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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

Christina E. Holbein
Loyola University Chicago

Kathy Zebracki
Shriners Hospitals for Children, Chicago, Illinois, and Loyola University Chicago

Grayson N. Holmbeck
Loyola University Chicago

Many children with chronic health conditions encounter enduring difficulties in their peer interactions and friendships. This study aimed to create and validate scales derived from an observational coding system (i.e., Peer Interaction Macro-Coding System, or PIMS) in a sample of children with spina bifida and their peers. Participants were 106 target child–peer dyads who completed a battery of questionnaires and interviews and were videotaped performing 4 interaction tasks, which were then coded across multiple domains of social functioning. Five scales (i.e., Control, Prosocial Skills, Positive Affect, Conflict, and Dyadic Cohesion) were rationally derived based on a review of the literature and a panel of experts. Internal consistency and interrater reliability at the scale level were good to excellent for all 5 scales. Interscale correlations were in the low-to-moderate range for 4 of the scales, although the Dyadic Cohesion Scale was highly correlated with two other scales and was subsequently dropped. Convergent validity and discriminant validity were established by examining the 4 remaining scales in association with comparable questionnaire and interview data. The 4 PIMS scales appear to be reliable and valid measures of social competence and may enhance future multimethod research efforts aimed at learning more about peer interactions and overall social competence.

Keywords: observational methods, scale development, social competence, spina bifida

Social competence is defined as "effective functioning within social contexts" (Cavell, 1990, p. 111) and comprises social outcomes, social skills, and actual social behavior. In pediatric populations, social competence has become an area of interest, as children with various health conditions have demonstrated difficulties in their peer interactions relative to their healthy peers (Ellerton, Stewart, Richie, & Hirth, 1996). Children with central nervous system conditions may be most at risk. A recent meta-analysis revealed large effect sizes of social competence impairment in children with central nervous system disorders (e.g., spina bifida, epilepsy, and so on); this large effect was greater than effect sizes computed for the other health conditions (e.g., obesity, blood disorders, diabetes, and so on; Martinez, Carter, & Legato, 2011).

Spina bifida (SB) is a central nervous system condition characterized by an incomplete closing of the spinal cord in early gestation that occurs in approximately 3 out of every 10,000 live births (Centers for Disease Control and Prevention [CDC], National Birth Defects Prevention Network, 2010). SB may place children at a particular social disadvantage because it limits mobility, often impairs neurocognitive ability, and results in multiple physical differences that are easily apparent to others (e.g., short stature and unusual gait). Overall, research suggests that youth with SB have more social problems, fewer close friendships, and poorer peer relations than their typically developing peers (Devine, Gayes, Purnell, & Holmbeck, 2012; Ellerton et al., 1996; Holmbeck et al., 2003, 2010; Wallander, Feldman, & Varni, 1989).

On the other hand, social difficulties are not evident in all studies of youth with SB. There were no differences on a measure of social acceptance between young adolescents with SB and their typically developing peers (Coakley, Holmbeck, & Bryant, 2006). Furthermore, emerging adults reported having numbers of friends comparable to the numbers of friends reported by their peers without SB (Zukerman, Devine, & Holmbeck, 2011). Clearly, more research is needed to determine what, if any, social deficits youth with SB face. The development and validation of an observational coding system for videotaped peer interactions (i.e., the Peer Interaction Macro-Coding System [PIMS]; Holmbeck, Zebracki, Johnson, & Belvedere, 2007) are presented in the current study, with the goal that these scales may provide an additional

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Christina E. Holbein, Department of Psychology, Loyola University Chicago; Kathy Zebracki, Shriners Hospitals for Children, Chicago, Illinois, and Department of Psychology, Loyola University Chicago; Grayson N. Holmbeck, Department of Psychology, Loyola University Chicago.

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Correspondence concerning this article should be addressed to Christina E. Holbein, Department of Psychology, Loyola University Chicago, Chicago, IL 60660. E-mail: tina.holbein@gmail.com

perspective on social competence for research focused on youth with chronic health conditions.

The majority of social competence assessments used in pediatric research rely solely on inexpensive, efficient questionnaire data rather than observational methods that require more labor and financial resources (Matson & Wilkins, 2009). Unfortunately, exclusive reliance on questionnaire data, even when collected from multiple informants, introduces the problem of shared method variance (Holmbeck, Li, Schurman, Friedman, & Coakley, 2002; La Greca & Lemanek, 1996). Observational methods introduce both a new method and a new informant (i.e., the trained coder) into the research protocol, thereby greatly reducing the possibility that shared method variance can be an alternative explanation for significant findings (Holmbeck, Li, et al., 2002). In fact, adding a new informant also increases the validity of findings because each informant may provide unique information related to the child's behavioral and emotional functioning (Renk, 2005). Social competence is frequently assessed via child self-report and/or peers' self-reports, but previous studies have demonstrated that children may not always be the most accurate informants of their own social standing and friendships (Gifford-Smith & Brownell, 2003). Parents also tend to exhibit bias when reporting on their children's social functioning (Dodge, Pettit, McClaskey, Brown, & Gottman, 1986) and frequently provide different responses than teachers and children (Colegrove & Huntzinger, 1994; Renk, 2005). Therefore, the objective observer may serve as another key source of information, with potentially less bias than sources that are well acquainted with the child or adolescent (Gardner, 2000). Further, direct observation of the social interactions of children with chronic health conditions may capture unique information not obtained by questionnaire measures (Noll & Bukowski, 2012). Therefore, subtle social deficits that fail to be assessed by questionnaire measures may be more easily detected in observational research. Once identified, specific behaviors and skills can be targeted by interventions aimed at increasing children's social competence.

Despite the advantages of observational research methods, there is a paucity of research employing such methods within the pediatric psychology literature (Holmbeck, Li, et al., 2002), especially in the area of social competence (see Kapp-Simon & McGuire, 1997, and Katz, Leary, Breiger, & Friedman, 2011, for exceptions). Many previous studies utilizing observational data collection methods have relied on frequencies of individual behavioral items instead of psychometrically supported scales (Dirks, Treat, & Weersing, 2007). One exception is Gottman's (1983) Rapid MACRO (R–MACRO) peer interaction coding system, which yields scales related to engagement (Kahen, Katz, & Gottman, 1994) and affect (Katz et al., 2011). However, the R–MACRO system was designed and normed on young, typically developing children with an age range of approximately 3–9 years (Gottman, 1983).

