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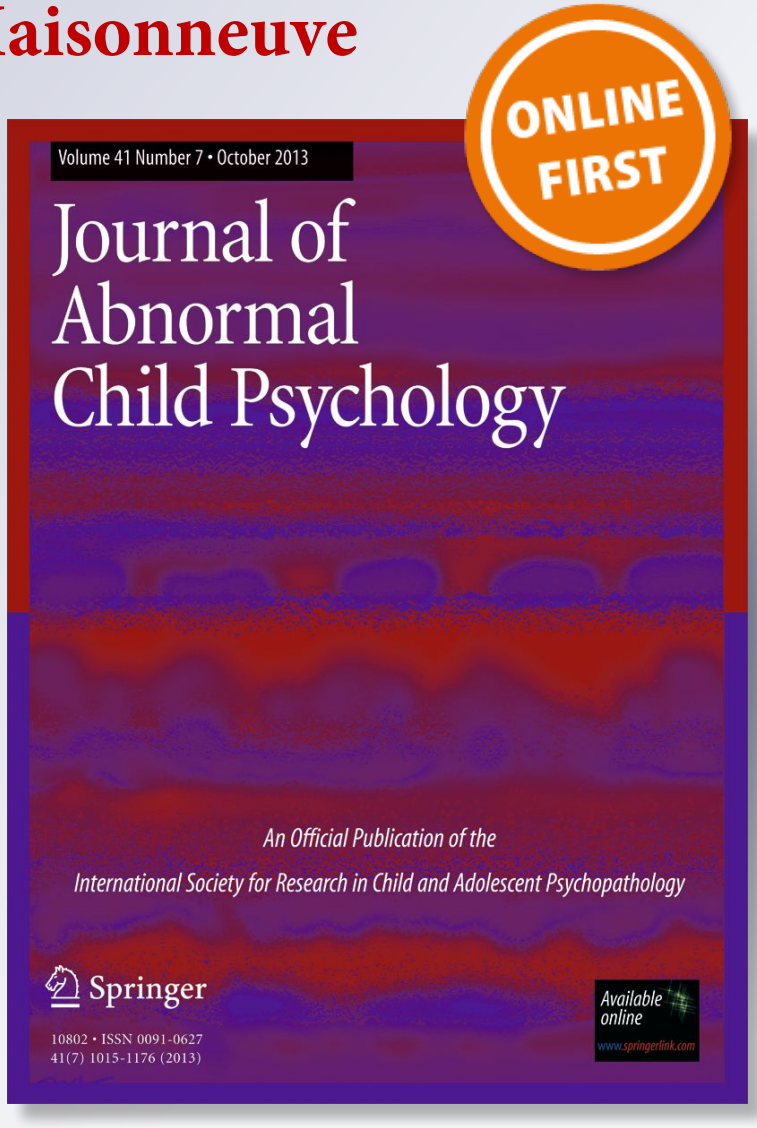

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Observed Free-Play Patterns of Children with ADHD and Their Real-Life Friends

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Abstract

Previous observational studies conducted in highly structured, analog situations indicate that children with Attention-Deficit/Hyperactivity Disorder (ADHD) mismanage their relationships with same-age peers and friends. Such structured situations may not, however, fully represent the true nature of children's play, which is typically characterized by free choice, intrinsic motivation, and spontaneity. The unique objective of the current observational study was to describe how 87 children with ADHD and 46 comparison (76% boys) aged 7–13 years behave when interacting with their *real-life* dyadic friends during an unstructured, free-play situation. Results indicate that dyads comprising one referred child with ADHD and an invited friend ("ADHD dyads") engaged in less cooperative play, displayed less companionship, and showed less sensitivity to friends than comparison dyads. ADHD dyads also engaged in more conflict and exhibited significantly more negative affect than comparison dyads. These findings complement and extend, possibly with somewhat enhanced ecological validity, results obtained in previous studies on the friendships of children with ADHD featuring closed-field observations and questionnaire methodology.

Keywords ADHD · friendship · peer relationships · observational study · free play

"It is a happy talent to know how to play"
— Ralph Waldo Emerson

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Children's friendships provide a context for social support known to buffer several stressful life events (Prinstein and Giletta 2016). Accumulating evidence now indicates that having a close friend protects children from the deleterious effects of family dysfunction (Bukowski et al. 2009), general peer rejection (Bukowski et al. 2010) and peer victimization (Fox and Boulton 2006). Longitudinal data suggests that friendships may also be associated with the ability to cope with negative affect and reduced experience of emotional distress (Masten et al. 2012). These benefits may depend on the quality of the friendship. Friendship quality is defined in terms of positive (e.g., companionship, caring, and support, validation) and negative (e.g., conflict, aggression, jealousy) features (Berndt 1996). Friendship quality is negatively related to maladaptive behaviors, internalizing problems, and school maladjustment. Stable, high-quality friendships are associated with later social adjustment (Bagwell and Schmidt 2011).

A growing body of studies during the past two decades indicates that children with Attention-Hyperactivity/Deficit Disorder (ADHD) experience significant and treatment-resistant friendship problems (Blachman and Hinshaw 2002; Hoza et al. 2005a; b; Marton et al. 2015). According to the Multimodal Treatment of ADHD (MTA) study, 56% of

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children with ADHD have no friends, compared to 32% of typical children (Hoza et al. 2005b). They also have trouble keeping their friends over time (Blachman and Hinshaw 2002; Marton et al. 2015; Normand et al. 2013). The few studies of the friendship quality of children with ADHD reveal that their friendships are characterized by less intimacy, reciprocity, and satisfaction with the relationship (Normand et al. 2011, 2013), but more conflict than those of typical children (Blachman and Hinshaw 2002; Normand et al. 2011, 2013). Interestingly, compared with other children, children with ADHD do not generally report more difficulties making or keeping friends (Bagwell et al. 2001; Marton et al. 2015), highlighting the need to assess friendship patterns with multiple methods and informants, including observational measurement (Bagwell and Schmidt 2011; Pellegrini 2013).

Previous Observational Studies on the Friendships of Children with ADHD

Observational methods provide rich data about children's peer behavior and interactions with friends, while also allowing for fine-grained assessments of behavioral change and context during play (Smith 2011). These methods can be used with participants who have limited verbal skills, and may also expose aspects of friendship that are less accessible through self-reports (Pellegrini 2013). They also circumvent many of the response biases that survey methods are prone to, such as self-presentation and social desirability (Stone et al. 2000). There is also some evidence that observational methods of children's social interactions during play may be better predictors of their concurrent and future social functioning than parent or teacher reports (Vaughn et al. 2009).

