type 1 error.

Analyses were also conducted to determine whether the social cognitive variables were correlated. Results indicated that DANVA, nonliteral language, inference making skills, and pragmatic judgment scores were, in fact, highly correlated (*r* = 0.56-0.86). The correlations between each of the three subtests from the CASL were particularly high.

Table 4. Measures Used to Assess Relevant Constructs

Construct	Measure	Reporters
Social Cognition		
Nonliteral Language	CASL	Standardized Assessment
Inference Making Skills	CASL	Standardized Assessment
Pragmatic Judgment	CASL	Standardized Assessment
Emotion Recognition	DANVA	Standardized Assessment
Social Competence		
Social Adjustment	Harter	Parent & Teacher Combined Child
Social Skills	SSRS	Parent (mother & father combined) Teacher
	SPGS-RE	Child (objective coders)
Social Performance	CSPI	Child
General Intellectual Functioning	WASI	Standardized Assessment

Note: All standardized assessments were administered to the child; CASL= Comprehensive Assessment of Spoken Language; DANVA= Diagnostic Analysis of Nonverbal Accuracy; SSRS= Social Skills Rating System; SPGS-RE= Social Goals and Problem Solving-Rejection Expectations Scale; CSPI= Children's Self Efficacy for Peer Interaction Scale; WASI= Wechsler Abbreviated Scale of Intelligence

Study Hypotheses

Social cognitive features of spina bifida. To test Hypothesis #1, one sample t-tests were conducted to determine whether children with spina bifida and hydrocephalus in the current study differed from the general population on measures of social cognitive functioning. It was predicted that children and adolescents with spina bifida and hydrocephalus will have scores significantly lower than the general population on measures of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition, as measured by the CASL and DANVA2. Results were consistent with the hypothesis, such that the study sample demonstrated significantly lower performance on these domains of social cognition when compared to the normal population on measures of emotion recognition. These findings can be found in Table 5.

Table 5. Comparison of Study Sample to the Normal Population on Measures of Social Cognition

Social Cognition Construct	*M*	*SD*	*t*	*df*	*n*	*p* value
Emotion Recognition	85.30	16.93	-8.770	101	102	<0.001
Nonliteral Language	90.58	18.83	-4.717	88	89	<0.001
Inference Making Skills	81.89	20.99	-8.140	88	89	<0.001
Pragmatic Judgment	85.37	19.18	-7.236	89	90	<0.001

M = mean; *SD* = standard deviation

Predictors of social cognitive abilities. Hypothesis #2 predicted that number of shunt surgeries would be negatively associated with performance on all measures of social cognitive functioning (nonliteral language, inference making skills, pragmatic judgment, and emotion recognition). Linear regression analyses were conducted to explore the association between number of shunt revision surgeries and each of the four dependent variables (measures of social cognitive functioning). In the first model, emotion recognition (DANVA2 composite score) was entered as the dependent variable. WASI score and SES were then entered into the first step in a forward fashion to control for the effects of cognitive functioning and socioeconomic status on the dependent measure. Cognitive functioning was controlled because it is generally correlated with formal measures of neuropsychologial and social cognitive functioning. SES was also controlled for because of its association with general intellectual functioning (Duncan, Brooks-Gunn, & Klebanov, 1994; McLoyd, 1998; Rubin & Balow, 1979). Number of shunt surgeries was entered as the predictor variable. Separate regression models were then run for each of the additional dependent variables (nonliteral language, inference making skills, and pragmatic judgment; see Table 6). Number of shunt surgeries was found to be a significant predictor of nonliteral language (β = -0.198; $F(3,80) = 42.70$, $p<.01$), and marginally significantly associated with inference making skills (β = -0.141; $F(3,80) = 42.81$, $p = .053$), when controlling for both general intellectual functioning and SES. Specifically, as shunt surgeries increased in number, nonliteral language scores became worse and there was a trend towards inference making skills scores becoming worse. No association was found between number of shunt surgeries and either emotion recognition or pragmatic judgment. The significant and marginally significant findings were consistent with Hypothesis #2, however, the lack of significant association between number of shunt surgeries and pragmatic judgment and number of shunt surgeries and emotion recognition was inconsistent with Hypothesis #2.

Table 6. Regression Results for Prediction of Social Cognition Variables from Number of Shunt Surgeries

Step	Variable	Beta	R	$R^2\Delta$	$F\Delta$
Model #1 DV = Emotion Recognition					
1	WASI	.642	.642	.412	62.385*
2	SES	-.029	.642	.001	0.085
3	# of Shunt Revisions	-.090	.648	.008	1.164
Model #2 DV = Nonliteral Language					
1	WASI	.754	.754	.568	107.793*
2	SES	.127	.761	.011	2.127
3	No. of Shunt Revisions	-.198	.785	.037	7.612*
Model #3 DV = Inference Making Skills					
1	WASI	.764	.764	.584	114.915*
2	SES	.144	.773	.014	2.854
3	No. of Shunt Revisions	-.141	.785	.018	3.845^{ms}
Model #4 DV = Pragmatic Judgment					
1	WASI	.768	.768	.590	119.512*
2	SES	-.017	.768	.000	.042
3	No. of Shunt Revisions	-.050	.770	.002	.455

NOTE: Beta weights are standardized and indicate the direction of the effect. *n*s vary somewhat because of missing values. WASI= Wechsler Abbreviated Scale of Intelligence; SES= Socioeconomic Status; No. = Number; DV = Dependent Variable; ^{ms} $p \leq .10$; * $p < .05$

Hypothesis #3 predicted that spinal lesion level would predict performance on measures of social cognitive functioning such that higher lesion levels would be associated with poorer performance. Lesion level was tested as a predictor of performance on nonliteral language, inference making skills, pragmatic judgment, and emotion recognition using multivariate analysis of covariance (MANCOVA) because of the categorical nature of the independent variable. MANCOVA analysis also reduced experimentwise error (false rejection of the null hypothesis) by allowing for several dependent variables to be entered into the same analysis. To ensure that differences in social cognitive functioning would not be confounded with general intellectual ability and socioeconomic status, WASI score and SES were entered as covariates in the analysis. Spinal lesion level, which consisted of three groups (i.e., sacral, lumbar, or thoracic), was entered as an independent variable and social cognitive functioning scores as dependent variables. Spinal lesion level was not found to predict performance on measures of social cognition. This is inconsistent with the original hypotheses. Means and standard deviations for social cognitive measures by lesion level group can be found in Table 7).

Given the seeming difference between social cognitive functioning scores for those with sacral and lumbar level lesions compared to thoracic level lesions, additional analyses were run with participants having sacral and lumbar region lesions combined into one group. These analyses did not yield significant difference between the two groups on any of the four measures of social cognition.

Table 7. Lesion Level Group Differences on Measures of Social Cognition

Measure	**Lesion Level**	***M***	***SD***	***n***
Nonliteral Language	Sacral	93.80	15.14	15
	Lumbar	93.31	18.50	58
	Thoracic	75.41	21.13	12
Inference Making Skills	Sacral	86.93	19.11	15
	Lumbar	83.24	21.55	58
	Thoracic	70.25	21.27	12
Pragmatic Judgment	Sacral	90.53	16.54	15
	Lumbar	86.48	19.45	58
	Thoracic	71.03	18.26	12
Emotion Recognition	Sacral	84.14	15.99	15
	Lumbar	90.37	14.03	58
	Thoracic	78.27	12.81	12

Social cognition and social outcomes. Hypothesis #4 predicted that neuropsychological measures of social cognitive functioning would be positively associated with social competence, as it was reported by objective parties (parents and teachers). Multiple regression analyses were run to test this hypothesis. Given the aforementioned intercorrelation findings, three separate analyses were conducted to account for the three dependent variables created from parent and teacher report (mother, father, and teacher combined report of social adjustment; parent report of social skills; and teacher report of social skills). Additionally, three separate analyses were conducted to account for the three objectively coded scales (content, social skills, and effectiveness) of the Social Goals and Problem Solving Scale, which assessed social skills. In the first model, objective report of social adjustment (mother, father, and teacher combined report of social adjustment) was entered as the dependent variable. WASI score and SES were then entered into the first step in a forward fashion to control for the effects of cognitive functioning and socioeconomic status on the dependent measure. Social neurocognitive measures were then entered in a forward fashion to determine which measure (predictor variable) had the highest correlation with the criterion variable. The remaining variables were then entered into the equations based on their predictive contribution. For this first model, WASI was shown to be significantly associated with social adjustment, as measured by combined scores for parents and teachers on the Harter Social Acceptance Scale (dependent variable; $\beta = 0.216$; $F(1,85) = 4.179$, $p < .05$), and emotion recognition (DANVA2) was shown to be marginally significantly associated with parent and teacher report of the Harter ($\beta = 0.230$; $F(3,83) = 3.216$, $p = .08$). These results indicated that higher WASI scores were associated with better social acceptance scores, and a trend towards better emotion recognition being associated with social acceptance. While the association between emotion recognition and social acceptance was a trend towards being consistent with the original hypothesis, the lack of significant findings for the other three social cognitive measures was inconsistent with hypotheses.

In the second and third models, objective report of social skills was entered as the dependent variable (combined mother and father report and teacher report, respectively). WASI score and SES were then entered into the first step in a forward fashion to control for the effects of cognitive functioning and socioeconomic status on the dependent measure. As with the first model, social neurocognitive measures were then entered in a forward fashion. For the second model, nonliteral language score was shown to be significantly associated with social skills as measured by parent report (SSRS; β = 0.342; F(3,83) = 1.804, *p* < .05). Specifically, better performance on nonliteral language measures was associated with better social skills. This is consistent with the original hypothesis. The lack of significant associations between the other three social cognitive measures and parent-report of social skills is inconsistent with hypotheses. For model three, WASI score was shown to be marginally significantly associated with social skills as measured by teacher report (β = 0.213; F(1,76) = 3.599, *p* =.06). Emotion recognition score was additionally shown to be marginally significantly associated with teacher report of social skills (β = 0.245; F(3,74) = 2.296, *p* = .09). These results indicated a trend towards better WASI and emotion recognition performance associated with better social skills. This was consistent with hypotheses. There were no significant findings associated with nonliteral language, inference making skills, or pragmatic judgment, which is inconsistent with hypotheses. Results for this hypothesis can be found in Table 8.

For models four, five, and six of Hypothesis #4, separate multiple regression analyses were conducted to accommodate the three category scales of the Social Goals and Problem Solving-Rejections Expectations Scale (SGPS-RE; content, social skills, and effectiveness). Each of the scales was considered as a dependent variable in its respective model. The same steps taken with models 1-3 were then subsequently followed. For model four, WASI score was significantly associated with content category (β = 0.250; F(1,83) = 5.544, *p* < .05). Likewise, pragmatic judgment score was shown to be significantly associated with content category score (β = 0.432; F(3,81) =

Table 8. Regression Results for Prediction of Social Outcomes from Social Cognition: Parent and Teacher Report of the Dependent Variable

Model #1
DV = Harter Social Adjustment
(Mother, Father, & Teacher Report Combined)

Step	Variable	Beta	R	$R^2\Delta$	$F\Delta$
1	WASI	.216	.216	.047	4.179*
2	SES	-.187	.267	.024	2.200
3	Emotion Recognition	.230	.323	.033	3.054ms
4	Nonliteral Language	-.064	.325	.002	.148
5	Pragmatic Judgment	.151	.334	.006	.533
6	Inference Making Skills	.017	.334	.000	.005

Model #2
DV = Social Skills Rating Scale
(Mother & Father Report Combined)

Step	Variable	Beta	R	$R^2\Delta$	$F\Delta$
1	SES	.097	.097	.009	.812
2	WASI	-.056	.108	.002	.183
3	Nonliteral Language	.342	.247	.050	4.385*
4	Inference Making Skills	.181	.262	.007	.659
5	Emotion Recognition	.045	.264	.001	.103
6	Pragmatic Judgment	-.049	.265	.001	.047

Model #3
DV = Social Skills Rating Scale (Teacher Report)

Step	Variable	Beta	R	$R^2\Delta$	$F\Delta$
1	WASI	.213	.213	.045	3.599ms
2	SES	-.077	.222	.004	.326
3	Emotion Recognition	.245	.292	.036	2.895 ms
4	Inference Making Skills	-.243	.327	.022	1.800
5	Pragmatic Judgment	.230	.347	.013	1.097
6	Nonliteral Language	.115	.351	.003	.217

NOTE: Beta weights are standardized and indicate the direction of the effect.
*n*s vary somewhat because of missing values. WASI= Wechsler Abbreviated Scale of Intelligence; SES= Socioeconomic Status; DV = Dependent Variable.
ms $p \leq .10$; * $p < .05$

5.623, $p < .05$). These findings indicated that higher WASI and pragmatic judgment were associated with higher scores on content category, which is consistent with hypotheses. In addition, SES was marginally significantly associated with content category (β = -0.220; F(2,82) = 4.358, $p = .09$), such that there was a trend towards higher SES being associated with higher content category scores, consistent with hypotheses. There were no significant associations between nonliteral language, inference making skills, or emotion recognition and content category, which was inconsistent with the original hypothesis.