A derivative of the R–MACRO system, the Peer Problem-Solving Interaction Communication Affect Rating coding system (PPS–I CARE; Webster-Stratton, Hollinsworth, & Rogers, 1991) was created specifically for children with conduct problems. Its use has focused on two general constructs, negative conflict tactics and positive social skills, both of which have demonstrated adequate discriminant validity (Webster-Stratton & Lindsay-Woolley, 1999). The exclusive use of this measure with children who have conduct problems indicates that it may have limited utility in youth with SB, a population that tends to demonstrate lower levels of conduct disorder than typically developing youth (Ammerman et al., 1998). Thus, a coding system that comprehensively assesses multiple facets of social competence and that takes into account both verbal and nonverbal behaviors is needed to provide better understanding of social competence in pediatric populations.

In the present study, we aimed to create and validate a set of second-order observational peer interaction scales in a sample of youth with SB and their peers. In pursuit of this goal, we first reviewed the literature and identified five distinct constructs (i.e., conflict, prosocial skills, positive affect, conflict, and dyadic cohesion) common to multiple models of social competence. Based on these constructs, we developed five rationally derived scales, which were expected to have adequate interrater and scale reliabilities and to be minimally-to-moderately correlated with each other. Once the scales were deemed reliable, it was anticipated that each of the proposed PIMS scales would be most strongly correlated with cross-method measures of corresponding constructs and less related to measures of less similar constructs (i.e., convergent and discriminant validity; Campbell & Fiske, 1959; see Table 1 for hypothesized relations).

Method

Participants

Participants were recruited to take part in a longitudinal study investigating neurocognitive, family, and social functioning in children with SB (e.g., Devine et al., 2012). Observational data were gathered during peer interactions at Time 1; this study also focused on questionnaire data related to social functioning and friendships. Families of children with SB were recruited from four local hospitals and a statewide SB association in the Midwest. Inclusion criteria were (a) a diagnosis of SB (myelomeningocele [MM], lipomeningocele, or myelocystocele); (b) age between 8 and 15 at Time 1; (c) ability to speak and read English or Spanish; (d) involvement of at least one primary caregiver; and (e) residence within 300 miles of the research lab to allow for data collection in 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, resulting in a sample size of 140 families (57% participation rate). SB characteristics were not significantly different between families who participated and those who did not on the following medical variables: type of SB (i.e., MM vs. other), $\chi^2(1) = .0002$, $p > .05$; shunt status, $\chi^2(1) = .003$, $p > .05$; and occurrence of shunt infections, $\chi^2(1) = 1.08$, $p > .05$.

Each family was asked to invite a friend of the child with SB to participate. Families were strongly encouraged to invite friends who were not related to the target child and who were within 2 years of the target child's age (age range = 6–17 years). One hundred twenty-one families provided a peer within the specified age range. Fifteen peers were related to the child with SB (e.g., cousins, siblings) and were removed from analyses. Thus, 106 children with SB (76% of the entire sample) and their friends were included in the analyses. Please see Table 2 for condition-specific characteristics of the sample. The mean age of youth with SB

Table 1
PIMS Scales and Corresponding Questionnaire and Interview Measures: Hypothesized Associations

Questionnaire/item	Reporter	α	PIMS scale hypothesized to be associated with questionnaire
Adaptive Behavior Assessment System–2nd ed. (Harrison & Oakland, 2003)			
Social Functioning Scale	M, F	.89, .90	Prosocial Skills
Child Behavior Checklist & Teacher Report Form (both measures: Achenbach & Rescorla, 2001)			
Internalizing Problems (Inverse)	M, F, T	.89, .86, .87	Positive Affect
Externalizing Problems (Inverse)	M, F, T	.89, .88, .92	Positive Affect
Social Problems (Inverse)	M, F, T	.71, .75, .72	Prosocial Skills
Children's Depression Inventory (Kovacs, 1992) (Inverse)	C	.78	Positive Affect
Children's Self-Efficacy for Peer Interaction Scale (Wheeler & Ladd, 1982)	C	.82	Prosocial Skills
Family Environment Scale (Moos & Moos, 1994)			
Conflict Scale	M, F	.68, .78	Conflict
Cohesion Scale	M, F	.63, .68	Dyadic Cohesion
Friendship Activity Questionnaire (Bukowski et al., 1994)			
Closeness Scale	C	.81	Dyadic Cohesion
Companionship Scale	C	.63	Dyadic Cohesion
Conflict Scale	C	.79	Conflict
Self-Perception Profile for Children (Harter, 1985)			
Self-Acceptance Scale	M, F, T, C	.78, .86, .69, .52[a]	Dyadic Cohesion
Social Skills Rating System (Gresham & Elliot, 1990)			
Assertion Scale	M, F, T	.80, .76, .88	Control
Cooperation Scale	M, F, T	.82, .81, .90	Prosocial Skills
Self-Control Scale	M, F, T	.80, .84, .85	Prosocial Skills
Friendship interview			
Making friends easily (Item)	M, F, C	N/A	Prosocial Skills
Time spent with friends (Item)	C	N/A	Dyadic Cohesion
Teasing others (Item)	C	N/A	Conflict
Friendship questionnaire			
Who suggests plans with a friend (Item)	M, F, C	N/A	Control
Who chooses activities (Item)	M, F, C	N/A	Control
Friendship closeness: 1–10 (Item)	C	N/A	Dyadic Cohesion

Note. PIMS = Peer Interaction Macro-Coding System; Inverse = expected inverse relationship; M = mother; F = father; C = child (with spina bifida); T = teacher.
[a] Child report of the measure was dropped due to low internal consistency.

was 11.19 years (*SD* = 2.40), and 55.7% were female. Of these children, 60.4% identified as White, 22.6% were Hispanic, 12.3% were African American, and 4.7% identified as an "other" race. The average Hollingshead Four-Factor Index (Hollingshead, 1975) for the sample was approximately 41.1 (*SD* = 15.8), suggesting a generally middle-class sample with some variability.

