AN ANALYSIS OF POSITIVE SOCIAL INFORMATION-PROCESSING, AGGRESSION, AND PEER FUNCTIONING AMONG CHILDREN WITH ATTENTION DEFICIT/HYPERACTIVITY DISORDER

by

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Abstract

Research has used social information-processing (SIP) theory to explain the association between social cognitive deficits among children with Attention Deficit/Hyperactivity Disorder (ADHD) and social dysfunction (aggression, low prosocial behaviour, peer problems). Scant research has investigated positive information-processing and social outcomes. This study examined SIP (cue encoding and attributions) of positive social situations among children with ADHD (n=77) and typically developing children (n=48) and explored whether SIP mediated the relation between ADHD symptoms and social outcomes. Results indicated that children with ADHD encoded more overall cues and neutral cues than typically developing children. Typically developing children encoded a significantly higher number of positive and negative cues than children with ADHD. There were no significant differences in intent attributions; however, children with ADHD provided more negative outcome attributions. SIP did not mediate the association between hyperactive-impulsive symptoms and peer problems. Elevated aggression did not moderate the association between SIP and social outcomes.
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Introduction

Peer relationships during the middle childhood developmental period play an important role in children’s social-emotional development (Rubin, Bukowski & Parker, 2006). Children who develop positive and enduring relationships with peers show well-developed, emotional and behavioural adjustment, and greater well-being (Bowker, Rubin, Burgess, Booth-LaForce & Rose-Krasnor, 2006; Guhn, Schonert-Reichl, Gadermann, Hymel & Hertzman, 2013). Those children who are rejected and have difficulty forming strong relationships with peers are less likely to feel emotionally supported, and may demonstrate more depressive symptoms, socially problematic behaviour as well as increased academic-related difficulties (Hawker & Bolton, 2000; Laursen, Bukowski, Aunola & Nurmi, 2007; Wu, Zhang, Su & Hu, 2015).

Children diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD) demonstrate deficits in age-appropriate social skills with peers (Gardner & Gerdes, 2015) and often experience social exclusion and rejection by peers (Shea & Wiener, 2003; Wiener & Mak, 2009). In the longer term, peer relationship problems in children with ADHD are associated with a number of problematic outcomes, including anxiety, delinquent behaviour, cigarette smoking, and overall impairment (i.e., in relationships, emotions, and recreational activities; Mrug et al., 2012). In order to prevent these negative social and emotional consequences, it is necessary to determine the factors that contribute to relationship problems with peers among children with ADHD. Past research has identified a number of child-level factors that are associated with problems in peer functioning. These include factors related to how children think about social
situations (i.e., social cognition) or those related to their behavioural skills (i.e., prosocial skills; McQuade & Hoza, 2008).

**Social Cognition**

Although there is no unified definition, social cognition generally refers to one’s perception of self and others, as well as how one views his or herself in relation to others (Fiske & Taylor, 1991). Children’s social cognitive understanding is a building block for their knowledge of how behaviour is linked with mental intentions and goals, feelings, and expectations for their social world (Thompson, 2006). Several social cognitive models have been developed to help explain the process by which children navigate peer interactions (Dodge, 1986; Menna & Cohen, 1997). To explain how individuals take in, store, process, and respond to social information, Crick and Dodge (1994) developed the Social Information Processing (SIP) theory – a reformulation of Dodge’s (1986; Dodge, Pettit, McClaskey, & Brown, 1986) information-processing model. The SIP model is well-supported, with citations in over 200 peer-reviewed studies (Dodge, Coie & Lynam, 2006). The model posits that children have a “database” of biological capabilities, past experiences, and stored memories of previous social situations that influence all steps of the SIP cycle (Crick & Dodge, 1994; See Figure 1).

According to the model, when engaged in a social interaction children must first attend to and encode the social cues available in the situation. Next, they must make sense of the social cues and interpret the content of the situation. They must access stored memories (e.g., schema and social knowledge) and consider their peer’s perspective when making attributions about the peer’s intention and evaluate the situation. The third step requires determination of a goal and desired outcome for the social interaction. After deciding on a goal, they then access their memory of possible behavioural responses (and may consider alternative responses – step five).
Finally, at step six children select and enact a behavioural response. Importantly, this model outlines the cognitive steps that all children utilize during a social interaction and highlights potential areas where deficits in information processing may contribute to social maladjustment. Typically, studies have applied SIP theory to investigate social functioning of children with aggression, disruptive behaviour disorders (i.e., Conduct Disorder and Oppositional Defiant Disorder), learning disabilities and less frequently, ADHD (e.g., Akhtar & Bradley, 1991; Bauminger & Kimhi-Kind, 2008; King et al., 2009; Matthys et al., 1999). The present study focused on the first two steps of the SIP model: cue encoding and interpretation.

\[Figure 1\] Model of SIP cycle as formulated by Crick and Dodge (1994).

The standard method of measuring SIP is to present participants with a series of hypothetical social scenarios, in which, a peer in the scenario performs a transgression against
them. However, the peer’s intent is ambiguous, so participants do not know whether the transgression was performed intentionally or by accident (Dodge, 1980). There is consistent evidence to indicate that children with peer relationship difficulties, particularly those with high levels of aggression, attribute hostile intent to peers in situations that are ambiguous. This deficit is coined the *hostile attribution bias* (Nasby, Hayden, & De-Paulo, 1980). For example, upon being presented with a social situation, such as, “A peer knocks into you from behind and you fall on the ground,” a child displaying a hostile attribution bias may perceive that the peer had bad intentions and purposely pushed him or her down (Dodge, 1986). Results of this research has demonstrated that aggressive children tend to attribute negative intent (i.e., the hostile attribution bias) on the part of others in ambiguous situations and, thereby, choose aggressive behavioural responses to “get even” with peers (Crick & Dodge, 1996; de Castro, Veerman, Koops, Bosch & Monshouwer, 2002; Dodge et al., 2015).

In addition to the study of aggression, the SIP model provides a framework for understanding other aspects of children’s social behaviour, including positive social behaviour (i.e., prosocial behaviour). Prosocial behaviour in childhood includes actions that promote positive social interactions, such as sharing, helping and co-operating with peers (Hay, 1994). However, a limited body of research has examined how SIP is associated with prosocial behaviour. Better understanding SIP of children’s prosocial behaviour is important for a number of reasons. First, it has been proposed that SIP may operate differently among children and adolescents who are more prosocial from those who are aggressive and rejected by peers (Nelson & Crick, 1999). For example, children who are more prosocial appear more likely to accurately encode social cues and less likely to demonstrate a hostile attribution bias than children who demonstrate less prosocial behaviour (Laible, McGinley, Carlo, Augustine, & Murphy, 2014;
Nelson & Crick, 1999). Overall, children who are more aggressive may be more negatively biased in interpreting ambiguous social situations that result in a transgression, whereas children who display more prosocial behaviours may be more likely to give a peer the benefit of the doubt. Second, the limitation with most current research is that the focus has been on ambiguous situations that result in a transgression (or negative outcome). Therefore, children’s SIP of ambiguous social situations that result in a positive outcome may be equally important to study because how children process positive peer interactions is a meaningful aspect of prosocial behaviour (Nelson & Crick, 1999).

**Diagnostic Criteria for ADHD**

According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM-5; American Psychiatric Association, 2013) criteria, ADHD has three presentations: predominantly hyperactive-impulsive, predominately inattentive, or combined. The presenting symptoms must be persistent, present in at least two settings, impairing (i.e., socially, academically and/or occupationally) and present before the age of twelve. An individual diagnosed with the predominantly hyperactive-impulsive presentation (ADHD-HI) exhibits symptoms, such as fidgeting and squirming, frequently leaving one’s seat, running and climbing in inappropriate situations, blurting out answers, and having difficulty waiting one’s turn. Symptoms that are characteristic of the predominately inattentive presentation (ADHD-I), include failing to give close attention to details or making careless mistakes, difficulty sustaining attention in various tasks, not seeming to listen when spoken to directly, and difficulty with organizing tasks and activities. The combined presentation (ADHD-C) is diagnosed when an individual meets criteria for both inattention and hyperactivity-impulsivity presentations. Results of a meta-analysis indicated that between 6.1% (as rated by parents) and 7.1% (as rated by teachers) of children and
adolescents meet DSM-IV criteria for ADHD. Children most frequently meet criteria for the predominantly inattentive presentation, however, the majority who are referred for clinical services have ADHD-C (Willcutt, 2012).

**Social Dysfunction among Children with ADHD**

It has been estimated that between 50 – 80% of children with ADHD experience peer relationship problems (Macias & Barkley, 2009; McQuade & Hoza, 2008). The most recent review concluded that there is a moderate association between deficits in social functioning and ADHD (Ros & Graziano, 2017). Problems with peers (i.e., rejection, stigmatization, lower quality friendships) appear to be chronic for children with ADHD and predict low academic achievement and association with deviant peer groups in adolescence (Gardner & Gerdes, 2015). Further, problems with establishing peer relationships put children with ADHD at a higher risk for psychopathology, such as anxiety and externalizing problems, later in development (Mrug et al., 2012).

McQuade and Hoza (2008) reviewed literature that examined the overt behaviours among children with ADHD that negatively affect their peer interactions. The authors reviewed evidence indicating that compared to typically developing children, those with ADHD were more likely to interrupt others, be argumentative, and make hostile comments to others. These findings are congruent with Barkley’s (1997) theory that the core hyperactive-impulsive symptoms present among many children with ADHD place them at elevated risk for aggressive behaviour, inappropriate social interactions and a propensity to dominate social relations. These maladaptive social behaviours seem to occur at the onset of peer interactions, which can result in low peer-rated social preference within minutes of entering a new social environment (Hodgens, Cole & Boldizar, 2000). Relatedly, Murray-Close and colleagues (2010) investigated the
developmental processes that affect children with ADHD’s peer problems over time. It was found that children with ADHD had initial difficulties with social skills, aggression, and accurate self-perceptions. These difficulties predicted subsequent peer rejection at future time points over a six year period.

