SOCIAL INFORMATION PROCESSING AND SUBTYPES OF AGGRESSIVE BEHAVIOUR IN ELEMENTARY AGE CHILDREN WITH AND WITHOUT ATTENTION DEFICIT HYPERACTIVITY DISORDER

by

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For my grandfathers: James Caldwell, who has been one of my greatest teachers in life, and Albert John King, who would have been so proud of me for reaching the "top of the class".

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Abstract

Examined social information processing (SIP), aggression use, and the effects of methylphenidate (Ritalin) on these constructs in children with and without Attention Deficit Hyperactivity Disorder (ADHD). Study 1 examined SIP in a sample of 83 children (62 boys, 21 girls) aged 6 to 12 years, including 49 children with ADHD and 34 controls. Children were shown a series of scenarios depicting peer interactions and asked to a) interpret each scenario and b) generate possible responses to the scenario. All children interpreted provocation scenarios in a more hostile manner than entry scenarios and generated more hostile responses to provocation scenarios than to entry scenarios. Children in the methylphenidate group generated more hostile responses to provocation scenarios than controls. Study 2 examined the hostile/instrumental and reactive/proactive aggression dichotomies in the same sample. Children participated in a laboratory aggression task that included hostile, instrumental, reactive, and proactive aggression conditions along with instances of low and high provocation from an imaginary opponent. All children engaged in more reactive aggression in the instrumental condition than in the hostile condition and following high provocation. Children in the placebo and control groups were more reactively aggressive than children in the methylphenidate group in the hostile condition. Children in the control group were more reactively aggressive than children in the methylphenidate group following low provocation. Children engaged in more proactive aggression in the instrumental condition than in the hostile condition. Aggression dissipated over the last six trials of the task, except in the hostile condition, where children in the methylphenidate group showed increased aggression. However, these children started with lower levels of aggression and ended at the same point as children in the other groups. Results suggest that a) children with ADHD may have similar SIP skills to their typically developing peers; b) children with ADHD may be motivated to use aggression based on saliency of potential rewards and presence of threat; and c) methylphenidate must be used cautiously in aggressive children, as the drug appears to increase aggression use in situations in which a threat is present. Limitations and future directions are discussed.

List of Abbreviations Used

AABC – Adolescent Antisocial Behavior Checklist

ADDH – Attention Deficit Disorder with Hyperactivity

ADHD – Attention Deficit Hyperactivity Disorder

ADHD-C - Attention Deficit Hyperactivity Disorder-Combined Type

ADHD-HI - Attention Deficit Hyperactivity Disorder-Hyperactive/Impulsive Type

ADHD-I - Attention Deficit Hyperactivity Disorder-Inattentive Type

ANCOVA – Analysis of Covariance

ANOVA – Analysis of Variance

CD – Conduct Disorder

C-DISC – Computerized Diagnostic Interview Schedule for Children

CNS – Central Nervous System

CP – Conduct Problems

CTRS – Conners' Teacher Rating Scale

DBD – Disruptive Behavior Disorders Rating Scale

DICA – Diagnostic Interview for Children and Adolescents

DSM-III – Diagnostic and Statistical Manual of Mental Disorders (3rd ed.)

DSM-IV – Diagnostic and Statistical Manual of Mental Disorders (4th ed.)

HA – Hyperactive-Aggressive

HHP – Hostile High Provocation

HLP – Hostile Low Provocation

HSD – Honestly Significant Difference

ICD-10 – International Classification of Diseases (10th ed.)

IHP – Instrumental High Provocation

ILP – Instrumental Low Provocation

MPH – Methylphenidate

MTA – Multimodal Treatment Study of Children with ADHD

N-HA – Non-Hyperactive-Aggressive

ODD – Oppositional Defiant Disorder

R – Reward Contingency

RC – Response Cost Contingency

STP – Summer Treatment Program

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When I fist started this project, I vowed that I would not end up writing a long, rambling Acknowledgements section; however, as I began to near the end, I realized that it is impossible to complete a project of this size without relying on many people for help along the way. It is for this reason that I ask the reader to bear with me while I ramble.