Table 2
Condition-Specific Characteristics of Youth With Spina Bifida

	Percentage (%)	*M (SD)*	*N*
Type of SB			
Myelomeningocele	84.0		89
Lipomeningocele	9.4		10
Myelocystocele	3.8		4
Unknown	2.8		3
Lesion level			
Sacral	19.8		21
Lumbar	62.3		66
Thoracic	12.3		13
Unknown	5.7		6
Shunt status (present)	73.6		78
No. of shunt revisions		2.62 (3.36)	
No. of nonshunt surgeries		3.04 (1.98)	
FSIQ		88.41 (19.80)	

Note. Demographic data is based on sample of 106 youth with spina bifida (SB) who had peers participate in the study. FSIQ = full scale intelligence quotient from the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999).

The mean age of the peers was 10.98 years (*SD* = 2.75), and 55.7% were female. Regarding racial background, 64.2% were White, 17.9% were Hispanic, 8.5% were African American, and 6.6% reported they belonged to an "other" racial background. Socioeconomic data were not available for families of peers.

Procedures

At Time 1, data were collected during two 3-hr home visits by trained undergraduate and graduate research assistants. During the first home visit, children with SB and their parent(s) or other caregivers completed a battery of questionnaires and engaged in videotaped family interaction tasks. Neuropsychological testing assessing cognitive functioning of the target child was also performed. At the second home visit, the target child and his or her friend each completed questionnaires and audiotaped interviews about general friendship characteristics, specific characteristics related to their friendship with each other, and their problem-solving approaches in social situations. The children with SB and their friends also engaged in structured interaction tasks that were videotaped. Data related to these interaction tasks were used to derive the observational scales described in this study.

Observational Assessment of Peer Interactions

Target children and their friends completed four interaction tasks. All but one of the tasks were counterbalanced across dyads. Tasks included (a) toy ranking (the dyad was asked to rank toys based on how much the dyad enjoyed playing with them; 5 min), (b) unfamiliar object task (develop a commercial advertising an ambiguous object; 5 min), (c) plan an adventure (discuss what the pair would do, where they would go, and so on; 5 min), and (d) conflict task (discuss previous peer conflicts and brainstorm other problem-solving ideas that could have been used; 10 min; this task was always presented last). Tasks were selected to fulfill the larger longitudinal study's goals of studying independence and the development of autonomy, both of which are key aspects of psychosocial development in this population. Therefore, tasks emphasized social engagement, collaborative problem solving, and assertiveness by eliciting opinions and ideas from both members of the dyad and allowing for displays of individuality and connectedness (Grotevant & Cooper, 1985). In addition, the larger study included family interaction tasks similar to the peer interaction tasks (Kaugars et al., 2011).

Coding of Observational Data

The PIMS is an adaptation of several previous coding systems (Holmbeck, Belvedere, Gorey-Ferguson, & Schneider, 1995; Johnson & Holmbeck, 1999; Smetana, Yau, Restreppo, & Braeges, 1991) and draws upon codes used in other systems (Allen, Hauser, Bell, McElhaney, & Tate, 1998; Allen, Porter, & McFarland, 2002; Buhrmester, Camparo, Christiansen, Gonsalez, & Hinshaw, 1992; Julien, Markman, Lindahl, Johnson, & Van Widenfelt, 1987; Levy, 1943; Paikoff, 1992). Coders were undergraduate and graduate student research assistants who viewed an entire peer interaction task before rating the target child and peer on 37 items. For all codes, a 5-point Likert scale was used with descriptive anchors specific to each code. For example, the item "eye contact" featured the following response options: 1 (*not at all*), 2 (*rarely*), 3 (*sometimes*), 4 (*frequently*), and 5 (*very often*). Anchors varied across items as appropriate.

Coders were trained for 10 hr before coding the videotapes. They were required to achieve a 90% agreement rate on practice items before they were authorized to code study videotapes (i.e., "agreement" = concordance across coders within 1 point on the Likert scale). For each of the four interaction tasks, behaviors 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 friend separately (for codes assessing individual constructs) or for each pair (for codes assessing dyadic constructs).

Scale Constructs

For this study, constructs that have received considerable attention within the social competence literature were chosen a priori to reflect a range of relevant behaviors that are commonly observed in peer interactions. Multiple models of social competence and development (Cavell, 1990; Dodge et al., 1986; Halberstadt, Denham, & Dunsmore, 2001; Hawley, 1999; Rose-Krasnor, 1997) were consulted for relevant constructs. Constructs were also identified based on their inclusion in well-known measures of social competence (Bukowski, Hoza, & Bolvin, 1994; Parker & Asher, 1993) and previous studies of social functioning. Finally, as the PIMS scales were intended to complement a set of family interaction scales (i.e., Family Interaction Macro-Coding System, or FIMS; Kaugars et al., 2011), continuity of constructs across both sets of observational scales was considered.

Individual constructs. Based on the review of the literature, three constructs emerged that reflect distinct characteristics of each child in the dyadic relationship. *Control* refers to the child's ability to attract the friend's attention and achieve submission to gain desired resources or increased self-esteem (Adams, Bartlett, & Bukowski, 2010; Gifford-Smith & Brownell, 2003). *Prosocial skills* refer to specific behaviors and/or characteristics associated with various positive social outcomes, such as peer acceptance and sociometric status (Caldarella & Merrell, 1997). Examples of prosocial skills include decision-making skills (McFall, 1982), empathy (Caldarella & Merrell, 1997), self-control (Bierman, 2004), overt age-appropriate verbal behaviors (i.e., emotion expression, asking questions, etc.), and overt prosocial nonverbal behaviors (i.e., eye contact, gestures, and so on; Cavell, 1990). *Positive affect* refers to the expression of the child's affect that facilitates positive and appropriate social interactions with others (Halberstadt et al., 2001). The child may smile, laugh, and joke with more frequency than a child who engages in more negative expressions, such as frowning, crying, or flat affect.

Dyadic constructs. In addition to constructs applied to each individual within the social interaction, models of social competence included constructs that tap characteristics of the overall dyad. One such dyadic construct is *conflict*, or the extent to which the interaction is characterized by argument, disagreement, mutual annoyance, and mistrust (Bukowski et al., 1994; Parker & Asher, 1993). *Dyadic cohesion* is defined as the degree of affiliation displayed by the peer dyads (e.g., caring, support, and interest; Bukowski et al., 1994; Parker & Asher, 1993). Cohesion has long been a key component of studies of family functioning and has been employed in observational family research (Holmbeck, Coakley, Hommeyer, Shapera, & Westhoven, 2002; Kaugars et al., 2011) but has been examined less frequently in studies of youth's close friendships.