**Subtypes of ADHD and their Relation to Peer Problems.**

Previous research has investigated how children with ADHD-I fare in peer relationships compared to those with primarily hyperactive-impulsive or combined symptoms. Hodgens, Cole and Boldizar (2000) found that the social impairment (based on peer nominations and behavioural observations) present among boys aged 8 – 11 with ADHD differed depending on subtype. After systematically observing three play sessions, the researchers found that the ADHD-I group were more likely to engage in solitary play and had less sustained interaction time with peers compared to children with ADHD-C and typically developing peers. In contrast, children with ADHD-C were more likely to initiate a social interaction compared to other groups; however, they were also more likely to start fights or arguments. Similarly, Cordier, Bundy, Hocking, and Einfeld (2010) found that while engaged in play, children with ADHD-HI and ADHD-C were more likely than typically developing playmates to be inconsiderate of others’ feelings, take objects from others and failed to wait their turn. Additionally, they were more likely to engage in playful mischief and to ‘clown around’ compared to children with the ADHD-I subtype.

The way that peers interact with children with ADHD may also differ by subtype. Peer rejection is more likely to be experienced by children with ADHD-C whereas children with ADHD-I are more likely to experience isolation and neglect by peers (Hodgens et al., 2000). Andrade and colleagues (2005) found that inattention was more highly associated with children’s
experiences of peer problems than hyperactivity-impulsivity. However, existing research has yet
to look separately at hyperactive-impulsive symptoms and inattentive symptoms when
examining the association between SIP and peer problems. It is possible that SIP may account
for the peer functioning outcomes experienced among children with ADHD, such as peer
problems as well as deficits in prosocial behaviour.

Prosocial Behaviour among Children with ADHD.

Prosocial behaviours are actions that promote positive social relations, including sharing,
helping, being supportive and cooperating with others (Hay, 1994). Children who demonstrate
these behaviours tend to have high peer-rated social status and show strong social problem-
solving skills (Warden & Mackinnon, 2003). Prosocial behaviours may also be somewhat
socially protective for children with some research showing that these may mitigate the severity
of peer problems experienced by children with disruptive behaviour (Andrade, Brown &
Tannock, 2014; Crick, 1996). Similarly, deficits in prosocial behaviour have been linked to
rejection by peers (Gardner & Gerdes, 2015; Vitaro, Gagnon & Tremblay, 1990). It appears that
the relationship between prosocial behaviour and peer functioning is reciprocal, in that children
who demonstrate socially competent behaviour elicit positive responses from peers that may then
increase their positive social behaviour (Eisenberg, Fabes & Spinrad, 2006). It has been
suggested that children with deficits in prosocial behaviour may not experience adequate levels
of prosocial responses from peers, thus contributing to a cycle that perpetuates low levels of
prosocial behaviour (Cunningham & Siegel, 1987).

Children who show high levels of prosocial behaviour tend to have knowledge of appropriate
social skills and demonstrate verbal or nonverbal behaviours that facilitate positive social
outcomes (Merrell & Gimpel, 2014). Rather, it has been argued that children who experience
difficulties with peers either have 1) deficits in the social skills required for social interactions, or 2) social performance deficits that negatively affect interactions of peers, despite having the social skills (Cavell, 1990).

Few studies have specifically examined prosocial behaviour in children with ADHD. Those that have, argue that children with ADHD show elevated social skill deficits, difficulty with implementing learned skills, and biases in their social cognitive abilities (Ros & Graziano, 2017). For example, in one study parents and teachers of children with ADHD reported that they lacked the developmentally appropriate skills required to get along with other children, particularly when having to manage conflict situations (Shea & Wiener, 2003). Findings from this study suggest possible social skills and performance deficits experienced by children with ADHD.

From a social cognitive perspective, children with ADHD appear to show biases in the ability to accurately monitor and evaluate their own social behaviour. Researchers have termed this biased thinking style, the positive illusory bias (PIB), or the tendency to overestimate competence on a respective task relative to others’ reports or his or her actual competency (Hoza, Pelham, Dobbs, Owens & Pillow, 2002). This bias tends to be enhanced in children with ADHD and disruptive behaviour compared to typically developing peers and children with other mental health difficulties (Hoza et al., 2004; Whitley, Heath & Finn, 2008). The PIB is typically assessed by calculating difference scores between children with ADHD’s ratings of their performance with parent- or teacher-ratings of performance, with children overestimating their competence (Owens, Goldfine, Evangelista, Hoza & Kaiser, 2007). More recent evidence has questioned the validity of the methodology used to measure the PIB. Jiang and Johnston (2017) found no evidence of the PIB among boys with ADHD when the researchers compared children’s ratings of performance to their actual objective performance on social tasks. Jiang and
Johnston (2017) argued that research and clinical resources should be focused on improving children with ADHD’s social behaviour as opposed to their self-perceptions. Therefore, further research is required to better understand children with ADHD’s competence in processing interactions with peers and how this is associated with peer functioning outcomes.

**Social Information-Processing and Children with ADHD**

**Cue Encoding.**

Children with ADHD may be less able to attend to and encode social cues (Matthys et al., 1999; Milich & Dodge, 1984). This hypothesis is plausible given that difficulties in attention and hyperactivity are core diagnostic symptoms of ADHD. A number of studies support this hypothesis. Matthys and colleagues (1999) examined SIP skills using videos depicting social scenarios among 7 – 12 year old boys diagnosed with oppositional defiant disorder (ODD) or conduct disorder (CD), ADHD, both ADHD and CD, internalizing disorder, and typically developing children. Findings showed that children with ADHD encoded significantly fewer social cues than typically developing age-matched peers. Children with comorbid ADHD and ODD/CD also demonstrated cue detection deficits; however, this group of children was also more likely to choose an aggressive response to solve the problem. Findings from this study suggest that children with ADHD with and without comorbid aggressive or disruptive behaviour demonstrate difficulties at the first stage of the SIP cycle. Other research supports this suggestion. Zentall, Cassady and Javorsky (2001) examined differences in attention to social cues between children with hyperactivity and comparison children without hyperactivity. After listening to problematic social scenarios, hyperactive children provided less relevant responses and tended to report inappropriate story cues when asked about what had happened in the scenarios compared to control children (Zentall et al., 2001).
Most research has focused on children’s cue encoding of social scenarios that result in a negative outcome. However, Andrade and colleagues (2012) examined SIP using ambiguous social vignettes that resulted in both positive and negative outcomes. Two groups of children, those with combined ADHD and conduct problems and controls were asked to listen to social scenarios that varied in intent (i.e., positive, negative, ambiguous) and outcome (i.e., positive, negative, ambiguous) and pretend that they were the main character in the stories. Participants then responded to questions that measured SIP, specifically, cue encoding and attributions. Results indicated that children with ADHD detected fewer social cues than control children regardless of whether the story contained positive or negative social information. Findings from this study raise the possibility that cue encoding deficits experienced by children with ADHD may be a general phenomenon regardless of the valence of social information. However, few studies have examined information processing of positive social information, especially in children with ADHD. The present study aimed to address this gap in the literature by investigating children’s ability to detect positive social cues in vignettes designed to be ambiguous with a positive outcome.

Cue Interpretation: Intent and Outcome Attributions.

A large body of research has investigated the interpretation stage of the SIP cycle. At this stage of information processing children make sense of, or interpret, the social cues that were encoded. Deficits at this stage reflect children’s biased perceptions of social interactions. There is consistent evidence to indicate that children with peer relationship difficulties, particularly those with high levels of aggression, attribute hostile intent to peers in situations that are ambiguous. This deficit, coined the hostile attribution bias (Nasby, Hayden, & De-Paulo, 1980), refers to the perception of hostile intent in a peer when faced with a hypothetical social situation.
in which the child is negatively impacted by a peer, but the hypothetical peer’s intent is unclear (Dodge, 1986).

Few researchers have applied the SIP model to examine how children with ADHD attribute meaning to social cues (Andrade et al., 2012; Coie & Dodge, 1998; Helseth, Waschbusch, King & Willoughby, 2015; King et al., 2009). Some studies have suggested that due to cue encoding deficits, children with ADHD may have difficulty taking others’ perspectives and be more likely to misattribute peer intent than typically developing children. For example, Cohen, Kershner & Wehrspann (1985) examined the role of externalizing and internalizing symptomatology on social perspective taking among children 6 – 12 years of age. They found that children with higher externalizing symptoms were more likely to be egocentric in their performance on a perspective taking task than children with more internalizing problems. Within the externalizing symptom domain, hyperactivity was significantly associated with immature social cognition and egocentric responding during the social cognition task. This was evidenced by being more likely to report privileged information when asked to retell a story that they heard from the perspective of a bystander who was not privy to the full story. Similarly, Marton and colleagues (2009) found that children with ADHD received lower scores on a task that required them to identify problems, feelings and evaluate the outcome of social situations compared to typically developing children. Social perspective taking skills were predicted by ADHD status above and beyond language ability and IQ (Marton et al., 2009).