For model five, the social skills category was found to be significantly associated with WASI scores (β = 0.336; F(1,83) = 10.591, $p < .05$) and pragmatic judgment scores (β = 0.456; F(3,81) = 7.278, $p < .05$). In the final model (model six), the effectiveness category was also found to be significantly associated with WASI scores (β = 0.282; F(1,83) = 7.175, $p < .05$) and pragmatic judgment scores (β = 0.395; F(3,81) = 5.321, $p < .05$). These relationships indicated that higher scores on cognitive measures were associated with higher scores on the social skills and effectiveness categories and were consistent with the original hypothesis. The lack of significant associations between nonliteral language, inference making skills, or emotion recognition and these two category scales (social skills and effectiveness) was inconsistent with that which was hypothesized. Results from models 4-6 can be found in Table 9.

Hypothesis #5 predicted that a curvilinear relationship would be found between performance on neuropsychological measures of social cognition and subjective (i.e., self-reported) measures of social competence, such that poor performance on social

Table 9. Regression Results for Prediction of Social Outcomes from Social Cognition: SGPS-RE as the Dependent Variable

Step	Variable	Beta	R	$R^2\Delta$	$F\Delta$
Model #4 DV = Content Category					
1	WASI	.250	.250	.063	5.544 *
2	SES	-.220	.310	.033	3.036 ms
3	Pragmatic Judgment	.432	.415	.076	7.465 *
4	Nonliteral Language	.233	.432	.014	1.421
5	Emotion Recognition	.075	.436	.003	.315
6	Inference Making Skills	.066	.437	.001	.086
Model #5 DV = Social Skills Category					
1	WASI	.336	.336	.113	10.591*
2	SES	-.143	.357	.014	1.321
3	Pragmatic Judgment	.456	.461	.085	8.752*
4	Nonliteral Language	.198	.472	.010	1.075
5	Emotion Recognition	.067	.475	.003	.269
6	Inference Making Skills	.004	.475	.000	.000
Model #6 DV = Effectiveness Category					
1	WASI	.282	.282	.080	7.175*
2	SES	-.175	.317	.021	1.924
3	Pragmatic Judgment	-.176	.406	.064	6.202*
4	Nonliteral Language	.235	.424	.015	1.440
5	Emotion Recognition	.074	.427	.003	.311
6	Inference Making Skills	-.027	.428	.000	.014

NOTE: Beta weights are standardized and indicate the direction of the effect. *n*s vary somewhat because of missing values. SGPS-RE= Social Goals and Problem Solving-Rejection Expectations Scale WASI= Wechsler Abbreviated Scale of Intelligence; SES= Socioeconomic Status; DV = Dependent Variable.

^{ms} $p \leq .10$; * $p < .05$

cognition will be associated with better self-reported social competence and high scores on social cognition to be associated with better scores on self-reported social competence. This hypothesis suggests that those who are neither severely impaired nor functioning at the same level as normally developing peers rate themselves as not having good social competence.

Curvilinear multiple regression analyses were run to test this hypothesis. Eight separate analyses were conducted to assess the relationship between each of the four independent variables (emotion recognition, nonliteral language, inference making skills, and pragmatic judgment) and the two dependent variables that tapped into social competence (social performance and social adjustment). A squared term was calculated for each of the four independent variables in order to test the curvilinear effect.

In the first through fourth models, social performance, as measured by child report on the CSPI, was entered as the dependent variable. WASI score and SES were then entered into the first step in a forward fashion to control for the effects of cognitive functioning and socioeconomic status on the dependent measure. The linear independent term was then entered (one for each of the four models). In the final step, the corresponding squared term was entered. Results from these analyses can be found in Table 10.

For the first model (DANVA2 as IV), WASI score was shown to be significantly associated with social performance as measured by child report ($\beta = 0.256$; $F(1,87) = 6.085$, $p < .05$), as was emotion recognition score ($\beta = 0.294$; $F(3,85) = 3.792$, $p < .05$). These findings indicate that higher scores on the WASI and measures of emotion

Table 10. Curvilinear Regression Results for Prediction of Child-Reported Social Performance from Social Cognition

Step	Variable	Beta	R	$R^2\Delta$	$F\Delta$
Model #5 DV = CSPI					
1	WASI	.256	.256	.065	6.085 *
2	SES	.056	.260	.002	.197
3	ER	.294	.344	.051	4.871 *
4	ER Squared	-.452	.348	.003	.285
Model #6 DV = CSPI					
1	WASI	.213	.213	.046	3.909^{ms}
2	SES	.090	.226	.005	.467
3	NLL	.031	.227	.000	.033
4	NNL Squared	-.938	.261	.017	1.401
Model #7 DV = CSPI					
1	WASI	.213	.213	.046	3.909^{ms}
2	SES	.090	.226	.005	.467
3	IMS	.286	.290	.033	2.881
4	IMS Squared	-.551	.303	.008	.677
Model #8 DV = CSPI					
1	WASI	.214	.214	.046	3.974^{ms}
2	SES	.094	.227	.006	.519
3	PJ	.284	.291	.033	2.940
4	PJ Squared	-.040	.291	.000	.003

NOTE: Beta weights are standardized and indicate the direction of the effect. *n*s vary somewhat because of missing values. CSPI= Children's Self Efficacy for Peer Interaction Scale; WASI= Wechsler Abbreviated Scale of Intelligence; SES= Socioeconomic Status; ER = Emotion Recognition; IMS = Inference Making Skills; NLL = Nonliteral Language; PJ = Pragmatic Judgment; DV = Dependent Variable. ^{ms} $p \leq .10$; * $p < .05$

recognition being associated with better social performance, contrary to the original hypothesis. When nonliteral language was considered as the IV (model 2), WASI score was shown to be marginally significantly associated with social performance as measured by child report ($\beta = 0.213$; $F(1,82) = 3.909$, $p = .05$). With inference making skills as the independent variable (model 3), marginally significant associations between WASI and social performance was again shown ($\beta = 0.213$; $F(1,82) = 3.909$, $p = .05$). The same was the case with and pragmatic judgment as the independent variables (model 3; $\beta = 0.214$; $F(1,83) = 3.974$, $p = .05$). These three marginally significant associations suggest a trend toward higher scores on the WASI being associated with better social skills. There were no significant relationships between nonliteral language, inference making skills, and pragmatic judgment and social performance. Additionally, there were no significant relationships between the curvilinear terms of the independent variables and social skills for any of the four models, indicating that there was not a curvilinear effect as was hypothesized.

In the fifth through eighth models, social adjustment as measured by child report on the Harter Social Acceptance Scale was entered as the dependent variable. The same steps as taken with the first four models for hypothesis #5 were then taken (one social cognitive predictor variable for each of the four models). Results from these analyses can be found in Table 11. There were no statistically significant associations between predictor variables (social cognitive skills) and the dependent variable (social adjustment) for any of these models. Again, there were no significant relationships between the

Table 11. Curvilinear Regression Results for Prediction of Child-Reported Social Acceptance from Social Cognition

Model #1

DV = Harter Social Adjustment

Step	Variable	Beta	R	$R^2\Delta$	FΔ
1	SES	.131	.131	.017	1.407
2	WASI	.065	.141	.003	.232
3	ER	-.008	.141	.000	.003
4	ER Squared	.772	.169	.009	.689

Model #2

DV = Harter Social Adjustment

Step	Variable	Beta	R	$R^2\Delta$	FΔ
1	WASI	.171	.171	.029	2.276
2	SES	.094	.187	.006	.456
3	NLL	-.010	.187	.000	.003
4	NNL Squared	.800	.216	.012	.901

Model #3

DV = Harter Social Adjustment

Step	Variable	Beta	R	$R^2\Delta$	FΔ
1	WASI	.171	.171	.029	2.276
2	SES	.094	.187	.006	.456
3	IMS	.104	.198	.004	.336
4	IMS Squared	-.182	.200	.001	.063

Model #4

DV = Harter Social Adjustment

Step	Variable	Beta	R	$R^2\Delta$	FΔ
1	SES	.171	.171	.029	2.307
2	WASI	.105	.191	.007	.579
3	PJ	-.036	.192	.001	.040
4	PJ Squared	1.240	.258	.030	2.363

NOTE: Beta weights are standardized and indicate the direction of the effect. *n*s vary somewhat because of missing values; WASI= Wechsler Abbreviated Scale of Intelligence; SES= Socioeconomic Status; ER = Emotion Recognition; IMS = Inference Making Skills; NLL = Nonliteral Language; PJ = Pragmatic Judgment; DV = Dependent Variable. ^{ms} $p \leq .10$; * $p < .05$

curvilinear terms of the independent variables and social adjustment for the four models. This indicated that there was not a curvilinear effect as was hypothesized.

Developmental considerations: Age as a moderator. To determine if age moderated the relationship between social cognition and social competence, hierarchical linear regressions were conducted with measures of social cognition as the independent variable and measures of social competence as the dependent variables.

Hypothesis #6 predicted that the association between neuropsychological measures of social cognition and measures of social competence would be stronger for older children/adolescents, such that better performance on social cognitive measures would be positively associated with components of social competence. To test this hypothesis, age was considered as a moderator. Six separate analyses were run for objective measures of social competence. As determined by preliminary analyses (see above), two separate analyses were conducted to assess teacher and parent report of social skills. A third analysis with parent and teacher combined report of social adjustment was also conducted. Additionally, three separate analyses were also conducted to accommodate the three category scales of social problem solving skills (content, social skills, and effectiveness). Each dependent variable assessed a specific component of social competence (social adjustment, social skills, and social performance) and they were, therefore, assessed separately to determine if associations were dependent on the component in question. Analyses were also conducted separately for each measure of social cognition, to determine if associations were dependent on specific neuropsychological constructs. These analyses were conducted for each of the four measures of social cognition variables (nonliteral language, inference making skills, pragmatic judgment, and emotion recognition), as measured by the CASL and DANVA2, and their association with the six dependent variables.

Multiple regression techniques were utilized to test for moderator effects. WASI scores were entered first to control for the effects of cognitive functioning on the dependent measure. SES was then entered to control for its effects on the dependent variable. The independent variable (main effect of social cognition) and moderator variable (age) were then entered into the equation in a forward fashion, thus allowing the variable with the most predictive utility to enter the equation first. Next, the two-way interaction (age x social cognition) was entered. Such cross products become interactions only when their constituent elements (i.e., main effects) are partialled out (Aiken & West, 1991). Main effects and interaction findings can be found in Tables 12-15.

