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Observed Differences in Social Behaviors Exhibited in Peer Interactions Between Youth With Spina Bifida and Their Peers: Neuropsychological Correlates

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Objective To identify differences in social behaviors in observed peer interactions between children with spina bifida (SB) and peers, and to examine neuropsychological correlates of these differences. **Method** A total of 100 youth (aged 8–15 years) with SB and peers participated in video-recorded interaction tasks, which were coded for interaction style, affect, and collaboration. Children with SB also completed a neuropsychological test battery. **Results** Children with SB demonstrated less adaptive social behaviors in peer interactions, particularly within the interaction style domain. Observational items found to be different between children with SB and their peers were best predicted by social language and attention abilities. **Conclusions** Children with SB exhibit a less adaptive interaction style and lower levels of social dominance but are comparable with typically developing peers on other social behaviors. The observed group differences may have a neuropsychological basis.

Key words neuropsychological functioning; observational methods; peer relationships; social competence; spina bifida.

Since the 1970s, children's peer relations have received much attention by psychological researchers (Ladd, 1999). Positive peer relationships have been linked to multiple short-term and long-term outcomes, including higher academic achievement (Flook, Repetti, & Ullman, 2005), higher vocational competence (Bagwell, Newcomb, & Bukowski, 1998), more positive romantic relationships (Roisman, Booth-LaForce, Cauffman, Spieker, & The NICHD Early Child Care Research Network, 2009), and decreased rates of internalizing problems (Modin, Oestberg, & Almquist, 2011; Pedersen, Vitaro, Barker, & Borge, 2007). Peer relationships are also important because they allow children and adolescents to learn and practice adaptive social skills (Bukowski, 2001).

Children with chronic health conditions may be at risk for poorer peer relationships due to difficulties coping with health-related stress, the stigma accompanying visible physical disabilities, various types of neurological impairments, and higher rates of adjustment difficulties (Lavigne & Faier-Routman, 1992; Wallander & Varni, 1998). In fact, a growing body of research suggests that children with chronic health conditions experience poorer peer relationships and lower social competence compared with healthy youth (Pinquart & Teubert, 2012). A recent meta-analysis of 57 studies found support for varying levels of social impairment across pediatric health populations, with the greatest deficits found in children with conditions of the central nervous system (CNS; Martinez, Carter, & Legato, 2011).

Children and adolescents with spina bifida (SB), a birth defect involving the CNS that occurs in approximately 3 of every 10,000 live births (National Birth Defects Prevention Network, 2013), have been shown to have difficulties with their peer interactions (Devine, Gayes,

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Purnell, & Holmbeck, 2012). SB is the result of an incomplete closure of the spinal cord during early gestation. Youth with SB experience multiple health complications, including impaired mobility, hydrocephalus, cognitive impairments, bowel and bladder problems, and frequent surgeries. Compared with their typically developing peers, youth with SB are less likely to participate in organized activities, and they tend to have friends who are younger (Blum, Resnick, Nelson, & St. Germaine, 1991). Further, youth with SB report lower quality friendships and fewer reciprocated best friendships than typically developing youth (Devine et al., 2012; Mueller-Godeffroy et al., 2008). Parents of youth with SB report greater social difficulties for their children (Wallander, Feldman, & Varni, 1989), and additional research suggests that these youth tend to be more passive and socially immature than their typically developing counterparts (Holmbeck et al., 2003).

Deficits in advanced cognitive abilities may partially account for the social difficulties encountered by individuals with SB (Fletcher et al., 1996). A child's ability to successfully navigate a social interaction with peers requires the complex interplay of multiple cognitive abilities, including nuanced language use, recognition of others' emotions, and attention to social interaction partners (Izard et al., 2001; Landry, Taylor, Swank, Barnes, & Juranek, 2013; Yeates et al., 2007). *Social language* includes both receptive and expressive language skills used within a social context, such as a child's understanding of a set of rules and goals that must then be communicated to a peer (Landry et al., 2013). Children with hydrocephalus, a common feature of SB, demonstrate poor conversational skills, struggle to interpret complex core meanings of their conversations, have difficulty making inferences, and exhibit hyperverbosity (Barnes & Dennis, 1998). Pragmatic language use and interpretation of inferences have also been identified as weaknesses in other samples of youth with SB (Roache, 2012; Vachha & Adams, 2003).

Emotion recognition is defined as an individual's ability to recognize and label expressions of another's emotional state (Izard et al., 2001), and it has been identified as an important predictor of social functioning in other pediatric samples (Bonner et al., 2008). Previous research has shown that youth with SB perform lower on measures of emotion recognition compared with the normal population (Roache, 2012). In addition, individuals with SB are more likely than their typically developing peers to be diagnosed with a nonverbal learning disability (Yeates et al., 2007), a condition that has previously been associated with poor perception of facial expressions of emotion (Rourke et al., 2002).

Attention is also a necessary component for children's competent social interactions. Children are required to attend consistently to frequently changing visual and auditory information over sustained periods (Andrade, Brodeur, Waschbusch, Stewart, & McGee, 2009). Individuals with attention deficits may fail to actively participate in and pay attention to social interactions, resulting in insufficient social information processing and the appearance of inappropriate social behaviors. Substantial research has established the presence of attention deficits (i.e., focusing, shifting attention) in children with SB (Dennis, Landry, Barnes, & Fletcher, 2006; Rose & Holmbeck, 2007), which have been linked to social skills deficits (Jandasek, 2008; Rose & Holmbeck, 2007).

Much of what is known about the social functioning and peer relationships of youth with SB is derived from parent-, teacher-, and self-reports on questionnaire or interview measures. Although efficient and inexpensive, exclusive reliance on questionnaire data, even when collected from multiple reporters, is problematic because of shared method variance between these measures and other outcome measures derived from questionnaire reports (Holmbeck, Li, Schurman, Friedman, & Coakley, 2002). In addition, research suggests that parents' reports of their children's social abilities may be biased (Dodge, Pettit, McClaskey, Brown, & Gottman, 1986) and children themselves may be inaccurate reporters of their friendships and social status (Gifford-Smith & Brownell, 2003). Observational research methods provide a possible way to address these issues. First, they introduce both a new method and a new informant (i.e., the observer) into the research protocol, thereby greatly reducing the possibility that shared method variance accounts for significant findings (Holmbeck et al., 2002). Second, the objective observer serves as another informant who may be less biased than reporters with existing relationships with the child or adolescent (Gardner, 2000). Finally, direct observation of peer interactions that require multiple cognitive, social, and language demands may be particularly useful in examining the association between neurocognitive skills and children's performances in social interactions with peers (Landry et al., 2013; Yeates et al., 2007).

Despite the time and financial costs associated with observational research methods, direct observation has the capability to address different research questions and satisfy various clinical assessment goals (Haynes, 2001). In fact, leading researchers in the field of pediatric psychology have asserted that children's social interactions cannot be adequately understood with the rating scales and checklists often used in research studies and clinical settings; rather, direct observation is required to best assess children's

social performance with peers (Noll & Bukowski, 2012; Yeates et al., 2007). Observational research methods allow investigators to learn more about the mechanisms implicated in complex social interactions (Gardner, 2000). Rather than reliance on retrospective reports of social behaviors, direct observation enables real-time observation of dynamic and transactional social processes.

The present study aimed to examine social differences between youth with SB and their close friends as they occur during observed interactions. Although several investigations have used observations of parent–child interactions in this population (Holmbeck et al., 2003; Kaugars et al., 2011), this is one of the first to examine peer interactions with observational data. A previous investigation provided preliminary psychometric support for a set of observational social competence scales (Holbein, Zebracki, & Holmbeck, in press). Using the same cohort of youth with SB and their friends, Devine and colleagues (2012) investigated differences in social competence and friendship status between youth with SB and their friends with questionnaire and interview data. While their findings provided valuable knowledge regarding the social strengths and weaknesses of youth with SB, their analyses relied solely on self-report and permitted children to report on friendships outside of the SB–peer dyads that were the focus of the observed interaction data. We sought to determine whether the social differences described by parents, teachers, and children are also observed in the youth's real-time social interactions with their peers.