Andrade and colleagues (2012) examined how children with ADHD (with and without conduct problems) and typically developing children interpreted peers’ actions in social situations. The researchers found that after controlling for conduct problems, children with ADHD provided more negative intent attributions, relative to children without ADHD. Unique to
this study, in addition to investigating children’s SIP in social situations with ambiguous peer actions with negative social outcomes (e.g., ‘a peer knocks into you from behind and you fall on the ground’), situations with ambiguous peer actions and positive social outcomes (e.g., ‘You lose your favorite pencil. Later in the day you see your friend holding your pencil and he gives it back to you’) were also studied. Findings showed that in social situations that were of an ambiguous-positive valence (i.e., ambiguous peer intent and positive situational outcome), children with ADHD used ambiguous peer intent, rather than the facts contained in the social situation, to interpret the cause of peer behaviour. In contrast, typically developing children were more likely to focus on the social outcome when interpreting peer actions in positive and negative situations. This finding provided initial evidence of biased information processing in positive social situations in children with ADHD.

Other studies have found that children with ADHD performed similarly to typically developing children in attributions of hostile intent. For example, King and colleagues (2009) compared SIP between three groups of children: medicated children with ADHD, unmedicated children with ADHD and typically developing children. Groups of children did not differ from each other in terms of the extent to which they inferred hostile intent to a peer in a negatively provoking situation. Given mixed results, further research is required to further elucidate the relation between ADHD and intent attribution biases.

Hughes, Robinson, and Moore (1991) were among the first to examine how SIP of positive behaviour is associated with peer rejection. They hypothesized that aggressive-rejected children are less likely to participate in positive socialization because of deficits in attributions of peers’ prosocial behaviours. Results indicated that compared to 74% of typically developing children in grades three and four, only 37% of aggressive-rejected children attributed a positive
intention to a peer in an ambiguous situation. This finding was only significant in a real-life situation and not so in hypothetical scenarios. Other research has shown significant results with the use of hypothetical scenarios among older children (in grades 4 – 6). For example, Nelson and Crick (1999) applied the SIP model to better understand factors associated with prosocial behaviour in youth. They found that prosocial youth were more likely to demonstrate a *benign attributional bias* in which they tended to give a peer the benefit of the doubt in hypothetical situations where a peer’s intentions were unclear. They speculated that this bias in thinking may be protective because it facilitates more positive interactions and adheres to adaptive social rules. Less research has looked specifically at positive SIP among ADHD populations. Further research is required to assess how SIP of positive situations accounts for difficulties with peers and prosocial behaviour among children with ADHD.

**SIP as a mediator of children’s social functioning.**

Several studies have investigated whether SIP is a key factor in the causal chain resulting in peer functioning difficulties in children (Dodge, Godwin, the Conduct Problems Prevention Research Group, 2013; Salzer Burks, Laird, Dodge, Pettit & Bates, 1999). These studies are important because they help to identify the process through which SIP contributes to the association between risk factors (e.g., aggression, ADHD symptoms) and poor peer functioning. For example, in a longitudinal study, Salzer Burks and colleagues (1999) studied children from kindergarten through eighth grade and looked at SIP as a mediator between early and later aggressive behaviour. They found that biased SIP accounted for the stability between aggressive behaviour in kindergarten and grade eight.

The potential of studying SIP biases as mechanisms of change has been examined through intervention research. Lochman and Wells (2002) used social-cognitive processing as a target for
intervention in the Coping Power program that aims to reduce at-risk children’s aggressive behaviours. They found that improvements in SIP (i.e., attributions, outcome expectations and decision-making) accounted for post-intervention reductions in fourth and fifth grade boys’ antisocial behaviours. Likewise, a preventative multiyear intervention study demonstrated that reductions in antisocial behaviours were mediated by the reduction of hostile-attributional biases as well as other social information processes (Dodge et al., 2013). These findings are important because they suggest that SIP can be changed through intervention. When children perceive peers’ intentions more accurately and in a less hostile manner, they are more likely to respond with more prosocial behaviours that facilitate the development of positive interactions and lasting friendships.

Although previous research has studied the mediating role of SIP in children’s behavioural and social outcomes, no studies have examined whether SIP mediates the relation between ADHD symptoms and social outcomes. Examining SIP as a potential mediator of the association between ADHD and peer functioning is important because findings from these studies can better inform interventions that can target SIP among children with ADHD.

As described earlier, most research has focused on children’s responses to ambiguous-negative social situations. Due to the research suggesting that children with ADHD display high levels of aggressive behaviour, it was important for the present study to also consider the role that aggression may play in the association between ADHD, SIP and peer outcomes.

**Aggression, ADHD and Social Information-Processing**

Aggression can be conceptualized as behaviour that one intentionally engages in and results in immediate harm to another individual, who aims to avoid the aggression (Anderson & Bushman, 2002). In school-age children, examples of aggressive behaviours include teasing
others, bullying, seeking revenge, physically fighting, being cruel and arguing with parents and teachers (Reynolds & Kamphaus, 2006). This includes both proactive (instrumental; i.e., used as a means of obtaining a desired goal or outcome) and reactive aggression (i.e., anger and hostility in response to a real or perceived provocation; Dodge & Coie, 1987; Polman, de Castro, Koops, van Boxtel & Merk, 2007).

Existing research consistently demonstrates that children with ADHD are more likely to demonstrate aggressive behaviour compared to children without ADHD (Connor, Chartier, Preen & Kaplan, 2010). This appears to be so for children with ADHD after accounting for co-occurring symptoms of ODD and CD (Waschbusch, 2002). One such study by King and colleagues (2009) found that children aged 6 – 12 with ADHD who were not receiving stimulant medication were more likely to engage in both reactive and proactive aggression than typically developing children. Although both forms of aggression are highly correlated, some research indicates that children with ADHD engage in significantly more reactive than proactive aggressive behaviours (Connor et al., 2010; Dodge, Lochman, Harnish, Bates, & Pettit, 1997).

There may also be differences in social outcomes between the forms of aggression. For example, Poulin and Boivin (2000) found that among children in grades 3 – 6, those with high levels of reactive aggression were more likely to be negatively perceived by peers and to experience victimization. However, children with greater proactive aggression did not experience similar difficulties. McAuliffe, Hubbard, Rubin, Morrow and Dearing (2010) tested the associations between aggression subtype, social skills, hyperactivity, and anger expression at two time points over one year among second grade children. They found that reactive aggression was concurrently correlated with higher levels of hyperactivity and anger expression, and with fewer social skills. These associations remained significant when assessed at both time points.
However, proactive aggression was not significantly related to any of the above problematic outcomes. It appears that reactive aggression is linked with more social impairment compared to proactive aggression.

Although there are demonstrated differences in social outcomes for children who show elevations in the two forms of aggression, Bushman and Anderson (2001) argued that proactive, controlled aggression cannot be separated from hostile, reactive aggression for two reasons. First, there are many instances where the features of these subtypes of aggression overlap. Second, there are issues with distinguishing between the types of motives that fuel reactive and proactive aggression. In theory, reactive aggression tends to be motivated by provocation or retaliation against a perceived threat whereas proactive aggression tends to be driven by a goal to achieve a self-serving outcome (Polman et al., 2007). However, in reality, Bushman and Anderson (2001) highlighted that aggressive behaviour may have mixed motives that may be reactive and hostile, but also premeditated. In addition, reactive and proactive aggression are moderately to highly correlated with each other and appear to be stable over time (Connor & McLaughlin, 2006; Smeets et al., 2017). These findings suggest that aggression may be best conceptualized as a unitary construct.

Children with ADHD and elevated levels of aggression experience significantly greater peer rejection and lower peer liking ratings compared to children with ADHD who are not aggressive (Waschbusch, 2002). Previous research has demonstrated the various short- and long-term consequences of childhood ADHD and aggressive behaviour, including social problems and further delinquency, employment difficulties and family dysfunction into adulthood (Klein & Mannuzza, 1991; Mrug et al., 2012). Although aggression appears to exacerbate the social difficulties experienced by children with ADHD, few studies have considered how aggression
influences the mechanistic role of SIP among children with ADHD. Better understanding the roles of SIP, aggression and ADHD on children’s peer functioning is necessary given the demonstrated associations between these variables.

**Present Study**

The present study used a moderated mediation framework to test the associations between ADHD symptoms, SIP and aggression on children’s social outcomes (i.e., peer problems and prosocial behaviour). This study investigated the first two steps of the SIP model: 1) encoding of cues and, 2) interpretation of social information, as these appear key to understanding how children with ADHD process social information. The following are the main objectives and hypotheses of the study:

**Objective 1:** To compare cue-encoding and interpretation of social information in vignettes containing ambiguous peer behaviour with positive social outcomes between a clinical sample of children with ADHD and typically developing children. Consistent with previous research, (Andrade et al., 2012) it is predicted that children with ADHD will encode fewer positive social cues across the vignettes compared to the typically developing group and will interpret information in these social situations primarily based on peer intent and not situational outcomes.

**Objective 2:** Using only the clinical sample of children with ADHD, we aimed to examine whether cue encoding and interpretation of positive social information in ambiguous-positive social situations mediates the association between ADHD symptoms and parent/teacher report of peer functioning (i.e., peer problems and prosocial behaviour). Both inattentive and hyperactive symptoms were predicted to be associated with higher peer problems and with lower prosocial behaviour. It was hypothesized that deficits in SIP would mediate the association
between ADHD symptoms and peer problems and prosocial behaviour based on previous research indicating that hyperactivity/impulsivity and inattention are both associated with social outcomes (Cordier et al., 2010; Hodgens et al., 2000). Figure 2 displays the overall conceptual mediation model.

![Conceptual model of ADHD symptoms (X; hyperactivity & inattention), SIP (M; cues encoded and attributions), and social outcomes (Y; prosocial behaviour and peer problems). Separate models will be run for each of the variables within X, M, and Y.](image)

**Objective 3:** To determine whether SIP mediates the relation between ADHD symptoms and peer functioning (i.e., prosocial behaviour and peer problems), depending on level of aggression. Specifically, given previous findings that aggression among children with ADHD is associated with more significant impairment, it was hypothesized that aggression would moderate the effect of SIP on social outcomes, such that the indirect effect of SIP would be larger among children with higher levels of aggressive behaviour.

