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Journal of Attention Disorders 2012 16: 491 originally published online 13 April 2011
DOI: 10.1177/1087054711401346

Journal of Attention Disorders
16(6) 491–504

DOI: 10.1177/1087054711401346
http://jad.sagepub.com
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Abstract

Objective: This study examined social information processing (SIP) of events with varied outcomes in children with ADHD and conduct problems (CPs; defined as oppositional defiant disorder [ODD] or conduct disorder [CD]) and controls. **Method:** Participants were 64 children (46 boys, 18 girls) aged 6 to 12, including 39 with ADHD and 25 controls. Vignettes were developed that systematically varied with regard to peer intention (ambiguous, negative, positive) and event outcome (ambiguous, negative, positive), and were used to evaluate participants' SIP abilities (cue encoding, interpretation, and response generation). **Results:** Results showed that, after controlling for CPs, children with ADHD detected fewer positive, negative, and neutral cues; attributed more negative and less positive intent to peers; focused less on situational outcomes of vignettes; and generated fewer positive responses compared with the control group. **Conclusion:** These results indicate that children with ADHD differ from non-ADHD children, even after controlling for CPs, in how they process positive and negative social experiences. (*J. of Att. Dis. 2012; 16(6) 491-504*)

Keywords

social information processing, ADHD, ODD, CD, prosocial, social cognition

Numerous studies have related information-processing deficits to aggressive behavior (Crick & Dodge, 1996), to peer rejection (Coie, Dodge, & Kupersmidt, 1990; Milich & Dodge, 1984), and to a lesser extent diagnosed disruptive behavior disorders (DBD; Dodge, 1993; Dodge, Pettit, Bates, & Valente, 1995; King, Waschbusch, Pelham, Frankland, Andrade, et al., 2009; Landau & Milich, 1988; Lochman & Dodge, 1994; Milich & Dodge, 1984; Moore, Hughes, & Robinson, 1992). Research in this area has been spurred by well-supported models of social cognition, including social information processing (SIP) theory (Crick & Dodge, 1994; Dodge, Pettit, McClasky, & Brown, 1986). This comprehensive model postulates that children rapidly proceed through six information-processing steps when they are presented with social situations: (a) encoding of external and internal cues, (b) interpretation of attributions in relation to self and others, (c) clarification of goal states, (d) accessing or generating responses, (e) deciding on a response, and (f) enacting the chosen response. These steps occur in conjunction with a "database" of stored memories that guide all processes.

Although each step is important, the encoding, interpretation, and response-generation steps have received considerable attention in terms of understanding social behavior. There is now clear and consistent evidence that these aspects of SIP are significantly associated with aggressive behavior in children (e.g., Dodge, Laird, Lochman, Zelli, & Conduct Problems Prevention Research Group, 2002). Specifically, research has shown that children with high rates of aggressive behavior tend to (a) pay less attention to relevant social cues, (b) interpret the motives of others in a more hostile manner when the outcome of

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the social situation is negative and the peer's intent is ambiguous, and (c) generate aggressive, hostile responses to social situations.

To date, SIP models have primarily been applied to understand the social-cognitive abilities of children with aggressive behavior, but several facts suggest that SIP theory may also help in understanding children with ADHD. First, the characteristic symptoms of ADHD (i.e., inattention, hyperactivity, and impulsivity) are likely related to SIP abilities. That is, children who are inattentive should attend to fewer or less-relevant social cues, and children who are impulsive should spend less time generating possible responses to social situations. Second, children with ADHD are often rejected by peers (Hoza, 2007; McQuade & Hoza, 2008; Pelham & Bender, 1982), and rejected children often have impaired SIP abilities (Dodge et al., 1986; Dodge & Price, 1994). This raises the possibility that impaired SIP abilities account for the peer rejection among children with ADHD. Third, and most persuasive, available research shows that children with ADHD have cue-encoding deficits that parallel those of reactively aggressive children (Matthys, Cuperus, & Van Engeland, 1999; Milich & Dodge, 1984; Moore et al., 1992), have biased interpretations of social information (Milich & Dodge, 1984; Moore et al., 1992; Murphy, Pelham, & Lang, 1992), and generate more inappropriate and fewer social responses than children without ADHD (King, Waschbusch, Pelham, Frankland, Andrade, et al., 2009; Matthys et al., 1999; Milich & Dodge, 1984; Murphy et al., 1992). These facts suggest that children with ADHD often have biased SIP.

Although much has been learned about SIP in children with ADHD, additional research is needed. To date, research on SIP in children with ADHD has focused exclusively on how they process information from social situations that have a negative valence—that is, social situations in which the target child experiences a negative outcome. These situations are clearly important, but understanding situations with a positive valence or with an ambiguous valence may also be important because how children process positive social information may be associated with the development of prosocial behavior and positive peer relationships just as biased negative information processing is associated with hostile behavior (Nelson & Crick, 1999). The important impact of prosocial behavior on child development has long been established (Eisenberg, Fabes, & Spinrad, 2006); however, the cognitive correlates of prosocial behavior are not well understood. Limited evidence suggests that compared with their peers, prosocial youth have less negative and more positive social-cognitive abilities (Nelson & Crick, 1999; Warden & MacKinnon, 2003). These findings argue that there are important differences between positive and negative aspects of social functioning and associated differences in positive social cognition; however, no research has examined whether children with ADHD differ in their positive SIP abilities compared with controls.

Evaluating positive SIP may be especially important in children with ADHD because they exhibit lower rates of prosocial behavior when interacting with peers (Cunningham & Siegel, 1987; Whalen et al., 1989). Likewise, boys with ADHD demonstrate less empathy than boys without ADHD (Braaten & Rosen, 2000), and attention has been described as a key component of empathic responding in normal developmental processes (Eisenberg et al., 2006). Finally, there is evidence that ADHD symptoms may account for deficits in prosocial behavior commonly reported in children with conduct problems (CPs; Hay, Hudson, & Liang, 2010). These studies suggest that children with ADHD may experience deficits in their ability to process social information in situations containing positive outcomes; however, research to date has only investigated SIP using social vignettes that have negative outcome valences. The present study extends current understanding of children's SIP by examining information-processing abilities of children with ADHD in situations that contain combinations of positive, negative, and ambiguous social information.