Measures

Convergent and discriminant validity questionnaire measures. All questionnaire measures used in the convergent and discriminant validity analyses are listed in Table 1, including citations and reliabilities based on data from the present study.

Convergent and discriminant validity interview measures. Interview measures of friendship and peer relationships were developed for the larger longitudinal study. The Friendship Interview assessed the quality, quantity, and various characteristics of the child's general social relationships and friendships. For this study, the following items were analyzed: "Not counting school, on how many days over the past week (the last 7 days) did you spend time with a friend or friends?" and "How often are you mean to other kids or tease them: *all the time*, *some of the time*, *once in a while*, or *never*?" (both measures child report only). Both children and their parents also answered the following item: "Do you find it

easy to make new friends: *very easy, somewhat easy, somewhat difficult, very difficult?*"

The Friendship Questionnaire assesses various characteristics of the specific friendship between the target child and friend. This study used the following items: "How close are you to [name of friend]: 1–10," "Who usually comes up with the idea to spend time together: me, my friend, we take turns, other (e.g., parent)," and "Who usually chooses which activities you do together: me, my friend, we decide together, other (e.g., parent)." Parents were asked similar questions about who initiates and plans their child's social activities, with choices of "my child, me or my spouse, my child's friend, or the friend's parent." Internal consistency statistics were not available for these measures because single items were used.

Data Analysis

For the PIMS, interrater reliability at the scale level was determined for both children with SB and their peers. Intraclass correlations (ICCs) were computed to yield reliability coefficients for each scale. The following criteria for ICC values were used: ≤.40 *poor to fair*; .41–.60 *moderate*; .61–.80 *good*; .81–1.00 *excellent* agreement (Landis & Koch, 1977). Internal consistency for each PIMS scale was ascertained by computing Cronbach's alpha reliability coefficients for both children with SB and their peers. Mean scores across the two coders for each item were used. Coefficient alphas of .70 or higher indicated adequate internal consistency within each scale. Correlations between all five PIMS scales were also computed to further establish the validity of each of the scales. Large interscale correlation coefficients would indicate redundancy across scales (Clark & Watson, 1995).

To evaluate the convergent validity of the PIMS Control subscale and provide support for discriminant validity, we conducted one-way analyses of variance (ANOVAs), with the PIMS scales entered as dependent variables and the discrete interview/questionnaire items entered as independent variables. Significant findings for analyses with the PIMS Control subscale as the dependent variables would provide evidence for convergent validity for that subscale, while nonsignificant analyses for all other analyses would support the discriminant validity of the PIMS scales.

For continuous measures, we examined convergent validity and discriminant validity by conducting bivariate Pearson correlations between each PIMS subscale and the scales and/or items selected from questionnaires or interviews due to their assumed similarity with the PIMS constructs (see Table 1). Evidence of convergent validity would be indicated by strong correlations between each PIMS subscale and measures of the same or very similar constructs; discriminant validity would be supported by weaker correlations between each PIMS subscale and measures of less similar constructs compared with those demonstrated in the convergent validity analyses (e.g., PIMS Prosocial Skills subscale would be expected to correlate more strongly with other measures of social skills than with measures of control, conflict, dyadic cohesion, and positive affect; Campbell & Fiske, 1959; Haynes, 2001). Both statistical significance (i.e., p values less than .05) and the magnitude of the resulting correlation coefficients were considered when interpreting effects. The guidelines proposed by Cohen (1992) were used to assess the magnitude of the associations between the observational scores and their corresponding questionnaire and interview measures, such that $r = .10$ indicates a small effect, $r = .30$ indicates a medium effect, and $r = .50$ and above indicates a large effect. All convergent and discriminant analyses were restricted to data from children with SB, as peers did not have data collected from parents or teachers.

Results

Content Sampling and Item Retention

Prior to the development of the PIMS scales, content validity was established in accordance with previous recommendations (Haynes, 2001; Holmbeck & Devine, 2009). First, the literature was reviewed as described earlier to determine key constructs of social competence (i.e., control, positive affect, prosocial skills, dyadic conflict, and dyadic cohesion) that would be used to define each scale. Based on these constructs, 26 relevant PIMS items were selected from the larger pool of 37 items based on their fit with the definitions of the scale constructs (15 "individual" items, 11 "dyadic items). Assignment of PIMS items to the five scales occurred in two rounds. Thirteen expert coders from our research team classified the subset of 15 *individual* PIMS items into the following categories: control, prosocial skills, and positive affect. Using a criterion of 75% agreement, they retained 14 items (two Control items, six Prosocial Skills items, six Positive Affect items) and one was dropped ("Requests input from individual"). Twelve experts classified the subset of 11 *dyadic* PIMS items into the following categories: conflict and dyadic cohesion. Ten items were retained (five Conflict items and five Dyadic Cohesion items) and one was dropped ("Positive escalation"). Items were allowed to be reverse-coded to best fit the chosen scale. The complete item composition of the initial PIMS scales is available in Table 3.

Interrater Reliability

Prior to computing interrater reliability coefficients, items were collapsed across all four tasks (i.e., rank toys, make a commercial, plan an adventure, and peer conflict) for each rater. Separate reliabilities were then calculated at the scale level for target and peer data using ICCs. Notably, three of the five items in both the Conflict and Dyadic Cohesion scales were coded at the dyadic level rather than the individual level. Because each of these scales also contained two individual-level items, separate reliabilities were calculated for the children with SB and their peers. In other words, when comparing reliabilities between children with SB and their peers for the Conflict and Dyadic Cohesion scales, ICCs were artificially similar due to overlapping data (i.e., the same dyadic score was used for the child with SB and the peer). Utilizing data from either target or peer data, four of the five PIMS scales demonstrated excellent interrater agreement: Control (SB target data: ICC = .84, 95% confidence interval [CI] [.76, .89]; peer data: ICC = .83, 95% CI [.74, .88]); Prosocial Skills (SB target: ICC = .86, 95% CI [.80, .91]; peer: ICC = .86, 95% CI [.79, .91]), Positive Affect (SB target: ICC = .87, 95% CI [.80, .91]; peer: ICC = .84, 95% CI [.77, .89]), and Dyadic Cohesion (SB target: ICC = .87, 95% CI [.80, .91]; peer: ICC = .85, 95% CI [.78, .90]). Interrater reliability for the Conflict scale was good (SB target: ICC = .75, 95% CI [.63, .83]; peer: ICC = .77, 95% CI [.66, .84]).