**Method**

**Participants**

Participants in the study were 138 children, 8 to 12 years of age. Thirteen of the children did not fully complete the SIP measure; therefore they were excluded from the analyses. The final sample was 125 children \((M\text{ age} = 10.26, SD = 1.18)\). The majority of the sample was male
(79.2%). 77 of the children met criteria for ADHD and 48 were typically developing children. Children were excluded from this study if they had been previously diagnosed with Autism Spectrum Disorder or a Pervasive Developmental Disorder, or had intellectual functioning below a standard score of 80 (as measured by the Kaufmann Brief Intelligence Test – 2nd Edition; KBIT-2; Kaufman & Kaufman, 2004).

Participant data for the ADHD group was acquired from an existing database of families who had accessed a children’s mental health clinic based within a mental health hospital in Toronto, Canada. The clinic provides psychiatric assessment and cognitive-behavioural treatment (both individualized and group) for children with disruptive behaviours. Prior to the initial assessment, parents were asked to participate in a larger study and provided consent to complete measures about their child as part of the assessment. The Computerized Diagnostic Interview Schedule for Children – Parent Version (C-DISC; Shaffer, Fisher, Lucas, Dulcan & Schwab-Stone, 2000) was administered to parents for clinical diagnostic purposes based on the DSM-IV. Children were included in the ADHD group if they met criteria for ADHD.

Data for typically developing participants was extracted from an existing dataset collected in Halifax, Canada (Andrade et al., 2012). These children and parents were recruited from the community using posters, radio and newspaper advertisements, and a university information service. To be included in the study, children had to be free of any mental health diagnoses (as reported by parents on the C-DISC). In addition, children were excluded from the study if their parent reported that they had received any previous intervention for behavioural or learning problems.
Measures

**SIP Vignettes: Child Social Situations Questionnaire.** The social vignettes that were used to measure SIP in this study were taken from the Child Social Situations Questionnaire (CSSQ; Andrade et al., 2012). The original CSSQ comprised 20 vignettes consisting of social situations involving children engaged in typical childhood activities (e.g., sports, recreational activities, classroom involvement). The vignettes varied in valence of peer action and situation outcome: 4 vignettes were of a positive valence (i.e., the peer in the story demonstrated a positive behaviour that resulted in a positive outcome experienced by the participant); 4 vignettes were of a negative valence (i.e., the peer in the story demonstrated a negative behaviour that resulted in a negative outcome experienced by the participant); 4 vignettes were ambiguous-positive (i.e., the peer in the story demonstrated an ambiguous behaviour that resulted in a positive outcome experienced by the participant); and 4 vignettes were ambiguous-negative (i.e., the peer in the story demonstrated an ambiguous behaviour that resulted in a negative outcome experienced by the participant). The present study only used the 4 ambiguous-positive vignettes in the analyses (see Appendix A).

During administration, the examiner would first complete a demonstration vignette with the child to ensure he or she understood. For example, the following is an ambiguous-positive vignette that would be read to a participant: “*Pretend that you can’t find your favourite pack of markers. The last time you remember seeing it was when you were working with a group of other kids on a project. Later that day you see John holding your markers and looking around. John sees you and hands you your markers.*” Then, a series of questions would follow. The questions were: A) What happened in the story?; B) How could you tell whether this was a nice way to act or a mean way to act?; C) How would you feel if John did this to you?; and D) What could you
say or do if this happened to you? Tell me as many ways as you can. After the child understood the task, the examiner would proceed with administering each of the vignettes to the participant. Participants’ responses to questions A (measuring cue encoding) and B (measuring cue interpretation) were used in the present study’s analyses. Children’s responses were audio recorded and transcribed after the assessment.

**Coding children’s responses.** Three undergraduate students were trained to code participants’ SIP responses (see Appendix B). For cues encoded (question A), coders referred to a list of cues that were provided to record the number of cues that a participant stated in his or her response to, “What happened in the story?” Each cue was also recorded as positive (e.g., “John was laughing”), negative (e.g., “John hit me”), or neutral (e.g., “John was walking”). The total number of cues that a participant stated across the 4 vignettes was computed as well as the proportion of positive, negative, and neutral cues.

To code the children’s interpretation of the social information (i.e., step two of the SIP model), coders recorded the number of peer intent and situational outcome attributions that were made by participants. To be classified as an intent attribution, a participant would have responded to question B, “How could you tell whether this was a nice way to act or a mean way to act?” by focusing on the peer’s reason or purpose for his or her action in the vignette. In the vignettes, the peer’s intent (i.e., thinking process) was not explicitly mentioned. Therefore, a child stating, “John is mean because he saw my markers and wanted to keep them” would be coded as an intent attribution because the participant referred to John’s intentions that were not stated in the vignette. Rather, outcome attributions consisted of responses that focused on the actual action in the vignette. For example, “John was nice because he handed me my markers” would be coded as an outcome attribution because this action occurred in the vignette. Again,
participants’ intent and outcome attributions were coded as positive, negative, and neutral. Intent and outcome attributions were totaled across the 4 ambiguous-positive vignettes.

**Reliability.** To measure inter-rater reliability, 33% of the participants’ data that was coded by two coders was examined by computing intra-class correlations (Shrout & Fleiss, 1979). The ICC values were interpreted based on recommendations by Koo and Li (2016). A high degree of reliability was found for total cues encoded, \( r_{ICC} = .95 \) (95% CI, .64, .96), \( F (38, 38) = 32.45, p < .001 \). For total intent attributions, there was moderate reliability, with ICC, \( r_{ICC} = .65 \) (95% CI, .34, .82), \( F (39, 39) = 2.84, p = .001 \). For total outcome attributions, there was moderate reliability between raters with ICC, \( r_{ICC} = .62 \) (95% CI, .27, .8), \( F (39, 39) = 3, p < .001 \).

**Behavioural Assessment System for Children, 2nd Edition (BASC-2).** Parents of children in the ADHD group completed the BASC-2 (Reynolds & Kamphaus, 2004) standardized rating scale. The scale dimensionally measures children’s behaviour and self-perceptions and includes several clinical scales. There are 134 – 160 items on the parent report, depending on the child’s age. For each item, the reporter indicates how often a child engages in behaviour by responding never, sometimes, often, or almost always. The BASC-2 has been normed and standardized with over 13,000 cases and has demonstrated moderate to good reliability and validity for its clinical scales (Reynolds & Kamphaus, 2004). The present study used the following clinical scales in its analyses: *Aggression* (example items: “hits other children”; “seeks revenge on others”), *Hyperactivity* (example items: “is unable to slow down”; “acts without thinking”) and *Attention Problems* (example items: “pays attention”; “is easily distracted”). Raw scores were converted into T-scores and used in the present study’s analyses.
Strengths and Difficulties Questionnaire (SDQ): To assess ADHD children’s peer functioning problems (i.e., peer problems and prosocial behaviour), the SDQ (Goodman, 1999) was completed by parents and teachers. It is a screening questionnaire that includes 25 items assessing five dimensions: (1) conduct problems; (2) prosocial behaviour; (3) emotional problems; (4) hyperactivity-inattention problems; and (5) peer relationship problems. Items are scored on a 3-point Likert scale which ranges from ‘not true’, to ‘somewhat true’, to ‘certainly true’. Each subscale produces a dimension score (from 0 – 10) which leads to a Total Difficulty score of the total of the four problem-functioning subscales. Higher total scores indicate greater problems (except for the Prosocial Behaviour subscale, in which, lower scores indicate greater problems). When both a participant’s parent and teacher completed the measure, the maximum score was used. Raw scores have been normed and can be converted to scaled scores.

The present study used scaled scores from the Prosocial Behaviour (example items: “Shares readily with other children”; “Kind to younger children”) and Peer Relationship Problems (example items: “Has at least one good friend”; “Picked on or bullied by other children”) subscales in the analyses. The SDQ has been extensively used in previous research and demonstrates strong validity and reliability (Stone, Otten, Engels, Vermulst, and Janssens, 2010). In the present sample, internal consistencies of the clinical scales were: Prosocial Behaviour ($\alpha = .72$) and Peer Problems ($\alpha = .49$). The low internal consistency coefficient for the Peer Problems subscale is consistent with reports from previous studies (Palmieri & Smith, 2007).

Procedure

The research ethics board at the Centre for Addiction and Mental Health approved the study. Parents of the children in this study provided written, informed consent and children gave
their assent to participate in the study. The children in the typically developing group completed the SIP measures as part of the previous study conducted by Andrade and colleagues (2012). The participants in the ADHD group completed the present study’s measures during a two hour pre-treatment assessment for a larger disruptive behaviour intervention study. A trained graduate student in psychology administered the C-DISC to parents and parents completed the questionnaires while children worked with research assistants to complete the CSSQ and K-BIT2 in a separate room. Parents completed a teacher information form, which gave consent for the research team to mail out the SDQ for the child’s teacher to complete (along with other questionnaires). At the end of the assessment, parents received $20 and children received a small toy for their participation.