The few observational studies of children with ADHD and their friends indicate that children with ADHD mismanage their friendships in several ways. In their 6-month, longitudinal, and multimethod study, Normand et al. (2011, 2013) found that while negotiating with their friends, children with ADHD adopted a more insensitive, controlling, and self-centered problem-solving approach than typically developing children. Furthermore, children with ADHD more frequently disagreed with their friends' suggestions regarding which games to play and more frequently violated game rules than comparison children (Normand et al. 2011). However, there were no significant findings with regard to negative affect displayed by children with and without ADHD in three highly structured, analog tasks (Normand et al. 2011). Unfortunately, longitudinal data from this study suggest that children with ADHD do not rectify their negative friendship behaviors over time (Normand et al. 2013). Whereas at a six-month follow-up, typically developing children significantly reduced the number of rule violations they committed, children with ADHD significantly *increased* the number of rule violations they committed. Moreover, when negotiating with friends, typically developing children, but not children with ADHD, reduced the number of self-centered and insensitive proposals at follow-up. Violations of game rules and a self-centered, insensitive negotiation approach predicted deterioration in friendship quality for children with and without ADHD over time (Normand et al. 2013).

The Free-Play Behaviors of Children with ADHD

Most previous observational studies on the peer interactions of children with ADHD were conducted in highly structured, conflict-provoking, analog situations (e.g., Normand et al. 2011, 2013). These analog situations provide accelerated access to important situations, such as conflict, that might not occur while natural, spontaneous play is observed. However, children's play is typically characterized by free choice, intrinsic motivation and spontaneity (Burghardt 2011; Pellegrini 2009), which is inconsistent with highly structured analog tasks. Shantz and Hartup (1992) proposed a distinction between *closed* and *open fields* in the study of conflict between friends. Their idea was that two kinds of variables are involved: *setting interdependence* and *relational interdependence*. Setting interdependence is typical of closed-field situations, where people know that they must interact, while relational interdependence is typical of an open field, where interactions are more voluntary. If there is a disagreement in a closed situation, the interaction will still continue, whereas in an open field, the dyad members may stop interacting with each other after a disagreement. Moreover, the strategies of conflict management may be different. Many closed-field situations are deliberately structured to make it very difficult if not impossible to avoid a conflict. It is not surprising, therefore, that, in closed situations, friends have more intense conflicts, are more assertive with one another, and have conflicts that last longer than those of non-friends.

Less structured situations may also offer some potential advantages in terms of ecological validity. We maintain that the classic distinctions between closed and open-field situations (Shantz and Hartup 1992) may not always apply to the dyadic interactions of real-life friends. For example, dyads of friends may play together in each other's homes or in their neighborhoods. Their play in these situations is not structured as in a laboratory but is likely to have time constraints imposed by school and family life. However, there is little chance that they will discontinue the interaction. If playing at home, they are not likely to include a third party. These considerations underline the importance of better understanding how children with ADHD behave when interacting with their friends in situations that are relatively unstructured to complement previous studies conducted in more structured, closed-field settings.

Whereas some authors have argued that children with ADHD should be less distinguishable from typical children

in free-play or low-demand settings than they are in highly restrictive ones (Roberts et al. 2014), Cordier et al. (2009) postulated that ADHD symptoms could in fact be heightened, and highly impairing, in unstructured settings that offer few immediate external rewards. Previous observational studies of free-play patterns of children with ADHD in playgroup or dyadic settings generally support the latter position. For example, Alessandri (1992) observed the free-play behaviors of 20 preschoolers with ADHD and 20 matched preschoolers without ADHD across a 6-week period in groups in a university-based preschool program. Children with ADHD engaged in less play, were less compliant and cooperative and were involved in more off-task activity than children without ADHD. The free-play of children with ADHD were characterized as less socially and cognitively mature than that of typically developing children. Specifically, children with ADHD engaged in more functional or sensorimotor play, but less constructive and dramatic play (Alessandri 1992).

Studies conducted with same-age dyads that were *not* friends also suggest that children with ADHD experience significant interaction problems during free play. For example, Cunningham and Siegel (1987) found that previously unacquainted ADHD/non-ADHD dyads ($n = 30$) showed higher levels of controlling behaviors than comparison dyads ($n = 30$). In their observational study of 8 dyads of previously unacquainted school-aged ADHD/non-ADHD boys and 8 dyads of non-ADHD boys (7–12 years), Hubbard and Newcomb (1991) found that during free play, ADHD/non-ADHD dyads engaged in more solitary play, but in less associative play, verbal reciprocity and affective expression than comparison dyads. More recently, Cordier et al. (2010) compared the play interactions of 112 dyads consisting of children with ADHD and their familiar playmates without ADHD (ADHD/non-ADHD dyads) and 126 matched comparison dyads. They concluded that children with ADHD show deficits in interpersonal empathy in their free play, as evidenced by their lower abilities to discriminate and identify the emotional states of their peers, to take the perspective or role of their counterparts, and to evoke shared affective responses.

The Present Study

To the best of our knowledge, there have been no studies to date on how children with ADHD interact with their *real-life* friends in unstructured free-play situations. The few observational studies on the free-play behaviors of children with ADHD were conducted with same-age peers but *not with real-life dyadic friends*. Given the known protective role of friendship in children's development (Bagwell and Schmidt 2011; Prinstein and Giletta 2016), it is imperative to understand better how children with ADHD play with their real-life friends. The unique objective of the current study is to describe the observed free-play patterns among children with ADHD and their real-life dyadic friends.

Hypotheses (a) We expected that dyads of referred children with ADHD and their invited friends ("ADHD dyads") would exhibit fewer positive features during their free play, as evidenced by less engagement in cooperative play, less companionship, and less sensitivity towards friends than dyads comprising comparison children and their friends ("comparison dyads"). (b) We also expected that dyads containing at least one child with ADHD ("ADHD dyads") would exhibit higher levels of negative free-play features, as evidenced by more conflict, more negative emotional reactions, more discontinuity in their play (i.e., more game transitions) and more unequal balance of power/communication than comparison dyads.