Consistent with the existing literature, youth with SB were expected to demonstrate less adaptive social behaviors as compared with their peers when observed in video-recorded social interactions. More specifically, we hypothesized that youth with SB would exhibit less adaptive characteristics across three domains: (1) interaction style (e.g., less engagement in the interaction, mutuality, eye contact); (2) affect (e.g., less humor and laughter, positive affect); and (3) collaboration (e.g., less tolerance for differences of opinion, social dominance, promotion of dialogue). In addition, we planned to conduct exploratory analyses examining the effect of gender and race match of the pairs of youth on the observed social behaviors.

A second aim of the study was to examine associations between relevant neuropsychological constructs (i.e., social language, emotion recognition, and attention) and the observed characteristics that were found to be significantly different between children with SB and their peers from the first hypothesis (i.e., social deficits). First, although there is support for the link between neuropsychological abilities and social functioning in this population (Roache, 2012; Rose & Holmbeck, 2007), there are few investigations that have examined this link using observational data. Second, these analyses were intended to show that the observational data indeed captured meaningful information about social interactions in youth with SB that aligns with previously established associations between neuropsychological functioning and social characteristics (i.e., convergent validity). Based on the behaviors included in each domain, it was anticipated that measures of social language and attention would be associated with characteristics in the interaction style domain, performance on emotion regulation tasks would be associated with characteristics in the affect domain, and social language measures would be associated with items from the collaboration domain. Measures of basic language (e.g., lexical knowledge) were also included in the analyses, given the importance of verbal abilities for performance on the interaction tasks included in this study; inclusion of basic language measures would provide a source of comparison with the social language measures to determine whether significant associations between neuropsychological functioning and observed social behaviors could be attributed to fundamental vocabulary knowledge rather than the use of pragmatic language in a social context.

Method

Participants

Participants were recruited from four local hospitals and a statewide SB association in the Midwest to participate in a longitudinal study investigating neurocognitive, family, and social functioning in children with SB. Inclusion criteria for children with SB (''target'' children) were (1) a diagnosis of SB (myelomeningocele [MM], lipomeningocele, or myelocystocele), (2) age between 8 and 15 years at Time 1, (3) ability to speak and read English or Spanish, (4) involvement of at least one primary caregiver, and (5) residence within 300 miles of the research lab to allow for data collection at families' homes. Of the 246 families approached, 163 families agreed to participate in the study. Twenty-one of those families were unable to be contacted or later declined and two families did not meet inclusion criteria (i.e., one child with SB was 7 years of age and another child did not have a diagnosis of SB), resulting in a sample size of 140 families (57% participation rate). Based on available data, SB characteristics were not significantly different between families who participated and those who did not: type of SB (i.e., MM vs. other), $\chi^2(1) = 0.0002$, $p > .05$, shunt status, $\chi^2(1) = 0.003$, $p > .05$, and occurrence of shunt infections, $\chi^2(1) = 1.08$, $p > .05$.

Before data collection, each family was asked to invite a ''best friend'' of the child with SB to participate in a research study at the family's home. The friends were told that their participation would help researchers learn about how children make friends. Inclusion criteria for the friends included (1) age between 6 and 17 years (±2 years of the target child with SB) at Time 1 and (2) the ability to speak and read English and/or Spanish. One hundred twenty-four families (89%) were able to recruit a peer who agreed to participate in the study. Three peers were excluded because they were older than 17 years. As the aim of this study was to learn more about the social skills of children with SB in interactions with their friends, any friends who were identified as family members ($N = 15$) or also had a diagnosis of SB ($N = 4$) were excluded from the analyses. For two SB–peer dyads, observational data were not available. Thus, 100 children with SB (71% of the entire sample of 140) and their friends were included in the present study.

Youth with SB in this study's sample of 100 ranged in age from 8 to 15 years ($M = 11.20$ years, $SD = 2.43$), and 55% were female. Of these children, 64% identified as White, 17% as Latino, 13% as Black, and 6% as an ''other'' race. SB characteristics of the target children, including type of SB, lesion level, shunt status, number of shunt revisions, number of surgeries unrelated to shunts, and full-scale IQ are reported in Table I. Peers included in the present study ranged in age from 6 to 17 years ($M = 11.05$ years, $SD = 2.71$) and were 57% female. Of the peers who participated, 66% identified as White, 15% as Hispanic, 9% as Black, and 10% as an unknown or ''other'' racial background. The 100 dyads analyzed in the present study included 47 pairs of females, 35 pairs of males, and 18 mixed-gender pairs. Further, there were 56 pairs of White youth, 24 pairs of racial minority youth, and 17 dyads in which one member was White and the other was a racial minority. Three dyads could not be assessed for racial match owing to missing data.

Table I. *Condition-Specific Characteristics of Youth With SB*

	Percent	*N*
Type of SB		
Myelomeningocele	84.0	84
Lipomeningocele	12.0	12
Myelocystocele	2.0	2
Unknown/missing data	2.0	2
Lesion level		
Sacral	31.0	31
Lumbar	53.0	53
Thoracic	13.0	13
Unknown/missing data	3.0	3
Shunt status (present)	74.0	74
	M (*SD*)	
Mean number of shunt revisions	2.71 (3.42)	
Mean number of nonshunt surgeries	3.07 (2.00)	
FSIQ	89.68 (19.50)	

Notes. Demographic data are based on a sample of 100 youth with SB who had peers without SB and who also participated in observed peer interactions; FSIQ = full-scale intelligence quotient from the Wechsler Abbreviated Scale of Intelligence.

Procedures

Before data collection, the study was approved by both university and hospital institutional review boards. At the first wave of the larger longitudinal study, data were collected via two 3-hr home visits by trained research assistants. Parental informed consent and child assent were obtained for children with SB and their peers.

During the first home visit, children with SB and their parent(s) or other caregivers completed a battery of questionnaires, engaged in video-recorded family interaction tasks, and children completed neuropsychological testing. At the second home visit, the target children and their peers completed questionnaires and audio-recorded interviews about general friendship characteristics, specific characteristics related to their own friendship with each other, and problem solving in social situations. SB–peer differences on these questionnaire measures were reported by Devine and colleagues (2012). Children with SB and their friends also engaged in video-recorded structured interaction tasks. Families and participating friends were compensated with small gifts (i.e., T-shirts and pens) and monetary compensation ($150 for families and $50 for friends). Families also granted permission to contact outside providers, including teachers and medical professionals (i.e., nurses or doctors), and they signed a release of information for a review of the child's medical chart. Teachers completed a battery of questionnaires to return via mail and were compensated $25 for their participation.

During the video-recorded interaction tasks, children with SB and their friends completed four interaction tasks that were adapted from tasks used in previous studies of children's social interactions (Dishion, Andrews, & Crosby, 1995). Tasks were selected in accordance with the larger study's emphasis on autonomy development. Thus, the tasks emphasized engagement in social interaction, collaborative problem solving, and assertiveness by eliciting opinions and ideas from dyad participants and allowing both children to demonstrate individuality and connectedness with the other (Grotevant & Cooper, 1985). Further, the peer interaction tasks were selected to complement the family interaction tasks completed

within the larger study (Kaugars et al., 2011). The following peer interaction tasks were completed: (a) Toy Ranking (youth ranked toys based on how much they believed that children would enjoy playing with them; 5 min), (b) Unfamiliar Object Task (youth developed a commercial that advertised an ambiguous object; 5 min), (c) Plan an Adventure (youth discussed what the pair would do, where they would go, etc.; 5 min), and (d) Conflict Task (youth discussed previous conflicts with other peers and brainstormed problem-solving ideas that could have been used; 10 min). All but one of the tasks were counterbalanced across dyads. The Conflict Task was always administered last to prevent any resulting negative interactions or affect from influencing behaviors on the other tasks. Although tasks were not adapted for gender or developmental level, flexibility was built into task instructions, thus allowing the tasks to be relevant to youth of different ages and genders.