Nonliteral language as the independent variable. Main effects and interaction results with nonliteral language as the predictor variable can be seen in Table 12. A significant main effect of age was found for social adjustment (Harter), with older children displaying more impaired social outcomes as reported by parents and teachers (combined). There was no interaction between nonliteral language and age. Analyses with the nonliteral language and social skills (SSRS) reported by parents as the dependent variable indicated a significant main effect of nonliteral language with better performance on nonliteral language being associated with better social skills. No interactions were found when parent report of social skills was considered as a dependent variable and nonliteral language as the independent variable. Analyses conducted with nonliteral language and teacher report of social skills as the dependent variable indicated a marginally significant main effect of age, such that there as a trend towards older children having better social skills.

Analyses conducted with the content category scale of social problem solving measure as the dependent variable, indicated a main effect for age, with older children displaying better social functioning. In addition, there was a main effect of nonliteral language, with better performance on nonliteral language associated with better social functioning in the content category. For the social skills scale of the social problem solving measure as the dependent variable, there was a main effect for age, such that there was a positive association between age and social skills (i.e., older children had better social skills). In addition, there was a main effect for nonliteral language, with better performance on the social cognitive measure being associated with more social skills. For the social effectiveness category scale of the social problem solving measure as the dependent variable, there was a main effect for age, such that there was a positive association between age and social effectiveness (i.e., older children had better social skills). In addition, there was a main effect for nonliteral language, with better performance on the social cognitive measure being associated with more social effectiveness.

Table 12. Multiple Regression Results for Interactions between Nonliteral Language and Moderator Variable Age as Predictors of Social Competence Variables

Step and Variable	Beta	R	$R^2\Delta$	$F\Delta$
Harter Social Scale- PRT&TCH (DV)				
Step 1: WASI	.230	.230	.053	4.576*
Step 2: SES	-.227	.296	.034	3.059
Step 3: Age	-.223	.364	.045	4.153*
Step 4: NL	.041	.365	.001	.059
Step 5: Age x NL	-.006	.365	.000	.003
Social Skills Rating Scale- PRT (DV)				
Step 1: SES	.132	.132	.017	1.443
Step 2: WASI	-.052	.138	.002	.148
Step 3: NL	.318	.244	.040	3.438*
Step 4: Age	.013	.244	.000	.013
Step 5: Age x NL	.001	.248	.002	.141
Social Skills Rating Scale- TCH (DV)				
Step 1: WASI	.249	.249	.062	4.877*
Step 2: SES	-.075	.256	.004	.303
Step 3: Age	.206	.322	.038	3.063^{ms}
Step 4: NL	.089	.327	.003	.245
Step 5: Age x NL	.064	.333	.004	.288
Content Scale of SGPS-RE (DV)				
Step 1: WASI	.252	.252	.063	5.337*
Step 2: SES	-.229	.314	.035	3.045^{ms}
Step 3: NL	.387	.400	.061	5.620*
Step 4: Age	.280	.478	.069	6.791*
Step 5: Age x NL	-.106	.489	.010	1.011
Social Skills Scale of SGPS-RE (DV)				
Step 1: WASI	.342	.342	.117	10.465*
Step 2: SES	-.139	.360	.013	1.158
Step 3: Age	.293	.455	.077	7.505*
Step 4: NL	.451	.537	.081	8.676*
Step 5: Age x NL	-.091	.544	.008	.815
Effectiveness Scale of SGPS-RE (DV)				
Step 1: WASI	.287	.287	.082	7.071*
Step 2: SES	-.183	.323	.022	1.950
Step 3: Age	.288	.423	.075	6.997*
Step 4: NL	.436	.505	.076	7.738*
Step 5: Age x NL	-.113	.516	.012	1.201

NOTE: PRT = parent report; TCH = teacher report; SGPS-RE = Social Goals and Problem Solving-Rejection Expectations scale; DV = dependent variable; WASI= Wechsler Abbreviated Scale of Intelligence; SES = socioeconomic status; NL= nonliteral language; * $p \leq .05$; ** $p \leq .01$; ^{ms} = marginally significant

Inference making skills as the independent variable. Main effects and interaction results with inference making skills as the predictor variable can be seen in Table 13. A significant main effect of age was again found for social adjustment, with older children displaying more impaired social outcomes as reported by parents and teachers (combined). Inconsistent with hypotheses, there was no interaction between inference making skills and age. Analyses with the inference making skills and social skills reported by parents as the dependent variable indicated a marginally significant main effect of inference making skills with better performance on inference making skills being associated with better social skills. No interactions were found when parent report of social skills was considered as a dependent variable and inference making skills as the independent variable. Analyses conducted with inference making skills and teacher report of social skills as the dependent variable indicated a marginally significant main effect of age, such that there as a trend towards older children having better performance on inference making skills.

With the category scales of the social problem solving measure as the dependent variables, there was a main effect for age, with older children displaying better social functioning in each category. In addition, there was a main effect of inference making skills for each analysis conducted, with better performance on inference making skills associated with better social functioning in each category.

Table 13. Multiple Regression Results for Interactions between Inference Making Skills and Moderator Variable Age as Predictors of Social Competence Variables

Step and Variable	Beta	R	$R^2\Delta$	$F\Delta$
Harter Social Scale- PRT&TCH (DV)				
Step 1: WASI	.230	.053	.053	4.576*
Step 2: SES	-.227	.087	.034	3.059
Step 3: Age	-.233	.132	.045	4.153*
Step 4: INF	.040	.133	.001	.056
Step 5: Age x INF	.070	.137	.004	.339
Social Skills Rating Scale- PRT (DV)				
Step 1: SES	.132	.132	.017	1.443
Step 2: WASI	-.052	.138	.002	.148
Step 3: INF	.280	.224	.031	2.634
Step 4: Age	.014	.225	.000	.014
Step 5: Age x INF	.029	.226	.001	.063
Social Skills Rating Scale- TCH (DV)				
Step 1: WASI	.249	.249	.062	4.877*
Step 2: SES	-.075	.256	.004	.303
Step 3: Age	.206	.322	.038	3.063
Step 4: INF	-.157	.336	.009	.728
Step 5: Age x INF	.007	.336	.000	.004
Content Scale of SGPS-RE (DV)				
Step 1: WASI	.252	.252	.063	5.337*
Step 2: SES	-.229	.314	.035	3.045ms
Step 3: INF	.354	.385	.050	4.525*
Step 4: Age	.280	.466	.069	6.680*
Step 5: Age x INF	-.145	.489	.019	1.826
Social Skills Scale of SGPS-RE (DV)				
Step 1: WASI	.342	.342	.117	10.465*
Step 2: SES	-.139	.360	.013	1.158
Step 3: Age	.293	.455	.077	7.505*
Step 4: INF	.403	.520	.063	6.603*
Step 5: Age x INF	-.149	.539	.020	2.085
Effectiveness Scale of SGPS-RE (DV)				
Step 1: WASI	.287	.287	.082	7.071*
Step 2: SES	-.183	.323	.022	1.950
Step 3: Age	.288	.423	.075	6.997*
Step 4: INF	.360	.479	.051	4.987*
Step 5: Age x INF	-.143	.498	.018	1.808

NOTE: PRT = parent report; TCH = teacher report; SGPS-RE = Social Goals and Problem Solving-Rejection Expectations scale; DV = dependent variable; WASI= Wechsler Abbreviated Scale of Intelligence; SES = socioeconomic status; INF= inference making skills; * $p \le .05$; ** $p \le .01$; ms = marginally significant

Pragmatic judgment as the independent variable. Main effects and interaction results with pragmatic judgment as the predictor variable can be seen in Table 14. A significant main effect of age was found for social adjustment, with older children displaying more impaired social outcomes as reported by parents and teachers (combined). There was no interaction between pragmatic judgment and age. Analyses with the pragmatic judgment and social skills reported by parents as the dependent variable indicated no main effects or interactions. Analyses conducted with pragmatic judgment and teacher report of social skills as the dependent variable indicated a marginally significant main effect of age, indicating a trend towards older children having better social skills.

For each analysis with a category scale of the social problem solving measure as the dependent variables, there was a main effect for age, with older children displaying better social functioning in each category. In addition, there was a main effect of pragmatic judgment for each analysis conducted, with better performance on pragmatic judgment associated with better social functioning in each category. Inconsistent with hypotheses, there were no significant interactions for these models.

Table 14. Multiple Regression Results for Interactions between Pragmatic Judgment and Moderator Variable Age as Predictors of Social Competence Variables

Step and Variable	Beta	R	$R^2\Delta$	$F\Delta$
Harter Social Scale- PRT&TCH (DV)				
Step 1: WASI	.230	.230	.053	4.654^{*}
Step 2: SES	-.223	.294	.033	2.991
Step 3: Age	-.212	.357	.041	3.774^{ms}
Step 4: PJ	.058	.358	.001	.128
Step 5: Age x PJ	.104	.371	.009	.817
Social Skills Rating Scale- PRT (DV)				
Step 1: SES	.135	.135	.018	1.541
Step 2: WASI	-.053	.142	.002	.158
Step 3: PJ	.165	.177	.011	.949
Step 4: Age	.003	.177	.000	.001
Step 5: Age x PJ	-.034	.180	.001	.079
Social Skills Rating Scale- TCH (DV)				
Step 1: WASI	.249	.249	.062	4.877^{*}
Step 2: SES	-.075	.256	.004	.303
Step 3: Age	.206	.322	.038	3.063
Step 4: PJ	.066	.325	.002	.124
Step 5: Age x PJ	.077	.332	.005	.381
Content Scale of SGPS-RE (DV)				
Step 1: WASI	.249	.249	.062	5.274^{*}
Step 2: SES	-.236	.315	.037	3.265^{ms}
Step 3: PJ	.427	.419	.076	7.200^{*}
Step 4: Age	.245	.479	.054	5.373^{*}
Step 5: Age x PJ	-.149	.497	.018	1.829
Social Skills Scale of SGPS-RE (DV)				
Step 1: WASI	.342	.342	.117	10.566^{*}
Step 2: SES	-.141	.360	.013	1.202
Step 3: PJ	.424	.453	.075	7.346^{*}
Step 4: Age	.317	.543	.090	9.799^{*}
Step 5: Age x PJ	-.138	.557	.016	1.708
Effectiveness Scale of SGPS-RE (DV)				
Step 1: WASI	.286	.286	.082	7.152^{*}
Step 2: SES	-.183	.323	.023	1.986
Step 3: Age	.283	.421	.072	6.868^{*}
Step 4: PJ	.406	.495	.068	6.945^{*}
Step 5: Age x PJ	-.123	.507	.012	1.257

NOTE: PRT = parent report; TCH = teacher report; SGPS-RE = Social Goals and Problem Solving-Rejection Expectations scale; DV = dependent variable; WASI= Wechsler Abbreviated Scale of Intelligence; SES = socioeconomic status; PJ = pragmatic judgment; * $p \leq .05$; ** $p \leq .01$; ^{ms} = marginally significant

Emotion recognition as the independent variable. Main effects and interaction results with emotion recognition as the predictor variable can be seen in Table 15. A significant main effect of age was found for social adjustment, with older children displaying more impaired social outcomes as reported by parents and teachers (combined), which, again, is contrary to expectations. There was no interaction between emotion recognition and age. Analyses with emotion recognition and social skills reported by parents resulted in no significant main effects or interactions. Analyses conducted with emotion recognition and teacher report of social skills as the dependent variable also indicated no significant main effects or interactions, though there was a marginally significant main effect of age, which indicated a trend towards age being positively associated with teacher report of social skills.

For each analysis with a category scale of the social problem solving measure as the dependent variables, there was a main effect for age, with older children displaying better social functioning in each category. There was also a marginally significant main effect for emotion recognition for each of the three categories as dependent variables, indicating a trend towards emotion recognition being positively associated with better scores on the category scales. There were no interactions for any of the dependent variables considered.