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CHAPTER ONE

Introduction

Overview

Attention-deficit hyperactivity disorder (ADHD) is one of the most common and most studied neurodevelopmental disorders of childhood (Rowland, Lesesne, & Abramowitz, 2002; Tannock, 1998; Wolraich, 1999). First identified by Crichton in the late 18th century (Palmer & Finger, 2001), ADHD has been described by numerous physicians and researchers as a constellation of symptoms including overactivity, inattention, poor volitional inhibition, and defective moral regulation of behaviour (Solanto, 2001). ADHD has been referred to by many names since the early 20th century, including minimal brain dysfunction, hyperkinetic disorder of childhood, and attention-deficit disorder with or without hyperactivity (Barkley, 1997; Rowland et al., 2002). The current conceptualization of the disorder as a syndrome comprising three core symptoms of inattention, impulsivity, and hyperactivity was introduced in the DSM-III, following work by Douglas (e.g., Douglas, 1972) suggesting that attention problems and impulse control were, in fact, primary features of the disorder.

The DSM-IV (American Psychiatric Association, 2000) now classifies ADHD as a unitary construct that can be further sub-typed into predominately inattentive (ADHD-I), predominately hyperactive/impulsive (ADHD-HI), and combined types (ADHD-C) (American Psychiatric Association, 2000; Marks, Himelstein, Newcorn, & Halperin, 1999). To meet diagnostic criteria, the individual must exhibit developmentally inappropriate symptoms of inattention, impulsivity, and/or hyperactivity prior to age seven and symptoms must be present for at least six months preceding diagnosis.

Additionally, symptoms must be present in more than one context (e.g., home and school), must cause the individual significant impairment in at least one area of functioning, and must not be better accounted for by another disorder (American Psychiatric Association, 2000; Whalen & Henker, 1998).

The prevalence of ADHD is estimated to be between 3-10% of the general childhood population (Barkley, 1997; Lahey, Miller, Gordon, & Riley, 1999; Tannock, 1998; Waschbusch et al., 2002), with boys outnumbering girls by a ratio of approximately 3:1 (J. C. Anderson, Williams, McGee, & Silva, 1987; Barkley, 1997). Prevalence of the disorder is much higher in psychiatrically referred populations, however, with rates estimated as high as 30-50% (Conner, Glatt, Lopez, Jackson, & Melloni, 2002; Zarin, Suarez, Pincus, Kupersanin, & Zito, 1998). The disorder is not limited to childhood; in many cases, ADHD persists into adolescence and/or adulthood (August, Realmuto, MacDonald, Nugent, & Crosby, 1996; Barkley, 1997; Moffitt, 1990; Willoughby, 2003). Attention-deficit hyperactivity disorder is currently believed to be one of the most common reasons for mental health referrals to child health care practitioners such as family physicians, paediatricians, neurologists, psychiatrists, and psychologists (Biederman, Newcorn, & Sprich, 1991; Cantwell, 1996).

Long-term outcomes for individuals diagnosed with ADHD are varied and individuals diagnosed with the disorder often experience difficulties across many areas of functioning. For example, studies have shown that a diagnosis of ADHD can be associated with low IQ (Moffitt, 1993), academic under-achievement and learning disabilities (Moffitt & Silva, 1988; Molina & Pelham, 2001), substance use and abuse (Molina & Pelham, 2001, 2003), adult psychiatric disorders and antisocial behaviour

(Dalsgaard, Mortensen, Frydenberg, & Thomsen, 2002; McKay & Halperin, 2001), involvement with the law (Moffitt, 1990), under-employment, and peer difficulties (Pelham & Bender, 1982).

Perhaps some of the most serious long-term ramifications of ADHD are the social difficulties experienced by children who have the disorder. It has been reported that up to 50% of children with ADHD have peer relationship problems (Guevremont & Dumas, 1994; Milich & Landau, 1982; Stormont, 2001). Studies have shown that, while behavioural outcomes can be good following treatment, children with ADHD still experience poor social outcomes and peer rejection, often within minutes of meeting a new peer (Pelham & Bender, 1982). Frankel and Feinberg (2002) also note that co-operation with peers, peer validation, and support skills tend to differentiate children with ADHD who are accepted by their peers from children with ADHD who are rejected by their peers. The importance of understanding the social relationships of children and adolescents with ADHD is evident based on studies indicating that there is a predictive relationship between dysfunctional peer relations in childhood and clinical disturbances in adolescence and adulthood (Landau, Milich, & Diener, 1998; Parker & Asher, 1987).