Observational Coding System

The video-recorded peer interaction tasks were coded using the Child–Peer Interaction Macro-Coding system (Holmbeck, Zebracki, Johnson, Belvedere, & Hommeyer, 2007). This coding system is an adaptation of several previous coding systems (Allen, Porter, & McFarland, 2002; Buhrmester, Camparo, Christiansen, Gonsalez, & Hinshaw, 1992; Holmbeck, Belvedere, Gorey-Ferguson, & Schneider, 1995; Johnson & Holmbeck, 1999; Smetana, Yau, Restreppo, & Braeges, 1991). A recent study established strong psychometric properties (i.e., interrater reliability, internal consistency, and construct validity) for a set of rationally derived scales composed of selected individual and dyadic items from the coding system (Holbein et al., in press). The coding system is composed of 37 codes in total, with 26 codes used to rate the target child and the peer separately and 11 codes applied to the dyad as a whole. The present study examined the 26 individual codes to allow for comparisons between target children and their peers. Codes were classified in the coding system's manual into the following categories: interaction style (12 individual codes; 2 dyadic codes), conflict (3 individual codes, 2 dyadic codes), affect (8 individual codes), control (2 individual codes), collaborative problem solving (1 individual code), and summary of child–peer dyad measures (7 dyadic codes).

Each coder viewed the entire peer interaction task before rating the target child and the peer on the 37 codes. For all codes, a 5-point Likert scale with detailed descriptive anchors was used by coders. For example, for the item assessing ''Dominance,'' coders evaluated each child in the dyad for how much he or she has control over the interaction, considering how much time each child spent talking and directing the conversation (5 = *very often*, 4 = *frequently*, 3 = *sometimes*, 2 = *rarely*, 1 = *not at all*). Each coder spent approximately 20–30 min coding each dyad.

Both undergraduate and graduate research assistants were trained for approximately 10 hr before coding the videos. Training consisted of discussions of individual item codes, reviewing coding of peer interactions by an expert coder, and practicing coding on a standard set of recorded interactions. Coders were required to achieve a 90% agreement rate on practice items before they were authorized to code study videos (i.e., ''agreement'' = concordance across coders within one point on the Likert scale). Overall, the pool of coders for the present study included 13 White females and 1 ethnic minority female.

For each of the four interaction tasks, behaviors and characteristics were rated by two coders, and item-level means across coders for each task were averaged across the tasks to produce a single score for each target child and peer separately (for codes assessing individual constructs) or for each pair (for codes assessing dyadic constructs). As the aim of the study was to examine differences between children with SB and their peers, only the individual codes, rather than the dyadic codes, were examined in these analyses.

Measures

Demographics

Parents reported on child and family demographic information through questionnaires. Parents reported on child age, gender, and race/ethnicity as well as SB health characteristics (e.g., shunt status, lesion level).

Neuropsychological Measures

For all neuropsychological measures, raw scores were converted to age-normed standardized scores based on norms in each measure's manual (see Table II).

Social Language

Three subtests from the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999) were administered to assess the participant's ability to understand and use language within a social context. The Nonliteral Language subtest captures recognition of figurative language, sarcasm, and indirect requests. The Inference subtest requires the individual to use contextual information to demonstrate understanding of a given scenario. Finally, the Pragmatic Judgment subtest measures the individual's ability to determine appropriate language for various everyday social interactions.

Table II. *Descriptive Statistics for Neuropsychological Measures*

	Type	*M*	*SD*	Scale α	Correlation range *r*
Social language				.94	.83–.86
CASL—Nonliteral Language	Standard	96.53	18.64		
CASL—Inference	Standard	88.18	20.36		
CASL—Pragmatic Judgment	Standard	89.63	18.72		
Emotion recognition				.72	.45–.50
DANVA2—Child Faces	Standard	91.33	21.10		
DANVA2—Child Paralanguage	Standard	89.50	14.81		
DANVA2—Child Postures	Standard	91.19	15.36		
Basic language				N/A	N/A
WASI—Vocabulary	T-Score	44.27	14.50		
Attention				.73	.22–.65
TEA-Ch—Sky Search	Scale	6.16	3.40		
TEA-Ch—Score!	Scale	8.03	3.58		
TEA-Ch—Sky Search DT	Scale	6.67	4.47		
TEA-Ch—Score! DT	Scale	7.75	3.43		
CAS—Number Detection	Scale	6.60	3.21		

Notes. CAS = Cognitive Assessment System; CASL = Comprehensive Assessment of Spoken Language; DANVA2 = Diagnostic Analysis of Nonverbal Accuracy—2nd Edition; TEA-Ch = Test of Everyday Attention—Children; WASI = Wechsler Abbreviated Scale of Intelligence.

Basic Language

The 42-item Vocabulary subtest of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was administered as a measure of general lexical knowledge. This subtest has demonstrated high levels of internal consistency for youth 6–16 years old (α = .89; Wechsler, 1999).

Emotion Recognition

Emotion recognition was measured by three subtests of the Diagnostic Analysis of Nonverbal Accuracy—Second Edition (DANVA2; Nowicki, 2003). The participant must decide how the person is feeling based on facial expressions, tone of voice, and body language (without facial expressions) for the Child Faces, Child Paralanguage, and Child Postures subtests, respectively. For each subtest, the participant chooses between the following emotions: happy, sad, fearful, and angry. Internal consistency for the individual subtests has ranged from .68 to .81 (Nowicki, 2003).

Attention

Four subtests from the Test of Everyday Attention—Children (TEA-Ch; Manly, Robertson, Anderson, & Nimmo-Smith, 1999) were administered. The Sky Search subtest assesses visual selective attention. The primary attention score indicates how well the child was able to identify visual target stimuli amid distracting visual information while controlling for motor control (number of correct responses and time per response were not included in analyses). The Score! subtest captures sustained audio attention. The Sky Search Dual-Task (DT) subtest measures an individual's ability to simultaneously perform a visual selective attention task and an audio attention task. Finally, the Score! DT subtest requires the child to perform simultaneous audio attention tasks. Both DT subtests measure sustained and divided attention.

The Number Detection subtest from the Cognitive Assessment System (CAS; Naglieri & Das, 1997) was also administered as a measure of focused attention. Youth must attend to given stimulus items while ignoring distractor stimuli under the pressure of time.

Data Analysis

To investigate the first hypothesis that youth with SB would exhibit less adaptive social characteristics than their peers across three main social domains (see below), three within-subjects multiple analyses of variance (MANOVAs) were conducted, with the observational codes entered as dependent variables and group status (i.e., SB vs. peer) entered as the within-subject variable. The individual observational codes from the five categories of the observational coding system (interaction style, affect, conflict, control, and collaborative problem solving) were included in the analyses. Of note, the latter three categories (conflict, control, and collaborative problem solving) contained four reliable individual items altogether; other items in these categories assessed the dyad as a whole. As all four items (i.e., dominance, pressures other to agree, promotes

dialogue/collaboration, and tolerates disagreements/differences) reflected agreeableness and cooperativeness (with some being reverse-scored), they were combined to form a ''collaboration'' domain. The interaction style and affect categories remained intact from the original coding system. Overall, three items were dropped due to insufficient interrater reliability (see more details below). The final MANOVA analyses were conducted according to the following domains: (1) interaction style (11 items); (2) affect (8 items); and (3) collaboration (4 items). Exploratory MANOVAs with either gender match of the dyad (i.e., both female, both male, male–female) or race match (i.e., both White, both racial minorities, White–racial minority) entered as between-subjects variables were also run to investigate potential interactions between gender (or race) and group (youth with SB vs. peers) as well as main effects of gender (or race).

To investigate hypothesized associations between neuropsychological functioning and observed social characteristics, linear stepwise regressions were conducted with the observational items found to differ between the child with SB and his/her peer entered as dependent variables and indices of neuropsychological abilities entered as independent variables. Composites of neuropsychological abilities were created to reduce the number of analyses by combining related neuropsychological measures (see Table II). Neuropsychological measures were averaged when Cronbach's α values for each construct were $\geq .70$. All observational and neuropsychological variables included in the regression analyses were exclusively based on data from youth with SB; peer data were not included in the regressions.