Table 15. Multiple Regression Results for Interactions between Emotion Recognition and Moderator Variable Age as Predictors of Social Competence Variables

Step and Variable	Beta	R	$R^2\Delta$	$F\Delta$
Harter Social Scale- PRT&TCH (DV)				
Step 1: WASI	.217	.217	.047	4.595*
Step 2: SES	-.187	.267	.024	2.389
Step 3: Age	-.226	.345	.048	4.934*
Step 4: ER	.206	.379	.025	2.614
Step 5: Age x ER	-.034	.381	.001	.111
Social Skills Rating Scale- PRT (DV)				
Step 1: SES	.101	.101	.010	.932
Step 2: WASI	-.093	.128	.006	.552
Step 3: ER	.082	.142	.004	.355
Step 4: Age	.040	.148	.001	.131
Step 5: Age x ER	-.018	.149	.000	.027
Social Skills Rating Scale- TCH (DV)				
Step 1: WASI	.199	.199	.040	3.437ms
Step 2: SES	-.096	.215	.006	.550
Step 3: Age	.189	.282	.033	2.912 ms
Step 4: ER	.211	.323	.025	2.228
Step 5: Age x ER	.081	.332	.006	.540
Content Scale of SGPS-RE (DV)				
Step 1: WASI	.293	.293	.086	8.259*
Step 2: SES	-.198	.336	.027	2.670
Step 3: Age	.275	.428	.070	7.360*
Step 4: ER	.217	.459	.028	2.987 ms
Step 5: Age x ER	-.155	.482	.021	2.317
Social Skills Scale of SGPS-RE (DV)				
Step 1: WASI	.372	.372	.138	14.131*
Step 2: SES	-.125	.386	.011	1.107
Step 3: Age	.324	.496	.097	11.069*
Step 4: ER	.209	.520	.024	2.828ms
Step 5: Age x ER	-.123	.533	.013	1.561
Effectiveness Scale of SGPS-RE (DV)				
Step 1: WASI	.325	.325	.105	10.373*
Step 2: SES	-.157	.350	.017	1.701
Step 3: Age	.327	.470	.099	11.069*
Step 4: ER	.210	.497	.026	2.828ms
Step 5: Age x ER	-.155	.518	.021	1.561

NOTE: PRT = parent report; TCH = teacher report; SGPS-RE = Social Goals and Problem Solving-Rejection Expectations scale; DV = dependent variable; WASI= Wechsler Abbreviated Scale of Intelligence; SES = socioeconomic status; ER = emotion recognition; * $p \leq .05$; ** $p \leq .01$; ms = marginally significant

Relationship between illness severity, social cognition, and social competence. In Hypothesis #7, to test whether social cognition mediated the relationship between illness severity and social competence in children and adolescents with spina bifida and hydrocephalus, linear regression analyses were conducted with illness severity as the independent variable and social competence components as the dependent variables. As described above, illness severity was a composite score of medical chart and maternal report of illness parameters. Social cognition was measured at the same time point (Time 1) via six separate measures (nonliteral language, inference making skills, pragmatic judgment, and emotion recognition), as described above.

In accordance with the recommendations of Baron and Kenny (1986) and Holmbeck (1997), the following four conditions need to be met for mediation and were assessed via three separate regressions per model: (1) the predictor must be associated with outcome variable of interest, (2) the predictor must be associated with the mediator, (3) the mediator must be associated with the outcome variable when controlling for the predictor variable, and (4) the effect of predictor on outcome must be less after controlling for the mediator. Given that these variables were assessed at the same time point, earlier levels of the mediator (social cognition) and the dependent variable (social competence) could not be controlled for throughout analyses. Separate analyses were conducted for each of the eight dependent variables (social competence) considered (see Table 3).

Objective report of social acceptance as the dependent variable. With parent and teacher report of social adjustment (Harter) as the dependent variable, none of the conditions were met to support the meditational model. This was the case when each social cognitive measure was considered as the mediator.

Parent report of social skills as the dependent variable. With parent report of social skills as the dependent variable, nonliteral language (β = 0.406; F(3,76) = 2.840, p <.05) was shown to be significantly associated with SSRS when controlling for the independent variable (conditions 3 and 4). This indicated that better nonliteral language skills were associated with better social skills as reported by parents, which is consistent with expectations. The other necessary criteria were not met, thereby not supporting the meditational model. Additionally, inference making skills (β = 0.327; F(3,76) = 1.982, p = .06) were shown to be marginally significantly associated with SSRS when controlling for the independent variable (conditions 3 and 4). This suggests a trend towards a positive association between inference making skills and social skills as reported by parents and is consistent with the hypothesis. Again, the other necessary criteria were not met, thereby not supporting the meditational model.

Teacher report of social skills as the dependent variable. With teacher report of social skills as the dependent variable, none of the conditions were met to support the meditational model. This was the case when each social cognitive measure was considered as the mediator.

Category scales of SGPS at the dependent variable. When the category scales of the social problem solving measures were considered as dependent variables, there were some significant associations between the mediators and dependent variables. However, none of the meditational models held up because all four conditions were not met for any of the three models. With the content scale as the dependent variable, pragmatic judgment (β = 0.403; $F(3,76) = 4.139$, $p < .05$) was significantly associated with the content category scale when controlling for the independent variable (condition 3 and 4), such that performance on the social cognitive measure was associated with better content category scores. Nonliteral language (β = 0.320; $F(3,75) = 3.287$, $p = .05$) was marginally significantly associated with content category performance when controlling for the independent variable (conditions 3 and 4), indicating a trend towards higher nonliteral language scores being associated with better performance scores on the content category. While these findings were in the expected direction, they were not consistent with hypotheses because the other criteria were not met, thereby not supporting the meditational model.

With the social skills category from the social problem solving scale as the dependent variable, nonliteral language (β = .340; $F(3,75) = 5.594$, $p < .05$) and pragmatic judgment (β = 0.408; $F(3,76) = 6.430$, $p < .05$) were significantly associated with the social skills category scale when controlling for the independent variable, such that performance on each of the social cognitive measures was associated with better social skills category scores (conditions 3 and 4). This was inconsistent with the original hypotheses, given that the other criteria were not met and the meditational model was not supported.

With the effectiveness category from the social problem solving scale as the dependent variable, pragmatic judgment (β = .332; $F(3,76) = 3.907$, $p < .05$) was significantly associated with the effectiveness category scale when controlling for the independent variable (condition 3 and 4). This indicated that performance on pragmatic judgment was associated with better effectiveness category scores. Nonliteral language ($\beta = 0.304$; $F(3,75) = 3.666$, $p = .06$) was marginally significantly associated with effectiveness category scores when controlling for the independent variable (conditions 3 and 4), indicating a trend towards nonliteral language being positively associated with social effectiveness. Again, the meditational models were not fully supporting because the other criteria were not met, thereby rendering the findings inconsistent with hypotheses.

Child report of social adjustment and social performance as dependent variables. With both child-report of social adjustment (Harter) and child-report of social performance (CSPI) as dependent variables, none of the conditions were met to support the meditational model, which was inconsistent with hypotheses.

CHAPTER V

DISCUSSION

The purpose of the current study was to examine social cognition in children with spina bifida and to determine whether deficits in these domains are associated with poor social functioning. The study utilized a heuristic model presented by Yeates and colleagues (2007) and concepts from social cognitive neuroscience to better understand how the neurological insults resulting from spina bifida and congenital hydrocephalus affect social cognitive functioning and, ultimately, social competence. This study builds upon this model by representing a focused investigation of social cognition and social competence in a group of children and adolescents who were subject to neurological insults prior to birth. Additionally, the current study represents the first investigation of neuropsychological functioning and social competence in children and adolescents with spina bifida and hydrocephalus from a social cognitive neuroscience perspective. Specific neuropsychological measures of social cognitive functioning were included to represent the domains of cognitive functioning that are posited to contribute to social competence. To build upon extant literature examining neuropsychological functioning and social functioning in spina bifida, multi-method, multi-informant data and a developmental, biopsychosocial perspective were utilized. Additionally, distinct aspects of social competence, as defined by social performance, social skills, and social adjustment, were considered.

Through this investigation, the current study addressed several questions regarding social cognitive functioning and social competence in children and adolescents with spina bifida and hydrocephalus. Specifically, several analyses were conducted to investigate: (1) differences in social cognition between children and adolescents with SBH and the general population, (2) potential neuroanatomical predictors of social cognition for children and adolescents with SBH, (3) whether measures of social cognition are useful in predicting social competence in children and adolescents with SBH, and (4) whether developmental factors (i.e., age) need to be considered when addressing the association between social cognition and social competence in these children.

Overall, the study suggests that children and adolescent with SBH perform at a lower level of social cognitive functioning than typically developing youngsters. In addition, there is evidence that these impairments in social cognition are associated with poor social functioning, particularly in regards to those components of social functioning that contribute to social competence (social skills, social adjustment, and social performance). The findings vary based on the individual social cognitive and social competence variables of interest. This suggests that the components of social competence are distinct constructs that speak to separate social abilities. Additionally, it is clear that the social cognitive measures utilized inform different social abilities. The context in which the social ability is assessed (i.e., school vs. home) also appears to play a role in these findings.

The following section will provide a brief review of the hypotheses, a summary of the findings, and possible explanations of the findings and lack thereof. Finally, study limitations, clinical implications of the current study findings, and future directions will be discussed.

Hypotheses

Social cognitive features of spina bifida. Numerous studies examining the neuropsychological profile of children with spina bifida and hydrocephalus have suggested deficits in various domains of cognitive functioning (Fletcher et al., 2000; Fletcher et al., 2004; Wills, 1993). Children and adolescents with SBH have also been shown to have executive dysfunction and attention impairments that make it difficult for them to adequately engage in social interactions. These neuropsychological features converge into a profile that may explain what is referred to as “cocktail party syndrome” in this population. In particular, some researchers have suggested that children with SBH have deficits in pragmatic judgment and inference making skills (Barnes & Dennis, 1998; Cull & Wyke, 1984), thereby impacting the ability to fully understand aspects of language that are necessary to grasp the nuances of social interactions. The current study sought to examine specific social cognitive features that are thought to contribute to social abilities. The social cognitive constructs of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition were specifically examined.

Given the expected deficits in social cognition, Hypothesis #1 predicted that children and adolescents with SBH would perform significantly worse on standardized assessments of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition, when compared to the general population as determined by standardized norms. This hypothesis was also based on evidence that congenital hydrocephalus results in stretching and thinning of the cortex, particularly in posterior regions and the corpus callosum (Barkovich, 1995; Braun et al., 1997; Caner et al., 1993; Catalan et al., 1994; Del Bigio, 1993; Fletcher, McCauley et al., 1996; Hannay, 2000; Tashiro & Drake, 1998), representing neural insults that leave persisting effects on cognitive and behavioral development (Anderson, 1975; Fletcher et al., 2000; Fletcher et al., 2004; Wills, 1993). Analysis of the data revealed that subjects with SBH performed in the average range on a measure of nonliteral language and in the low average range on measures of inference making skills, pragmatic judgment, and emotion recognition, all of which were significantly worse compared to the general population. This set of findings is consistent with study expectations and with literature which has pointed towards those with SBH having impairments in these domains (Barnes & Dennis, 1998; Cull & Wyke, 1984). These findings are also consistent with and support Yeates et al.'s (2007) suggestion that traumatic brain injury incurred in childhood has negative implications for social cognitive abilities, and suggest that the neurological insults resulting from congenital hydrocephalus may affect brain regions responsible for social cognition.

Predictors of social cognitive abilities. The next two hypotheses explored the relationship between estimates of neurological severity and impairments of measures of social cognitive functioning. The objective was to identify condition severity variables that might be helpful in predicting difficulties with social cognitive functioning, and therefore, social competence.