Internal Consistency

Items were collapsed across all raters and all tasks to form means. Again, analyses were conducted for target and peer data separately, and similarities in coefficient values between children with SB and peers for the Conflict and Dyadic Cohesion scales must be interpreted with caution due to overlapping dyadic data. Alpha coefficients were adequate for four of the five PIMS scales: Prosocial Skills (SB target: $\alpha = .84$; peer: $\alpha = .86$), Positive Affect (SB target: $\alpha = .81$; peer: $\alpha = .75$), Conflict (SB target: $\alpha = .86$; peer: $\alpha = .89$), and Dyadic Cohesion (SB target: $\alpha = .92$; peer: $\alpha = .91$). Peer data for the Control Scale yielded adequate internal consistency ($\alpha = .73$). The reliability coefficient using data from the child with SB ($\alpha = .69$) was lower. On the other hand, this scale was retained for youth with SB because of its close approximation to the stated criterion of .70. Previous measures of observational family functioning in pediatric populations have deemed similar reliability coefficients to be acceptable (Kaugars et al., 2011).

Interscale Correlations

Bivariate Pearson correlations among all five PIMS scales were computed to demonstrate the distinctness of each scale. With the exception of two correlations, absolute values of correlation coefficients ranged from .14 to .55 using data from children with SB and from .18 to .61 using data from peers (see Table 4). Although the majority of these correlations were significant at the .01 level, it should be noted that significant correlations are common among observational scales (Kaugars et al., 2011). The Dyadic Cohesion scale correlated particularly strongly with the Prosocial Skills and Positive Affect scales (target data: $r = .86$ and $r = .73$, respectively; peer data: $r = .84$ and $r = .69$, respectively), suggesting the Dyadic Cohesion scale may be measuring a construct that is somewhat indistinct from prosocial skills and positive affect.

To further explore the high correlations among the Dyadic Cohesion, Prosocial Skills, and Positive Affect scales, we calculated bivariate Pearson correlations between all items from the corresponding scales using data from the child with SB. Multiple high correlations of items from the Prosocial Skills and Positive Affect scales with the Dyadic Cohesion scale (i.e., $r \geq .70$) indicated that the latter scale may be more of a general summary scale measuring aspects of social skills and affect. As a result of this measurement overlap, the Dyadic Cohesion scale was dropped from subsequent analyses.

Table 3
Final Composition of PIMS Scale Items Based on Rational Scale Development

PIMS Scale	Items
Control	Dominance
Child with SB ($\alpha = .69$)	Pressures other to agree
Peer ($\alpha = .73$)	
Prosocial Skills	Confidence in stating opinions
Child with SB ($\alpha = .84$)	Eye contact
Peer ($\alpha = .86$)	Listens to others
	Shows maturity
	Promotes dialogue and collaboration
	Receptive to statements made by other
Positive Affect	Anger[a]
Child with SB ($\alpha = .81$)	Humor and laughter
Peer ($\alpha = .75$)	Intensity of negative affect[a]
	Frequency of negative affect[a]
	Intensity of positive affect
	Frequency of positive affect
Conflict	Able to reach an agreement/resolution[a]
Child with SB ($\alpha = .86$)	Attempted resolution of issues[a]
Peer ($\alpha = .89$)	Level of conflict within dyad
	Negative escalation
	Tolerates differences and disagreements[a]
Dyadic Cohesion	Mutuality
Child with SB ($\alpha = .92$)	Supportiveness
Peer ($\alpha = .91$)	Warmth
	General atmosphere: isolated, apathetic[a]
	General atmosphere: openness, comfortableness, warmth

Note. SB = spina bifida; PIMS = Peer Interaction Macro-Coding System.
[a] Items were reverse-coded.

Table 4
Bivariate Correlations Among All Five PIMS Scales

Scale	Control	Prosocial Skills	Positive Affect	Conflict	Dyadic Cohesion
Control	—	.32**	.19*	.24*	.18
Prosocial Skills	.36**	—	.53**	−.61**	.84**
Positive Affect	.14	.54**	—	−.43**	.69**
Conflict	.22*	−.51**	−.49**	—	−.58**
Dyadic Cohesion	.25*	.86**	.73**	−.55**	—

Note. $N = 104$. Correlation coefficients using target data are represented in the bottom left of correlation matrix, and correlation coefficients using peer data are represented in the upper right. PIMS = Peer Interaction Macro-Coding System.
* $p < .05$. ** $p < .01$.

Convergent Validity

Data reduction methods were utilized to minimize Type I error rates. Mother, father, and teacher versions of similar questionnaires that were correlated at or above .40 were averaged to form aggregate measures of the respective construct. All mother and father reports on measures of continuous scales met the given criterion and were averaged to form composite parent reports. Teacher reports did not correlate significantly on comparable measures with either individual mother and father reports or combined parent reports.

Several items expected to converge with the Control scale were measured on an ordinal scale, thereby requiring alternative data reduction methods. First, items were recoded such that higher scores indicated more control. Chi-square analyses were conducted to assess the similarity between mother and father reports on similar measures. A significant chi-square analysis showed that mothers and fathers provided significantly different responses to the ordinal items. As all analyses were significant at $p < .01$, mother and father reports were not averaged.