Method

Participants

As part of a larger longitudinal, multimethod study on the dyadic friendships of children with ADHD (see Normand et al. 2011, 2013), participants included 87 children with a diagnosis of ADHD (67 boys), 46 comparison children without diagnosis (34 boys) and their 133 respective invited friends. All children were aged between 7 and 13 years old (90.6% Caucasian); however, there was a small percentage of Latin-American, Arabic, African, and Asian children. We asked each participant to invite his or her best friend. We refer throughout to four groups of participants: (1) "children with ADHD" denotes children with ADHD who were directly referred to the study; (2) "comparison children" denotes typically developing children without ADHD who were recruited for the study; (3) "friends of children with ADHD" were invited by children with ADHD; and (4) "friends of comparison children" were invited by children without ADHD.

Children with ADHD were referred over a two-year period (2007–2009) from various pediatric and/or ADHD clinics and community schools in urban and suburban communities in southeastern Canada. Both informed parental consent and child assent were required. Inclusion criteria for children with ADHD were: (a) a previous diagnosis of ADHD by a qualified health care professional; and (b) *both* parent and teacher ratings containing at least one *T*-score at or above 65 on *either* the DSM-IV Inattention *or* Hyperactivity subscale of the Conners Rating Scale-Revised: Long Form (CRS-R:L; Conners et al. 1998a, b). Because many medicated children with ADHD continue to show impairment in their peer relationships (Hoza et al. 2005a), medicated children were neither excluded nor asked to suspend their medication. In our sample, 69% of children with ADHD were medicated.

We recruited comparison children over the same two-year period from local schools and community organizations (e.g., Scouts) in southeastern Canada. Comparison children were not recruited from clinics. We sent brochures about the study to parents via the schools/organizations; interested parents contacted the researchers for more details and to schedule a research session. For inclusion in the comparison group, both parent and teacher T-scores had to be below 60 on both the Conners' DSM-IV Inattention and Hyperactivity-Impulsivity subscales. Fourteen potential comparison children were excluded because of elevated scores. Parents of comparison children reported no previously diagnosed psychological disorders.

Exclusion criteria for both the ADHD and comparison groups included previously-administered Full Scale IQ less than 80 (available for 77% of the children with ADHD), pervasive developmental disorder, psychosis, not being enrolled in a regular classroom, and not having a friend who was willing to participate. Twenty-nine potential participants (27 children with ADHD and 2 comparison children), not included in the 133 participants reported above, could not participate because during the screening call the parent reported that their child had no friends. Common ADHD comorbidities (e.g., oppositional defiant disorder [72%, according to at least one informant]), anxiety disorders [48%], and learning disabilities [20%]) were not excluded from the ADHD group to promote generalizability.

As indicated in Table 1, children with ADHD and comparison children did not differ with respect to most demographic variables. However, children with ADHD were slightly more likely than comparison children to be instructed in English rather than French and to live in single-parent families. In line with previous studies (Bagwell et al. 2001; Blachman and Hinshaw 2002; Marton et al. 2015; Normand et al. 2011), the friends of children with ADHD displayed more inattentive, hyperactive/impulsive, and oppositional behaviors than the friends of comparison children (see Table 1). About a quarter of the friends of children with ADHD also displayed ADHD symptoms in the clinical range (*T*-scores >65 on the Conners parent *and* teacher DSM-IV ADHD scales). None of the friends of comparison children had clinically elevated ADHD symptoms (for more details, see Normand et al. 2011 and discussion below).

Measures

Conners Parent and Teacher Rating Scales-Revised – Long Forms (CPRS-R:L and CTRS-R:L) The CPRS-R-L and CTRS-R:L (Conners et al. 1998a, b) were used to assess symptoms of ADHD, oppositional behaviors, anxiety symptoms, and peer problems (e.g., unaccepted; doesn't make friends; poor social skills) in children with and without ADHD and their invited friends. Following the procedure used by Blachman and Hinshaw (2002), we used only parental ratings in situations where teachers had seen children exclusively on medication ($n = 24$ or 27.6% of the ADHD sample). The CPRS-R:L and CTRS-R:L have proven to be internally consistent in community and clinical samples of children and adolescents with Cronbach's alphas ranging from 0.73 to 0.95. Predictive validity has also been evidenced by overall correct classification rates varying from 85% to 93% (Conners et al. 1998a, b). In the present study, we determined ADHD presentations and comorbidities by examining both the Conners parent and teacher rating scales *T*-scores (with a cut-off at 65) of the DSM-IV ADHD Symptom Subscales. We designated a child's symptoms as an ADHD Inattentive or Hyperactive-Impulsive Presentation if the ratings of *either* the parent or the teacher were at or above T-score of 65 on *either* the Inattentive or Hyperactivity-Impulsivity subscales. We designated the symptoms as an ADHD Combined Presentation if the ratings of *at least one informant* reached at or above a *T*-scores 65 on *both* the Inattentive and Hyperactivity-Impulsivity subscales. We defined comorbid anxiety or oppositionality status if ratings by *at least one informant* were at or above a T-score of 65 on the Conners Anxious/Shy or Oppositional subscales.

Friendship nominations In order to confirm a reciprocal friendship, participants and their invited friends privately completed a friendship nomination form, where they wrote or dictated to the research assistant the names of all of their friends, the duration of their friendships, the location where their friendships began, and the name of their best friend in the whole world (Parker and Asher 1993). Reciprocal friendship nominations (i.e., requiring both members of the dyad to nominate each other as friends) were used to confirm the mutual nature of the relationship (Bagwell and Schmidt 2011; Parker and Asher 1993). "Best friend" status was also confirmed with reciprocal nominations of both members of the dyad. *Reciprocal* friendship nominations provide confirmation of the presence of a friendship and circumvent many of the response biases that self-report measures are prone to, such as positive illusory self-perceptions (Stone et al. 2000).

Dyads in which one or both participants failed to nominate his or her partner as a friend were not included in the final analyses ($n = 11$ dyads; 7 ADHD dyads). Children with ADHD with and without reciprocal friendships did not differ significantly in terms of ADHD symptoms or socioeconomic status. Participants in all groups retrospectively perceived their friendships as quite stable (Children with ADHD: $M = 4.33$ years, $SD = 2.99$ years; Comparison children: $M = 4.80$ years, $SD = 3.12$ years). The majority of children participated in the research session with their best friends (Children with ADHD: 83.9%; Comparison children: 89.1%). The majority reported starting these friendships at school (Children with ADHD: 58.6%; Comparison children: 58.7%).