Number of shunt surgeries as a predictor. Previous studies of children and adolescents with spina bifida have shown those who are shunted for hydrocephalus to have impairments in a variety of cognitive domains. In particular, they have been shown to have higher rates of attention problems, difficulties with problem solving, and poorer academic functioning (Dennis, Edelstein, Copeland, et al., 2005; Dennis, Edelstein, Frederick, et al., 2005; Fletcher, Brookshire, et al., 1996; Holmbeck & Faier-Routman, 1995; Hommeyer et al., 1999; Snow, 1999). There is also evidence that those who have gone through several shunt revision surgeries are at increased risk for cognitive and academic difficulties (Bier et al., 1997; Hommeyer et al., 1999). Based on this evidence, it was hypothesized that the number of shunt surgeries would predict the degree of impairment in social cognitive domains of nonliteral language, inference making skills, pragmatic judgment, and emotion recognition. Specifically, it was expected that having more shunt surgeries would be associated with greater impairment on these measures because each surgery would create opportunity for infection and damage in or around the site of the shunt. Additionally, more surgeries would be an indication of a more serious history of infection or recurrence of hydrocephalus.

As hypothesized, number of shunt surgeries was found to be a significant predictor of nonliteral language and marginally significantly associated with inference making skills. Specifically, as shunt surgeries increased in number, nonliteral language scores became worse and there was a trend towards inference making skills scores being worse. Contrary to expectation, number of shunt surgeries was not shown to be associated with either pragmatic judgment or emotion recognition.

The finding that number of shunt surgeries was associated with nonliteral language and trending towards being associated with inference making skills is consistent with Hurley et al.'s (1990) suggestion that right hemisphere lesions caused by shunting may be responsible for deficits in comprehension of tone and emotion in language, which is also referred to as language prosody. These social cognitive abilities require that one is able to extract meaning when it is not explicitly stated with words. Meaning must be constructed from tone, and the underlying messages within metaphor and irony must be extracted, in order for the nonliteral aspects of language to be understood. The literature examining neurological functioning and language point towards the right hemisphere as housing language prosody. As such, it makes sense that the number of shunt revisions would be associated with difficulties in this cognitive domain.

The lack of significant association between number of shunt surgeries and pragmatic judgment, while unexpected, can be explained by further discussion of the construct being assessed. The pragmatic judgment subtest of the CASL assessed the knowledge and use of appropriate language. While this, in part, requires social intuition and skills, the major aspect is the ability to understand standard interactions. This ability, as it is measured by the CASL, does not require that the child/adolescent interprets language that is otherwise not explicitly expressed. The pragmatic judgment subtest requires one to describe what they would do in a particular situation given a set of circumstances. This does not require that children interpret tone, prosody, or other unspoken aspects of language that have shown to be impaired in children with SBH (Hurley et al., 1990). Children with good pragmatic judgment skills are able to readily understand and utilize specific types of language given the social context at hand (Carrow-Woolfolk, 1999; Owens, 1988). In addition, they are more likely to know when and how to modify language accordingly (e.g., in informal vs. formal situations). For children with SBH who have difficulty interpreting non-literal aspects of language, pragmatic judgment might prove to be an easier skill because it is more straightforward and calls upon specific rules of interaction (i.e., “What do you say when you are introduced to Mary’s dad, John Smith?”).

As noted above, there is a planning and organizational aspect to pragmatic judgment that the other measures of the CASL lack. As such, it can be suggested that pragmatic judgment, as assessed by the CASL, is considered to measure aspects of executive functioning. The finding that number of shunt surgeries does not predict pragmatic judgment, therefore, is consistent with Rose and Holmbeck’s (2007) research which showed that number of shunt surgeries was not a significant predictor of executive dysfunction in children with SBH.

Another explanation for the lack of findings is that there were a number of participants who did not complete the CASL due to fatigue or impaired cognitive ability. In general, the participants who did not complete this measure tended to be more cognitively impaired than those who were able to complete the measure. In some instances, research assistants opted to discontinue testing if it seemed that the child/adolescent was not capable of understanding the test stimuli. In addition, pragmatic judgment was the final measure administered and, therefore, even more likely to not be completed by participants. As a result, it is possible that the analyses did not include the more impaired participants who are expressing pragmatic judgment deficits. The overall lack of variability for pragmatic judgment may have contributed to the lack of findings.

Despite the fact that the form and content of language are often intact, children with hydrocephalus commonly demonstrate difficulties with pragmatic components of language, particularly in oral discourse (Brewer et al., 2001; Dennis et al., 1994; Vachha & Adams, 2002). The lack of association between number of shunt surgeries and pragmatic judgment can also be accounted for by the fact that pragmatic judgment was assessed separate from the other important social cues that are present during social interactions. The measure is a structured and organized presentation of social events that works to eliminate some of the uncertainty that real life situations pose. Perhaps these children can perform well on standardized measures, but exhibit difficulty when interacting with peers.

Likewise, the lack of significant association between number of shunt surgeries and emotion recognition was also contrary to the original hypothesis. This non-significant finding might be accounted for by the fact that emotion recognition was assessed mostly by visual cues of emotion. It is possible that the number of shunt surgeries does not impact cognitive functioning that taps into visually presented visual cues. This would be also be consistent with the idea that children and adolescents express more impaired ability to understand verbal complexities of social interactions (Barnes & Dennis, 1998; Cull & Wyke, 1984).

There is also research to suggest that right-hemisphere somatosensory cortices are important for the processing of emotional and social information from a variety of cues.

This is particularly the case since most people rely more heavily on information from the left half of their visual fields (which is processed by the right side of the brain) when making judgements about emotional expression (Burt & Perrett, 1997; Jansari, Tranel, & Adolphs, 2000). Subjects with damage to the right hemisphere have been shown to perform significantly worse than left-hemisphere damaged subjects and normal controls in recognizing emotion from faces and other cues (Adolphs, Damasio, Tranel, Cooper, & Damasio, 2000; Benowitz et al., 1983). This has been shown to be the case for recognition of emotion from both facial expressions and verbal prosody (Adolphs, Damasio, & Tranel, 2002). Given that shunts are generally placed in the right hemisphere, it is possible that the initial shunt placement causes enough damage to regions important in emotion recognition to result in skill impairment. It is possible that additional shunt surgeries do not result in further impairment in this ability because the damage has already been done.

Lesion level as a predictor. Past research has shown lesion level to be associated with cognitive functioning (e.g., higher lesion level has been linked to lower intelligence; Bier et al., 1997). Thus, Hypothesis #3 predicted that having a higher lesion level would be associated with poorer performance on measures of social cognition. Contrary to expectations, lesion level was not shown to predict any of the measures of social cognition. These contrary findings were consistent with Hommeyer et al.'s (1999) research, which indicated that lesion level in children with SBH was not significantly associated with either parent or teacher report of child cognitive ability, and can be accounted for by the fact that spinal lesion level does not affect neurological outcomes, but rather determines peripheral impairment. As such, lesion level can be seen as a crude predictor of motor functioning, with higher lesion levels indicating worse motor functioning.

Although lesion level has been shown to be associated with cognitive functioning in some past research (Bier el al., 1997), these findings are likely due to the motor-intensive components of the measures utilized. Given that children with SBH exhibit impairments on measures requiring fine motor output (Fletcher, Brookshire, et al., 1996; Wills, 1993), it is not surprising that they perform worse than their normally developing peers of cognitive measures with motor components. The finding that lesion level was not shown to predict social cognitive functioning can be explained by the fact that the social cognitive measures utilized for the current study do not require motor functioning.

Social cognitive correlates of social competence: Objective report. Hypothesis #4 considered the association between social cognitive functioning and objective report of social competence. Based on Yeates et al.'s (2007) heuristic, problems with social cognition might help explain the common occurrence of social deficits in children with SBH. The goal of the current study was to capture social cognitive functioning skills in children and adolescents with SBH by utilizing standardized measures of assessment. Preliminary analyses conducted for the current study indicate that children and adolescents with SBH performed significantly worse than the general public on measures of social cognition. This indicated that the link between social cognition and social competence (social skills, social adjustment, and social performance), as suggested by the original hypotheses, was worth further investigation. Given that those with SBH are expected that have difficulties with cognitive skills that are necessary for effective social interactions (social cognition), pragmatic judgment, nonliteral language, inference making skills, and emotion recognition were captured via standardized assessment.

Parent- and teacher-reported social adjustment. The Harter was used to assess parent and teacher-report of the target child's social adjustment. While none of the social cognitive measures were significant predictors of social adjustment (as measured by the Harter parent and teacher report), emotion recognition was shown to be a marginally significant predictor of the outcome variable. This finding suggests that children and adolescents with SBH who have difficulty extrapolating emotion from facial expressions, postures, and intonation tend to have difficulties with social adjustment (parent- and teacher- report). While the current study indicated that children and adolescents have significantly worse ability to understand the subtleties of language and extract meaning from that which is not explicitly spoken and to (nonliteral language, inference making skills, and language pragmatics) when compared to the normal population (Hypothesis #1), these social cognitive skills were not found to be significant predictors of social adjustment. It is not clear why emotion recognition was found to be a predictor of social adjustment and the other social cognitive skills (nonliteral language, inference making skills, and pragmatic judgment) were not. One possibility is that the ability to understand the emotions of others without verbal cues is important for social adjustment. For those who are not able to read facial expressions, posture, and tone, it may be difficult to express empathy. This can result in the child appearing awkward and socially inappropriate, thereby rendering them less likely to be accepted by their social cohort.

The lack of findings for the other social cognitive as predictors of social adjustment can be accounted for by the possibility that the ability to interact within a social context in a successful manner does not require that a child or adolescent be able to readily interpret meaning from words that are not literally spoken. Additionally, the lack of findings might reflect the possibility that these social cognitive measures do not generalize to real-life social behaviors. Perhaps for these children, their seemingly preserved and intact verbal skills (see Wills, 1993) make up for their verbal weaknesses. The ability to understand emotion from body language and tone, however, remains essential for meaningful social interactions that result in emotional connections with peers.

Recent research on empathy supports a model of two separate systems for empathy: an emotional system and a cognitive system. Emotional empathy refers to the capacity to experience affective reactions to the observed experiences of other (Shamay-Tsoory, 2011). One of the major underlying processes of this ability is emotion recognition. Cognitive empathy, on the other hand, involves the capacity to make inferences regarding the other's affective and cognitive states (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). There is also evidence supporting the possibility that individuals with autism, for example, can show impairment in one system and intact ability in the other system (Dziobek, Rogers, Fleck, Bahnemann, Heekeren, & Wolf, 2008). The emotional system ability can be measured by emotion recognition skills, whereas cognitive empathy can be assessed via theory of mind skills. It is possible that having an intact emotional empathy system is a predictor of social adjustment in children and adolescents with SBH. This theory supports the marginally significant finding that emotion recognition is a predictor of social adjustment in children and adolescents with SBH (as measured by parents and teachers), because it allows for the idea that individuals can demonstrate empathy without having a complete cognitive understanding of the emotions and beliefs of others. Given that the finding is marginally significant, this finding out to be cross-validated in future research studies that assess both emotional and cognitive empathy and their association with social adjustment.

As discussed above, those with SBH tend to have difficulty readily interpreting the unspoken thoughts of others, thereby making it difficult for them to put themselves in another's "shoes." However, it is possible that having intact emotion recognition acts as a protective factor for these children. If they are able to mirror the emotions of others, perhaps that is enough to make and maintain friends in childhood and adolescence. This would also account for the fact that the other social cognitive abilities were not shown to be significant predictors of social acceptance for these children. It would be interesting, however, to explore whether or not emotional empathy is sufficient for peer acceptance when these children and adolescents enter adulthood and friendships become more complex and, perhaps, require a greater cognitively driven empathic system.