It was hypothesized that the four PIMS scales from the SB sample would be positively related to paper-and-pencil measures assessing similar components of social competence (see Table 1). One-way ANOVA F values (for discrete measures), bivariate correlation coefficients (for continuous measures), and p values are

Table 5
Convergent and Discriminant Validity: F Statistics for Associations Among PIMS Scales and Control-Related Discrete Questionnaire/Interview Items

Interview item/reporter	*N*	*F* value for PIMS scale: Control[a]	Prosocial Skills	Positive Affect	Conflict
Initiation of social plans					
Mother	91	4.34*	0.03	1.43	0.57
Father	77	3.30	0.13	0.25	1.18
Child	101	1.83	5.13**	2.32	1.55
Choosing social activities					
Mother	89	4.32*	0.38	3.94	0.02
Father	77	0.02	0.12	0.16	0.45
Child	100	0.15	0.37	0.35	0.73

Note. Peer Interaction Macro-Coding System (PIMS) scales were entered as dependent variables while discrete interview/questionnaire items were entered as independent variables. Responses for discrete items were categorized as "Child initiates/chooses" and "Someone else initiates/chooses" (parent report); "Child and peer take turns initiating/choosing" was also a category included for child report. For significant *F* statistics, higher PIMS scale values were associated with reports that children were more responsible for initiating social plans or choosing social activities.
[a] Associations intended for convergent validity analyses.
* $p < .05$. ** $p < .01$.

presented in Tables 5 and 6. Essentially, all convergent validity hypotheses were at least partially supported, and all significant correlations were in the expected direction. Higher PIMS Control scale scores were found for mothers who reported that their child is responsible for choosing activities and initiating social activities with friends compared with mothers who reported that someone else (e.g., a parent, peers, someone else) undertakes these responsibilities. PIMS Control scores did not differ by father or child report of activity decision making or initiation of social activities (see Table 5). The PIMS Control scale was positively associated with both parent and teacher reports on the Social Skills Rating System (SSRS; Gresham & Elliot, 1990) Assertion scale, with these associations yielding small effects (see Table 6).

Medium effects were found for the association between the PIMS Prosocial Skills scale and parent report on the SSRS Self-Control scale as well as parent and teacher reports on the SSRS Cooperation scale (see Table 6). Small effects in the expected direction were found between the PIMS Prosocial Skills scale and the Adaptive Behavior Assessment System (2nd ed., ABAS–II; Harrison & Oakland, 2003) Social Skills scale, teacher report on the SSRS Self-Control scale, child report of ease of making friends, and the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) Social Problems scale. Although predicted associations were not significant, small effects were also observed between the PIMS Prosocial Skills scale and the Teacher Report Form (TRF; Achenbach & Rescorla, 2001) Social Problems scale and the Children's Self-Efficacy for Peer Interaction Scale (CSPI; Wheeler & Ladd, 1982).No effects were found for parent report of the child's ease in making friends.

The third hypothesis was partially supported in that small effects in the expected direction were observed between the PIMS Positive Affect scale and TRF Internalizing Problems and TRF Externalizing Problems, although the correlation with the latter was not statistically significant. No effects were found for other expected associations—CBCL Internalizing Problems, CBCL Externalizing Problems, Children's Depression Inventory (CDI; Kovacs, 1992).

Consistent with predictions, a medium effect was found between the PIMS Conflict scale and the Friendship Activity Questionnaire (FAQ; Bukowski et al., 1994) Conflict Scale. No effects were found for correlations between the PIMS Conflict scale and Family Environment Scale (FES; Moos & Moos, 1994) Conflict scale or child report of teasing others.

Discriminant Validity

Discriminant validity was evaluated by analyzing *F* statistics of three of the PIMS scales with the two cross-construct items selected to establish convergent validity for the PIMS Control scale (see Table 5). Children rated higher on the PIMS Prosocial Skills scale reported that they were significantly less likely to independently initiate a social activity than to initiate the activity together with friends. All other ANOVA analyses were not statistically significant.

Discriminant validity was further assessed by examining bivariate correlations between each PIMS scale and the questionnaire and interview items that were *not* expected to be significantly related (i.e., cross-construct measures). It was anticipated that these correlations would be lower in magnitude and less likely to reach significance compared with the correlations conducted to establish convergent validity. Absolute values of the correlation coefficients between the PIMS Control scale and the cross-construct measures ranged from .01 to .27 (see Table 6). Although most associations were low in magnitude and did not attain statistical significance, ABAS Social Skills, parent-reported SSRS Self-Control, and CSPI were positively correlated with PIMS Control at a similar magnitude and higher *p* value than the two continuous measures selected to determine convergent validity.

The PIMS Prosocial Skills scale was not significantly related to measures that assess social control or conflict, with correlation coefficients demonstrating small or no effects. Among the measures of affective and mood characteristics, the PIMS Prosocial Skills score was significantly related in the negative direction to the scores on the CBCL Externalizing scale and the CDI; of note, these associations did not exceed the correlations observed between PIMS Prosocial Skills and the other measures of social skills in magnitude or *p* value.

Most correlations between the PIMS Positive Affect scale and cross-construct measures were small at best (range .01–.18) and did not reach statistical significance, with the exception of correlations with teacher report of self-control and cooperation on the SSRS ($r = .25$ and .26, respectively). However, correlations between the PIMS Positive Affect scale and the two SSRS subscales were lower in magnitude with larger *p* values than the correlations between the SSRS subscales and the similar PIMS scale (i.e., Prosocial Skills).

With two exceptions, correlations between the PIMS Conflict scale and the cross-construct measures were small in magnitude (range .03–.20) and did not reach statistical significance. Small, significant negative effects were found between PIMS Conflict and parent report of social skills (ABAS) and teacher report of cooperation (SSRS). Both correlations were of lesser magnitude

Table 6
Convergent and Discriminant Validity: Bivariate Pearson Correlations for Associations Among PIMS Scales and Questionnaire/Interview Measures

Questionnaire/reporter	*N*	*r* values for PIMS scale: Control	Prosocial Skills	Positive Affect	Conflict
Social Skills Rating System–Assertion					
Parent	102	.24*[a]	.17	.09	−.10
Teacher	94	.23*[a]	.15	.04	.07
Adaptive Behavior Assessment System–Social Skills					
Parent	101	.27**	.27**[a]	.16	−.24*
Social Skills Rating System–Self-Control					
Parent	102	.26**	.30**[a]	.17	−.15
Teacher	94	.10	.29**[a]	.25*	−.10
Social Skills Rating System–Cooperation					
Parent	102	.14	.23*[a]	.14	−.19
Teacher	94	.01	.36**[a]	.26*	−.20*
Child Behavior Checklist–Social Problems					
Parent	96	−.11	−.21*[a]	−.01	.10
Children's Self-Efficacy for Peer Interaction Scale					
Child	100	.26**	.14[a]	.18	−.11
Making Friends–Friendship Interview					
Child	102	−.05	.23*[a]	.05	−.13
Teacher Report Form–Internalizing					
Teacher	91	−.10	−.16	−.23*[a]	.09
Child Behavior Checklist–Externalizing					
Parent	96	−.02	−.21*	−.03[a]	.17
Children's Depression Inventory					
Child	101	.02	−.20*	−.12[a]	.20
Friendship Activity Questionnaire–Conflict					
Child	100	.17	−.17	−.12	.34**[a]