Table 1 Descriptive statistics for demographic data and conners ratings: means and SDs (in parentheses)

	Comparison ($n = 46$)	ADHD ($n = 87$)	Friend of Comparison ($n = 46$)	Friend of ADHD ($n = 87$)	*F or* X^2 *(3,266)*[a]	Effect sizes[b]
Demographic variables						
Age (years)	10.41 (1.72)	10.30 (1.85)	10.22 (1.68)	10.39 (2.22)	0.11	0.00
Grade	4.28 (1.86)	4.32 (1.87)	4.33 (1.77)	4.39 (2.02)	0.04	0.00
Children's sex (% Boys)	73.9	77.0	69.6	74.7	*0.89*	*0.06*
Parents' sex (% Mothers)	82.6	88.5	87.4	84.8	*1.07*	*0.06*
Language of instruction (% French)	95.7_b	80.5_a	93.5_b	88.0_{ab}	*8.40**	*0.18*
Ethnicity (% Caucasian)	87.0	92.0	91.3	90.8	*7.34*	*0.10*
Two-parent household (%)	91.3_b	73.6_a	89.1_b	77.1_a	*8.89**	*0.18*
SES score	50.21 (12.22)	47.97 (11.98)	52.15 (10.93)	50.65 (9.68)	1.60	0.02
Median annual family income, K$ (CDN)	79.16 (15.78)	79.75 (17.01)	79.19 (15.82)	82.76 (19.35)	0.72	0.01
Rating-scale data						
CPRS-R (*T*-scores)						
DSM-IV Inattention	$46.96\ (5.64)_b$	$73.86\ (8.65)_a$	$48.96\ (7.21)_b$	$55.78\ (11.90)_c$	123.71***	0.59
DSM-IV Hyperactivity	$47.76\ (4.44)_b$	$71.37\ (13.67)_a$	$49.57\ (7.78)_b$	$55.04\ (12.42)_c$	64.80***	0.43
Opposition	$49.70\ (6.86)_b$	$68.11\ (12.94)_a$	$49.89\ (10.15)_b$	$54.65\ (12.90)_b$	39.42***	0.31
Peer Problems	$48.87\ (5.40)_b$	$68.75\ (13.93)_a$	$48.93\ (6.19)_b$	$53.83\ (11.76)_b$	52.25***	0.38
CTRS-R (*T*-scores)						
DSM-IV Inattention	$46.42\ (5.02)_b$	$64.66\ (10.94)_a$	$46.75\ (6.57)_b$	$53.92\ (11.15)_c$	51.58***	0.40
DSM-IV Hyperactivity	$45.71\ (4.17)_b$	$61.82\ (13.75)_a$	$46.80\ (5.46)_b$	$52.01\ (9.47)_c$	35.08***	0.31
Opposition	$48.16\ (7.45)_{bc}$	$61.08\ (15.09)_a$	$47.25\ (5.10)_c$	$53.30\ (11.73)_b$	19.11***	0.20
Peer Problems	$49.42\ (6.56)_b$	$59.56\ (15.96)_a$	$47.36\ (5.21)_b$	$52.38\ (11.79)_b$	12.97***	0.14

Entries with different subscripts differ significantly

[a] One-way ANOVA for continuous variables; Pearson chi-square statistic (in italics) for categorical variables

[b] Effect Size type: Partial $\eta 2$ for continuous variables; Cramer's V for categorical variables

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Free-Play Task The free-play situation was adapted from Hubbard and Newcomb (1991) and was used to examine the friendship interactions of children with and without ADHD during unstructured free play. Participants were invited to play together in any way at anything they would like for 10 min. Different board games (e.g., *Operation, Piranha Panic, Sonic Skillball, Trouble*) appropriate for school-age children were available in the testing room for participants. Participants were free to change games at any time.

Procedure

We invited participating children and their friends to a research session conducted in a private room either at the University or at a local school. Participant and their friends provided their assent (including assent to be filmed), then completed the friendship nominations separately, before being reunited for the free-play task. In order to ensure comprehension, research assistants read each question aloud. Finally, two handheld cameras installed on tripods in opposite corners of the room filmed the participating children and their friends during the free-play situation. During free play, research assistants were as unobtrusive as possible; they had been instructed to intervene only if a child was in danger or asked for clarification/help.

We conducted pilot sessions in order to verify that the different board games were appropriate for both boys and girls 7 to 13. We administered all measures in either French or English; there were no mixed French-English-dominant dyads. Parents and teachers completed a questionnaire about the children's behavior; parents also completed a questionnaire with demographic information. Participating families were offered a $20 honorarium for the 90-min research session.

Observational Coding

We conducted a total of 30 h of training using a coding manual (available from first author). We reviewed the coding rules, checked reliability, and provided feedback on accuracy in each training session. Once criterion reliability (inter-rater 80% of agreement) was reached, formal coding started using

the Noldus Observer XT (Version 11). Verbalizations and gestures were coded for each member of the dyad (i.e., individual variables: sensitivity towards the friend, affect) or for the whole dyad (i.e., dyadic variables: social play, game transitions, conflict, balance of power/communication, companionship) for each 30-s interval. Coding the individual variables for each of the two friends was possible because there were cameras oriented toward each member of the dyad. We coded 30-s intervals rather that event coding because it seemed more feasible to code subtle behaviors reliably if coders examined a predetermined time interval of play. We chose 30 s because our experience in observing the sessions was that this was the optimal length of time in which to capture most instances of specific behaviors. To minimize coding drift, ongoing monthly training sessions were organized and post-training reliability was checked weekly. One trained graduate student (*MMS*) performed the coding. An undergraduate student (*MPVM*), then independently recoded a random sample of 50% of the sessions for inter-rater reliability. Neither was informed of the identity and diagnosis of the participants. Definitions of the coding categories and excellent inter-rater reliability data appear in Table 2.

Data Reduction and Analytic Strategy

We reduced the 17 originally coded observational variables listed in Table 4 for hypothesis testing by transforming raw frequency variables that were linearly dependent (e.g., number of intervals where the friends were sensitive vs. insensitive to each other) into a proportion variable (e.g., number of intervals where the friends were highly sensitive, or coded as "2" or "3" divided by the total number of intervals; this created the "high sensitivity" proportion variable, see Table 4).