Results

Statistical Analyses

SPSS version 24.0 was used to complete all statistical analyses in the present study. Normality was tested by referring to the Shapiro-Wilk test for normality as a guide as well as visually examining histogram and Q-Q plots. Group comparison analyses were performed with bootstrapping at 1000 samples to reduce the impact of potential biases in the data. Tests of mediation used PROCESS macro computational tool for path analysis that uses bootstrapping to test the indirect effect (Hayes, 2013). For the mediation models, given that children with ADHD are a heterogeneous group with subtypes that are differentially associated with social outcomes, the plan was to conduct separate mediation models for inattentive symptoms and hyperactive-impulsive symptoms. Each SIP construct (i.e., cues encoded and attributions made) was to be tested in a separate model. Also, peer problems and prosocial behaviour were to be examined as separate outcome variables in each model.
Descriptive Statistics by Group

First, preliminary analyses were performed to test for group differences in demographic variables (see Table 1). Results of a 2 (Group: ADHD, Typically Developing) x 2 (Sex: male, female) chi-square analysis indicated that groups significantly differed by sex, $\chi^2 (1) = 5.17, p = .026$. Based on the odds ratio, the odds of being a male were 2.74 times higher in the ADHD group than in the typically developing group. Next, an independent-samples $t$-test examined whether the groups differed in the number parent-reported CD symptoms. Children in the ADHD group had significantly more CD symptoms than children in the typically developing group, $t$ (109.61) = -.10.56, $p = .001$. Levene’s test indicated unequal variances ($F = 30.87, p <.001$), so degrees of freedom were adjusted from 123 to 109.61.

Table 1
Descriptive Statistics for ADHD group and Typically Developing group

<table>
<thead>
<tr>
<th></th>
<th>ADHD Group ($n = 77$)</th>
<th>TD Group ($n = 48$)</th>
<th>Total ($N =125$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age ($SD$)</td>
<td>10.34 (1.14)</td>
<td>10.13 (1.25)</td>
<td>10.26 (1.18)</td>
</tr>
<tr>
<td>Sex (% male) *</td>
<td>85.7</td>
<td>68.8</td>
<td>79.2</td>
</tr>
<tr>
<td>Medication Status (% Yes)</td>
<td>53.2</td>
<td>0</td>
<td>66.5</td>
</tr>
<tr>
<td>% Mother Report</td>
<td>89.6</td>
<td>84.4</td>
<td>87.7</td>
</tr>
<tr>
<td>% Maternal Post-Secondary Ed.</td>
<td>87.7</td>
<td>72.1</td>
<td>81.9</td>
</tr>
<tr>
<td>$M$ CD Symptoms ($SD$)*</td>
<td>5.29 (3.44)</td>
<td>.63 (1.41)</td>
<td>3.5 (3.63)</td>
</tr>
</tbody>
</table>

Note. *Significant difference between groups at $p <.05$; Typically developing (TD), Conduct Problems (CD)

Last, an independent-samples $t$-test was conducted to compare groups by age. There was no significant group difference in age, $t$ (123) = -.965, $p = .337$.

Objective 1: Comparing SIP between children with ADHD and Typically Developing Children
Table 2 reports the results of the t-tests for the SIP variables. Children with ADHD encoded significantly more total cues in response to the ambiguous-positive vignettes than children in the typically developing group, BCa 95% CI [-3.56, -1.49], with a large effect size. Among the total cues encoded, children with ADHD detected significantly fewer positive (BCa 95% CI [.01, .07]) and negative cues (BCa 95% CI [.02, .08]) and significantly more neutral cues (BCa 95% CI [-.13, -.05]) than children in the typically developing group.

There were no significant differences between the ADHD and typically developing groups in the total number of intent attributions, total number of outcome attributions, and number of positive outcome attributions across the four ambiguous-positive vignettes. However, children with ADHD made significantly more negative outcome attributions among the ambiguous-positive vignettes than children in the typically developing group, BCa 95% CI [-.32, -.06]; significant results represented a small effect size.

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADHD M (SD)</th>
<th>TD M(SD)</th>
<th>Cohen’s d</th>
<th>t^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cues Encoded</td>
<td>13.39 (2.04)</td>
<td>10.88 (3.47)</td>
<td>.88</td>
<td>-4.55^b**</td>
</tr>
<tr>
<td>% Negative Cues Encoded</td>
<td>33 (5.1)</td>
<td>38 (10.3)</td>
<td>.62</td>
<td>3.13^b**</td>
</tr>
<tr>
<td>% Positive Cues Encoded</td>
<td>32.8 (5.2)</td>
<td>36.7 (9.2)</td>
<td>.56</td>
<td>-2.71^b**</td>
</tr>
<tr>
<td>% Neutral Cues Encoded</td>
<td>34.3 (5.8)</td>
<td>25.3 (13.1)</td>
<td>.88</td>
<td>-4.47^b**</td>
</tr>
<tr>
<td>Total Intent Attributions</td>
<td>1.83 (1.05)</td>
<td>1.92 (1.29)</td>
<td>.08</td>
<td>.415</td>
</tr>
<tr>
<td>Positive Intent Attributions</td>
<td>1.42 (.97)</td>
<td>1.25 (1.19)</td>
<td>.16</td>
<td>-.83^b</td>
</tr>
<tr>
<td>Negative Intent Attributions</td>
<td>.41 (.66)</td>
<td>.67 (.86)</td>
<td>.34</td>
<td>1.89</td>
</tr>
<tr>
<td>Total Outcome Attributions</td>
<td>1.85 (1.26)</td>
<td>2.16 (1.06)</td>
<td>.27</td>
<td>-1.45</td>
</tr>
<tr>
<td>Positive Outcome Attributions</td>
<td>1.89 (1.04)</td>
<td>1.75 (1.21)</td>
<td>.12</td>
<td>.134</td>
</tr>
<tr>
<td>Negative Outcome Attributions</td>
<td>.29 (.49)</td>
<td>.1 (.31)</td>
<td>.46</td>
<td>-2.6^*</td>
</tr>
</tbody>
</table>
Objective 2: Examining the Indirect Effects of SIP on ADHD Symptoms and Peer Functioning

Simple Correlations. First, bivariate Pearson correlations were run among the study variables of interest and potential covariates (i.e., age, sex, medication status) for children with ADHD. Results are presented in Table 3. Age was significantly positively correlated with children taking ADHD medication. ADHD medication was significantly positively correlated with total number of cues encoded. Child sex was significantly positively correlated with total cues encoded. Hyperactive-impulsive symptoms were significantly positively correlated with inattentive symptoms, aggression, and peer problems. Inattentive symptoms were positively correlated with aggression. Peer problems were significantly negatively correlated with the total number of intent attributions made and significantly positively correlated with the total number of positive outcome attributions made across the ambiguous-positive vignettes.
Table 3  
*Intercorrelations between predictors, potential covariates, and outcome variables among ADHD group*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>9</th>
<th>10</th>
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<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Age</td>
<td>1</td>
<td>0.07</td>
<td>.36**</td>
<td>.12</td>
<td>0.14</td>
<td>0.09</td>
<td>-0.06</td>
<td>-0.07</td>
<td>0.12</td>
<td>-0.08</td>
<td>-0.04</td>
<td>0.12</td>
<td>0.08</td>
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<td>0.2</td>
<td>-0.06</td>
<td>-0.09</td>
<td>0.04</td>
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<td>2: Child Sex</td>
<td>1</td>
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<td>-0.05</td>
<td>0.09</td>
<td>-0.02</td>
<td>0.08</td>
<td>0.22</td>
<td>0.01</td>
<td>-0.25*</td>
<td>0.2</td>
<td>0.06</td>
<td>0.12</td>
<td>0.01</td>
<td>0.15</td>
<td>-0.1</td>
<td>-0.03</td>
<td>-0.16</td>
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<td>3: Medication</td>
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<td>0.2</td>
<td>-0.08</td>
<td>0.06</td>
<td>-0.12</td>
<td>0.3*</td>
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<td>-0.00</td>
<td>0.18</td>
<td>-0.07</td>
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<td>0.19</td>
<td>0.09</td>
<td>0.06</td>
<td>0.02</td>
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<tr>
<td>4: Hyperactive-Impulsive</td>
<td>1</td>
<td>.57**</td>
<td>.46**</td>
<td>.27*</td>
<td>-0.1</td>
<td>0.06</td>
<td>0.07</td>
<td>0.04</td>
<td>-0.1</td>
<td>-0.01</td>
<td>-0.08</td>
<td>0.1</td>
<td>0.03</td>
<td>0.02</td>
<td>0.02</td>
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<tr>
<td>5: Inattention</td>
<td>1</td>
<td>.23*</td>
<td>0.18</td>
<td>-0.17</td>
<td>-0.00</td>
<td>0.09</td>
<td>-0.1</td>
<td>0.01</td>
<td>0.04</td>
<td>-0.01</td>
<td>0.08</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.07</td>
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<td>6: Aggression</td>
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<td>0.02</td>
<td>0.1</td>
<td>-0.03</td>
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<td>-0.07</td>
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<td>7: Peer Problems</td>
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<td>-0.09</td>
<td>-0.17</td>
<td>0.1</td>
<td>-0.06</td>
<td>-0.24*</td>
<td>-0.21</td>
<td>-0.04</td>
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<td>0.24*</td>
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<td>8: Prosocial Skills</td>
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<td>0.09</td>
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<tr>
<td>9: Total Cues Encoded</td>
<td>1</td>
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<td>.01</td>
<td>.44**</td>
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<td>-0.12</td>
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<td>10: Positive Cues Encoded</td>
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<td>-0.58**</td>
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<tr>
<td>11: Negative Cues Encoded</td>
<td>1</td>
<td>-0.54**</td>
<td>-0.05</td>
<td>-0.05</td>
<td>0.02</td>
<td>0.05</td>
<td>0.05</td>
<td>0.06</td>
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<tr>
<td>12: Neutral Cues Encoded</td>
<td>1</td>
<td>0.08</td>
<td>.17</td>
<td>-0.13</td>
<td>-0.1</td>
<td>.12</td>
<td>.02</td>
<td>.05</td>
<td>.01</td>
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<tr>
<td>13: Total Intent Attributions</td>
<td>1</td>
<td>.79**</td>
<td>.42**</td>
<td>-0.99**</td>
<td>-0.89**</td>
<td>-0.23*</td>
<td>1</td>
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<td>14: Positive Intent Attributions</td>
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<td>-0.41**</td>
<td>-0.04</td>
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<td>.22*</td>
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<td>16: Total Outcome Attributions</td>
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<td>17: Positive Outcome Attributions</td>
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<td>18: Negative Outcome Attributions</td>
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Attributions

*Note.* *p* < .05; **p** < .01
**Tests of Mediation.** According to Baron and Kenny’s (1986) causal method approach, there are four steps to mediation: Step 1 states that $X$ (i.e., ADHD symptoms: hyperactivity-impulsivity and inattention) must be significantly correlated with $Y$ (i.e., social outcomes: peer problems and prosocial behaviour); Step 2 states that $X$ must be significantly correlated with the mediator, $M$ (i.e., SIP variables: cues encoded and attributions); Step 3 states that $M$ be significantly correlated with $Y$ (controlling for $X$); Last, Step 4 establishes mediation if the significant effect of $X$ on $Y$ is reduced when $M$ is included in the model.