Parent-reported social skills. The Social Skills Rating Scale was completed by parents to assess the target child's social skills. Nonliteral language was shown to be a significant predictor of social skills with better nonliteral language associated with better social skills. This finding suggests that the ability of children and adolescents with SBH to understand the aspects of language that are not literally spoken, such as sarcasm and colloquial ways of speech, is associated with social skills performance reported by parents.

One possible explanation for this finding can reside with the skill being assessed. Social skills, as defined by the current study, are specific abilities that enable one to perform competently within social tasks (Cavell, 1990). The social cognitive measure of nonliteral language assessed the ability to understand meaning from spoken words that is not literally spoken (i.e., sarcasm, humor, irony, figurative language) and requires that the individual is able to determine how to interact based on “missing” information. Likewise, social skills require that one is able to accurately perceive a social situation given contextual cues, come up with an appropriate plan for how to respond, and, finally, act upon that response. Given that the social cognitive ability of nonliteral language requires that one is able to interpret experiences that are not straightforward, it is not surprising that this skill is associated with social skills. Both constructs involve the capacity to interpret situations and act on the knowledge in an appropriate way.

No other measures of social cognition (language pragmatics, inference making skills, and emotion recognition) were shown to be predictors of parent-reported social skills. While this is contrary to expectations, these findings may reflect the possibility that these social cognitive abilities are only one of the many abilities that contribute to good social skills. While language pragmatics, inference making skills, and emotion recognition might play an important role in social competence development, there may be other skills that these children can rely on to inform their social interactions. It is also possible that parents of children and adolescents with SBH are more lenient in their expectations of good social skill expression in these children. The SSRS has several questions that assess social skill performance (i.e., "Joins group activities without being told."). However, these items do not assess the success with which the child interacts. Parents may want to give their child credit for these behaviors since they are capable of displaying them, but the measure does not truly assess the quality of these social skills. With the potential overestimation of social skills in children involved in the current study, a true relationship between the other social cognitive skills and social skills cannot be determined.

Teacher-reported social skills. The Social Skills Rating Scale was completed by teachers to assess the target child's social skills. While none of the social cognitive measures were significant predictors of social skills (as measured by teacher-report), emotion recognition was shown to be a marginally significant predictor of the outcome variable. This finding suggests that difficulty extrapolating emotion from facial expressions, postures, and intonation is associated with worse social skills (according to teachers). This finding indicated a trend towards consistency with the original hypothesis that emotion recognition is an important predictor of social skills. While emotion recognition was not found to be a predictor of social skills as reported by parents (see previous finding), it seems that this ability is more relevant to social skills as they are evaluated by teachers. One explanation for this finding is that teachers witness peer interactions throughout the day and are more in tune with the subtleties of social performance that are driven by social skills. It is possible that when teachers completed their social skills assessment they automatically, and perhaps unknowingly, made comparisons between the target student and their typically developing students. This is consistent with existing research that suggests teachers tend to compare the social behavior of one child with another, while the parents may not have other reference points (Macintosh & Dissanayake, 2006). The assessment of social skills (as measured by the SSRS teacher report) includes items that might be influenced by emotion recognition abilities. For example, one item is "Cooperates with peers without prompting." Teachers often observe these interactions from the sidelines and may base their assessments in part on the child's ability to interpret nonverbal cues, such as body language and facial expressions, when engaging with peers.

It is not clear why emotion recognition was found to be a predictor of social acceptance whereas the other social cognitive skills (nonliteral language, inference making skills, and pragmatic judgment) were not. One possible explanation is that teachers are less concerned with these skills when assessing peer interactions and subsequent social performance/skills. More specifically, it is possible that teachers observe expressions of emotion recognition in their students and see them as essential for effective day-to-day interactions between peers. On the other hand, teachers might recognize nonliteral language, inference making skills, and pragmatic judgment abilities as having an impact on the subtleties of peer interactions, but not determinants in the quality of peer relationships. This is consistent with the existing literature, which has shown that the ability to recognize nonverbal emotional cues (i.e., facial expressions) is related to social adjustment, as rated by teachers and peers, in childhood (Custrini & Feldman, 1989; Edwards, Manstead & MacDonald, 1984; Nowicki & Duke, 1992; 1994)

Objective coding of target child Social Goals and Problem Solving-Rejection Expectations Scale. Target children and adolescents verbally responded to questions from the Social Goals and Problem Solving-Rejection Expectations Scale (SGPS-RE). The three categories pertinent to the current study (content, social skills, and effectiveness) were objectively coded to determine features of social competence. Pragmatic judgment was found to be a significant predictor of each of the three category scales. This indicated that better pragmatic judgment is associated with better social competence for each category and suggested that the ability to understand and effectively respond to a social context predicts social skills as measured by the SGPS-RE. While this finding is consistent with expectations, it is also not surprising. The social cognitive construct of pragmatic judgment was assessed with a measure that required target children to respond to hypothetical social situations. These situations were presented in a straightforward manner and called for the child/adolescent to come up with socially appropriate ways to interact. These situations, while sometimes complex, did not involve nonliteral aspects of language. The SGPS-RE assessed social skills in a very similar manner. Social scenarios were presented and the child provided ways in which s/he would respond if s/he was in such a situation. The two measures had a great deal of overlap in stimuli structure and both assessed the ability to interpret social situations and respond appropriately given contextual cues (i.e., social information processing). The significant findings can possibly be accounted for by the fact that the predictor and outcome variables were essentially measuring the same construct via different methods. The three category scales were also highly correlated (r = .97 - .98; See Preliminary analyses above), providing further explanation for pragmatic judgment being a significant predictor of all three variables.

Findings from the current study indicated that none of the other social cognitive measures (emotion recognition, nonliteral language, and inference making skills) were significant predictors of social skills as measured by the SGPS-RE. While this was contrary to the initial hypothesis, one possible explanation for the lack of significant findings is the manner in which the outcome variable was measured. As mentioned above, the SGPS-RE presented social scenarios and allowed for the target child to provide structured responses that the child knows are appropriate theoretical reactions. This, however, does not mean that the child would be able to respond in such a way when actually in a social situation with a peer. Actual social situations require individuals to recognize and respond to nonliteral cues, including tone of voice, nonliteral language, facial expressions, and body language (Nowicki & Duke, 1994), and the ability to infer what others are thinking based on these cues (Landa, 2000). Since the outcome variable (SGPS-RE) does not require any of these skills to be present, it follows that the social cognitive abilities that measure them (nonliteral language, inference making skills, and emotion recognition) would not be good predictors.

Social cognitive correlates of social competence: Subjective report. Hypothesis #5 considered the association between social cognitive functioning and social competence as reported by the target child (subjective report). This hypothesis was based on the findings of Minchom et al. (1995) that children and adolescents who are more cognitively impaired tend to report higher self-competency than those who are less impaired and more aware of their deficits. This suggests that those with impaired social cognitive abilities might be less capable of monitoring their own social behavior and understanding its impact on others. In addition, those children with high scores on measures of social cognition are expected to report high scores on social competence. Based on the marginality hypothesis, the children and adolescents who struggle with social competence are those who are aware of their abilities (i.e., not severely impaired), yet are not functioning at the same level as their normally developing peers. As such, it was hypothesized that a curvilinear relationship was expected to be found between performance on measures of social cognition and subjective (i.e., self-reported) measures of social competence, such that poor performance on social cognition would be associated with better self-reported social competence, and high scores on social cognition would be associated with better scores on self-reported social competence. This hypothesis suggested that those who are neither severely impaired nor functioning at the same level as normally developing peers rate themselves as not having good social competence.

The Children's Self Efficacy for Peer Interaction Scale (CSPI) was used to assess objective report of social performance and the Social Acceptance Scale of the Harter was used to assess child-reported social adjustment. The expectation was that children who are either severely impaired or doing as well as their normally developing peers on social cognitive ability would rate themselves on measures of social competence as doing better than those in the "middle" would rate themselves. Results did not support this hypothesized curvilinear relationship between social cognition and social competence for any of the predictor variables or outcome variables considered. Emotion recognition, however, was shown to be a positive predictor of high social performance scores, as measured by the CSPI.

For the CSPI, target children responded to questions that assess how difficult/easy it is for them to engage in a specific social situation (e.g., "Some kids want to play a game. Asking them if you can play is _______ for you;" The method for assessing child-reported social performance may account for the contradictory findings for hypothesis #5. More specifically, the CSPI did not measure the quality of social performance, but rather the willingness of the child to interact socially. If an objective party were to observe such social interactions, it is possible that s/he would rate them as inappropriate. In fact, it is possible that the children who more likely to respond with "very easy" to items on the CSPI (which indicates better social performance) are more likely to have awkward or inappropriate interactions with peers. This finding may be reflective of the "cocktail party syndrome" that is often characteristic of children with SBH (Hurley et al., 1990). As noted above, those with CPS struggle with oral discourse and the ability to readily interpret the social desires of others (Brewer et al., 2001; Dennis et al., 1994; Vachha & Adams, 2002). This is consistent with the possibility that those who respond on the CSPI such that they are doing well socially are in fact viewed as awkward and inappropriate. As such, it follows that the true association between emotion recognition and CSPI may point towards difficulty understanding facial expressions and tone as a predictor of inaccurate reading of social situations and subsequent inappropriate social performance. This would, in part, support the original hypothesis.

The lack of findings with the other social cognitive measures as independent variables with both the CSPI (social performance) and Harter (social adjustment) as dependent variables can further be explained by the possibility that the children in the current study are placed in peer situations that allow for adequate peer relationships. For example, it is possible that children who are more impaired in social cognition are enrolled in special education classes with other children who have similar difficulties, thereby resulting in an even playing field for peer interactions.

Developmental considerations. Hypothesis #6 considered age when examining the effects of social cognition on social competence outcomes. Given that the brain structures involved in social cognition undergo gradual development, it is expected that social competence becomes more complex as children get older. Since children with spina bifida incur neurological insults that impact areas involved in social cognition, it is expected that their social cognitive functioning skills do not increase at the same rate as their peers, if at all. Since social interactions become more complex as children get older, the effects of these social deficits are expected to be seen with greater intensity with age increase. As such, it was hypothesized that the association between social cognition and social competence would stronger as children and adolescents with SBH become older.

Overall, none of the analyses supported age as a moderator of the relationship between social cognition and social competence. This indicated that the positive relationship between social cognition and social competence does not become stronger with age. One possible explanation for this finding could be that reporters (parents and teachers) are more lenient in their assessment of social functioning of these children with

SBH and that this leniency becomes more apparent with increase in age. Given that social interactions become more complex with age as children experience increases in cognitive capacity, it is possible that parents and teachers become increasingly aware that the child with SBH is not able to keep up with demands and their willingness to grant leniency increases with time. More specifically, parents and teachers may not have responded to questionnaires relative to how they would have responded for a more typically developing child. Rather, they may have considered the medical condition with which the target child is dealing and lowered their expectations given the obstacles the child faces cognitively, physically, and socially. It is possible that this leniency is neither apparent nor necessary until children are older and social and cognitive expectations increase.

The lack of findings with the Social Goals and Problem Solving- Rejection Expectations Scale category scales as dependent variables can be accounted for by the fact that the measure does not contain scoring/coding norms based on age. Responses to social scenarios were coding based on a system that did not incorporate an assessment standard for varying age ranges. Specifically, all participant responses were evaluated based on the same standards, regardless of age or developmental status. As such, the concept that social interactions become more complex and expectation increase as children become older is not factored into assessment criteria, thereby minimizing or eliminating any effect that age may have on the relationship.

Despite the lack of support for the original hypothesis, there were some significant main effects. In particular, a main effect of age was consistently found for parent and teacher combined report of social adjustment (Harter), indicating that age was negatively associated with Harter scores (as children get older, Harter scores became worse). This finding suggests that as children and adolescents get older, parents and teachers rate their social adjustment lower. Hypothesis #6 was based on the assumption that children with SBH sustain a brain injury early in life, which ultimately affects neurological development and, subsequently, cognitive functioning. Since social interactions become more complex with age, these neurological and cognitive deficits may not become apparent until later in childhood or adolescence. This main effect supports this idea in that parents and teachers reported that older children have more difficulty making and maintaining friendships.