Among our 7 primary observational variables, 5 were dyadic (i.e., social play, game transitions, conflict, balance of power/communication, companionship) and 2 were coded separately for each child (i.e., sensitivity towards the friend, affect; see italicized variables, Table 4). The average intraclass correlations (i.e., between the two friends) for sensitivity towards the friend and affect were 0.67 and 0.74, respectively, indicating that the behaviors of each friend were extensively influenced by the behavior of the other friend. We therefore conducted the analyses at the dyadic level for all variables, using the means of the combined data of each dyad for sensitivity towards the friend and affect. We used arcsine-transformed proportions of these observational variables to account for non-normal distribution in all analyses.

Table 2 Definitions of coding categories

Category (kappa)	Definition
Social play (0.91)	The extent to which members of the dyad engaged in four mutually exclusive types of play. Subcategories of social play: *Solitary play* = One child plays while the friend is engaged in a different activity; *Parallel play* = Both friends are playing but they are engaged in different games or game parts (they have no common goals); *Associative play*: The friends are not involved in a game or play mechanically together while conversing about a topic not related to the game; *Cooperative play*: Both friends are actively involved in the same game; they are paying attention to the progress of the game and to the actions of the other child. They have one common purpose. This is a dyadic variable rated for each 30-s coding interval.
Game transitions (0.97)	Presence of any change of game. This is a dyadic variable coded for each occurrence.
Conflict (0.87)	Every form of argument, accusation, or insult. This is a dyadic variable coded for each occurrence.
Balance of power/ communication (0.84)	This code measures which friend appears to have greater control over the interaction (e.g., dominating the conversation, steering the direction of the discussion and the choice of games played). 0 or 1 rating [0 = *Equal balance of power/communication;* 1 = *one child is more controlling*]. This is a dyadic variable rated for each 30-s coding interval.
Companionship (0.87)	Expression of warmth, mutual appreciation, and cohesiveness, 0–3 rating [0 = *the friends appear disengaged and disconnected from one another and do not appear to function as a team; little warmth or closeness is seen in most of the interaction;* 3 = *The dyad clearly functions as a team, and the friends appear to have fun with one another*]. This is a dyadic variable rated for each 30-s coding interval.
Sensitivity towards the friend (0.82)	The degree to which each friend is globally supportive and attuned to the other's preferences, needs and emotions. 0–3 rating [0 = *The child is not listening to his friend, interrupts his friend frequently, and is not supportive of his friend;* 3 = The target child is highly attuned and sensitive to his/her friend's emotions or needs]. This is an individual variable rated for each 30-s coding interval.
Affect (0.80)	The extent to which members of the dyad express nonverbal and verbal manifestations of affect. Subcategories of affect: *Positive affect* = The extent to which members of the dyad express positive affect (e.g., smiling, laughter, enthusiastic verbalizations, expressions of satisfaction, joy); *Neutral affect* = The extent to which partners manifest neutral affect for most of the segment. *Negative affect*: The extent to which friends express negativity toward one another or toward the situation (e.g., orders, threats, dissatisfaction, frustration, disappointment, reprimands, visible tension, anger and nervousness). This is an individual variable rated for each 30-s coding interval.

Table 3 Zero-order pearson correlations between the study variables

	1	2	3	4	5	6	7	8	9
1. Children's Age									
2. Cooperative play	0.05								
3. Transitions	0.02	−0.16							
4. Conflict	−0.41***	−0.20*	−0.13						
5. Unequal power	−0.25**	−0.10	0.01	0.25**					
6. High companionship	0.17	0.45***	−0.05	−0.29**	−0.22*				
7. High sensitivity between friends	0.43***	0.54***	−0.03	−0.59***	−0.26**	0.57***			
8. Negative affect	−0.28**	−0.29**	−0.10	0.63***	0.24**	−0.39***	−0.61***		
9. CPRS-R L peer problems	−0.10	−0.37***	0.04	0.41***	0.16	−0.27**	−0.38***	0.30***	
10. CTRS-R L peer problems	−0.01	−0.20*	0.06	0.22*	0.07	−0.27**	−0.26**	0.21*	0.43***

Transitions, At least one game transitions; Conflict, At least one conflict; Unequal power, unequal balance of power; High companion, high dyadic companionship; High sensitivity, high sensitivity between friends; CPRS-R L peer, Conners Parent Rating Scale-Revised Long Form Peer Problems; CTRS-R L peer, Conners Teacher Rating Scale-Revised Long Form Peer Problems. Observational variables (variables #2–8) reported represent arcsine-transformed proportions; see Data analytic strategy section for more details

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

We used our data on friendship with other sources about children's peer functioning (i.e., parent and teacher reports) to validate the observational data. As indicators of validity, we expected, first of all, that the observational categories would be moderately correlated, suggesting that they are tapping related yet independent aspects of friendship interactions. Both the negative and positive correlations between the parent and teacher ratings of peer problems and observational categories that are conceptually related to peer problems, such as conflict and negative affect, provide an additional indicator of validity. These correlations are presented in Table 3 and reviewed in the Results section, below.

Raw proportional data (in %) are reported in the MANCOVAs and ANCOVA results displayed in Table 4 to facilitate interpretation. Although preliminary analyses indicated significant gender differences in the category pertaining to games transitions (see *Interactions Between Friends During Free Play* section below and Table 4), there were no significant multivariate gender X ADHD status interaction effects. Thus, even though boys and girls differed on this variable, there were no multivariate gender differences within the referred ADHD group in any of our free-play observational variables. Nevertheless, we decided to enter both gender and ADHD status (ADHD, comparison) as fixed factors and age and length of friendship as covariates in the MANCOVAs and ANCOVAs (with Bonferroni post hoc corrections). We re-analyzed the data, first without the girls ($n = 32$), and then without the cross-gender friendship data ($n = 8$). As the overall pattern of results was virtually identical to the one with all the participants, the main results reported below included the full sample. Only differences that remained significant after Bonferroni corrections were retained. Effect sizes were computed with partial eta squared and interpreted with the following conventions: small =0.01 – 0.06, medium =0.06 – 0.14, large = 0.14 and above (Cohen 1988).

When ADHD presentation, comorbid oppositionality or anxiety status, medication status, dyadic composition status (i.e., dyads with 1 vs. 2 children with ADHD), and "best friends-only dyads" status were included in the supplementary multivariate analyses, results remained virtually identical, and there were no interactions with ADHD status for any of these variables. For more information on these supplementary analyses, see Supplemental On-Line Materials and Supplementary Tables 1–6.