It is not clear exactly why children with ADHD experience such negative social interactions and peer rejection; however, research has shown these children may display both knowledge deficits and performance deficits when engaging in social interactions (Guevremont & Dumas, 1994; Landau et al., 1998). That is, children with ADHD appear less knowledgeable than typically developing children about appropriate social behaviours and they are less likely to behave in socially appropriate ways when interacting with peers. Given such findings, it is possible that using a social-cognitive

framework may aid in understanding the social difficulties experienced by children with ADHD.

The remainder of the introduction will provide a comprehensive literature review of social information processing, aggression use, and the use of methylphenidate in children with ADHD. First, a general introduction to social information processing will be given, followed by a review of studies of social information processing in children with ADHD, with a particular emphasis on comparing and contrasting findings to studies of social information processing in aggressive children. Next an introduction to the basic definitions and subtypes of aggression will be given, followed by a review of studies of aggressive behaviour in children with ADHD. Finally, the use of stimulant medication, particularly methylphenidate (Ritalin) to treat ADHD will be discussed with a review of findings pertaining to social information processing and aggressive behaviour.

Social Information Processing

Social information processing refers to the mental processes involved in an individual's perceptions of and reactions to other individuals in his or her social environment. Social information processing approaches to social relationships are based on the principle that social cognitions lead to observable behaviours which, in turn, provide the basis by which the individual is evaluated by others (Crick & Dodge, 1994; Dodge, Pettit, McClaskey, & Brown, 1986). Specifically, it has been suggested that competent social performance depends on the successful execution of a series of social information processing steps (Crick & Dodge, 1994; Dodge & Price, 1994). Conversely, unsuccessful execution of one or many of these steps would result in incompetent social performance and, presumably, difficulties with social behaviour and social relationships.

Currently accepted models of social information processing and social adjustment in children suggest that, to become socially competent, children must successfully execute a series of cognitive steps while they are processing social information (e.g., Crick & Dodge, 1994; Huesmann, 1998; Rubin & Krasnor, 1986; Rubin & Rose-Krasnor, 1992). Crick and Dodge (1994) suggest that children approach social situations with a set of biological capacities as well as a memory store of past social experiences from which to draw on when faced with a social interaction. This memory store, often referred to as a database, is drawn upon as children execute the cognitive steps necessary to process social information. Crick and Dodge (1994) posit that the social cognitive process is comprised of six interdependent steps: (1) encoding of relevant stimulus cues; (2) interpretation of cues; (3) clarification of goals; (4) response access or construction; (5) response decision; and (6) behavioural enactment.

In Step 1 (Encoding of Cues) of Crick and Dodge's (1994) social information processing model, the individual must encode the cues presented in a given social situation. Both appropriate or inappropriate cues may be encoded, and encoding may occur automatically or may involve conscious effort on the part of the individual (Dodge et al., 1986). For example, one child may encode relevant cues (e.g., a peer's facial expression or tone of voice), whereas another child may encode irrelevant cues (e.g., the colour of a peer's clothing) (Dodge et al., 1986). These examples highlight that there are individual differences in encoding patterns among children. These individual differences may influence subsequent processing, thereby leading to different behavioural responses among children.

In Step 2 of this model (Interpretation of Cues), the child attaches meaning to the mentally encoded social cues (Dodge et al., 1986). Crick and Dodge (1994) note that cue interpretation can be influenced by one or more of the following partially independent processes: (a) a filtered, individualized mental representation of situational cues that is subsequently stored in long-term memory; (b) analysis of the events that occurred during the social interaction, including an assessment of why an intended goal was or was not attained; (c) attributions regarding the intent of other individuals; (d) assessment of whether the goals of previous social exchanges were obtained; (e) evaluation of previous outcome and self-efficacy predictions made in previous social exchanges with the peer; and (f) evaluation of the meaning of the present exchange as well as past exchanges. These processes may all be influenced or guided by social schemata, scripts, or knowledge possessed by the child; in turn, interpretational processes can exert influence on previous knowledge, thereby changing the contents of the child's database of social knowledge (Crick & Dodge, 1994).