Results

Preliminary Analyses

Interrater Reliability

Intraclass correlations (ICCs) were computed to determine the interrater reliability of each individual observational item separately for children with SB and their peers. Before computing ICCs, the observational items were averaged across all four interaction tasks (i.e., Toy Ranking, Unfamiliar Object, Adventure, Conflict) for each of two coders. The following criteria for ICC values were used: $\leq .40 =$ *good to fair*; .41–.60 = *moderate*; .61–.80 = *good*; .81–1.00 = *excellent* agreement (Landis & Koch, 1977). As a conservative approach to interrater reliability, items with ICCs $\geq .50$ were retained; items below that criterion were dropped from further analysis. Of the 26 individual items analyzed in the present study, 23 items met the specified criterion using both SB and peer data. Three items (i.e., child is needy, withdrawal from conflict, attempted resolution of issues) with ICCs below the criterion were dropped from further analysis. The majority (i.e., 43) of ICCs for both SB and peer data that met reliability criteria were in the *good* or *excellent* range; only one and two items were in the *moderate* range for the SB and peer data, respectively. Following establishment of adequate interrater reliability, the total score for each observational item was calculated by averaging together each coder's score for the item across the tasks. In other words, the final item score was based on eight ratings (2 coders × 4 tasks).

Outliers

Outliers for the observational data (i.e., item scores that were not within three standard deviations of the item mean; Tabachnick & Fiddell, 2007) were identified and replaced with values that were one-tenth of a unit higher (or lower) than the last score within three standard deviations. Of the 23 individual codes used to rate children with SB and their peers separately (i.e., 46 codes total), three items had three outliers, 10 items had two outliers, 16 items had one outlier, and 17 items did not have any outliers. Using the same guideline of three standard deviations from the mean, no outliers were found for the neuropsychological data.

Power

Power analyses were conducted using G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) to determine whether the sample size was adequate to detect a medium-to-large effect size. Assuming a medium effect size $f = .25$, power = .95 and $\alpha = .05$, a total sample size of 46 was required for the MANOVA with the *most* DVs (i.e., interaction style: 11 DVs). Using the same parameters, a sample size of 74 was needed for the MANOVA with the fewest dependent variables (DVs; i.e., collaboration: 4 DVs). Based on a large effect size $f = .40$, total sample sizes of 26 and 32 was required for the MANOVAs examining interaction style and collaboration, respectively. Thus, our sample size of 100 was sufficient to detect medium to large effect sizes. Sample sizes were not large enough to detect small effect sizes.

Hypothesis 1: SB–Peer Differences

It was hypothesized that children with SB would demonstrate scores indicating less adaptive functioning in the categories of interaction style, affect, and collaboration. Three within-subjects MANOVAs were conducted to evaluate differences between the children with SB and their peers. See Table III to reference correlations between

Table III. *Bivariate Pearson Correlations (r) Between Observational Items by Domain*

Observational items	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Interaction style											
1. Involvement in the task	**.52****	.77**	.64**	.73**	.72**	.56**	−.73**	.62**	.59**	.51**	.17
2. Clarity of thought/idea expression	.75**	**.56****	.70**	.78**	.71**	.55**	−.58**	.63**	.67**	.51**	.11
3. Confidence stating opinions	.69**	.78**	**.24***	.58**	.49**	.15	−.24*	.26**	.20*	.26*	.36**
4. Provides explanations for positions	.70**	.83**	.71**	**.52****	.72**	.61**	−.66**	.59**	.55**	.49**	.00
5. Requests input	.66**	.73**	.59**	.70**	**.38****	.69**	−.64**	.70**	.57**	.60**	.12
6. Listens	.51**	.43**	.11	.46**	.48**	**.59****	−.66**	.88**	.70**	.61**	−.08
7. Off-task behavior	−.70**	−.50**	−.26**	−.52**	−.40**	−.65**	**.74****	−.64**	−.70**	−.41**	.05
8. Receptive to other's statements	.60**	.58**	.34**	.51**	.53**	.81**	−.58**	**.64****	.67**	.60**	.07
9. Maturity	.63**	.68**	.42**	.61**	.44**	.49**	−.66**	.54**	**.48****	.47**	−.12
10. Eye contact	.38**	.39**	.29**	.40**	.50**	.49**	−.30**	.51**	.39**	**.64****	.07
11. Physical contact	.23*	.10	.32**	.03	.22*	−.19	.15	−.09	−.13	−.02	**.88****
Affect											
1. Positive affect—intensity	**.54****	.90**	−.05	−.08	.55**	.27**	.84**	.01			
2. Positive affect—frequency	.90**	**.65****	−.02	−.04	.60**	.32**	.81**	.03			
3. Negative affect—intensity	−.20*	−.16	**.69****	.96**	−.45**	−.55**	.03	.79**			
4. Negative affect—frequency	−.22*	−.18	.97**	**.67****	−.43**	−.54**	−.02	.76**			
5. Warmth	.69**	.63**	−.42**	−.44**	**.53****	.77**	.40**	−.37**			
6. Supportiveness	.49**	.46**	−.46**	−.48**	.75**	**.59****	.19	−.54**			
7. Humor and laughter	.89**	.85**	−.16	−.18	.56**	.41**	**.79****	.05			
8. Anger	−.10	−.05	.81**	.76**	−.29**	−.42**	−.13	**.65****			
Collaboration											
1. Tolerates differences/disagreement	**.87****	−.17	−.72**	.15							
2. Dominance	−.15	**−.37****	.57**	.69**							
3. Pressures other to agree	−.71**	.55**	**.38****	.21*							
4. Promotes dialogue/collaboration	−.01	.71**	.35**	**.23***							

Notes. *$p < .05$; **$p < .01$; r values in bold across the diagonal represent correlations between the SB and peer data for each item. The r values below the diagonal represent correlations between observational items using SB data only, while those above the diagonal represent correlations using peer data only.

items within each domain and Table IV for the complete multivariate and univariate results.

Interaction Style

Consistent with Hypothesis 1, multivariate results revealed significant differences in interaction style between children with SB and their peers, Wilks' $\Lambda = .74$, $F(11, 89) = 2.83$, $p < .01$. Follow-up univariate analyses revealed that children with SB were less involved in interactions, $F(1, 99) = 5.43$, $p < .05$, spoke with less clarity, $F(1, 99) = 12.82$, $p < .001$, were less confident stating opinions, $F(1, 99) = 8.04$, $p < .01$, offered fewer explanations of their opinions, $F(1, 99) = 7.28$, $p < .01$, exhibited more off-task behavior, $F(1,99) = 6.70$, $p < .05$, and were less mature, $F(1, 99) = 4.68$, $p < .05$.

Affect

Contrary to Hypothesis 1, children with SB were not found to differ significantly from their peers regarding affect, Wilks' $\Lambda = .856$, $F(8, 92) = 1.97$, $p > .05$. Moreover, univariate analyses failed to detect significant differences between children with SB and their peers for any affect-related observational items.

Collaboration

Contrary to Hypothesis 1, MANOVA results were not significant for items in the collaboration domain, Wilks' $\Lambda = .93$, $F(4, 96) = 1.78$, $p > .05$. However, univariate analyses showed that children with SB were less socially dominant, $F(1, 99) = 4.19$, $p < .05$, and less likely to promote dialogue and collaboration, $F(1, 99) = 6.38$, $p < .05$, as compared with their peers.