Note. The following measures did not correlate with any of the four Peer Interaction Macro-Coding System (PIMS) scales and were, therefore, not included in this table: Teacher Report Form–Social Problems, Making Friends (Parent Report–Friendship Interview), Child Behavior Checklist–Internalizing Symptoms, Teacher Report Form–Externalizing Symptoms, Family Environment Scale–Conflict, and Teasing Others.
[a] Associations intended for convergent validity analyses.
* $p < .05$. ** $p < .01$.

and higher *p* values than the significant correlation presented for convergent validity (i.e., between PIMS Conflict and FAQ Conflict).

Discussion

To address the need for observational measures of social competence in pediatric populations (Noll & Bukowski, 2012), we describe a rational approach to the construction of social competence scales derived from observational peer interaction data in a sample of youth with SB and their peers. Psychometric characteristics of the scales were also reported. The observational PIMS scales were examined separately using data from both children with SB and peers when possible. In general, four of the five proposed PIMS scales exhibited adequate psychometric properties: Control, Prosocial Skills, Positive Affect, and Conflict. The fifth scale, Dyadic Cohesion, appeared to be redundant with aspects of other scales, so it was dropped from subsequent analyses.

The PIMS scales demonstrated adequate reliability characteristics. Good-to-excellent interrater reliability statistics (i.e., ICCs) at the scale level using data from either children with SB or peers suggested that observed social interactions can be reliably evaluated by coders using a macro-coding system. In addition, adequate-to-excellent internal consistency indexes (i.e., Cronbach's alpha coefficients) indicated that each scale contains items that measure the same construct, providing support for the construct validity of the expert coders' classifications during initial scale development. It should be acknowledged that estimates of internal consistency may have been higher due to the stability afforded by averaging scores across two raters and four interaction tasks. On the other hand, by creating means for each scale item, it was possible to provide a more comprehensive, ecologically valid evaluation of the given item. In other words, had the analyses relied on scores from only one rater and/or one interaction task, the ability to generalize the data to an individual's actual repertoire of social behaviors exhibited in daily life may have been more limited. Further, use of multiple interaction tasks likely increased the breadth of social behaviors and characteristics demonstrated by children with SB and their peers. The goal of the PIMS scales is to produce data that resemble children's real social behaviors as closely as possible.

Investigation of the correlations among all PIMS scales revealed concerns about the proposed Dyadic Cohesion scale due to high correlations (i.e., $\geq .70$) with both the Prosocial Skills and Positive Affect scales. Correlations between the items across the three scales demonstrated particularly high levels of redundancy for several of the Dyadic Cohesion items, eliminating the possibility

that deleting one or two redundant items from the scale would increase the distinctiveness of the scale. Overall, these results suggest that the Dyadic Cohesion scale may be a comprehensive measure of both prosocial skills and positive affect; it does not appear to capture unique variability, and therefore, it was removed from further consideration. The correlations among the remaining four PIMS scales were low to moderate, indicating that each scale measured a distinct construct (i.e., conflict, control, prosocial skills, positive affect) while also tapping a more global construct (i.e., social competence). These correlations provide further support for the utility of the four scales in the assessment of observed social competence.

Hypotheses predicting convergent validity between the PIMS scales and interview and questionnaire methods were partially supported. First, the PIMS Control scale was associated with both parent and teacher report of assertiveness on the SSRS, a well-validated, psychometrically sound questionnaire measure (Matson & Wilkins, 2009). In addition, children who were reported by their mothers to initiate social plans and take an active role in choosing activities with friends were rated higher on the PIMS Control scale. Considering the strength of parents' ability to report on observable behaviors in their children (La Greca & Lemanek, 1996), it is not surprising that mothers' responses are most similar to the observations of independent coders on these items.

Of the 10 associations between the PIMS Prosocial Skills scale and parent, teacher, and child measures of social skills, two demonstrated medium effects and seven demonstrated small effects in the expected direction (seven of the 10 associations were statistically significant). Accordingly, this PIMS subscale is supported by converging evidence from questionnaire and interview items assessing both specific skills and more global skill indexes. As expected, children with SB who possessed strong prosocial skills exhibited fewer problems in their social interactions (as noted by significant others).

Of the five hypothesized correlations between the PIMS Positive Affect scale and questionnaire measures, teacher report of internalizing symptoms and externalizing symptoms yielded small effects. Teachers' perceptions of a child's anxious and depressive symptoms likely were based on their observation of the child's outward affect instead of the child's actual internalized thoughts and emotions (Achenbach et al., 1987). Similarly, characteristics of externalizing disorders (e.g., ADHD, conduct disorder, oppositional defiant disorder, etc.) may be easier to judge and be more readily observable by teachers. In support of these findings, a meta-analysis (Achenbach et al., 1987) revealed that teachers and trained observers tend to provide similar reports of children's emotional and behavioral function. Therefore, the PIMS Positive Affect scale appears to reflect directly observable facial expressions and body language associated with symptoms of anxiety, depression, ADHD, and behavioral problems.

Of the three correlations proposed for the validation of the PIMS Conflict scale, one (i.e., child report of conflict with a best friend) produced a medium effect. Given the tendency for children to have unique perspectives on their own social competence (Colegrove & Huntzinger, 1994), it is notable that this PIMS scale appears to capture conflict as perceived by the youth themselves. Relational aggression is particularly prevalent in adolescence and is less likely to be detected by parents, teaches, or other adults (Prinstein, Boergers, & Vernberg, 2001); thus, the perspective of the youth themselves may be more valid when the focus is on conflicts in social interactions.