Results

Associations Among Observational Measures, Parent, and Teacher Reports of Peer Functioning

Zero-order correlations among the observational variables are displayed in Table 3. As shown, observed cooperative play correlated significantly and positively with companionship and sensitivity between friends but correlated significantly and negatively with conflict and negative affect. Conflict correlated significantly and positively with unequal balance of power/communication and negative affect, but significantly and negatively with companionship and sensitivity between friends. Unequal balance of power/communication also correlated significantly and positively with negative affect, but negatively with companionship and sensitivity between friends. Companionship correlated significantly and positively with sensitivity between friends, but negatively with negative affect. Sensitivity between friends correlated significantly and

negatively with negative affect (see Table 3). Overall, the medium-to-large correlations between the observational variables suggest that they are tapping related yet unique features of friendship interactions.

Correlations among the free-play observational variables, and parent- and teacher-reported peer problems are also presented in Table 3. Observed cooperative play, high sensitivity between friends, and companionship during free play correlated significantly and negatively with parent and teacher reports of peer problems. In contrast, observed conflict and negative affect during free play correlated significantly and positively with parent and teacher reports of peer problems (Table 3). Overall, these findings suggest that observed behaviors during free play are associated in the directions expected with greater impairment in relations with peers in daily living.

Interactions Between Friends during Free Play

Multivariate analysis of variance (MANCOVA) indicated a significant difference between boys and girls in the free-play observational variables, $F(7, 122) = 2.16; p = 0.042$, partial $\eta^2 = 0.11$); see Table 4. Follow-up analyses showed that this difference was small and specific to game transitions: girls made significantly more game transitions than boys during free play (Table 4). There was no significant multivariate gender X ADHD status interaction effect.

MANCOVA indicated a significant difference between the ADHD and comparison dyads in the free-play observational variables, $F(7,121) = 6.87$; $p < 0.001$, partial $\eta^2 = 0.29$; see Table 4). As expected, follow-up univariate ANCOVAs indicated that ADHD dyads were less engaged in cooperative play, displayed less companionship, and adopted fewer sensitive behaviors between friends than comparison dyads (hypothesis a;

Table 4 Descriptive statistics and two-way analysis of covariance results for dyadic free-play interactions by group (% Means with SDs in parentheses)

Category	Comparison Dyads ($n = 46$)	ADHD Dyads ($n = 87$)	Boys ($n = 101$)	Girls ($n = 32$)	Gender $F(1,129)$	Gender Effect Size[a]	ADHD Status $F(1,129)$	ADHD Status Effect Size[a]
Social play								
Solitary play	2.45 (5.06)	2.53 (5.33)	2.40 (4.99)	2.82 (5.97)				
Parallel play	13.80 (15.93)	30.90 (16.93)	25.27 (19.85)	24.11 (13.27)				
Associative play	0.70 (2.43)	0.62 (2.19)	0.61 (2.17)	0.78 (2.57)				
Cooperative play	*83.05 (16.84)*	*65.95 (19.24)*	*71.72 (21.62)*	*72.29 (14.61)*	*0.48*	*0.00*	*25.58****	*0.17*
Game transitions								
No transition	97.17 (4.67)	97.63 (3.65)	97.86 (3.57)	96.25 (5.08)				
At least one transition	*2.83 (4.67)*	*2.37 (3.65)*	*2.14 (3.57)*	*3.75 (5.08)*	*4.32**	*0.03*	*0.72*	*0.01*
Conflict								
No conflict	83.92 (17.35)	67.49 (19.47)	74.04 (19.02)	70.44 (23.96)				
At least one conflict	*16.08 (17.35)*	*32.51 (19.47)*	*25.96 (19.02)*	*29.56 (23.96)*	*1.03*	*0.01*	*18.85****	*0.13*
Balance of power/ communication								
Equal balance	70.69 (15.64)	65.84 (20.28)	66.81 (18.04)	69.73 (21.51)				
Unequal balance	*29.31 (15.64)*	*34.16 (20.28)*	*33.19 (18.04)*	*30.27 (21.51)*	*1.12*	*0.01*	*3.45* [b]	*0.03*
Companionship								
Low companionship	29.82 (24.36)	45.31 (31.84)	41.01 (31.36)	36.61 (26.78)				
High companionship	*70.18 (24.36)*	*54.69 (31.84)*	*58.99 (31.36)*	*63.39 (26.78)*	*0.41*	*0.00*	*8.16***	*0.06*
Sensitivity towards the friend								
Low sensitivity	22.65 (20.69)	42.14 (23.17)	36.87 (25.40)	30.78 (19.23)				
High sensitivity	*77.35 (20.69)*	*57.86 (23.17)*	*63.13 (25.40)*	*69.22 (19.23)*	*1.23*	*0.01*	*20.72****	*0.14*
Affect								
Positive	52.90 (20.61)	45.78 (22.71)	46.67 (21.51)	53.18 (23.90)				
Neutral	41.95 (20.42)	41.34 (21.80)	42.70 (21.16)	37.93 (21.50)				
Negative	*5.15 (6.94)*	*12.88 (9.89)*	*10.63 (9.69)*	*8.89 (9.69)*	*1.43*	*0.01*	*19.07****	*0.13*

Italicized variables (e.g., high sensitivity) are those used for hypothesis testing; the descriptive statistics of other non-italicized and linearly dependent variables (e.g., low sensitivity) are only presented here for heuristic purposes

[a] Effect size type: Partial η^2

[b] $p = 0.066$; *

$p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4). Results indicate that ADHD dyads spent twice as much time in parallel play (i.e., both friends were simultaneously playing different games) than comparison dyads. ADHD dyads were also significantly more engaged in conflict and exhibited significantly more negative affect than comparison dyads (hypothesis b; Table 4). ADHD dyads were, however, not more unequally balanced in terms of power/communication than comparison dyads (hypothesis b), despite some trend in the findings that did not correspond to conventional levels of statistical significance ($p = 0.066$; Table 4). There were no significant univariate differences between ADHD and comparison dyads in the proportion of game transitions (hypothesis b).

Discussion

The current observational study provided the first examination of the interaction patterns of children with and without ADHD with their *real-life* dyadic friends in a relatively unstructured free-play setting. We consider this critical given the undisputed importance of play and close friendship in children's development (Pellegrini 2011; Prinstein and Giletta 2016). It has also been posited that ADHD symptoms and related social behaviors could be highly impaired during such unstructured, free-play situation (Cordier et al. 2009). As mentioned previously, less structured situations may also offer some potential advantages in terms of ecological validity because children's play is typically characterized by free choice, intrinsic motivation and spontaneity (Burghardt 2011; Pellegrini 2009). The main results revealed not only differences in free-play patterns and dyadic behaviors between ADHD and comparison dyads, as we predicted, but also some interesting and unexpected similarities. The very fact that 27 potential participants with ADHD (and only 2 potential comparison children) were excluded because their parents reported that they had no friend with whom to participate in the study underscores the friendship problems of children with ADHD.