In addition, a marginally significant main effect of age predicting teacher report of social skills (SSRS) was consistently found, such that age was positively associated with social skills. This finding is contrary to the finding that indicated an increase in age predicted worse parent-reported social adjustment. This main effect is also not consistent with the theory that the social difficulties expressed by children with SBH will become more salient as they become older and are expected to interact with peers at a more complex level. However, this finding can be accounted for by the possibility that teachers are more lenient in their ratings of social skills for children with physical and cognitive disabilities (see discussion of Hypothesis #4). It is also likely that the teachers working with children with SBH who are more cognitively impaired and express greater social and academic difficulties also work with other children with special needs. Their standards or expectations for social skills may be different than that of mainstream teachers. When reporting on social skills for children in this study, it is possible that they are using a baseline that is relative to special needs kids. In other words, these teachers see an improvement in social skills with age, but at a trajectory that may still indicate that these children with SBH are behind in social skill development when compared to typically developing peers.

Finally, a main effect of age was found for each of the category scales (content, social skills, and effectiveness) of the Social Goals and Problem Solving-Rejection Expectations Scale. Given that social behaviors are expected to improve with age, this finding is not surprising. It would be interesting to compare children with SBH to a group of typically developing children to determine if the increase in social competence occurs at the same rate for the two groups. Given the hypothesis that children with SBH do not develop social cognition at a rate consistent with that of typically developing children, illness status ought to be considered as a moderator of the relationship between age and social competence.

A discussion of additional main effect findings for each of the independent variables considered will be provided below.

Nonliteral language as the independent variable. When nonliteral language was considered as the predictor variable, there was a main effect of nonliteral language predicting parent report of social skills. This finding indicated that better nonliteral language ability was associated with better parent-reported social skills and confirms that which was found in a previous hypothesis (see Hypothesis #4).

Inference making skills as the independent variable. When inference making skills was considered as the predictor variable, there was a marginally significant main effect of inference making skills predicting parent report of social skills. This suggested a trend towards better inference making skills being associated with better parent-reported social skills (SSRS). This marginally significant main effect is consistent with the idea that the ability to make inferences given non-explicit cues within a social context will render a child/adolescent better equipped with social skills. Many of the items on the SSRS inquired about the target child's ability to initiate socially appropriate behaviors. As such, it makes sense that the ability to make inferences about social situations without explicit verbal information would predict the ability to make socially appropriate initiations.

Pragmatic judgment as the independent variable. When pragmatic judgment was considered as the predictor variable, there was a main effect of pragmatic judgment predicting each of the three category scales of the SGPS-RE, indicating that better pragmatic judgment predicted better scores on each of the three categories of the SGPS-RE (content, social skills, and effectiveness). This is consistent with that which was found in previous analyses (see Hypothesis #4).

Emotion recognition as the independent variable. When emotion recognition was considered as the predictor variable, there was a marginally significant main effect of emotion recognition predicting each of the three category scales of the SGPS-RE. This suggested a trend towards better emotion recognition associated with better scores on the three category scales (content, social skills, and effectiveness). This positive association supports the hypothesis that the ability to effectively interpret emotion from facial expressions and other body language is important for appropriate social information processing (Boyatzis & Satyaprasad, 1994). In addition, it suggests that these children with SBH may have some similarities to children with nonverbal learning disabilities who struggle to accurately perceive emotion from facial expressions (Rourke et al., 2002; Zillmer & Spiers, 2001), making it difficult for them to have adequate social interactions (Nowicki & Mitchell, 1998).

Social cognition as a mediator. Hypothesis #7 proposed that social cognition would mediate the relationship between illness severity and social competence in children and adolescents with SBH. More specifically, it was expected that lower illness severity would predict better social cognition, which, in turn, would predict better social competence. Separate analyses were conducted for each of the six objectively measured social competence dependent variables (see below). Analyses of the mediational model revealed some significant associations. In particular, results indicated that nonliteral language was significantly associated with and inference making skills marginally significantly associated with parent-reported social skills (SSRS), while controlling for illness severity. In addition, both pragmatic judgment and nonliteral language were shown to be consistently associated with each of the category scales of the SGPS. For each of these findings, the social cognitive skill was positively associated with better social competence outcomes. These findings are consistent with finding from previous hypotheses and possible explanations are explained above (see Hypotheses #4 and #6).

The additional steps necessary to support the mediational models indicated non-significant associations between illness severity and social cognitive functioning and illness severity and social competence. Therefore, the full mediational models were not supported. The significant associations between social cognition (the mediator) and social competence components (the dependent variable) are not surprising, given these findings. They support earlier hypotheses (#4 and #6) and the heuristic model presented by Yeates and colleagues (2007). Once again, it is important to consider the specific measures utilized with these findings in order to best understand the significant relationships. For example, the significant relationship between nonliteral language and parent-reported social skills (SSRS) can be accounted for by the idea that both measures assess the ability to respond to social situations without all information explicitly stated and contextual cues available to make appropriate decisions. It is not surprising that there is a significant positive association between the two, even when controlling for illness severity. Likewise, the relationship between pragmatic judgment scores and the three category scales of the SGPS-RE are repeated findings for the current study and can be explained by the fact that the pragmatic judgment subtest of the CASL and the SGPS-RE are very similar in the presentation and content of their stimuli. That they are correlated is not surprising.

It is interesting that illness severity was not found to be significantly associated with either social cognition or social competence. One possible explanation for the non significant relationship between illness severity and objective report of child's social competence is that parents and teachers may be lenient in their assessment of target children's social competence. Parents may be inclined to consider their child's abilities when completing measures of social competence. As a result, it is possible that they provide ratings outside of the context of how typically developing children perform, simply rating their child relative to his/her own baseline. For example, parents of a child who had no social interactions at age 7 but expresses interest in a friendship at age 9 may be seen as socially competent. In relation to typically developing peers, it might be clear that this child is behind. As a result, the true relationship between illness severity and social competence disappears (statistically speaking). Additionally, teachers may provide social competence ratings relative to the child's social performance previous years. Also, they may assess the child within the context of a special education classroom. As such, the child might be performing satisfactorily relative to their peers.

Study Limitations

The current study has several limitations that should be considered in both interpretation and future research endeavors in this area of study. First, the current investigation represented a focused study of one particular illness group, spina bifida. As such, findings of this study may not be extended to other pediatric samples. Additionally, the current study sample was restricted to children and adolescents with spina bifida who also have a diagnosis of hydrocephalus and, therefore, findings cannot be generalized to those who do not have congenital hydrocephalus. It should also be noted that some children in the current study sample were unable to complete portions of the social cognitive testing for various reasons (i.e., fatigue, cognitive impairment). It is possible that the children who were unable to complete portions of the CASL and DANVA2 are also those who were rated low on measures of social competence. With these missing data, the association between social cognition and social competence components may have been attenuated, thereby not showing the true strength of the association between predictor and outcome variables.

The statistical methodology utilized in this study had several limitations. First, the sample size was relatively small, thereby limiting statistical power. Although sample size is a common problem in pediatric research, it nonetheless limits the ability to detect statistically significant results. A larger sample size would also increase confidence in generalizability of these results by likely resulting in greater variability in social cognitive functioning status. This would allow for a better understanding of how those children with SBH who do not perform well on measures of social cognition are evaluated in terms of social competence outcomes.

Second, it is important to note that the data for the current study was collected at one time point and that the analyses were, as a result, correlational in nature. Associations suggested by the regression analyses conducted are, therefore, not indicative of temporal or causal relationships. The current study hypothesized that neurological insults impact cognitive functioning, thereby leading to social difficulties. Although a relationship in the reverse direction is not intuitive, it is possible that there is a third variable unaccounted for in the current study could be causing impairment on both the predictor and outcome measures (e.g., a hypothetical example worthy of examination would be auditory processing skills). A more thorough and longitudinal analysis of the relationship between these factors would be useful in the future.

Third, although the current study included children from ages 8-15, it is important to note that participants are continuing to develop. In particular, the anterior regions of the brain that are associated with social behavior continue to undergo gradual development through mid-to-late adolescence and proceeds in a back-to-front direction (Giedd et al., 1999; Klingberg et al., 1999; Sowell et al., 1999). Given that spina bifida-related hydrocephalus negatively affects neurological structures in a back-to-front manner (Fletcher et al., 2000), it is possible that children and adolescents with SBH are more delayed that their typically developing peers in the development of the anterior regions that are important in social interactions. When considering these additional potential delays in brain development, it is possible that the current studied did not include participants old enough to display the social cognitive skills that develop in conjunction with anterior regions.

Another limitation of the current study is that it utilized relatively few measures of social cognition. As mentioned above there are thought to be two separate systems involved in the development of empathy: an emotional system that supports ability to empathize emotionally, and a cognitive system that allows cognitive understanding of the other's perspective (Shamay-Tsoorey, 2011). The DANVA2, in its attempt to assess emotion recognition, does not adequately assess both of these systems. The CASL assesses cognitive abilities, but does not measure the cognitive aspects of empathy. As such, a complete emotion recognition profile of children and adolescents with SBH was not obtained in the current study. In addition, there are limitations to the subtests of the CASL. Specifically, the individual subtests, while claiming to measure distinct constructs, are very similar in their stimuli and appear to overlap a great deal in what they are measuring. Correlation analyses presented above indicate that the three subtests were highly correlated (r = .56 - .86). As a result of this multicollinearity, the true prediction value of each of the independent variables was not assessed. Statistically, the first social cognitive variable could have entered the model and, because of these high correlations, the others drop out of the model.

Along a similar vein, the study was limited by the measures utilized to assess the outcome variable of interest (social competence). Specifically, the current study assessed social competence and its components via self-report measures. While both objective and subjective self-report measures were utilized, these variables were often not utilized for the same study hypotheses (i.e., separate hypotheses were proposed for objective and subjective outcomes). In addition, each outcome construct of interest was assessed by a single measure, oftentimes consisting of very few items. The Social Acceptance Scale of the Harter, which assessed social adjustment, consisted of only three items for parent and teacher report and 6 items for child report. While reliability was adequate for all three measures, the limited items likely weaken the depth to which social adjustment was measured.

Yet another limitation to the current study is that no distinction was made for those participants who spoke Spanish as a primary and/or first language. Although all 108 participants spoke English and were administered cognitive measures and questionnaires in English, it is possible that having Spanish as a primary language impacted performance on measures of social cognition, particularly those from the

CASL. The CASL contains many stimuli that draw upon colloquial speech that is most readily understood by native speakers of English. The current study did not examine levels of acculturation or language proficiency for either children or caregivers. Despite the fact that participants spoke English fluently, it is possible that their caregivers are not as familiar with the subtleties of English and are, therefore, not as likely to use colloquial speech in the home. In turn, their children would not be as familiar with these colloquial phrases. This could result in attenuated performance on components of the CASL, particularly nonliteral language and inference making skills.

Clinical Implications of the Current Study

The results of the current study have important implications for parents, educators, and health care professionals involved in the care of children and adolescents with spina bifida and hydrocephalus. First, the findings of the current study suggest that those with SBH perform worse than their normally developing peers on measures of social cognition, thereby putting them at risk for not having the skills to adequately engage in social arenas. Based on Yeates' et al.'s (2007) heuristic, these deficits are a result of brain insults that occur during brain development. Given this finding, caregivers could be helped to be more aware of domains in which these children are likely to struggle. For example, clinicians and educators can focus on improving these skills with practice and other therapeutic interventions. Additionally, this knowledge adds to the understanding that children and adolescents with SBH may require additional services in the school setting that specifically target social cognitive abilities.