When examining how the valence (positive, negative, ambiguous) of social situations influences children's SIP, it may be important to distinguish between social intention and social outcome. We define intention as what the peer meant (or intended) to do to the target child. Intent information is inferred by the child based on their interpretation of the information cues in a social situation. In contrast, outcome information is concrete and represents what actually happened to the target child. For instance, if a peer meant to give the target child a cold drink but instead spilled it on his or her shirt, the intention could be described as positive but the outcome as negative. However, if the peer meant to throw a cold drink on the target child's shirt and then did so, both the intent and outcome could be described as negative. This example illustrates a few key points. First, the intent and outcome of social situations can, and likely should, be distinguished from each other when examining SIP. Second, the valence of intentions and outcomes can independently vary from positive to ambiguous to negative. Third, intentions and outcomes may provide different information to children and thus, result in different impacts on social behavior. Importantly, no research has systematically varied the valence of intention and outcome when examining children's SIP. Separately assessing interpretations of intent and outcome in positive, negative, and ambiguous situations may provide a more representative estimation of children's SIP in situations encountered in their daily life.

The purpose of this study was to investigate differences in specific aspects of SIP between children with ADHD and typically developing children using hypothetical social

Table 1. Means (Standard Deviations) or Percentages for Demographic and Rating Scale Measures as a Function of Group

Measure	Control (n = 25)	ADHD (n = 39)	Statistical test
Age (years)	9.2 (1.9)	9.4 (1.6)	$F = 0.24$
Gender (% male)	64.0%	76.9%	$\chi^2 = 1.26$
Socioeconomic status[a]	52.0$_a$ (14.9)	47.5 (11.8)	$F = 1.81$
DBD symptom counts[b]			
Inattention	0.3 (0.8)	7.7 (2.4)	$F = 228.26$[d]
Hyperactive/impulsive	0.4 (1.0)	7.5 (2.0)	$F = 266.67$[d]
Oppositional defiant	0.2 (0.5)	6.0 (2.3)	$F = 155.76$[d]
Conduct disorder	0.0 (0.0)	2.7 (2.6)	$F = 25.71$[d]
Impairment Rating Scale[c]			
Peer relationships	0.2 (0.8)	4.8 (1.8)	$F = 142.08$[d]
Getting along with adults	0.4 (0.9)	4.8 (1.6)	$F = 152.46$[d]
School functioning	0.3 (1.0)	4.9 (1.6)	$F = 161.65$[d]
Self-esteem	0.6 (1.5)	4.8 (1.8)	$F = 94.10$[d]
Overall impairment	0.6 (1.4)	5.2 (1.4)	$F = 156.67$[d]

Note: DBD = disruptive behavior disorders.
[a]Socioeconomic status for occupations in Canada (Blishen, Carroll, & Moore, 1987).
[b]Number of symptoms endorsed by parents or teachers on the Disruptive Behavior Disorder Rating Scale (Pelham et al., 1992).
[c]Maximum score across parent and teacher ratings on the Impairment Rating Scale (Fabiano et al., 2006).
[d]ADHD and controls differ at $p < .05$.

situations designed to systematically vary in the valence (positive, negative, ambiguous) of intent and outcome. To accomplish this purpose, new hypothetical social vignettes allowing for the evaluation of different intent and outcome valence combinations were developed and validated as a measure of children's SIP abilities. Next, these vignettes were used to evaluate SIP abilities (cue detection, interpretation, and response generation) in children with and without ADHD. It was hypothesized that compared with controls, children in the ADHD group would (a) encode fewer total cues across all vignettes categories, (b) encode fewer positive cues in vignettes that contain positive social information, (c) make more negative intent attributions in vignettes that contain ambiguous and negative social information, (d) make less positive and more negative intent and outcome attributions in vignettes that contain ambiguous and positive social information, and (e) generate more negative and less positive responses in all vignettes, regardless of valence of intent and outcome. Furthermore, these differences would remain even after controlling for co-occurring CP. Finally, it was hypothesized that information-processing deficits shown by children with ADHD would be robust across different vignettes.

Method

Participants

Participants were 64 children, including 46 boys and 18 girls, who ranged from 6 to 12 years of age ($M = 9.32$, $SD = 1.75$). Thirty-nine children were diagnosed with ADHD and 25 were typically developing children without ADHD, oppositional defiant disorder (ODD), or conduct disorder (CD; controls). Rating scale and demographic characteristics for ADHD and control participants are summarized in Table 1.

The majority (n = 31) of children with ADHD were recruited through a treatment program in eastern Canada, and the remaining eight were recruited through community advertisements. ADHD, ODD, and CD were diagnosed using *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) criteria as evaluated using several sources of information. First, symptom counts were computed for each child and were considered present if they were endorsed by either parent or teacher on the DBD Rating Scale or by parent response on the *DSM-IV* version of the Diagnostic Interview Schedule for Children (DISC). Next, impairment was evaluated using parent and teacher ratings on the Impairment Rating Scale. Finally, diagnoses were made by doctoral-level clinicians if a sufficient number of symptoms were endorsed (using symptom-count criteria specified in the *DSM-IV*) and if there was evidence of clinically significant impairment. Specifically, a diagnosis of ADHD-inattentive type was assigned if at least 6 of the 9 inattention symptoms were endorsed, a diagnosis of ADHD-hyperactive/impulsive type was assigned if at least 6 of the 9 hyperactive/impulsive symptoms were endorsed, and a diagnosis of ADHD-combined type was assigned if both of these conditions were met. Likewise, a diagnosis of ODD was assigned if at least 4 of the 8 ODD symptoms were

endorsed, and a diagnosis of CD was assigned if at least 3 of the 15 CD symptoms were endorsed. In all cases, children also had to show evidence of impairment, although this was always the case for children who met symptom-count criteria. Of the children with ADHD, 84.6% ($n = 33$) met criteria for ADHD-combined type, 7.7% ($n = 3$) met criteria for ADHD-inattentive type, and 7.7% ($n = 3$) met criteria for ADHD-hyperactive/impulsive type. All but one child with ADHD also met criteria for ODD ($n = 20$, 50.3%) or CD ($n = 18$; 46.2%). Based on previous research suggesting that stimulant medication may have acute effects on SIP (King, Waschbusch, Pelham, Frankland, Andrade, et al., 2009), all children with ADHD were unmedicated for at least 12 hr prior to their participation.