Reduced Positive Free-Play Features

We found strong support for hypothesis a. Results indicate that dyads comprising one referred child with ADHD and an invited friend (ADHD dyads) engaged in much less cooperative play than comparison dyads. It was particularly striking that ADHD dyads were more than twice as likely than comparison dyads to be involved in parallel play during unstructured time with their real-life friends (i.e., both friends were simultaneously playing different games). Parallel play requires less reciprocal interaction and less mutual planning and execution than does cooperative play (Pellegrini 2011). This result is consistent with previous observational studies showing that preschoolers with ADHD are less cooperative and more engaged in parallel play than typically developing children during playgroups with acquaintances (Alessandri 1992) or during free-play with previously unacquainted school-aged peers (Hubbard and Newcomb 1991). Our findings extend the results of these studies to show that this is equally the case in their play with their real-life friends. This is concerning because friends have to cooperate to ensure that both of their needs are equally satisfied when faced with the potential threat of relationship dissolution (Laursen and Bukowski 1997). Being less cooperative with their friend during unstructured free-play may partly explain why children with ADHD have trouble keeping their friends over time (Blachman and Hinshaw 2002; Marton et al. 2015; Normand et al. 2013). The fact that ADHD and comparison dyads spent about 2.5% of their time in solitary play (i.e., one child plays while the friend is engaged in a different activity) could possibly be explained by the participants' age (7–13 years old). Spending time in solitary play could possibly be more prevalent in younger dyads of children with or without ADHD and their friends than in school-aged dyads of friends (Coplan 2011).

The finding that ADHD dyads were characterized by less companionship is concerning because this dimension is likely to contribute to both the formation of new friendships and the enhancement and stability of existing ones (Asher et al. 1996). School-age children expect their friends to be good companions who provide enjoyable companionship (Bagwell and Schmidt 2011). This result also corroborates previous studies using self-report measures completed by children with ADHD and their friends (Normand et al. 2011, 2013), but not those of Blachman and Hinshaw (2002) who found that the ratings of girls with ADHD indicate no significant shortcomings in positive friendship features, including companionship. It is possible that gender partly explains the discrepancy in findings because girls (with and without diagnoses) are known to generally report more positive friendship features than boys (Prinstein and Giletta 2016). Another explanation for the discrepancy could be that Blachman and Hinshaw (2002) reported neither observational data nor friendship ratings by the friends of children with ADHD. The exclusive reliance on self-reports is insufficient for measuring friendship in any population, and is particularly problematic when studying children with ADHD. Researchers typically find minimal concordance between ratings of friendship by children with ADHD and other reliable sources of information (e.g., Hoza et al. 2005b), highlighting the importance of using multi-method and multi-informant approaches when measuring friendship (Bagwell and Schmidt 2011).

The less sensitive approach of children with ADHD during free play with friends is also troublesome because sensitivity between friends predicts children's friendship quality (Normand et al. 2013) and stability (Fonzi et al. 1997). This finding is in line with previous observational studies of dyads of previously unacquainted (Hubbard and Newcomb 1991) or familiar school-aged playmates children during free play (Cordier et al. 2010), and dyads of real-life friends during structured analogue tasks (Normand et al. 2011, 2013).

These findings are also consistent with other studies showing that children with ADHD have poorer social perspective-taking skills than non-diagnosed children (Marton et al. 2009). That children use approaches that lack sensitivity may reflect a general inability to acknowledge and respond to their friends' social cues, needs, and preferences.

Greater Negative Features of Free Play

Our findings provided partial support for hypothesis b. As expected, the finding that one third (32%) of ADHD dyads' interactions were conflictual during free play (vs. 16% of comparison dyads' interactions) is notable. They replicate, with somewhat enhanced ecologically validity in a free-play setting, previous findings that children with ADHD more frequently disagreed with their friends' suggestions while negotiating with them than comparison children in highly structured, conflict-provoking tasks (Normand et al. 2011).

As expected, our findings that ADHD dyads exhibited significantly more negative affect than comparison dyads during free play (twice as much) are consistent with those of Al-Yagon (2016), who discovered that adolescents with comorbid ADHD and learning disorders self-reported more negative affect in their close relationships with peers, teachers and parents than did participants with learning disorders only and participants without any diagnosed disorder. Our findings are, however, in sharp contrast to those of Normand et al. (2011) who found that there were no significant findings with regard to negative affect displayed by children with and without ADHD in three highly structured, analog tasks (Normand et al. 2011). If replicated, the results of our current study may suggest that children with ADHD are at greater risk to display negative affect in unstructured settings (such as free play) than in highly rewarding or structured environments with their friends (Cordier et al. 2009; Normand et al. 2011). This is worrisome given that negative affect is an important predictor of peer victimization in children with and without ADHD (Fogleman et al. 2016).

Interestingly, and contrary to hypothesis b, ADHD dyads did not show more discontinuity in their play (i.e., more game transitions) than other dyads. This contrasts with the results of Alessandri (1992), who found that preschoolers with ADHD were involved in more off-task transitional activity than children without ADHD while playing with matched preschool playmates without ADHD across a 6-week period in groups at a university-based preschool program. One possible reason for this is that game transitions may occur more frequently during the preschool period than during the school-age period (Pellegrini 2011). It is also possible that real-life dyadic friends (with or without ADHD) show greater continuity in their play generally than matched "playmates" in a group brought together for research. Also, our 10-min time frame may have been too short to show group differences in game transitions. Although we found that girls made significantly more game transitions than boys during free play, it is important to note that only 3.75% of girls' and 2.14% of boys' interactions included game transitions, indicating that these were rare overall.