Exploratory Moderation Analyses

We also sought to examine the influence of the gender or racial match of the dyad on observed social behaviors between the child with SB and his or her peer (see Table V). In the first set of exploratory MANOVAs with planned contrasts, gender was entered as a between-subjects variable with three groups (i.e., dyads were both male, both female, or mixed gender. There were no multivariate gender match × group interaction effects for any of the three

Table IV. *Multivariate and Univariate Analyses of Social Interaction Differences Between Youth With SB and Their Peers*

	Multivariate analyses			Univariate analyses			
	Wilks' Λ	*F*	Cohen's *f*	SB *M (SD)*	Peer *M (SD)*	*F*	*d*
Interaction style	.74	2.83**	.59				
Involvement in the task				3.68 (.48)	3.79 (.47)	5.43*	.23
Clarity of thought/idea expression				3.38 (.64)	3.59 (.55)	12.82**	.37
Confidence stating opinions				3.37 (.56)	3.56 (.50)	8.04**	.29
Provides explanations for positions				2.71 (.56)	2.85 (.51)	7.28**	.27
Requests input				2.84 (.46)	2.92 (.46)	2.29	.16
Listens				3.62 (.39)	3.59 (.45)	0.79	.08
Off-task behavior				2.19 (.54)	2.09 (.53)	6.70*	.26
Receptive to other's statements				3.58 (.48)	3.54 (.48)	0.79	.10
Maturity				3.20 (.50)	3.31 (.46)	4.68*	.22
Eye contact				3.06 (.37)	3.05 (.37)	0.08	.03
Physical contact				1.58 (.46)	1.57 (.43)	0.28	.05
Affect	.85	1.97	.41				
Positive affect—intensity				2.73 (.54)	2.73 (.55)	0.00	.00
Positive affect—frequency				2.81 (.50)	2.76 (.53)	1.42	.12
Negative affect—intensity				1.40 (.34)	1.35 (.31)	2.82	.20
Negative affect—frequency				1.38 (.30)	1.35 (.29)	1.44	.12
Warmth				3.18 (.49)	3.17 (.51)	0.02	.02
Supportiveness				2.88 (.49)	2.93 (.54)	1.60	.11
Humor and laughter				2.52 (.68)	2.48 (.63)	0.78	.09
Anger				1.16 (.26)	1.14 (.23)	1.59	.10
Collaboration	.93	1.78	.27				
Tolerates differences/disagreements				4.42 (.41)	4.44 (.45)	0.44	.09
Dominance				3.12 (.65)	3.33 (.58)	4.19*	.30
Pressures other to agree				1.77 (.45)	1.83 (.49)	1.09	.11
Promotes dialogue/collaboration				2.86 (.62)	3.04 (.55)	6.38*	.25

Notes. *$p < .05$; **$p < .01$.

domains, although there was one multivariate between-subjects effect of gender match on interaction style, $F(22, 174) = 1.69$, $p < .05$. Univariate planned contrasts revealed that female dyads demonstrated significantly greater task involvement, clarity of ideas, and maturity and less off-task behavior than both mixed-gender dyads and male dyads. Further, pairs of females were more likely to provide explanations for ideas, request input, promote collaboration, and exhibit dominant behavior than mixed-gender pairs.

The MANOVAs were then conducted with race entered as a between-subjects variable with three groups (i.e., dyads were both White, both racial minority, or mixed [White and minority]). There was no significant race match × group interaction effects for any of the three domains, although a significant multivariate effect of racial match on interaction style was found, $F(22, 168) = 1.76$, $p < .05$. In general, White dyads were rated higher in task involvement, provision of explanations, requesting input, maturity, social dominance, and promotion of collaboration than mixed-race dyads. Compared with minority dyads, White pairs were also more likely to demonstrate greater task involvement, intensity of positive affect, warmth, and social dominance in their interactions.

Hypothesis 2: Association Between Neuropsychological Abilities and Observed Social Characteristics

Preliminary Analyses

As noted, to reduce the number of analyses while creating robust indicators of neuropsychological function, Cronbach's α values were computed for clusters of neuropsychological measures that assessed similar abilities (see Table II). Initially, two distinct attention variables were created: (1) selective attention, composed of the TEA-Ch Sky Search and Sky Search DT subtests and the CAS Number Detection subtest, and (2) sustained attention, composed of the TEA-Ch Score! And Score DT subtests. However, Cronbach's α values for the two composites were

Table V. *Multivariate and Univariate Effects of Gender and Racial Match on Observed Social Characteristics*

	Gender match of dyad				Racial match of dyad			
	F	Both female *M* (*N* = 47)	Both male *M* (*N* = 35)	Mixed *M* (*N* = 18)	*F*	Both White *M* (*N* = 56)	Both minority *M* (*N* = 24)	Mixed *M* (*N* = 17)
Interaction style	1.69*				1.76*			
Involvement in the task	4.50*	3.85[a,c]	3.66[a]	3.55[c]	–	–	–	–
Clarity of thought/idea expression	4.70*	3.65[a,b]	3.38[a]	3.28[b]	5.56**	3.64[c,d]	3.32[c]	3.27[d]
Provides explanations for positions	4.27*	2.91[c]	2.71	2.57[c]	3.20*	2.87[a]	2.76	2.55[a]
Requests input	4.18*	2.96[c]	2.90[b]	2.66[a,c]	3.29*	2.96[a]	2.83	2.71[a]
Off-task behavior	4.54*	1.99[a,c]	2.28[c]	2.27[b]	–	–	–	–
Maturity	7.40**	3.41[a,c]	3.09[c]	3.16[a]	3.14*	3.35[a]	3.17	3.11[a]
Affect	1.45				1.68			
Positive affect—intensity	–	–	–	–	3.98*	2.86[a]	2.59[a]	2.61
Warmth	–	–	–	–	4.76*	3.29[c]	2.97[c]	3.17
Collaboration	1.26				1.61			
Dominance	3.27*	3.30[a]	3.19	3.07[a]	4.68*	3.31[a,c]	3.09[c]	3.13[a]
Promotes dialogue/collaboration	4.22*	3.08[c]	2.89	2.74[c]	3.53*	3.06[a]	2.87	2.75[a]

[a]*Note*. *$p < .05$; **$p < .01$; [a] and [b] indicate pairs that differ at $p < .05$; [c] and [d] indicate pairs differ at $p < .01$.
Table does not include data for between-subjects effects that were not significant.

both low at .61. Therefore, all five subtests were combined to form an overall attention variable with adequate internal consistency, $\alpha = .73$. Alphas for the social language and emotion recognition domains also exceeded .70. To create these neuropsychological composites (i.e., social language, emotion recognition, and attention), corresponding measures were combined by averaging. The basic language variable included one neuropsychological measure (i.e., WASI Vocabulary subtest). For all indices, higher scores indicated better neuropsychological performance.

Linear Regressions

Stepwise linear regressions were conducted to determine the association between relevant neuropsychological measures and the eight items (i.e., involvement in the task, clarity of thought/idea expression, confidence stating opinions, provides explanations for positions, off-task behavior, maturity, dominance, and promotes dialogue/collaboration) found to be significantly different between children with SB and their peers (see Table VI). For each analysis, the observational item was included as the dependent variable and the four neuropsychological indices were entered as independent variables.

Consistent with Hypothesis 2, social language was significantly associated in the positive direction with five of the six observational items in the interaction style domain. Further, attention was also significantly related to four of the observational interaction style items in the expected positive direction, although it was a weaker predictor than social language (with the exception of the off-task behavior item). Only one item was significantly related to emotion recognition in the negative direction; children with SB with weaker emotion-recognition skills were more likely to provide explanations for their opinions. This was the only regression finding that ran contrary to the hypotheses.

Similarly, social language was the strongest predictor of both items in the collaboration domain. Children with better performance on the social language measures were more likely to promote dialogue and exhibit social dominance. Attention was also positively related to promotion of dialogue and collaboration, although this association was weaker in magnitude than the relation with social language. Neither emotion recognition nor basic language skills were significantly related to either observational collaboration item. In fact, basic language skills were not significantly associated to any of the observational dependent variables.