The control children ($n = 25$) were recruited through parent response to posters, public service announcements on the radio and in the newspaper, and through a university information service. Control children were screened for mental health problems using information obtained from the DISC-IV and DBD Rating Scale. In addition, parents of control children were queried by interview to determine whether their children had ever received intervention for behavioral or learning difficulties. Children with evidence of current or past behavior or learning problems were excluded from participation.

Procedure

Procedures used in the study were approved by a university institutional review board. Parents gave written, informed consent and children gave assent before participating in the study.

SIP measures were administered during a 40 to 60 min session with a trained research assistant. Frequent breaks were taken to reduce fatigue and to maintain a high level of engagement. Children were rewarded for completion of each vignette by a sticker of their choice and at the end of the activity by a small reward of their choice (e.g., sticker packet or toy). Parents completed diagnostic and behavior ratings. For children recruited from the treatment program, parent measures were completed pretreatment and child (SIP) measures were completed during treatment. For children recruited from the community, parent and child measures were completed at the same time in separate rooms with different research assistants.

Diagnostic and Screening Measures

DBD Rating Scale. The DBD Scale measures *DSM-IV* symptoms of ADHD, ODD, and CD (Pelham, Gnagy, Greenslade, & Milich, 1992) with well-supported reliability and validity (Pillow, Pelham, Hoza, Molina, & Stultz, 1998; Wright, Waschbusch, & Frankland, 2007). Items are rated using Likert-type scales that range from 0 (*not at all*) to 3 (*very much*), with symptoms rated 2 or 3 considered present in the child. Internal consistency (α) reliability estimates for the DBD scales in this sample were ADHD-inattention = .98, ADHD-hyperactive/impulsive = .97, ODD = .97, and CD = .88.

National Institute of Mental Health (NIMH) DISC-IV. The DISC-IV is a structured clinical interview designed to provide *DSM-IV* diagnoses of major mental health disorders in children aged 6 to 17 (NIMH-DISC Editorial Board, 1999). The computerized version of the DISC-IV was self-administered by parents unless the parent had reading or language problems, in which case, the computerized version was administered by a clinician or trained research assistant. A CP score was computed from the DISC-IV by summing the number of ODD and CD symptoms that were endorsed ($M = 3.93$, $SD = 4.09$, $\alpha = .92$).

Impairment Rating Scale (IRS). The IRS measures the child's current functioning and need for treatment in several developmentally important areas, including peer relationships, teacher and parent relationships, academic/school functioning, self-esteem, and overall adjustment (Fabiano et al., 2006). Items are evaluated using visual-analogue scales that are scored using a 0 (*no problems*/*no need for treatment*) to 6 (*severe problems*/*definitely needs treatment*) metric. Alphas are not reported for the IRS as each item is scored separately, but the reliability and validity of the IRS have been supported in several samples. For instance, in one sample (Fabiano et al., 2006), 1-year test–retest reliability correlations for teacher ratings on the IRS ranged from .40 to .67 and interrater (parent and teacher) reliability correlations ranged from .47 to .64 with criterion-validity correlations ranging from .44 to .80.

Development of SIP Vignettes

Following earlier research (Dodge & Price, 1994), the SIP vignettes used in this study were developed in three steps: (a) vignette construction, (b) expert review, and (c) vignette validation. These steps are described next.

Vignette construction. Thirty-five vignettes were initially developed for examination. These vignettes described social situations involving peers participating in activities such as sports, game-play, sharing, cooperating, playground and school yard accidents, and other common childhood social scenarios. The vignettes were designed to vary with regard to peer intent and situation outcome as follows: (a) *positive* (2 vignettes)—positive intent with positive outcome. The peer in the story meant to do something positive (had a positive intention), and his or her action produced a positive outcome for the participant; (b) *negative* (2 vignettes)—negative intent with negative outcome. The peer in the story meant to do something negative (had a negative intention),

and his or her action produced a negative outcome for the participant; (c) *ambiguous* (10 vignettes)—ambiguous intent with ambiguous outcome. It was unclear what the peer in the story intended to do (ambiguous intent), and his or her behavior produced a neutral outcome (neither good nor bad) for the participant; (d) *ambiguous-positive* (14 vignettes)—ambiguous intent with positive outcome. The intention of the peer was unclear, but his or her behavior produced a positive outcome for the participant; and (e) *ambiguous-negative* (7 vignettes)—ambiguous intent with negative outcome. The intention of the peer was unclear but his or her behavior produced a negative outcome for the participant. Four of the ambiguous-negative vignettes were identical to those used in previous research (Dodge & Frame, 1982; Dodge & Price, 1994) and the remaining 31 vignettes were novel to this study. A larger number of ambiguous and ambiguous-positive vignettes were developed because they were novel to this study, and we wished to maximize the probability of obtaining valid vignettes.

Expert review. The 35 vignettes were submitted to an expert review. Experts consisted of four PhD-level university faculty who had expertise in child development and developmental psychopathology. After agreeing to participate, experts were given a questionnaire containing the 35 potential vignettes and were asked to independently rate (forced choice) the intention of the child and the outcome of the situation as positive, negative, or ambiguous. Participants were asked to consider intent and outcome as independent constructs and not let one rating influence the other.

Expert ratings showed 100% agreement for 22 vignettes on intention ratings and for 12 vignettes on outcome ratings. Experts also showed 75% agreement for 9 vignettes on intention ratings and for 10 vignettes on outcome ratings. Less than 75% agreement was found for other vignettes, and these were dropped from further analysis. Vignettes with 75% or greater agreement on intention and outcome ratings were further refined during panel discussion with experts who completed the review. Additional 3 vignettes were also developed during this panel discussion. After the expert review (including the discussion), 38 vignettes were produced.