During Step 3 (Clarification of Goals), the child selects a desired goal or outcome for the situation. Crick and Dodge (1994) hypothesize that children arrive in a given social situation with an orientation towards producing a desired outcome, such as getting even with another child, making a new friend, gaining entry into a peer group or obtaining a desired toy. The child's propensity toward one or more particular outcomes is based on previous experiences and the success of various responses in the past, along with other factors such as a biological or genetic predisposition to engage in certain behaviours. The child's orientation may change, however, and he or she may revise his or her goals depending on the content of the presenting social interaction.

In Step 4 (Response Access or Construction), children retrieve possible responses to a given situation from memory or, particularly if the situation is novel, they may construct new behaviours in response to a peer's social cues. The rules for accessing a response are acquired throughout development and are thought to consist of matching an interpretation of cues with a given response (Dodge et al., 1986). Previous work has suggested that even very young children have a large repertoire of possible behavioural responses to a social situation (Dodge et al., 1986) and that having a large repertoire of responses is predictive of competent social behaviour. Alternatively, it has been suggested that it is not the quantity of responses that matters when interacting with a peer; rather, it is the quality of these responses that determines competent social performance (Rubin & Krasnor, 1986). For example, two children may each retrieve the same number of potential responses to a particular social situation, but if one child's responses consist entirely of engaging in negative interactions with peers (e.g., bullying, aggression) and the other's responses consist of both positive and negative strategies, it is likely that the child who generates more positive strategies will become more socially competent over time (Rubin & Rose-Krasnor, 1992).

Step 5 (Response Decision) entails the child evaluating the possible responses generated and selecting one for enactment. In making this decision, the child evaluates expected outcomes for each possible response (outcome expectations), the degree of confidence he or she has in being able to enact the chosen response (self-efficacy), and the appropriateness of each possible response (response evaluation).

Finally, at Step 6 (Behavioural Enactment), the child's chosen response to the social cues and situation is carried out. Selecting a response and enacting it does not

necessarily mean that the individual will achieve a successful result, however. For example, a socially incompetent child may have a goal of befriending another child and select a behaviour he or she believes will achieve this goal; however, because the child in question is unlikely to have a sufficient database of appropriate actions for interacting with others, the enacted behaviour will not lead to friendship either because it was inappropriate for the situation or because it was enacted poorly. Interventions designed to improve social skills in socially incompetent children work primarily at the behavioural enactment stage of the social information processing sequence.

The path from a single stimulus to the resultant behavioural response follows the above-mentioned steps in a sequential manner, yet the entire process is dynamic and processing can occur for multiple cues simultaneously (Dodge, 1993). For example, when the individual is presented with multiple cues upon which to base a response, he or she is encoding new cues while evaluating responses to previous cues. The somewhat simplified process described above occurs in a sequential manner only when the individual is faced with a single cue from which to derive a response; that is, when faced with multiple cues concurrently, an individual will process these simultaneously (Dodge, 1993).

Social Information Processing and Aggression. The social information-processing framework described above has been widely researched and has received considerable empirical support. One of the primary applications of the model has been to study social cognition as it relates to childhood conduct problems (CP), such as oppositional defiant disorder (ODD) and conduct disorder (CD), and aggression. There are a number of reasons for this trend. First, conduct problems in childhood are a serious

problem, as long-term outcomes for these disorders have been found to be particularly negative (Loeber & Farrington, 1997), including serious antisocial behaviour and involvement with the law (e.g., Moffitt, 1990; Moffitt, 1993). Second, conduct problems and aggression in childhood have been linked to negative reputation among peers and to the development and maintenance of peer rejection (Dodge, 1983). The social information-processing framework has therefore been suggested as a possible method by which to understand the underlying mechanisms that may contribute to the social difficulties experienced by aggressive children and those meeting criteria for conduct problems (see Rubin, Bream, & Rose-Krasnor, 1991; Rubin & Krasnor, 1986).

In general, the logic behind a social information-processing approach to aggression and conduct problems is that maladaptive processing actions are correlated with deviant behaviours (Dodge, 1993). For example, if a child's processing actions include attributing hostile intent to other individuals, evaluating aggression favourably, and choosing to enact aggressive responses in social interactions, then social cues are more likely to be interpreted in a manner that is biased towards aggressive responding. Subsequently, a general behavioural tendency towards aggression and conduct problems is more likely to develop (Dodge, 1993). Indeed, studies of social information processing in clinically referred samples of children have indicated that this group exhibits deficits at many stages of processing.