Discussion

The primary purpose of this study was to examine differences in social characteristics between youth with SB and their peers using observational peer interaction data. It was expected that youth with SB would exhibit less adaptive social behaviors compared with their peers in the domains of interaction style, affect, and collaboration. In support of this hypothesis, the interaction style of children with SB was found to be significantly different than that of their peers, with univariate analyses suggesting that children with SB demonstrated less socially competent behaviors (e.g., less involvement in the activity, more off-task

Table VI. *Stepwise Regression Analyses Examining Associations Between Neuropsychological Measures and Observational Items*

Dependent variable	Independent variable	R^2	β	*F*	F^2
Interaction style					
Involvement in the task	Social language	.28	.53	34.43**	.39
Clarity of thought/idea expression	Social language	.48	.69	80.30**	.92
	Attention	.58	.37	20.58**	1.38
Confidence stating opinions	Social language	.36	.60	48.69**	.56
Provides explanations for opinions	Social language	.36	.60	49.69**	.56
	Attention	.40	.23	5.32*	.67
	Emotion recognition	.44	−.26	5.94*	.79
Off-task behavior	Attention	.07	.26	6.10*	.08
Maturity	Social language	.18	.43	19.51**	.22
	Attention	.23	.24	4.70*	.30
Collaboration					
Dominance	Social language	.32	.56	39.94**	.47
Promotes dialogue/collaboration	Social language	.42	.65	62.05**	.72
	Attention	.47	.26	8.13**	.89

Notes. *$p < .05$; **$p < .01$.
R^2 values reflect variance accounted for by significant variables entered at each step in the model.

behavior). Although overall omnibus differences were not found for the affect or collaboration domains, children with SB were also rated lower in social dominance and promotion of dialogue and collaboration as compared with their peers.

The observed differences in social behaviors between youth with SB and their peers add to the literature examining social characteristics of youth with SB. Similar to previous findings suggesting that youth with SB are more passive, immature, and likely to have friendships with younger children (Blum et al., 1991; Holmbeck et al., 2003), youth in the present investigation exhibited less-mature socially dominant behavior. In fact, many of the social deficits (i.e., less clarity of thought, lower confidence in stating opinions, fewer explanations of one's thoughts, less promotion of dialogue) present in this sample are related to the quality of verbal language usage. These children may have particular difficulty engaging in reciprocal verbal exchanges with their peers owing to established deficits in language processing, conversational skills, and social cognition (Barnes & Dennis, 1998; Dennis et al., 2006), although verbal communication deficits have not been found in all studies of youth with SB (Van Hasselt, Ammerman, Hersen, Reigel, & Rowley, 1991). Given the importance of conversational skills for friendship development and peer acceptance (Burleson, 1994; Hemphill & Siperstein, 1990), the social behavioral problems observed in the present study appear to contribute to the friendship difficulties experienced by youth with SB (Devine et al., 2012; Mueller-Goddefroy et al., 2008).

Children with SB also possessed many social strengths in their interactions with peers. For instance, children with SB and their peers exhibited similar affect, with generally higher levels of positive affect relative to negative affect. Indeed, the ability to regulate one's emotions during a social interaction is adaptive (Lemerise & Arsenio, 2000). Additional behaviors that were equivalent for both children with SB and their peers included eye contact, openness to the other's thoughts, and listening skills. These findings complement research that suggests that youth and young adults with SB are sociable, polite, and cooperative (Barnes & Dennis, 1998; Dennis et al., 2006).

Differences in observed social behaviors between children with SB and their peers did not differ as a function of the gender or racial match of the dyads. However, several interesting between-subjects main effects of gender and race match were found. Although social behaviors were largely consistent regardless of the gender or racial composition of the dyad, pairs that demonstrated the most adaptive social behaviors (e.g., greater clarity of thought, maturity, dominance, warmth) tended to consist of two females or two White youth. Indeed, the developmental literature suggests that females are more socially skilled (Rose & Rudolph, 2006) than males. Mixed-gender interactions have been found to include higher levels of maladaptive behaviors than same-gender interactions (Underwood, Schockner, & Hurley, 2001). Research also suggests that interracial friendships tend to be less stable and lower in quality (Graham, Taylor, & Ho, 2009). Although such differences may be due to cultural and

gender mechanisms, the coders' racial and gender biases also may have contributed to these findings (Wang, Wiley, & Zhou, 2007). Codes assigned to the peer interactions in the present study may reflect a female and White perspective given the characteristics of the coders in this study. The lack of variability in coders' demographics precluded attempts to control for their race and gender in our analyses.

We also investigated neuropsychological predictors of the most salient social behaviors (i.e., those that differed between youth with SB and their peers). For these identified social deficits, it is important to identify predictive factors to inform screening practices and targets for intervention. Overall, children with SB with poorer social language and attention skills tended to exhibit greater social difficulties, such as lower maturity and more difficulties expressing clear ideas. Social language performance emerged as the strongest predictor for seven of the eight observational items, suggesting that children with SB who possess more advanced nuanced language skills in social situations demonstrate more adaptive social behaviors and characteristics, including more engagement in the social interaction, increased clarity of spoken statements, and greater overall maturity. Our results are supported by findings of Landry and colleagues (2013), who found social language to be an important predictor of social problem-solving behaviors in a sample of preschoolers with SB. Of note, basic language skills were not significantly related to observed social behaviors in our study. Thus, it appears that more complex social language skills may be more influential than fundamental language skills in the development of adaptive social behaviors.

Attention was also significantly associated with five of the eight observational social behaviors. Specifically, children with SB who performed better on tasks of focused and divided attention were less likely to engage in off-task behavior and more likely to express their ideas clearly, provide explanations for their opinions, exhibit higher maturity, and promote dialogue and collaboration. The present results using observational data confirm previous research that has demonstrated the link between attention and questionnaire measures of social functioning in this population (Jandasek, 2008; Rose & Holmbeck, 2007). With the exception of one analysis, emotion recognition was not significantly associated with observational items. This may be due in part to the lack of affect-related items investigated as dependent variables in the regression analyses. Alternatively, it is possible that the DANVA2 does not capture specific emotion recognition skills that are required in a dynamic and ever-changing social interaction.

Overall, social language and attention abilities were related to observed social behaviors in our sample of children with SB. In addition to providing support for previous findings, these results provide preliminary evidence for the convergent validity of the observational coding system. Previous research has demonstrated convergent validity using parent-, teacher-, and self-report of social functioning as predictors (Holbein et al., in press). In fact, the moderate correlations found in the Holbein et al. (in press) investigation suggest that the observational coding system captures unique information about social competence relative to questionnaire measures. The present study advances psychometric knowledge about the coding system by linking the observational items with neuropsychological measures relevant to social function in these youth. In the future, it will be essential to evaluate the incremental validity of the observational coding system. This may be accomplished by comparing the predictive validity of the coding system with that of questionnaires for relevant outcomes (Haynes, 2001). Previous research with other coding systems has shown that observational methods can be stronger predictors of long-term outcomes than parent-report questionnaires in studies of children (Patterson & Forgatch, 1995).

The present findings have important implications for clinical practice. Children with SB who present with social difficulties (e.g., lack of close friendships, low social acceptance) at medical and/or mental health clinics can be screened for immaturity, social passivity, and underdeveloped conversational skills. By accurately identifying problematic social behaviors, children can be referred for the most appropriate treatments, such as social skills training interventions (Dirks et al., 2007). Further, existing social skills training interventions may be adapted to specifically target the behaviors identified as weaknesses in the present study. For instance, interventions may focus more on assertiveness and social language skills (e.g., making inferences, pragmatic judgments, understanding sarcasm and nonliteral language) instead of emotion recognition and regulation, listening skills, and tolerance for disagreements. Parents of youth with SB may also assist with addressing social deficits. For example, during conversation with their children, parents can promote their children's confidence in stating opinions, encourage explanation of their thoughts, and provide prompts for paying attention. In addition, given the finding that higher attention scores were linked with more adaptive social characteristics (less off-task behavior, greater clarity of thought, etc.), clinical assessment and treatment of attention difficulties in youth with SB may play a crucial role in addressing social deficits. Behavioral strategies and/or stimulant medications have

been shown to improve social skills in children with attention-deficit/hyperactivity disorder (Hoza, 2007); similar effects may be found for youth with SB. Observational methods may also be used as measures of treatment effectiveness. Repeated observations of the child's social interactions can serve as an indicator of immediate and intermediate effects of interventions aimed at improving children's social competence (Haynes, 2001). A shorter list of codes, perhaps limited to the eight codes found to differ between youth with SB and their peers in the present study, could be studied as a more feasible and cost-effective method for use in clinical settings.