Vignette validation. Finally, the validity of the 38 vignettes was evaluated using ratings collected from 14 advanced (4th or 5th year) psychology graduate students who were naive to the purpose of the study. The use of student ratings of vignette valence has been successfully used in previous research to validate SIP measures (e.g., Dodge & Frame, 1982; MacBrayer, Milich, & Hundley, 2003). After volunteering to participate, graduate students completed ratings on an electronic version of the 38 vignettes produced by the expert review. These vignettes were broken into two parts; the first part represented the intention of the child in the vignette, and the second part represented the outcome of the vignette. Students rated the valence of each part (independently) using 5-point Likert-type scales that ranged from 1 (*very much positive*) to 5 (*very much negative*). These ratings were used to select 20 vignettes that best distinguished the valence (positive, negative, ambiguous) of the intention and outcome (details available from the first author). The final 20 vignettes used in the study consisted of 4 vignettes for each of the five intention/outcome combinations (positive, negative, ambiguous, ambiguous-positive, and ambiguous-negative).

SIP Administration

Children were instructed to pretend that they were the protagonist in the story, following which they were to read a vignette (described above) in which they experienced positive, negative, or neutral outcomes due to a peer's behavior that was clearly positive, clearly negative, or ambiguous (not clearly positive or negative). After the story, children were asked a series of questions that were designed to evaluate different aspects of their SIP. These questions were partly derived from previous research (Crick & Ladd, 1990; Dodge, 1980; Dodge & Frame, 1982; Rubin & Krasnor, 1983) and included the following:

1. What happened in the story?
2. How could you tell whether this was a nice way to act or a mean way to act?
3. What could you say or do if this happened to you? Tell me as many ways as you can.

After Question 3 was asked, children were prompted by the examiner to "please tell me some more ways." This prompt was given until children clearly did not have any more responses.

All responses were transcribed during the interview and each interview was video recorded to verify accuracy of written content. Interviews were conducted by one master's level psychology student and one advanced undergraduate student.

SIP Response Coding

SIP responses were coded by two advanced undergraduates who were naive to the study purpose and diagnostic status of participants. Training involved detailed instruction of code types and code categories, including examples of prototypic responses that did and did not meet criteria for different codes. Ongoing consultation with the primary author was provided to resolve any questions. Coding was used to measure the participant's cue detection, intent and outcome attributions, and response generation using procedures described below. Following the experimental design,

codes were scored as a function of the five vignette types (positive, negative, ambiguous, ambiguous-positive, and ambiguous-negative) and the three code valences (positive, negative, and neutral), resulting in 15 scores for each type of social information (except as noted elsewhere).

Cues detected. Cues detected by participants were coded from answers to Question 1 (i.e., "What happened in the story?"). Coders were provided with a list of cues and asked to indicate those that were present in the response. Cue content within vignettes was determined using a three-step process. First, the first author developed a list of cues contained within each vignette. Second, four individuals naive to the study classified each cue as positive, negative, or neutral. Third, these classifications were reviewed and compared with the investigators a priori judgments. Minimal discrepancies in classifications were found and these were resolved by discussion. The total number of cues detected (regardless of valence) and the percentage of positive, negative, and neutral cues detected (out of total cues present) were computed for each vignette.

Intent and outcome attributions. Intent and outcome attributions were derived from answers to Question 2 ("How could you tell whether this was a nice way to act or a mean way to act?"). Intent attribution was coded if participants focused on the *reason* or the *purpose* for which the child in the vignette committed an action. A response coded as an intent attribution *implied* a thought process of the child in the vignette; however, the thought process was not included in the vignette. For example, a participant's response coded as intent was "Sam is mean because he does not like me" or "Sam is mean because he is mean to a lot of kids." These responses refer to Sam's thought processes that were not described in the vignette (i.e., Sam wanting to be mean to a lot of kids). Outcome attribution was coded if participants focused on an *action* that occurred in the vignette. For example, outcome was coded if a participant responded "Sam was mean because *he shoved me*" or "Sam was nice because *he shared his Gameboy™ with me*." Intent and outcome attributions were coded as positive, negative, or neutral. The total number of each type of attribution (positive, negative, neutral) were summed separately for intent and outcome and separately for each type of vignette.

Response generation. Response generation was derived from answers to Question 3 ("What could you say or do if this happened to you? Tell me as many ways as you can."). Responses generated were coded as positive, negative, or ambiguous. The total number of responses (regardless of valence) and the proportion of positive versus negative versus neutral responses (out of total responses generated) were computed for each type of vignette.

Reliability. Internal consistency was computed within each type of vignette using Cronbach's alpha. Results were as follows: cues detected (α = .94), intent attributions (α = .81), outcome attributions (α = .83), and responses generated (α = .93). Interrater reliability was evaluated by having the two coders overlap on a randomly selected 33% of the participants and was examined in two steps. First, paired sample *t* tests were used to compare the two coders and showed that scores did not differ between them—total cues detected, $t(19) = -0.76$, $p = .455$; total intent attributions, $t(19) = -0.37$, $p = .717$; total outcome attributions, $t(19) = -0.58$, $p = .871$; total responses generated, $t(19) = -2.01$, $p = .059$. Second, Pearson correlations were computed and were acceptable for cue detection (total $r = .97$, $p < .001$; positive $r = .95$, $p < .001$; negative $r = .93$, $p < .001$; neutral $r = .96$, $p < .001$), intent attributions (total $r = .64$, $p < .001$; positive $r = .59$, $p < .001$; negative $r = .71$, $p < .001$), outcome attributions (total $r = .76$, $p < .001$; positive $r = .80$, $p < .001$; negative $r = .69$, $p < .001$), and response generation (total $r = .95$, $p < .001$; positive $r = .85$, $p < .001$; negative $r = .68$, $p < .001$). Interrater reliability for neutral intent attributions, neutral outcome attributions, and neutral response generation were not acceptable (rs ≤ .27) most likely because of the fact that they infrequently occurred and were thus dropped.

Analytic Plan

Data were examined using a series of repeated measures ANCOVAs with group (ADHD vs. control) included as a between-participants factor, vignette (positive vs. negative vs. ambiguous vs. ambiguous-positive vs. ambiguous-negative) included as a within-participants factor, and CPs (defined as the total number of ODD and CD symptoms endorsed by parent on the DISC-IV) included as a covariate. Other measure-specific factors were also included in the ANCOVAs as described below. Significant interactions were followed up with simple effects tests and by computing standardized mean difference effect sizes (Hedges's *g*) as follows: (ADHD *M* – Control *M*)/pooled *SD*. Effect sizes were computed using means adjusted for the covariate. To save space, only significant effects involving group were followed up.