The finding that number of shunt revision surgeries is negatively associated with nonliteral language and inference making skills is cause for concern. It suggests the possibility that revision surgeries are resulting in further brain insults that are negatively impacting cognitive functioning. It is important for clinicians and parents to be aware of these negative side effects so that they can better understand impairments that are exacerbated from or arise after surgery and, subsequently, intervene with rehabilitative services focused on skills building.

Although those with higher lesion levels tend to experience the greatest orthopedic and ambulation difficulties, the current study results did not identify lesion level as a predictor of social cognition. This is an important distinction because of the potential clinical implications. Orthopedic and ambulation difficulties associated with lesion level are visible and make children with SBH obvious to those with whom they interact. The social difficulties that children face can be hypothesized to be associated with these physical disabilities that make them different from their peers. Shunt revision status and brain insults that result, on the other hand, are not visible variables. It is important for caregivers to be cognizant of these subtle, non-visible differences/changes that distinguish children with SBH from their normally developing peers and potentially render them less socially competent.

While there are limitations to the study design (i.e., correlational) and measures of social cognition, the significant and marginally significant findings have implications for the cognitive and social functioning of children and adolescents with SBH. Most importantly, perhaps, is that brain development is recognized as an important factor in the acquisition of cognitive skills that inform social competence for these individuals. Given this knowledge, clinicians will be better equipped to tailor interventions in this pediatric population. Additionally, teachers will be able to assess cognitive and social functioning more readily and be able to alter curriculum to incorporate skills building modules.

Interventions should be designed to include education of parents and/or caregivers about social cognition and how to look for signs of difficulties, even if they are subtle in nature. Caregivers could then work to build social cognitive skills through everyday interactions. For example, a parent who recognizes that their child does not pick up on facial expressions and tone of voice as indicators of nonverbal expression of emotion could work to encourage the child to pay attention to and better understand these nonverbal aspects of language. Training could come in the form identifying one of a list of emotions that matches a visual representation of a facial expression. For those children who struggle to identify and name emotion, work can be done with the child to develop a vocabulary of feelings.

Clinical interventions should also include involvement of teachers or other behavioral therapists in school settings. Teachers are able to observe children's social abilities as they are developing and can get a sense of how they compare to others on social cognitive skill expression. With education, teachers will be able to target and identify relative deficits and intervene appropriately given the age of the child. For example, a teacher who is able to recognize that a child is struggling in peer interaction because they do not pick up on the subtleties of non-verbal language might incorporate a classroom lesson that teaches such skills. This is particularly salient for younger children who are just developing these higher order social cognitive skills and the brain region that subserve them. For older children, it might not be developmentally appropriate for a lesson to include social cognitive skill building for all students. Rather, recognition by teachers of relative weaknesses in their older students with spina bifida compared to normally developing peers may initiate a referral for further assessment of cognitive abilities and a potential Individualized Education Plan. Interventions for children and adolescent of all ages can also include behavior therapies that target skills building of social cognitive abilities, such as Applied Behavioral Analysis (ABA) techniques, which have been shown to be effective in teaching children with autism appropriate communication and social skills (Strain & Schwartz, 2001).

Clinicians, teachers, and caregivers of children and adolescents with spina bifida should be aware of these potential difficulties early on and encourage early peer interactions that may enhance social cognition and positively impact long-term social competence outcomes. While any extracurricular activity is important for development of peer relationships, social activities that are dependent on verbal interactions and, therefore, help sharpen social skills should be encouraged. Specifically, involvement in Girl Scouts or science club will encourage practice of social cognitive skills, whereas activities such as sports allow the child to effectively engage without necessarily appropriate verbal interactions.

Future Directions

Future research efforts in this area are necessary to further elucidate social cognitive functioning in children and adolescents with spina bifida and hydrocephalus and its association with social competence outcomes. Specifically, longitudinal data investigating relationships between these factors would be useful. In addition, longitudinal analyses would allow for a better understanding of how the association between social cognitive functioning and social competence differ during different developmental periods. A longitudinal study would also provide the opportunity to assess those with SBH into later adolescence and early adulthood. Given the impact of brain development on cognitive functioning, particularly those requiring higher order abilities, such data would provide the opportunity to quantify changes over time. In addition, longitudinal analyses would provide a better understanding of when these social cognitive abilities come on-line for children with spina bifida and hydrocephalus. Along these same lines, future research should include control samples, including typically developing peers, those with other chronic illnesses that are not associated with brain insults, and children with brain insults of other etiology (i.e., traumatic brain injury or hypoxia).

Secondly, future research would benefit by obtaining larger sample sizes in order to increase statistical power and the likelihood of finding greater effects. Considering the difficulty in recruiting large sample sizes in pediatric psychology, collaboration of researchers across disciplines and sites may be essential.

Third, the results of the current study reflect our interpretation of Cavell's model and how we operationalized the various constructs within the model. Future research could improve upon the conceptualization of Cavell's model and determine more sound ways to operationalize its constructs. This would allow for researchers to adequately and consistently measure each of the constructs that contribute to social competence (social skills, social performance, and social adjustment).

Fourth, future research would benefit from more comprehensive measures of social cognitive functioning. In particular, it would be interesting to include a measure of emotion recognition that assesses both cognitive empathy and emotional empathy (Shamay-Tsoory, 2011) to determine if children and adolescents with SBH demonstrate impairments in one system and not the other. While the DANVA2 assesses the construct of emotional empathy, it does not adequately assess cognitive empathy and one's capacity to make inferences regarding another's affective and cognitive states. The Interpersonal Reactivity Index (IRI; Davis, 1983), however, measures both components of empathy. It is a 28-item self-report questionnaire and the only published measure, to date, that allows a multi-dimensional assessment of empathy. In addition to two affective scales which assess emotional empathy, the IRI contains two cognitive scales. The two cognitive scales are: (1) the perspective-taking scale, which measures the reported tendency to adopt spontaneously the psychological point of view of others, and (2) the fantasy scale, which measures the tendency to imaginatively transpose oneself into fictional situations.

Future research and theory would also benefit from expanding the definition of emotion recognition to include cognitive empathy so as to determine if this higher order skill is associated with social competence in those with SBH. Measures of theory of mind can be utilized to assess this construct (Shamay-Tsoory, 2011). Theory of mind (ToM) is the ability for one to consider and take the perspective of others. Individuals who experience a theory of mind deficit have difficulty determining the intentions of others, lack understanding of how their behavior affects others, and have a difficult time with social reciprocity (Moore, 2002). False-belief tasks, such as the *Sally-Anne Test* (Baron-Cohen, Leslie, & Frith, 1985), and appearance-reality tasks, such as the and the *John and Mary ice cream story* (Perner & Wimmer, 1985), assess one's ability to understand that another's mental representation of situations can differ from their own. The child must be able to predict behavior based on that understanding. In order to initiate and maintain appropriate and adequate social interactions, it is important to be able to anticipate the thoughts of others and behave accordingly (Baker, 2003). The *Strange Stories Test* (Happe, 1994), is an advanced theory of mind task that could be used to assess one's ability to provide context-appropriate mental state explanations for non-literal (i.e., irony, sarcasm, lies) statements. Such an addition to the research would only further expand the way in which emotion recognition is considered and measured.

Additionally, future research should incorporate measures of nonliteral language, inference making skills, and pragmatic judgment in addition to those subtests found in the CASL. For example, measures that assess idiom comprehension would be another means for measuring nonliteral language and inference making skills. Research on idiom comprehension has utilized various methods of assessing understanding of figurative language and metaphors, including the presentation of pictures depicting the literal and figurative interpretations of common expressions (See Papagno, Lucchelli, Muggia, & Rizzo, 2003). The use of visual stimuli to assess these constructs would be important for future research, particularly given the developmental challenges that children and adolescents with SBH face in areas of social cognition. Future research would also benefit from utilizing measures of problem solving such as the Test of Problem Solving (TOPS; Bowers, Huisingh, & LoGiudice, 2005; Zachman, Huisingh, Barrett, Orman, & LoGiudice, 1994), which is a diagnostic test of social problem solving and critical thinking. This standardized measure assesses language-based thinking abilities and strategies using logic and experience towards social decision-making. Children are presented questions about a series of photographs and performance is based on how they use language to think and problem solve in social situation. Responses show performance in: problem solving, determining solutions, drawing inferences, empathizing, predicting outcomes, using context cues, and vocabulary comprehension. While the TOPS is a well-normed and reliable test of social-emotional cognition, it has not been evaluated for its relation to social functioning (McKown, 2007). However, there is some evidence that the TOPS is marginally significantly associated with social functioning provides incrementally useful information regarding social functioning over and above IQ, age, and gender (McKown, 2007). Overall, the TOP's holistic approach to assessing problem solving would add value to research examining each of the four social cognitive constructs in the current study.

Future research would also improve upon the current study if specific language features were taken into consideration. Specifically, it is important to consider the possible effects that speaking English as a second language have on social cognitive functioning, as measured by the CASL and DANVA2. In the current study, all measures were conducted in English because all target children spoke English. However, the level of English proficiency was not controlled for. Future research should include language factors as moderating or control variables so as to account for the possibility that English is not spoken as frequently, if at all, in the home. In addition, it is possible that for those households in which English is spoken by all family members, but is not the first language, certain colloquialisms are not readily utilized or understood. This could impact performance on certain measures of social cognition, particularly those that include nonliteral language and require inferences being made from verbal cues.

Finally, future research ought to include brain studies by utilizing magnetic resonance imaging (MRI). In particular, it would be interesting for research to not only incorporate structural imaging of children and adolescents with spina bifida and hydrocephalus, but also to utilize functional MRI to understand the specific brain regions that inform social cognitive skills and to better understand their underlying neural mechanisms. Such research could suggest a core mechanism for impaired socioemotional processing in children with spina bifida and hydrocephalus, as has been done for those with autism (See Kleinhans et al., 2011). Such information would enhance the understanding of the underpinnings of essential social cognitive processes. Recent research suggests that emotional and social cognitive processes have similar neural underpinnings (Hynes, Baird, & Grafton, 2006; Vollm et al., 2006). Given that hydrocephalus results in brain insults, it is possible that neural mechanisms for social cognitive processes in those with SBH differ from normally developing peers. By further clarifying the neural substrate of social cognition in children with SBH, health care providers will be more informed about the capabilities of these children and adolescents.

This knowledge can then be incorporated in treatment guidelines, such as assisting in the determination of occupational therapy or special education interventions that pay heed to the cognitive abilities of the child. For example, fMRI research in this area can better assist caregivers in determining if children with SBH are likely to be more responsive to interventions that target visual versus verbal abilities.

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VITA

Caitlin R. Roache completed her undergraduate degree at Dartmouth College in Hanover, NH, earning a BA in Anthropology. Following graduation, she sought to gain experience in the fields of medicine and psychology by working as a research assistant at Joslin Diabetes Center in Boston, MA and was involved in multiple aspects of several clinical trials. The effects of chronic illness on psychosocial and neuropsychological outcomes instilled in her a desire to better understand how experiences shape people and their behaviors.

In 2005, she moved to Chicago to attend Loyola University Chicago's doctoral program in Clinical Psychology. She received her M.A. in Clinical Psychology from Loyola in December 2007, writing her thesis on the effects of parenting styles of children and adolescents with spina bifida on body image and eating behaviors. While her research interests have been focused on pediatric populations, her clinical interests have been directed towards adults. She completed several therapy practica with a diverse adult population, including those struggling with infertility, infant loss, and miscarriage.

In June 2011, she returned to Hanover, NH with her family to begin a pre-doctoral internship at West Central Behavioral Health through Dartmouth Medical School. Following the conclusion of her doctorate, she will be completing a fellowship at West Central Behavioral Health-Dartmouth Hitchcock Medical Center in both Child &

Adolescent and Adult services. She looks forward to a career as a clinician, working to help individuals learn about themselves and achieve mental wellness.