There are several limitations that must be considered when interpreting these findings. First, the comparisons between children with SB and their peers were not independent, as the peers were preexisting friends of the study participants. Thus, selection effects may have influenced the findings. For example, children with SB may have chosen friends with similar social characteristics to their own (Burleson, 1994). It is also possible that peers who develop friendships with children with disabilities have unique qualities (e.g., more accepting, experience with a family member with a disability) compared with their counterparts who do not have friends with disabilities. However, the ecological validity of findings is enhanced because the peer interactions examined here are based on real-world friendships rather than contrived interactions between children in a laboratory setting (Gardner, 2000). Similarly, a second limitation is that children with SB who were not able to recruit a friend to participate were not included in the analyses. Therefore, it is possible that the children with the greatest social deficits may have been excluded. A third limitation is that the observed peer interactions described in this study are only a brief window on the child's typical functioning in a given context. These short contrived interactions cannot account for all social behaviors and characteristics typically exhibited by children with SB or their peers (Gardner, 2000) and may not resemble interactions that occur in everyday life. Therefore, generalizability to other contexts is limited. Fourth, it is possible that the dyads did not behave as they typically would owing to their awareness of the camera's presence, although reactivity effects have shown little influence on the validity of findings (Gardner, 2000). Fifth, the selection of neuropsychological measures was limited due to time constraints during data collection. For example, had more time been available during the initial home visits, administration of additional neuropsychological measures, such as additional CASL subtests, a continuous performance task, and other tests of social cognition (e.g., theory of mind, facial recognition), may have bolstered the validity of the regression analyses.

This study's findings may serve as a catalyst for new research questions. It should be noted that differences in observed social characteristics between children with SB and their peers were relatively small, so conclusions regarding clinical significance are limited. Further research should investigate the clinical significance of the observed social differences identified in this study. Future work is needed to determine characteristics (e.g., personality traits, gender, age, family functioning, condition severity) of youth with SB and/or their peers that predict more adaptive social behaviors in the peer interactions of youth with SB. Moreover, a study using a longitudinal design to investigate long-term outcomes associated with observed social deficits, such as social acceptance or romantic relationship involvement, would provide valuable information about the significance of the present findings. Additional study is required to determine the differences between the peer interactions of children with SB and interactions of dyads of typically developing youth.

In summary, this study aimed to identify differences in social behaviors during observed peer interactions between children with SB and their close friends. Findings revealed that children with SB exhibited characteristics of a less adaptive interaction style (e.g., immature, lower clarity of thought) and lower levels of social dominance and collaboration. However, children with SB and their peers demonstrated similar levels of affect (with the majority of expressed affect being positive), tolerance for another's differences, and eye contact. Neuropsychological measures of social language and attention were significantly associated with observed social behaviors, supporting previous research and providing additional support for the validity of the observational coding system. Findings may inform the adaptation of social-skills interventions for youth with SB and fuel future research endeavors.

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References

Andrade, B. F., Brodeur, D. A., Waschbusch, D. A., Stewart, S. H., & McGee, R. (2009). Selective and

sustained attention as predictors of social problems in children with typical and disordered attention abilities. *Journal of Attention Disorders, 12*, 341–352. doi:10.1177/1087054708320440

Allen, J. P., Porter, M. R., & McFarland, F. C. (2002). *Autonomy-relatedness Coding Manual for Adolescent Peer Dyads*. Unpublished manuscript, University of Virginia.

Bagwell, C. L., Newcomb, A. F., & Bukowski, W. F. (1998). Preadolescent friendship and peer rejection as predictors of adult adjustment. *Child Development, 69*, 140–153.

Barnes, M. A., & Dennis, M. (1998). Discourse after early-onset hydrocephalus: Core deficits in children of average intelligence. *Brain and Language, 61*, 309–334.

Blum, R. W., Resnick, M. D., Nelson, R., & St. Germaine, A. (1991). Family and peer issues among adolescents with spina bifida and cerebral palsy. *Pediatrics, 88*, 280–285.

Bonner, M. J., Hardy, K. K., Willard, V. W., Anthony, K. K., Hood, M., & Gururangan, S. (2008). Social functioning and facial expression recognition in survivors of pediatric brain tumors. *Journal of Pediatric Psychology, 33*, 1142–1152.

Buhrmester, D., Camparo, L. B., Christensen, A., Gonzalez, L., & Hinshaw, S. (1992). Mothers and fathers interacting in dyads and triads with normal and hyperactive sons. *Developmental Psychology, 28*, 500–509.

Bukowski, W. F. (2001). Friendships and the worlds of childhood. *New Directions for Child and Adolescent Development, 91*, 93–105.

Burleson, B. R. (1994). Friendship and similarities in social-cognitive and communication abilities: Social skills bases of interpersonal attraction in childhood. *Personal Relationships, 1*, 371–389.

Carrow-Woolfolk, E. (1999). *Comprehensive assessment of spoken language*. Circle Pines, MN: American Guidance Service.

Centers for Disease Control and Prevention. (2011). *Neural tube defect ascertainment project*.

Dennis, M., Landry, S. H., Barnes, M., & Fletcher, J. M. (2006). A model of neurocognitive function in spina bifida over the life span. *Journal of the International Neuropsychological Society, 12*, 285–296.

Devine, K. A., Gayes, L., Purnell, J., & Holmbeck, G. N. (2012). Friendships of children and adolescents with spina bifida: Social adjustment, social performance, and social skills. *Journal of Pediatric Psychology, 37*, 220–231.

Dirks, M. A., Treat, T. A., & Weersing, V. R. (2007). Integrating theoretical, measurement, and intervention models of youth social competence. *Clinical Psychology Review, 27*, 327–347.

Dishion, T. J., Andrews, D. W., & Crosby, L. (1995). Antisocial boys and their friends in early adolescence: Relationship characteristics, quality, and interactional processes. *Child Development, 66*, 139–151.

Dodge, K. A., Pettit, G. S., McClaskey, C. L., Brown, M. M., & Gottman, J. M. (1986). Social competence in children. *Monographs of the Society for Research in Child Development, 51*(2, Serial No. 213).

Faul, F., Erdfelder, E., Lang, A.G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175–191.

Fletcher, J. M., Brookshire, B. L., Landry, S. H., Bohan, T. P., Davidson, K. C., Francis, D. J., … Morris, R. D. (1996). Attentional skills and executive functions in children with early hydrocephalus. *Developmental Neuropsychology, 12*, 53–76.

Flook, L., Repetti, R. L., & Ullman, J. B. (2005). Classroom social experiences as predictors of academic performance. *Developmental Psychology, 41*, 319–327.

Gardner, F. (2000). Methodological issues in the direct observation of parent-child interaction: Do observational findings reflect the natural behavior of participants? *Clinical Child and Family Psychology Review, 3*, 185–198.

Gifford-Smith, M. E., & Brownell, C. A. (2003). Childhood peer relationships: Social acceptance, friendships, and peer networks. *Journal of School Psychology, 41*, 235–284.

Graham, S., Taylor, A. Z., & Ho, A. Y. (2009). Race and ethnicity in peer relations research. In K. H. Rubin, W. M. Bukowski, & B. Laursen (Eds.), *Handbook of peer interactions, relationships, and groups: Social, emotional, and personality development in context* (pp. 394–413). New York, NY: Guilford Press.

Grotevant, H. D., & Cooper, C. R. (1985). Patterns of interaction in family relationships and the development of identity exploration in adolescence. *Child Development, 56*, 415–428.

Haynes, S. N. (2001). Clinical applications of analogue behavioral observation: Dimensions of psychometric evaluation. *Psychological Assessment, 13*, 73–85.

Hemphill, L., & Siperstein, G. N. (1990). Conversational competence and peer response to mildly retarded children. *Journal of Educational Psychology, 82*, 128–134.

Holbein, C. E., Zebracki, K., & Holmbeck, G. N. (in press). Development and validation of the Peer Interaction Macro-coding System scales (PIMS): A new tool for observational measurement of social competence in youth with spina bifida. *Psychological Assessment*, in press.

Holmbeck, G. N., Belvedere, M., Gorey-Ferguson, L., & Schneider, J. (1995). *Family Macro-coding Manual—March of Dimes triadic version*. Unpublished manual, Loyola University Chicago.