Results

Cue Detection

Total cues detected. Total cues detected were examined using a 2 (group) × 5 (vignette) ANCOVA and resulted in significant main effects of vignette, $F(4, 244) = 25.75$, $p < .001$, and group, $F(1, 61) = 8.08$, $p = .006$. After controlling for CPs, control children detected more cues than children with ADHD (control: $M = 13.02$, $SD = 3.59$; ADHD: $M = 10.12$, $SD = 3.43$; Hedges's $g = -0.83$).

Valence of cues detected. The proportion of positive versus neutral cues detected in positive vignettes was

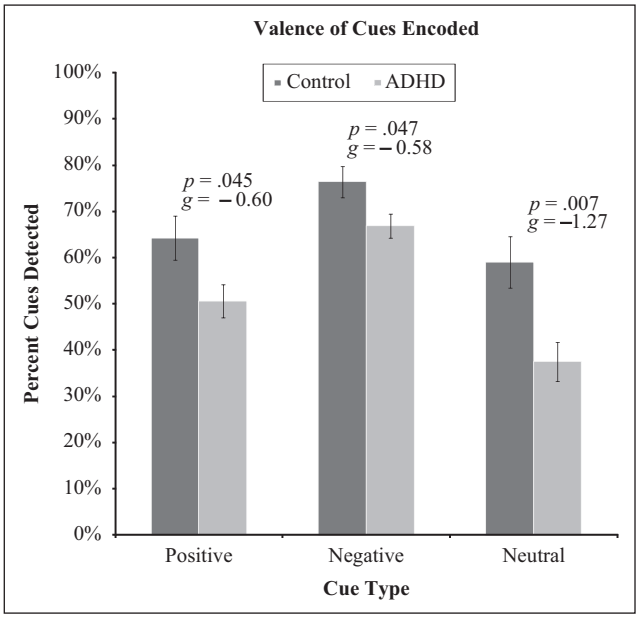

Figure 1. Proportion of positive, negative, and neutral cues detected as a function of group
Note: *p* = *p* value from simple effects tests; *g* = Hedges's *g* effect size.

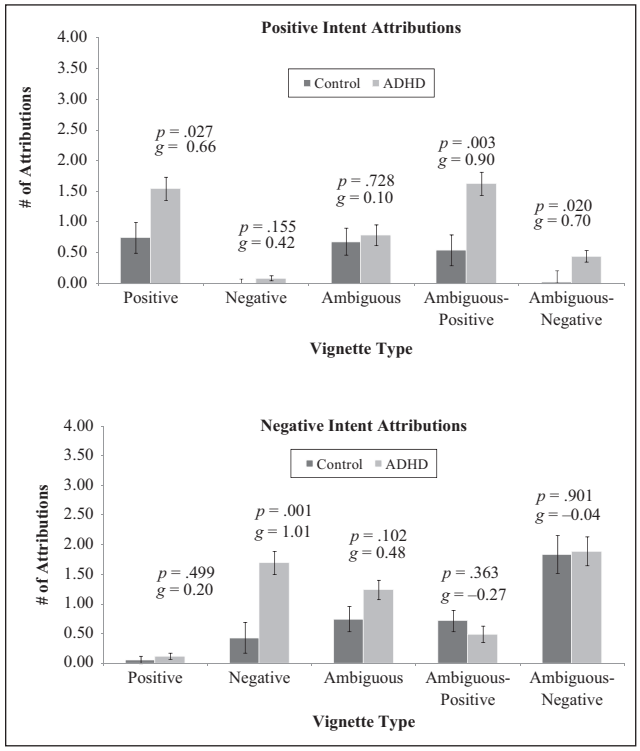

Figure 2. Number of positive (top graph) and negative (bottom graph) intent attributions as a function of group and vignette type
Note: *p* = *p* value from simple effects tests; *g* = Hedges' *g* effect size.

examined using a 2 (group) × 2 (cue: positive vs. neutral) ANCOVA. These data were examined separately from other cue data because, by design, there were no negative cues in the positive vignettes. There was a significant main effect of group, $F(1, 61) = 10.82$, $p = .002$, which showed that after controlling for CPs, control children detected a higher proportion of cues than did children with ADHD (control: $M = 0.66$, $SD = 0.21$; ADHD: $M = 0.46$, $SD = 0.20$, Hedges' $g = –0.98$). The 2 (group) × 3 (cue) × 4 (vignette) ANCOVA examining the remaining vignettes resulted in significant main effects—vignette: $F(3, 183) = 5.11$, $p = .002$; cue: $F(2, 122) = 36.87$, $p < .001$; group: $F(1, 61) = 6.33$, $p = .015$—and two-way interactions—Cue × Group: $F(2, 122) = 3.43$, $p = .036$; Vignette × Cue: $F(6, 366) = 15.02$, $p < .001$. As illustrated in Figure 1, after adjusting for CPs, control children detected a significantly larger proportion of positive, negative, and neutral cues than did children with ADHD, but the difference was largest for neutral cue detection.