Results of the simple correlation analysis indicate support for Step 1, such that hyperactive-impulsive symptoms ($X$) were significantly correlated with peer problems ($Y$; see Figure 2). However, neither hyperactive-impulsive nor inattentive symptoms were significantly correlated with any of the SIP variables (i.e., cues encoded and intent and outcome attributions as mediators). As such the assumption for step 2 of mediation was not met. Total number of intent attributions and positive outcome attributions were significantly correlated with peer problems ($Y$; qualifying step 3 of the model for some of the SIP variables). Although the requirement for step 2 was not met, simple mediation analyses were completed based on Hayes’s (2013) bootstrapping method of testing indirect effects. This method has become a more preferred method than Baron and Kenny’s (1986) causal method approach as contemporary conceptualizations of mediation argue that statistical significance for each part of the mediation model is not required (Hayes, 2013). Indirect effects were tested using a bias-corrected bootstrap confidence interval based on 5000 bootstrap samples. Based on the significant $X$ to $Y$ and $M$ to $Y$ correlations, 2 mediation analyses were conducted, with results discussed below.

**Mediation Analysis 1: SIP (intent attributions) mediation of the effect of hyperactive-impulsive symptoms on peer problems.** Results of a simple mediation analysis conducted using
ordinary least squares path analysis (see Figure 3), indicate that the indirect effect of hyperactive-impulsive symptoms on peer problems through total number of intent attributions made in ambiguous-positive vignettes was not significant, $b = -.0003$, BCa CI [-.012, .01].

Figure 3. Simple mediation model for the indirect effect of intent attributions on hyperactive-impulsive symptoms and peer problems.

Note. * $p < .05$

**Mediation Analysis 2: SIP (positive outcome attributions) mediation of the effect of hyperactive-impulsive symptoms on peer problems.** Results of a simple mediation analysis (see Figure 4) conducted using ordinary least squares path analysis, indicate that the indirect effect of hyperactive-impulsive symptoms on peer problems through total number of positive outcome attributions in ambiguous-positive vignettes was not significant, $b = -.0006$, BCa CI [-.014, .01].

Figure 4. Simple mediation model for the indirect effect of positive outcome attributions on hyperactive-impulsive symptoms and peer problems.

Note. * $p < .05$

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Objective 3: Aggression as a moderator of the SIP mediation model

Given that there was no evidence of mediation for any of the proposed models, there was no basis for testing aggression as a moderator of the model. This hypothesis was not supported.

Exploratory Analyses

Three supplemental analyses were performed to test within-group differences among participants with ADHD. First, because of significant correlations between peer problems and some of the SIP variables (i.e., total intent attributions, and total positive outcome attributions) we were interested in whether there would be differences in the number of intent attributions and positive outcome attributions made among children with ADHD with differing levels of peer problems. Second, since the present study’s focus was on SIP of positive information, we were interested in exploring whether children with ADHD, grouped by level of peer problems, would differ in the number of positive cues encoded. ADHD participants were split into two groups based on reported severity of peer problems: ‘high’ and relatively ‘low’. Participants who had a score of five or higher on the peer problems subscale were considered to have high levels of peer problems based on clinical cut-off scores (Goodman, Ford, Simmons, Gatward & Meltzer, 2003). Splitting participants into two groups resulted in 38 children in the low peer problems group and 38 children in the high peer problems group.

Three independent $t$-tests with bootstrapping were computed with (1) total positive cues encoded; (2) total intent attributions; and (3) total positive outcome attributions as dependent variables. On average, children with ADHD with lower peer problems encoded more positive cues ($M = 4.58$, $SD = .5$), than children with ADHD with high levels of peer problems ($M = 4.08$, $SD = .75$). This difference, .5, BCa 95% CI [.21, .81], was significant $t (74) = 3.42$, $p = .001$ and represented a medium effect size, $d = .79$. There was no significant difference, .4, BCa 95% CI [-
between the number of intent attributions made between ADHD children with relatively low ($M = 2.03, SD = 1.04$) and high levels of peer problems ($M = 1.63, SD = 1.05$), $t (73) = 1.64, p = .106$. Last, there was no significant difference, -.35, BCa 95% CI [-.82, .1], between the total number of positive outcome attributions made between children with ADHD with relatively low ($M = 1.7, SD = 1.02$) and high levels of peer problems ($M = 2.05, SD = 1.04$), $t (73) = -1.47, p = .146$.

**Discussion**

The current study examined SIP of children with ADHD and typically developing children using vignettes depicting social situations with ambiguous peer behaviour and positive social outcomes. Participants were read social stories that were unclear, but ended in a positive outcome. The associations between aggression, SIP, ADHD and social outcomes were also investigated. First, it was hypothesized that children with ADHD would demonstrate biases in the number and valence of social cues encoded and in their interpretation of peer intent and situational outcomes. Second, that SIP deficits of positive information would account for (i.e., mediate) the association between ADHD symptoms (i.e., hyperactivity-impulsivity and inattention) and social outcomes (i.e., peer problems and prosocial behaviour). Third, it was predicted that elevated aggression would moderate the association between SIP and social outcomes. Findings showed limited support for hypotheses.

**Cue Encoding**

The first objective of the study was to compare the cue detection step in the SIP model proposed by Crick and Dodge (1994), between children with ADHD and typically developing children. At this stage of information processing children are tasked with identifying and encoding the pieces of information, or cues, in the social situation. Unexpectedly, children with
ADHD encoded significantly more cues and a greater proportion of neutral cues than the typically developing children. As such, children with ADHD encoded cues that represented general information from the story that did not describe or infer any positive or negative behaviours, emotions or characteristics to the peer in the story. Although not hypothesized, we speculate that this finding may be associated with selective attention deficits that have been reported in children with ADHD (Brodeur & Pond, 2001; Jonkman, 2005).

Selective attention refers to the ability to take in important information in one’s environment and to filter out information that is less relevant (Brodeur, Trick & Enns, 1997). In the present study children with ADHD may have had difficulty attending to the salient content within the social vignettes. As such, they reported a greater frequency of neutral cues, and proportionally less information rich positive and negative cues. Successful completion of the task and real world interaction requires attention to be directed towards salient information in a social interaction. Children with ADHD may have had more difficulty filtering out the less relevant (neutral) information in the ambiguous-positive scenarios. Further research is required to examine the association between selective attention and SIP among children with ADHD as there is inconclusive support that a selective attention deficit is characteristic of children with ADHD (Huang-Pollock, Nigg & Carr, 2005).

Additionally, a recent study examining aggressive children’s attention to social scenarios using an eye-tracking technique, found no evidence for an attentional bias towards hostile cues (Horsley, de Castro & Van der Schoot, 2010). Instead, researchers found that aggressive children looked longer at non-hostile cues, particularly after seeing a neutral emotion, compared to non-aggressive children. This finding by Horsley and colleagues may also provide some explanation as to why children with ADHD in the present study encoded more neutral cues given that
children with ADHD tend to have more negative peer interactions compared to typically developing children. Therefore, when presented with ambiguous-positive information, they may require more cognitive resources to process information, compared to children without ADHD, which may result in a diminished ability to encode and store positive social information.

On the other hand, typically developing children encoded a significantly higher proportion of positive and negative cues than children with ADHD. This finding is somewhat consistent with past research (Andrade et al., 2012). Although not predicted, this may be important given that encoding salient information cues may facilitate accurate downstream interpretation of information in social situations (Crick & Dodge, 1994). However, this finding should be interpreted with caution given that typically developing children encoded fewer cues overall and proportionally more negative cues, both of which are somewhat inconsistent with past research (Andrade et al., 2012; Matthys et al., 1999).

An objective of the present study was also to investigate the associations between aggression, SIP and social behaviour in children with ADHD. Researchers have argued that cue encoding deficits in children with ADHD may be mostly accounted for by the degree of aggressive behaviour and not solely due to inattention and impulsivity (Matthys et al., 1999). Findings from the present study show that aggressive behaviour was significantly correlated with both hyperactive-impulsive and inattentive symptoms, supporting the argument that ADHD often co-occurs with aggression. Although not a core hypothesis, this finding is not surprising given that the children with ADHD recruited for this study were referred to a clinic for disruptive behaviour. The associations between ADHD and aggression have been reviewed in a number of studies (King et al., 2009; King & Waschbusch, 2010; Waschbusch, 2002). Research by Connor and colleagues (2010) showed that children with ADHD were significantly more aggressive than
controls. This finding was demonstrated across all forms of aggression (i.e., overt, reactive and proactive). However, other research has shown that there may be some differences in the forms of aggression demonstrated between the ADHD subtypes (Connor & Ford, 2012). Researchers studied four groups of children: clinic-referred children with ADHD-C, ADHD-I, non-ADHD psychiatric participants and controls from the community. They found that overt (threatening, fighting, property destruction) and proactive forms of aggression were significantly higher in children with ADHD-C, which is characterized by hyperactive-impulsive symptoms, compared to the other groups of children. There was no significant difference in reactive aggressive behaviours between children with ADHD-I and ADHD-C; both groups displayed equally higher levels of reactive aggression than the non-ADHD psychiatric group and community controls. Therefore, it appears that hyperactive-impulsive symptoms are particularly impairing for children and are overall, are a stronger driver for engaging in aggressive behaviours (Connor & Ford, 2012).