Holmbeck, G. N., Li, S. T., Schurman, J. V., Friedman, D., & Coakley, R. M. (2002). Collecting and managing multisource and multimethod data in studies of pediatric populations. *Journal of Pediatric Psychology, 27*, 5–18.

Holmbeck, G. N., Westhoven, V. C., Phillips, W. S., Bowers, R., Gruse, C., Nikolopoulos, T., . . . Davison, K. (2003). A multimethod, multi-informant, and multidimensional perspective on psychosocial adjustment in preadolescents with spina bifida. *Journal of Consulting and Clinical Psychology, 71*, 782–796.

Holmbeck, G. N., Zebracki, K., Johnson, S. Z., Belvedere, M., & Hommeyer, J. S. (2007). *Child-peer Interaction Macro-coding Manual*. Unpublished manuscript, Loyola University Chicago.

Hoza, B. (2007). Peer functioning in children with ADHD. *Journal of Pediatric Psychology, 32*, 655–663.

Izard, C., Fine, S., Schultz, D., Mostow, A., Ackerman, B., & Youngstrom, E. (2001). Emotion knowledge as a predictor of social behavior and academic competence in children at risk. *Psychological Science, 12*, 18–23.

Jandasek, B. N. (2008). *Predictors of social competence in adolescents with spina bifida* (Doctoral dissertation). Retrieved from ProQuest. (3332352)

Johnson, S. Z., & Holmbeck, G. N. (1999). *Parental overprotectiveness coding manual*. Unpublished manuscript, Loyola University Chicago.

Kaugars, A. S., Zebracki, K., Kichler, J. C., Fitzgerald, C. J., Greenley, R. N., Alemzadeh, R., & Holmbeck, G. N. (2011). Use of the Family Interaction Macro-coding System with families of adolescents: Psychometric properties among pediatric and healthy populations. *Journal of Pediatric Psychology, 36*, 539–551.

Ladd, G. W. (1999). Peer relationships and social competence during early and middle childhood. *Annual Review of Psychology, 50*, 333–359.

Landis, J. R., & Koch, G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*, 159–174.

Landry, S. H., Taylor, H. B., Swank, P. R., Barnes, M., & Juranek, J. (2013). Longitudinal mediators of social problem solving in spina bifida and typical development. *Rehabilitation Psychology, 58*, 196–205.

Lavigne, J. V., & Faier-Routman, J. (1992). Psychological adjustment to pediatric physical disorders: A meta-analytic review. *Journal of Pediatric Psychology, 17*, 133–157.

Lemerise, E. A., & Arsenio, W. F. (2000). An integrated model of emotion processes and cognition in social information processing. *Child Development, 71*, 107–118.

Manly, T., Robertson, I. H., Anderson, V., & Nimmo-Smith, I. (1999). *TEA-Ch: The Test of Everyday Attention for Children*. London: Harcourt Assessment.

Martinez, W., Carter, J. S., & Legato, L. J. (2011). Social competence in children with chronic illness: A meta-analytic review. *Journal of Pediatric Psychology, 36*, 878–890.

Modin, B., Oestberg, V., & Almquist, Y. (2011). Childhood peer status and adult susceptibility to anxiety and depression. A 30-year hospital follow-up. *Journal of Abnormal Child Psychology, 39*, 187–199.

Mueller-Godeffroy, E., Michael, T., Poster, M., Seidel, U., Schwarke, D., & Theyen, U. (2008). Self-reported health-related quality of life in children and adolescents with myelomeningocele. *Developmental Medicine and Child Neurology, 50*, 456–461.

Naglieri, J. A., & Das, J. P. (1997). *Cognitive Assessment System Administration and Scoring Manual*. Itasca, IL: Riverside Publishing.

National Birth Defects Prevention Network. (2013). *Neural Tube Defect Ascertainment Project*. Retrieved from http://www.nbdpn.org

Noll, R. B., & Bukowski, W. B. (2012). Commentary: Social competence in children with chronic illness: The devil is in the details. *Journal of Pediatric Psychology, 37*, 959–966. doi:10.1093/jpepsy/jss058

Nowicki, S. (2003). *A Manual and Reference List for the Diagnostic Analysis of Nonverbal Accuracy (DANVA) Tests*. Atlanta, GA: Unpublished manual, Department of Psychology, Emory University.

Patterson, G. R., & Forgatch, M. S. (1995). Predicting future clinical adjustment from treatment outcome and process variables. *Psychological Assessment, 7*, 275–285.

Pedersen, S., Vitaro, F., Barker, E. D., & Borge, A. I. (2007). The timing of middle-childhood peer rejection and friendship: Linking early behavior to early-adolescent adjustment. *Child Adjustment, 78*, 1037–1051.

Pinquart, M., & Teubert, D. (2012). Academic, physical, and social functioning of children and adolescents with chronic physical illness: A meta-analysis. *Journal of Pediatric Psychology, 37*, 376–389.

Roache, C. R. (2012). *Social cognitive functioning and social competence in children and adolescence with spina bifida and hydrocephalus: Social cognitive neuroscience as a model*. Dissertations, Loyola University Chicago, Paper 314.

Roisman, G. I., Booth-LaForce, C., Cauffman, E., & Spieker, S (2009). The NICHD Early Child Care Research NetworkThe developmental significance of adolescent romantic relationships: Parent and peer predictors of engagement and quality at age 15. *Journal of Youth and Adolescence, 38*, 1294–1303.

Rose, A. J., & Rudolph, K. D. (2006). A review of sex differences in peer relationship processes: Potential trade-offs for the emotional and behavioral development of girls and boys. *Psychological Bulletin, 132*, 98–131.

Rose, B. M., & Holmbeck, G. N. (2007). Attention and executive functions in adolescents with spina bifida. *Journal of Pediatric Psychology, 32*, 983–994.

Rourke, B. P., Ahmad, S. A., Collins, D. W., Hayman-Abello, B. A., Hayman-Abello, S. E., & Warriner, E. M. (2002). Child clinical/pediatric neuropsychology: Some recent advances. *Annual Review of Psychology, 53*, 309–339.

Smetana, J. G., Yau, J., Restrepo, A., & Braeges, J. L. (1991). Adolescent-parent conflict in married and divorced families. *Developmental Psychology, 27*, 1000–1010.

Tabachnick, B. G., & Fidell, L. S. (Eds.), (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn & Bacon.

Underwood, M. K., Schockney, A. E., & Hurley, J. C. (2001). Children's responses to same- and other-gender peers: An experimental investigation with 8-, 10-, and 12-year-olds. *Developmental Psychology, 37*, 362–372.

Vachha, B., & Adams, R. (2003). Language differences in young children with myelomeningocele and shunted hydrocephalus. *Pediatric Neurosurgery, 39*, 184–189.

Van Hasselt, V. B., Ammerman, R. T., Hersen, M., Reigel, D. H., & Rowley, F. L. (1991). Assessment of social skills and problem behaviors in young children with spina bifida. *Behavioral Science, 3*, 69–80.

Wallander, J. L., Feldman, W. S., & Varni, J. W. (1989). Physical status and psychosocial adjustment in children with spina bifida. *Journal of Pediatric Psychology, 14*, 89–102.

Wallander, J. L., & Varni, J. W. (1998). Effects of pediatric chronic physical disorders on child and family adjustment. *The Journal of Child Psychology and Psychiatry, 39*, 29–46.

Wang, Y. Z., Wiley, A. R., & Zhou, X. (2007). The effect of different cultural lenses on reliability and validity in observational data: The example of Chinese immigrant parent-toddler dinner interactions. *Social Development, 16*, 777–799.

Wechsler, D. (1999). *Wechsler abbreviated scales of intelligence (WASI)*. San Antonio, TX: Psychological Corporation.

Yeates, K. O., Bigler, E. D., Dennis, M., Gerhardt, C. A., Rubin, K. H., Stancin, T., . . . Vannatta, K. (2007). Social outcomes in childhood brain disorder: A heuristic integration of social neuroscience and developmental psychology. *Psychological Bulletin, 133*, 535–556.