Intent and Outcome Attributions

Intent and outcome attributions were examined using a 2 (group) × 5 (vignette) × 2 (attribution type: intent vs. outcome) × 2 (attribution valence: positive vs. negative) ANCOVA. There was a significant main effect of vignette, $F(4, 244) = 2.57$, $p = .039$); significant two-way interactions, Attribution Type × Group: $F(1, 61) = 13.79$, $p < .001$; Attribution Type × Vignette: $F(4, 244) = 16.30$, $p < .001$; Vignette × Attribution Valence: $F(4, 244) = 132.03$, $p < .001$; and a significant three-way interaction Attribution Type × Attribution Valence × Vignette: $F(4, 244) = 9.64$, $p < .001$), but these were qualified by a significant Group × Vignette × Attribution Type × Attribution Valence interaction, $F(4, 244) = 7.39$, $p < .001$. The four-way interaction was examined by graphing intent attributions (see Figure 2) and outcome attributions (see Figure 3) as a function of group, attribution valence, and vignette. In positive and ambiguous-positive vignettes, children with ADHD made significantly more positive intent attributions than controls (see top half of Figure 2); however, in these same vignettes, controls made significantly more outcome attributions than children with ADHD (see top half of Figure 3). Likewise, in clearly negative vignettes, children with ADHD made significantly more negative intent attributions than controls (see bottom half of Figure 2), whereas in these same vignettes, controls made significantly more negative outcome attributions than children with ADHD (see bottom half of Figure 3). Children with ADHD also made significantly more positive intent attributions than controls in ambiguous-negative vignettes (see top half of Figure 2). The four-way interaction was also followed up by comparing intent and outcome attributions separately for each group. For children with ADHD, intent attributions were always equal to or significantly higher than

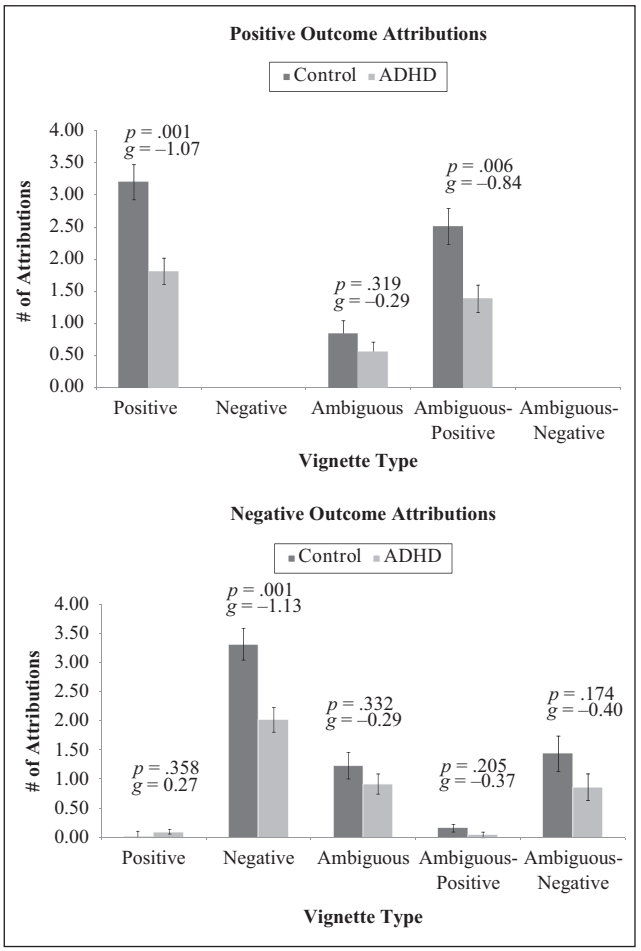

Figure 3. Number of positive (top graph) and negative (bottom graph) outcome attributions as a function of group and vignette type
Note: *p* = *p* value from simple effects tests; *g* = Hedges's *g* effect size.

outcome attributions. For control children, outcome attributions were always equal to or higher than intent attributions with the exception that negative intent attributions were higher than negative outcome attributions in ambiguous-positive events.

Response Generation

Total responses generated. Total responses generated were examined using a 2 (group) × 5 (vignette) ANCOVA. There was a significant main effect of vignette, $F(4, 244) = 10.87$, $p < .001$, but no significant effects involving group.

Valence of responses generated. The valence of responses generated was examined using a 2 (group) × 5 (vignette) × 2 (response valence: positive vs. negative) ANCOVA. There were significant main effects group: $F(1, 61) = 10.20$, $p = .002$; response: $F(1, 61) = 340.21$, $p < .001$ and significant two-way interactions, Response × Group: $F(1, 61) = 6.24$, $p = .015$; Vignette × Response: $F(4, 244) = 3.76$, $p = .005$; but these were qualified by a significant Vignette × Response × Group interaction, $F(4, 244) = 3.39$, $p = .010$. As illustrated in Figure 4, after controlling for CPs, control children generated significantly more positive responses than children with ADHD in the clearly negative and ambiguous vignettes, whereas children with ADHD generated significantly more negative responses than controls in negative vignettes.

Discussion

This study examined SIP abilities in children with ADHD, the majority of whom also had CPs, in situations that varied in the valence of intent and outcome. We first developed vignettes that allowed for the separate evaluation of the role of peer intent and situational outcome on SIP. These vignettes were then used to evaluate several components of Dodge's SIP model (Crick & Dodge, 1994; Dodge et al., 1986)—namely, cue encoding, intent and outcome attributions, and response generation—in children with and without ADHD while controlling for CPs. It was hypothesized that compared with controls, children in the ADHD group would encode fewer cues (especially positive cues in vignettes with a positive valence), make more negative intent attributions in vignettes that contain ambiguous and negative social information, make less positive and more negative intent and outcome attributions in vignettes that contain ambiguous and positive social information, and generate more negative and less positive responses in all vignettes. As described next, the results generally supported the hypotheses.

In support of the first hypothesis, results showed that children with ADHD encoded fewer cues than control children. Furthermore, children with ADHD encoded a lower percentage of positive, negative, and neutral cues in all vignettes (see Figure 1). These results are consistent with other studies demonstrating cue-detection deficits in children with ADHD (Cadesky, Mota, & Schachar, 2000; Dodge & Newman, 1981; Matthys et al., 1999; Milich & Dodge, 1984; Moore et al., 1992). This study adds to this literature by showing that this deficit is generally robust with regard to the valence of the social cues, the valence of peer intent, and the valence of the social outcome. An important question for future research is what accounts for these cue-detection deficits. One possibility is inattention. It may be that children with ADHD simply do not notice the cues when they are presented. Alternatively, it may be that the children initially attend to the cues but fail to encode them due to working-memory deficits. For example, children with ADHD may not miss salient negative social cues (e.g., being "bumped in the back") but may miss less salient cues and have a limited ability to "mentally manipulate" the