A surprising finding was that cue encoding was not significantly associated with the degree of children’s aggression. Previous authors have reported on hostile attributions (commonly associated with aggression) and have theorized that it originates from hypervigilance toward negative (i.e., hostile/threatening) cues (Crick & Dodge, 1994). The present study investigated encoding of social cues in positive social situations. Although the situations were ambiguous, they predominantly contained positive social information. Past work to identify the links between cue encoding and aggression were undertaken with social situations comprised of primarily negative social information. As such, findings from this study may be different because the type of social situations and social information differed from past research. However, further study is required to explore this finding.
Another objective of the present study was to examine whether encoding of cues from ambiguous-positive social vignettes was associated with children’s prosocial behaviour and degree of peer problems among children with ADHD. Findings showed no association between cue encoding and peer problems or cue encoding and prosocial behaviour. Overall, compared to the research investigating attributional biases and social outcomes, there is less research focusing on the association between cue encoding and social outcomes. Previous studies examining cue encoding in situations containing negative social information have found that children who make more errors when encoding relevant cues in social situations experience more peer rejection and biased processing patterns in peer-group entry and provocation situations (Dodge & Coie, 1987; Dodge & Price, 1994). Findings from this study may differ from those previous because cue encoding was examined in situations containing predominantly positive social information. As such, it may be that for children with ADHD, their ability to encode predominantly positive social cues is not associated with their degree of peer problems or observed prosocial behaviour. However, much further study is needed to support this assertion.

**Intent Attributions**

Differences in the second step of the SIP model, interpretation of social information, were also examined in children with ADHD and a typically developing group. At the interpretation step, children are required to interpret social information by providing an attribution based on their perception of the intent of the peer and outcome of the situation in the scenario. The present study focused on two aspects of interpretation; peer intent attribution and situational outcome attribution. These refer to the degree to which children interpreted social situations using information related to a peer’s intentions or the outcome of the social situation.
Analyses of intent attributions made by children showed that there were no significant differences between typically developing children and those with ADHD in the number or valence (i.e., positive, negative and neutral) of intent attributions. This finding differs from past studies that found that children with ADHD exhibited a social cognitive bias towards interpreting peer behaviour based on presumed intent (Andrade et al., 2012). Further, findings in the present study differ from studies that found that in ambiguous situations with negative outcomes, children with aggression are more likely to attribute a hostile intent to a peer than non-aggressive children (de Castro et al., 2002).

However, in line with the present study, Hughes and colleagues (1991) presented hypothetical positive social scenarios to aggressive children who were rejected by peers and non-aggressive children who were accepted by peers. They found no significant group differences in the frequency of positive intent attributions. Similarly, Matthys and colleagues (1999) found that boys with ADHD showed cue encoding deficits compared to controls, but did not show biased interpretation of the social cues. Further study is required to better understand potential biases in the interpretation of positive peer intent in children with ADHD.

Results from the present study showed that the number of intent attributions made by children with ADHD was significantly correlated with fewer peer problems. Although relatively small ($d = -.25$), this finding was unanticipated and somewhat inconsistent with previous studies. For example, Lansford and colleagues (2010) followed children throughout middle childhood and found that hostile intent attributions directly predicted peer rejection. Sociometric interviews were used to measure children’s peer relationships. Although a number of possibilities exist, one explanation for divergent findings in the present study is due to methodological differences in social functioning outcomes. The present study used a short measure of parent and teacher report
of peer problems. Although these perspectives are highly valuable, sociometric ratings by children’s peers appear to be a more valid estimate of children’s peer functioning because it is an objective measure of how peers rate their liking of others (Bagwell, Molina, Pelham & Hoza, 2001). Peer rejection and negative imbalance (i.e., a child receives more negative ratings by peers than he or she gives to others) were deemed to be the best discriminators between children with ADHD and typically developing peers (Mrug et al., 2009). In the present study, the peer problems subscale had low internal consistency. Therefore, it is likely that the measure of children’s peer functioning used in this study tapped into more than just peer rejection (i.e., also asked about: getting along better with adults, being solitary, getting picked on by others) that differed from what is commonly measured in SIP social outcomes literature. Given that sociometric interviews can be methodologically more difficult to obtain, future research could use a more comprehensive rating scale of children’s social functioning, such as the Social Skills Improvement System with multi-informants (i.e., self, parent and teacher report; Gresham & Elliot, 2008).

There was no significant relation between the number of positive, negative, neutral or total intent attributions and prosocial behaviour, which was also unexpected. This finding differs from previous research that has linked prosocial behaviour with a lower likelihood to infer negative intent in ambiguous situations (Nelson & Crick, 1999). Further, Laible and colleagues (2014) found that children’s prosocial behaviour significantly predicted benign attribution bias across middle childhood. However, these studies differed from the present study in their methodology and sample characteristics. First, the previous studies used ambiguous vignettes that resulted in negative outcomes, as opposed to the ambiguous-positive vignettes used in the present study. Second, to assess intent attributions, the previous studies relied on forced-choice
responses, in which, children provided a response when asked to give a reason for provocation in the vignette based on a few options on a scale. Rather, the present study had children give open-ended responses about attributions. As open-ended responses are verbally loaded, this may have affected children with ADHD’s responses to the questions, given previous evidence that showed weaker language abilities among children with ADHD (Marton et al., 2009). Third, prior studies used community samples of children whereas this study was comprised of a clinical-sample of children with ADHD. Therefore, how children attribute intent in positive situations may not be associated with prosocial behaviour among children with ADHD. Additional research is required to support the present study’s finding.

**Outcome Attributions**

Outcome attributions referred to the degree to which children’s interpretations of the social situations incorporated the peer’s actions and the outcome at the end of the social situation. Analyses of outcome attributions showed that children with ADHD did not differ from typically developing children in the total number of outcome attributions made for positive social information. They also provided a similar number of positive outcome attributions. However, the groups of children differed in the number of negative outcome attributions that they gave. Children with ADHD were significantly more likely to focus on a negative outcome when providing an explanation for why they thought the child in the vignette’s behaviour was ‘mean’ or ‘nice’. These findings differ from past studies that demonstrated that typically developing children provided more outcome attributions compared to children with ADHD and that in positive situations, controls focused significantly more on positive outcome attributions (Andrade et al., 2012).
In the present study, the peer’s intention in the vignettes was ambiguous; however, each vignette had a clear positive outcome. There may be a couple of explanations for why children with ADHD reported negative outcome attributions. First, for children with ADHD to have made more negative outcome attributions suggests that they might have been more likely to misunderstand the story due to the ambiguity in the beginning of the vignette. Second, they may have experienced more difficulty sustaining attention and comprehending the whole vignette, and as a result made a conclusion about the outcome based on their social knowledge or a biased representation of what occurred in the situation. There is some previous evidence that supports this assumption. Marton and colleagues (2009) found that language and cognitive reasoning skills predicted social perspective taking among children with ADHD. Children with identified language impairments were also more likely to be diagnosed with ADHD and displayed deficits in SIP (Cohen et al., 1998). Children with ADHD are more likely to experience poor social interactions and rejection compared to typically developing children (Cordier et al., 2010; Gardner & Gerdes, 2015). Therefore, if children with ADHD had difficulty understanding or attending to the story they may have relied on their knowledge of past social experiences, which may have been more negative.

Additionally, among the ADHD group, peer problems were positively correlated with positive outcome attributions. This finding differs from previous research that found that typically developing children made significantly more positive outcome attributions and argued that a positive outcome focus would be related to more adaptive SIP (Andrade et al., 2012). Overall, there has been limited research examining outcome attributions; further research is required to better inform understandings of the relation between children’s outcome attributions in positive situations to social functioning.
Mediation Effects

An objective of the present study was to determine whether SIP of positive social-information would mediate the relation between ADHD symptoms and social outcomes. Two mediation models were run based on significant correlations between hyperactive-impulsive symptoms, attributions and peer problems.

First, attributions of intent in ambiguous-positive social vignettes was proposed to be a factor that would account for the finding from previous studies that children with hyperactive-impulsive symptoms experience significant social problems (Andrade & Tannock, 2012). Although, the total number of intent attributions that children with ADHD made was directly associated with peer problems, intent attributions did not account for the association between hyperactivity-impulsivity and peer problems. Second, positive outcome attributions did not account for the association between hyperactive-impulsive symptoms and peer problems. Although it is not surprising that those children in the present study who had higher levels of hyperactivity-impulsivity experienced greater peer problems (Andrade & Tannock, 2012), it was unexpected that interpretation of positive social information was not an important part of this pathway.

Some evidence is consistent with the present study’s findings. Kofler and colleagues (2015) found no significant effect of SIP as a mediator between ADHD and children’s social behaviour. In fact, middle school children with elevated ADHD symptoms did not display a social-cognitive problem solving bias compared to children without ADHD, after accounting for ODD symptoms. Other evidence is inconsistent with the present study’s findings. Results of some studies have indicated that intent attributions explain the associations between various variables, such as (1) aggression and peer rejection, (2) SIP intervention and the reduction of antisocial behaviour, and
(3) physical abuse and conduct problems (Dodge et al., 1995; Dodge et al., 2013; Lansford et al., 2013). Unlike the present study, past research that has looked at the mediating role of SIP has focused on the hostile attribution bias in response to ambiguous-negative social situations or did not look specifically at how SIP explains children with ADHD’s social outcomes. These differences in study methodology may explain the differing results. Future research is required to examine how other variables outside of SIP, such as co-occurring ODD or withdrawal from peers, affect children with ADHD’s peer problems.