Overall, there was also evidence for discriminant validity for all four PIMS scales. The majority of correlations between each PIMS scale and the cross-construct measures yielded small effects at best and were not statistically significant. Of the nine cross-construct associations that attained statistical significance, all effects were small in magnitude, and most were of similar or lower strength than the convergent validity correlations. Discriminant validity appears strongest for the PIMS Prosocial Skills and PIMS Conflict scales, as both featured medium effects for convergent validity and small or no effects in cross-construct analyses. Further, several discriminant validity associations may reflect meaningful relationships between the PIMS scale construct and other constructs. For example, children with SB who were observed to use more prosocial skills in their peer interactions were more likely to endorse fewer depressive symptoms and to be rated lower in externalizing symptoms by their parents; these associations have been demonstrated in past studies as well (Campbell, Spieker, Burchinal, Poe, & the NICHD Early Child Care Research Network, 2006; Segrin, 2000). Finally, the ABAS Social Skills scale was notably related to three of the four PIMS scales. Upon further examination, this measure includes items that reflect general social competence (e.g., "Has one or more friends," and "Shows good judgment in selecting friends"), which may explain the high correlations across multiple PIMS scales.

The present study has several strengths. First, there is a clear need for the proposed observational PIMS scales, given the social deficits reported by parents, teachers, and children with SB (Ellerton et al., 1996). Second, in accordance with recommendations by Holmbeck and Devine (2009), content validity was "built in" to the scales at the start of the development process. Scale constructs were chosen after a comprehensive review of the literature, and PIMS items were then selected according to their relevance to the research-based constructs. Compared with factor analytic methods, rational scale development incorporates theories with strong empirical foundations. Third, interrater reliability, internal consistency, and convergent and discriminant validity were evaluated. Information garnered from these analyses resulted in a revision to the proposed scales (i.e., the Dyadic Cohesion scale was dropped from subsequent analyses).

Despite the strengths of the study, findings should be interpreted in the context of several limitations. The inherent bias in the rational approach to scale development must be acknowledged. Although a large number of experts were employed during scale development in an effort to minimize subjectivity, classification of items was based on human judgment. Furthermore, the reliability analyses using data from youth with SB versus data from peers were not entirely independent for the PIMS Conflict and Dyadic Cohesion scales. Six items in the coding system were rated for the overall dyad rather than for the child with SB and the peer separately. Thus, reliability results for these scales are overlapping for targets and peers due to a lack of data independence. In addition, the limited sample size precluded the use of confirmatory factor analysis; such analyses would make it possible to test the fit of the rationally derived scales (Holmbeck & Devine, 2009).

It should also be noted that the present study is limited compared with a full multitrait–multimethod design (Campbell & Fiske, 1959). Without a comprehensive multitrait–multimethod

design, it is not possible to determine whether intercorrelations between different traits assessed by the same method (e.g., ABAS Social Problems and CBCL Externalizing Symptoms, or FAQ Conflict and SSRS Assertion) are higher than the cross-method, same-trait correlations reported in the convergent validity analyses. Indeed, it is possible that the highest correlations may be attributed more to "shared methods" than to "same traits." In short, it is possible that the PIMS subscales are more like each other (i.e., they measure similar aspects of underlying social competence) than the distinct constructs they intend to measure. Convergent and discriminant findings must be interpreted within this limitation.

There are also limitations to the study that are inherent to observational research in general. The observation is merely a snapshot of the child's typical functioning in a given context and cannot account for all behaviors and characteristics typically demonstrated by the child (Gardner, 2000). Peer interactions occurred at home between the child with SB and his or her peer and included a standard set of activities. Generalizability to other contexts and populations is not possible without further research. However, the natural setting (i.e., the home) in which the peer interactions took place likely yields more valid data, compared with clinical or lab settings (Gardner, 2000). Although it is possible that the children did not behave as they typically would due to their awareness of the camera's presence, research has demonstrated that reactivity effects likely have little influence on the validity of findings (Gardner, 2000).

Further, the interaction tasks required significant verbal skills that may not be required or demonstrated across all real-life peer interactions. The selected tasks may have been less likely to elicit nonverbal behaviors (e.g., facial expressions, gestures, and so forth) that often occur in more play-based activities, and they may not be as likely to capture the difficulties children with SB face in physically keeping up with their typically developing peers (Blum, Resnick, Nelson, & St. Germaine, 1991). It is also possible that differences in social competence occurred across the four observational tasks, as this was not investigated. That is, youth with SB and their peers may have behaved differently on some tasks relative to others. Finally, although the complexity of the PIMS allows for comprehensive measurement of social competence, the time and resources required for administration and reliable coding may prevent its use as a screening measure for use by clinicians to address socially based referral questions (Achenbach et al., 1987; Gardner, 2000). In the future, validation of a briefer version of the PIMS scales that utilizes a single interaction task would be a useful endeavor.

The PIMS scales may be a useful in future studies of children's social competence. Given the successful application of our *family* observational scales (i.e., FIMS) to a sample of children with diabetes and their families (Kaugars et al., 2011), we are optimistic that the PIMS scales could be validly used with other populations. Also, the scale constructs emerged from a comprehensive literature review and will likely be useful in determining the social strengths and weaknesses of children with other physical and mental conditions.

It is also recommended that the predictive validity and incremental utility of the PIMS scales be examined to provide additional support for the use of the PIMS scales in research (Haynes, 2001). For example, do the PIMS scales provide useful information beyond what is provided by existing questionnaire measures of social competence? A future study may address this question by investigating whether the PIMS scales or social competence questionnaires are stronger predictors of future romantic relationship status and social activity when participants are older adolescents or young adults. In addition, larger samples would facilitate the application of confirmatory factor analysis to further support the factor structure of the PIMS. From a clinical perspective, more accurate measurement of social competence would improve the ecological validity of research conclusions. For instance, use of the PIMS scales may reveal aspects of social competence that are particular strengths or weaknesses for youth with SB that could then be targeted in subsequent interventions aimed at improving their social functioning and friendships.

In summary, subdomains of social competence (i.e., conflict, control, prosocial skills, and positive affect) can be reliably and validly assessed based on observations of peer interactions between youth with SB and their peers. The observational PIMS scales provide an additional strategy in the conduct of multi-informant–multimethod research. More sophisticated methods for the investigation of social competence will increase the validity and generalizability of conclusions made from such research.

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