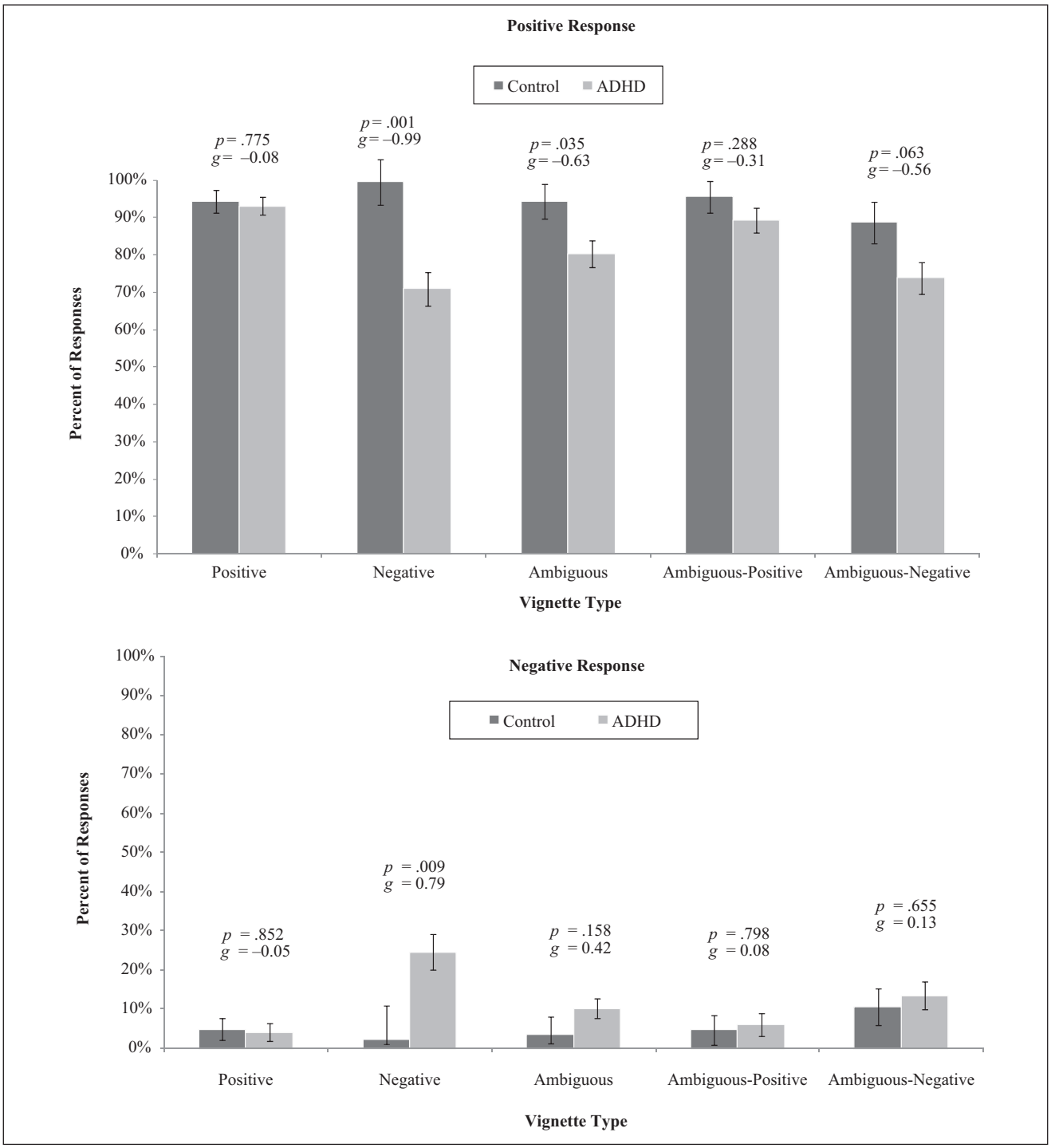

Figure 4. Proportion of positive (upper graph) and negative (lower graph) responses generated as a function of group and vignette type
Note: *p* = *p* value from simple effects tests; *g* = Hedges's *g* effect size.

information or forget details when asked. Each of these explanations is viable as both inattention (Douglas, 1999; Losier, McGrath, & Klein, 1996) and deficient working memory (Shiels et al., 2008; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005) are associated with ADHD. Regardless of the underlying cause, the effect is likely impairing

because cue detection is the first step of the SIP cycle. This suggests that children with ADHD will not have the same amount of relevant social information at their disposal as other children. This could have a cascading effect on other SIP steps and may be one factor that contributes to the well-established peer problems in children with ADHD (Hoza, 2007; Hoza et al., 2005; Pelham & Bender, 1982).

As demonstrated in Figures 2 and 3, results investigating the second step of Dodge's SIP model showed that ADHD and control children differed on intent and outcome attributions. The outcomes in the stories consisted of observable information, whereas the peer intents in the stories were not observable. These results may suggest that children with ADHD rely more heavily on their own opinion of what is taking place in social situations, rather than on observable factual information. In support of this explanation, previous research with aggressive children—many of whom may have had ADHD—has shown that they are significantly biased toward using intent attributions rather than factual information (Dodge & Somberg, 1987). This interpretation is also consistent with the cue-encoding deficits described earlier in that children with ADHD may have failed to encode the observable facts in the vignettes (because of inattention or working memory deficits or both) and thus, had to infer the missing information. This hypothesis—that the intent–outcome attribution differences between control and children with ADHD reflects the fact that children with ADHD are less likely to rely on observable social information—could be directly evaluated by using vignettes that separate not only intent from outcome but also observable from ambiguous information. More specifically, had we included not only ambiguous intents with clear outcomes but also clear intents with ambiguous outcomes, we could directly test whether it is the type of information (intent or outcome) or the amount of observable information (clear or ambiguous) that is most important to ADHD versus controls when assessing social situations. Including these stories in future research could be informative.