**Limitations**

There are a number of limitations to consider in the present study. First, this study examined ADHD symptoms, SIP, and social outcomes at one time point, which prevents one from making causal assertions. Longitudinal studies can look at the predictive relationship between ADHD symptoms, SIP of positive social-information and social outcomes.

Second, there were some limitations regarding the measures used in the present study. To assess children’s SIP, the present study included four ambiguous-positive vignettes. It is possible that a restricted range in scores for attributions (i.e., scores range from 0 to 4) limited our ability to find group differences. Past research incorporated a larger number of vignettes. Future research may maximize power by including more vignettes with a larger range of scores. The inter-rater reliability for intent and outcome attributions, although moderate, could also have been stronger.

In addition, a very brief questionnaire (SDQ; 5 items on each subscale) measuring children’s peer problems and prosocial behaviour was used and had somewhat low internal consistency. The questionnaire may not have adequately tapped into the true nature of children’s social outcomes. Future studies should measure peer rejection more comprehensively by using
sociometric nominations as they are a more comprehensive estimate of children’s social functioning (Coie et al., 1982).

Another potential limitation of the present study is that children’s attributions were measured through open-ended responses to the vignettes rather than forced-choice responses. Some previous research had children select from a limited number of responses when asked to provide a reason for why they perceived a character in the social situation acted the way he or she did. For children with ADHD, this format of responding may be more beneficial. Open-ended responding relies on free recall; for children with ADHD who are more likely to have working memory and language deficits, measurement of cues encoded and attributions may be confounded by these deficits (Kofler et al., 2011; Martinussen, Hayden, Hogg-Johnson & Tannock, 2004). For example, Marton and colleagues (2009) found that language ability predicted social perspective taking skills among children with ADHD, such that those with weaker language abilities performed worse on a social perspective taking task. Also, children with ADHD are more likely to also have learning disabilities (DuPaul, Gormley & Laracy, 2013). Previous research has shown that children with learning disabilities demonstrate difficulties in SIP (Bauminger & Kimhi-Kind, 2008; Bauminger, Schorr Edelsztein & Morash, 2005). The present study did not examine the roles of language, working memory or learning disabilities in SIP of positive social situations. Future research should measure children with ADHD’s SIP of positive information using forced-choice methods to help minimize the impact of cognitive and learning deficits on performance.

Fourth, the ADHD group in this study were a clinical group of children who were referred for treatment for disruptive behaviour. Therefore, it is likely that there was a high level of co-morbidity among this group, with many of the children also possibly meeting criteria for
ODD, CD, learning disabilities or other psychiatric diagnoses. The present study did not control for co-morbid diagnoses in the analyses, which may be a confounding factor that could have influenced the results. In addition, the majority of the participants in this study were boys, which prevented sex specific analyses. Previous research suggests that SIP may operate differently among girls and that girls engage in more relational aggression compared to boys (Crain, Finch & Foster, 2005). Therefore, future research is required to examine SIP of positive information among girls with ADHD.

**Implications, Future Directions and Conclusions**

Findings from the present study add to the SIP literature, providing some evidence that children with ADHD may process aspects of positive information differently than children without ADHD. Better understanding the mechanism for these differences and whether children with ADHD may be missing salient emotional information and misunderstanding situations that contain positive social information is important. Future research may include techniques to more closely approximate real-world social encounters such as mood induction, or methods to study specific aspects of information processing, such as eye-tracking techniques to explore how children with ADHD process the emotional aspects of positive situations (e.g., identification of feelings, verbal expression, and facial emotions). Last, the present study examined social outcomes through a broad measure. It may be more worthwhile for further research to specifically study peer rejection, through either sociometric ratings or a measure that specifically looks at children’s experiences of rejection or victimization.
References


adolescence: A meta-analysis of differential relations with psychosocial adjustment.  


with attention deficit hyperactivity disorder by subtypes. *Australian Occupational Therapy Journal, 57,* 137-145.


Dodge, K. A., & Coie, J. D. (1987). Social-information-processing factors in reactive and


coefficients for reliability research. *Journal of Chiropractic Medicine, 15*(2), 155-163.


Nasby, W., Hayden, B., & DePaulo, B. M. (1980). Attributional bias among aggressive boys to


properties of the parent and teacher versions of the strengths and difficulties
questionnaire for 4-to 12-year-olds: A review. *Clinical Child and Family Psychology
Review, 13*(3), 254-274.

Thompson, R.A. (2006). The development of the person: Social understanding, relationships,
conscience, self. In R.M. Lerner, W. Damon, & N. Eisenberg (Eds.), *Handbook of child


their sociometric status, empathy, and social problem-solving strategies. *British Journal


Whitley, J., Heath, N., & Finn, C. (2008). The role of attention-deficit hyperactivity disorder in
the self-perceptions of children with emotional and behavioural difficulties. *McGill


A meta-analytic review of links to emotional maladjustment. *Clinical pediatrics, 54* (10),
941-955.

Appendix A

Social Information Processing Vignettes (CSSQ)

Demonstration questions:
A) Pretend that you really like candy and your best friend Sam gives you a whole bag of candy.
   i) What happened in the story? (Prompt the participant to remember to tell me everything from
      beginning to end.)
   ii) How could you tell whether this was a nice way to act or a mean way to act?
      (Prompt the participant to tell you all the things in the story that happened or that Sam did that
      told the participant that this was a nice thing to do or a mean thing. Prompt for multiple
      responses).
   iii) How would you feel if Sam did this to you?
      (Prompt the participant to tell you a feeling they would have if Sam gave them candy. You can
      tell them that some kids could be happy, sad, upset, mad, frustrated or other feelings)
   iv) What could you say or do if this happened to you?
      (Prompt the participant by saying: In the story Sam gave you candy so you could say something
      to Sam, do something to Sam or say or do something with someone else. You can say all the
      different ways.)

Repeat above steps with question “B” if child requires additional practice
B) Pretend that you don’t like eating Broccoli and your friend Pat gives you Broccoli to eat
   instead of giving you candy.
   Begin the questionnaire by saying “Now I’m going to read some other stories to you followed
   by the same type of questions. Let me know what your answers are and I will be writing
   them down on these pages. Let’s begin:

Question 1) Pretend that you have just arrived at school and you were really in a rush. When
you get to the classroom you realize you left one of your books in the hallway. You go into the
hallway to get it and see a kid named Brandon looking through your book. Brandon sees you and
hands you your book.
   a. What happened in the story?
   b. How could you tell whether this was a nice way to act or a mean way to act?
   c. How would you feel if Brandon did this to you?
   d. What could you say or do if this happened to you? Tell me as many ways as you can.

Question 2) Pretend that you can't find your favorite pack of markers. The last time you
remember seeing it was when you were working with a group of other kids on a project. Later
that day you see John holding your markers and looking around. John sees you and hands you
your markers.
   a. What happened in the story?
   b. How could you tell whether this was a nice way to act or a mean way to act?
   c. How would you feel if John did this to you?
   d. What could you say or do if this happened to you? Tell me as many ways as you can.
Question 3) Pretend that you and your classmates are about to play a game of baseball. Patrick and Steve are chosen as team captains. Pretend that every time Patrick has been captain he has always chosen you last. You see Patrick looking at you before he begins to choose kids. Patrick chooses you close to first.

a. **What happened in the story?**
b. **How could you tell whether this was a nice way to act or a mean way to act?**
c. **How would you feel if Patrick did this to you?**
d. **What could you say or do if this happened to you? Tell me as many ways as you can.**

Question 4) Pretend that you can’t find your favorite pencil but you are sure that you brought it to school with you. Later that day you see one of the kids in your class named Jesse walking towards your desk with the pencil. Jesse puts your favorite pencil on your desk.

a. **What happened in the story?**
b. **How could you tell whether this was a nice way to act or a mean way to act?**
c. **How would you feel if Jesse did this to you?**
d. **What could you say or do if this happened to you? Tell me as many ways as you can.**
Appendix B

CSSQ Coding Sheet Instructions

• Instructions applicable to all the vignettes in the questionnaire
• When making a note in the “Comments” section, write the question number first (e.g. Q1Ai – is the first question in the “Child’s description of the story” under What happened in the story)
• Using the transcribed CSSQ: write the examiners’ name, transcribers’ initials, child’s ID, date the session was conducted, and child’s gender (1 = male, 2 = female)

A. What happened in the story?
  i. Code the child’s description of the story:
     1. 0 = neutral, 1 = negative, 2 = positive
  ii. Determine the number of positive, negative and neutral cues:
     1. If the cue is in the story: determine the total number of that cue and enter as a numerical under YES and positive, negative or neutral, accordingly.
     2. If the cue is not in the story: determine the total number of that cue not in the story and enter as a numerical under NO and positive, negative or neutral, accordingly
        • If there are no distinguished positive, negative or neutral cues, enter 0 under their corresponding headings on the coding sheet.

B. How could you tell whether this was a nice way to act or a mean way to act?
  i. Determine if the child makes a reference to the intention of the child in the story:
     1. 1 = Negative reference to intention
     2. 2 = Positive reference to intention
     3. 0 = Neutral reference to intention *NOTE: if the child makes no reference to the intention of the child in the story, assume neutral and code 0
  ii. Determine if the child makes an outcome judgment when evaluating the child in the story:
     1. 1 = Negative reference to outcome
     2. 2 = Positive reference to outcome
     3. 0 = Neutral reference to outcome *NOTE: if the child makes no outcome judgment when evaluating the child in the story, assume neutral and code 0