Similarly, and contrary to our hypothesis b, ADHD dyads were no more likely than comparison dyads to have an unequal balance of power (although there was a non-significant trend in that direction). This result could be interpreted as somewhat reassuring because controlling behaviors towards a friend is one reason often provided by children to explain friendship dissolution (Parker and Seal 1996). This result, however, differs from those of Cunningham and Siegel (1987) who found that previously unacquainted ADHD dyads showed higher levels of controlling behaviors than typically developing dyads. It is also in sharp contrast with the closed-field research findings of Normand et al. (2011) who showed that children with ADHD adopted a more controlling problem-solving approach than typically developing children while negotiating a limited resource with their friends. Although speculative, it is possible that the controlling behaviors of children with ADHD are heightened in structured situations of potential conflict than they are in free-play or low-demand settings (Roberts et al. 2014). For example, Normand et al. (2011) presented each dyad with a selection of trading cards featuring a variety of sports personalities, cartoon characters and popular artists. Perhaps that the authors' analog situation, which required children to decide how to share an unequal number of desired trading cards, provided accelerated access to important friendship features, such as balance of power/communication, that might not occur while natural, free play is observed.

Limitations and Implications for Future Research

The present findings must be interpreted in the context of some limitations. First, though representative of the local population, the sample population in the current study was largely homogeneous (90% Caucasian). Thus, the findings of the current study should be replicated in a more ethnically diverse community before generalizations can be made.

Second, our cross-sectional, correlational design does not allow us to explain the origins of the friendship problems of children with ADHD during free play. However, more general literature on the peer relationships of children with ADHD suggests that different deficits within children with ADHD (e.g., inappropriate social behaviors, emotional dysregulation, and sociocognitive deficits) may prevent them from forming reciprocal and stable friendships (Mikami and Normand 2015). In their recent review, Mikami and Normand (2015) also posit that it is essential to also consider different peer group factors (e.g., peers' stigmatizing attitudes, exclusionary behaviour, and persistent negative impressions toward children with ADHD) that may also contribute to peer and friendship impairment for

children with ADHD. Longitudinal, experimental designs are warranted to better understand why and how children with ADHD may engage in poor-quality free play with their friends and how this influence their adjustment over time. For example, the findings from this cross-sectional study would be greatly enriched if presented in the context of predictive utility of earlier play patterns, negative affect, and friendship abuse.

Third, while our free-play task may have offered some potential advantages in terms of ecological validity, our observations were conducted in a University lab. Collecting data in a home or other play settings could be a challenging yet worthwhile future endeavor, even though there are still contextual and temporal constraints on play in those settings as well. Another direction for future research is to extend the observational period beyond 10 min, perhaps using a time sampling approach (see Chorney et al. 2014).

Fourth, our results did not seem to vary according to gender, age, ADHD presentation, comorbidities, medication status, dyadic composition status (i.e., dyads with 1 vs. 2 children with ADHD), length of friendship status and "best friends-only dyads" status. The lack of stronger findings for relationship problems among participants with both ADHD and oppositional behaviors is somewhat surprising given that oppositional behaviors can be highly alienating. It is also important to note that 84% of referred children with ADHD and 89% of comparison children participated in the research session with their best friends; thus, it is possible that our conclusions can only be generalized to dyads of best friends. However, our exploratory findings of dyads of "best friends" were virtually identical to those obtained with the full sample in the main analyses. Overall, it is premature to make firm conclusions on these supplementary analyses given their limited statistical power. The vast majority of studies regarding the friendships of youth with ADHD, including the current study, have been conducted among school-age boys and the results regarding the effects of the various ADHD presentations and comorbidities are conflicting (Becker et al. 2012). Future research with larger samples is needed to draw reliable conclusions about the possible role of gender, age, ADHD presentation, comorbidities, medication, dyadic composition status, length of friendship, and friendship status on the challenges that youth with ADHD face with their real-life friends during free play.

Implications for Clinical Practice

Whereas evidence-based treatments for ADHD symptoms are often effective in improving children's inappropriate behaviors, this rarely leads to increased peer acceptance and befriending (Hoza et al. 2005a). Similarly, there is now a consensus among clinical researchers that social skills training is ineffective for children with ADHD (Evans et al. 2013). Despite those disappointing conclusions, a focus on friendship in intervention with children with ADHD still seems indispensable given our findings and others in the literature.

Play is an important context for fostering children's friendships (Coplan and Arbeau 2009). Current literature suggests that parents could play an important role in influencing children's friendships during play in various ways. For example, parents could organize fun and rewarding playdates with potential friends (Mikami et al. 2010b). More specifically, parents could also teach their children how to behave in a way that promotes friendship during playdates. Parents could also be taught to give in-vivo reminders to their children to improve treatment generalization (Mikami et al. 2010b). Unfortunately, parents of children with ADHD are less naturally inclined to organize playdates to facilitate friendships. In spite of this, the friendship facilitating behaviors of parents during playdates are more strongly related to positive peer relationships for children with ADHD than for typical children (Mikami et al. 2010a). Thus, engaging parents could be a promising component to include in programs targeting the friendship problems of children with ADHD. Mikami and colleagues developed such an intervention, known as Parental Friendship Coaching, in order to involve parents as intervention agents (Mikami et al. 2010b). This parent-based approach may emerge as more effective than social skills training in results of trials under way. There have also been a number of attempts at working therapeutically with pairs of friends or potential friends (i.e., Pair Therapy; Selman et al. 1997). This dyadic approach has strong theoretical appeal but awaits empirical validation of its effectiveness in enhancing the real-life friendships of children with ADHD.

It is important to remember that about a quarter of the participating children with ADHD had a friend with elevated ADHD symptoms compared to 0% of the comparison sample (see Normand et al. 2011), as it indicates that comparison children may avoid ADHD children as potential friends (Hoza et al. 2005b). Our results also provide some evidence that the presence of a second child with ADHD within a friendship dyad probably did not result in more dysfunctional dyadic interactions, at least during free play. Of course, we do not know anything about the adjustment of the members of these dyads before the study or exactly how, or to what degree, they may have influenced each other. However, we might speculate that, if they had influenced each other negatively, the members of dyads in which both members were children with ADHD would probably be more maladjusted than members of "mixed" dyads in which only one child had ADHD, which was not the case. This may mean that the negative contagion that some authors fear when children with externalizing disorders are grouped together may not be as general as those authors fear. Whether this is applicable to social skills training programs (Mikami 2015) or behavioral peer interventions in recreation settings that often include several children with ADHD in larger groups (e.g., Summer Treatment

Programs [STP]; Pelham and Hoza 1996) is an empirical question that awaits further research.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in the study involving human participants were in accordance with the ethical standards of the University of Ottawa and Children's Hospital of Eastern Ontario institutional research committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included.

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