Results investigating the response-generation step of Dodge's SIP model showed that both groups of children generated a high proportion of positive responses to all five types of vignettes, even those with negative outcomes (see Figure 4). However, a significantly higher portion of the control children's responses were positive in negative and ambiguous situations as compared with children with ADHD, whereas children with ADHD generated a higher proportion of negative responses in negative situations. Consistent with these results, past research has shown that hyperactive/aggressive children generate significantly more negative responses and fewer prosocial responses to hypothetical ambiguous-negative situations than controls (Milich & Dodge, 1984). The present results suggest that response-generation challenges extend to situations where both the peer intent and the outcome of the peer's behavior are ambiguous. Researchers have speculated that lower rates of positive responses are a product of infrequent exposure to appropriate social situations or practice with enacting positive social behaviors (Coie et al., 1990; Crick, 1996; Wentzel & McNamara, 1999). Considering that inattention is significantly associated with social problems (Andrade, Brodeur, Waschbusch, Stewart, & McGee, 2009) and that children with ADHD appear to miss important social information (see Figure 1), it seems likely that they will consequently have fewer positive social experiences. In fact, evidence suggests that children with ADHD have significantly higher rates of negative interactions with peers (Hoza, 2007; Pelham & Bender, 1982) and are almost immediately rejected by them (Erhardt & Hinshaw, 1994; Pelham & Bender, 1982). It is noteworthy that cue detection, attribution, and response-generation deficits demonstrated by children with ADHD were found regardless of vignette valence, peer intent, or social outcome, highlighting that children with ADHD experience SIP deficits regardless of the content of social information. Likewise, differences were found between the groups not only on negative and ambiguous-negative vignettes but also on positive and ambiguous-positive vignettes. Specifically, the attribution results showed that children with ADHD endorsed positive intent attributions more strongly than controls on the positive and ambiguous-positive vignettes but not in other vignettes (see Figure 2). Similarly, controls endorsed positive outcome attributions more strongly than children with ADHD in positive and ambiguous-positive vignettes but not in other vignettes. As such, failure to include the vignettes with positive information would have missed detecting these effects. Past SIP research has typically focused on the association between processing of negative social information and hostile behavior. By including vignettes with predominantly positive social information, this study adds to the growing body of literature highlighting the importance of also considering prosocial information processing on children's development. Better understanding attribution of positive information in situations that contain positive vignettes is a step toward clarifying the impact of positive social cognition on prosocial behavior. Results of the present study support the hypothesis that SIP biases for children with ADHD may be prevalent for both negative and positive social information and that these biases may vary depending on the type of social interaction (i.e., ambiguous, positive, negative). At the same time, caution is needed in interpreting these results. First, although group differences emerged on positive situations for attributions, they did not emerge for encoding or response generation. Second, the meaning of differences on positive situations remains unclear. That is, although it is well established that SIP of

ambiguous-negative situations is clinically meaningful, predicting outcomes such as behavior with peers and social status (Crick & Dodge, 1994; Dodge, 1986; Dodge & Coie, 1987), it is currently unknown whether the same is true for SIP of positive situations. Additional research evaluating these questions would be informative.

Several limitations of this study should be noted. First, SIP was examined using hypothetical stories. This is a standard procedure for evaluating SIP abilities, but the study would have been strengthened by including more ecologically valid measures of SIP. Second, although the present study used rigorous diagnostic screening, including initial phone screening for cognitive and learning difficulties, IQ was not explicitly measured or incorporated into the analyses. This is consistent with much previous research on SIP in children, but consideration of cognitive factors, including the potential impact of working memory abilities, may be important for future larger scale investigations. Third, the participants in the study were typically in lower to middle socioeconomic status and living in a small urban center in Canada. The results can be safely generalized to similar populations but may not be representative of children in other settings (e.g., rural areas, larger urban centers). Fourth, children with ADHD were unmedicated at the time of the study. Past research suggests that stimulant medication may have significant acute effects on the SIP abilities of children with ADHD (King, Waschbusch, Pelham, Frankland, Andrade, et al., 2009), suggesting that different results may emerge for children with ADHD who are treated with medication. Therefore, results can only be safely generalized to children with ADHD who are unmedicated. Fifth, virtually all children with ADHD also had clinically significant CPs. We included a measure of CPs as a covariate in all analyses, thereby ensuring that differences between the ADHD and control group were considered after taking CPs into account. At the same time, this approach does not allow for a test of ADHD and CPs alone and in combination (i.e., as an interaction). To accomplish this, it is necessary to include children with ADHD only, CPs only, and ADHD/CPs (as well as controls), but this was not possible in the present study because of pragmatic concerns.

Implications for Research, Policy, and Practice

Results have a number of implications for clinical and research practice. Findings provide preliminary support for distinguishing between positive and negative information when evaluating social functioning, including SIP. Positive and negative information may be processed differently. If so, treatment programs or research studies that emphasize only negative or positive aspects of cognition (or likely behavior) may miss inclusion of the other valuable component. Results of the present investigation also clearly demonstrate the importance of taking ADHD into account when examining SIP. This same point has been made for at least 25 years (Milich & Dodge, 1984) but warrants repeating as ADHD continues to be neglected in many studies of aggression and social functioning.

The results of this study suggest a number of areas for future research. First, it would be interesting to replicate this study using other methods of evaluating SIP, such as videotapes or virtual-reality tasks. In addition, investigation of SIP using vignettes that separate all combinations of positive, negative, and ambiguous intent and outcome information would provide a more thorough understanding of SIP abilities in children with ADHD. Second, we speculated that cue-encoding deficits may be related to inattention or working memory and that response-generation deficits may be related to the impulsivity. Direct tests of these and other possibilities would provide important information about SIP in disruptive children. Finally, an important goal of future research is to translate these findings into intervention for ADHD and/or aggressive behavior. Limited research suggests that stimulant medication may influence SIP abilities (King, Waschbusch, Pelham, Frankland, Andrade, et al., 2009; King, Waschbusch, Pelham, Frankland, Corkum, et al., 2009; Murphy et al., 1992), but much more research is needed to better understand effects of treatment—both medication and behavior therapy—on SIP abilities. Likewise, research is needed that examines whether treatments targeting SIP abilities (e.g., Lochman, Barry, & Pardini, 2003) have adjunctive value when added to empirically supported treatments for ADHD.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research and/or authorship of this article: This research was conducted as part of the first author's doctoral dissertation and was partially supported by grants from the Nova Scotia Health Research Foundation, the Social Sciences and Humanities Research Council of Canada, and the IWK Health Centre.

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