Aggressive children have been found to have difficulties at the encoding stage of social-information processing in that they tend to attend to fewer situational cues (Dodge & Newman, 1981). Dodge and Newman (1981) demonstrated this social information-processing pattern in a study in which aggressive and non-aggressive boys were

presented with hypothetical social scenarios in which they were required to gather evidence in favour of or against a peer. Aggressive boys chose to gather less evidence about the perpetrator of a given act than their non-aggressive peers, thereby increasing the likelihood of an inaccurate "conviction". The inaccurate gathering of information (i.e., encoding of social cues) on the part of aggressive boys would, in theory, lead to inaccurate interpretation of these cues. In fact, aggressive boys in Dodge and Newman's study were also more likely to attribute hostility to the intentions of another individual, suggesting biased interpretation of cues.

The suggestion that aggressive boys are biased in their interpretation of social cues supports earlier research. Dodge (1980) also found that aggressive boys tend to attribute hostile intent to the actions of others; however, results suggest that this tendency is evident only for ambiguous stimuli. That is, when a given social situation results in an outcome that is unfavourable for the child, and when the reasons for this unfavourable outcome are unclear, aggressive children are more likely to attribute hostile intent to other individuals to explain why the unfavourable outcome occurred. This is not to say that aggressive children are unable to accurately determine whether an isolated social stimulus is hostile or not. A study by Nasby, Hayden, and DePaulo (1980) indicated no difference between aggressive children and non-aggressive children in the identification of hostile cues when they were presented in isolation. Instead, the key point is that aggressive boys are more likely to attribute hostile intent to another individual in contexts when the reasons behind other's actions are unclear and when the other child's actions causes the aggressive boy to experience some negative outcome, as happens in many social interactions.

Aggressive children have also been shown to exhibit processing deficits at the response decision step of Crick and Dodge's (1994) social information-processing model. Specifically, aggressive children have been found to evaluate aggressive solutions to social problems more favourably than other possible solutions to these problems (Crick & Dodge, 1996). Additionally, aggressive children feel more confident than non-aggressive children in their ability to enact an aggressive response to a social problem (i.e., have higher self-efficacy for aggression) and have positive outcome expectations for aggression as a means to solve a problem (Crick & Ladd, 1990). A potential explanation of this pattern of behaviour is that, unlike their non-aggressive peers, aggressive children foresee more positive and less negative consequences of their aggressive behaviour in comparison to typically developing children, thereby leading them to continue utilising these strategies in social interactions (Nasby et al., 1980).

Naturalistic studies of childhood aggression echo the findings of studies in which hypothetical situations are used to study the construct of social information processing. In a study of social problem solving and aggression in childhood, 40 Canadian elementary school children were asked to solve hypothetical social problems as well as participate in dyadic interactions with peers in which social problem solving was assessed (Rubin et al., 1991). Aggressive children more often suggested physically aggressive strategies to solve problems and were more likely than non-aggressive children to use bargaining strategies when attempting to solve social problems (i.e., attempting to entice a peer to comply with their wishes during a social task). These results indicate biased processing at Steps 4 (Response Access) and 5 (Response Decision) of the Crick and Dodge (1994) model in that aggressive children have a social cognitive framework that favours physical

aggression and disruption of ongoing peer behaviour and a belief that enticement leads to compliance in social situations.

Social Information Processing and ADHD. Studies such as those cited above provide a good understanding of how social cognition relates to aggression and conduct problems in children. However, few of these studies of social cognition and conduct problems take ADHD into account. This is a potentially important shortcoming for a number of reasons. First, there is a high degree of overlap between ADHD and conduct problems in children. It has been noted that co-morbidity of ADHD and conduct problems may be as high as 50% in psychiatrically referred children (Newcorn et al., 2001) and up to 30% in non-referred community samples (Wolraich, Hannah, Baumgaertel, & Feurer, 1998). Further, there is evidence that the overlap may be asymmetric; that is, nearly all elementary age children with conduct problems have ADHD, whereas about 50% of elementary age children with ADHD have conduct problems (Pliszka, Carlson, & Swanson, 1999). It is entirely possible, then, that a large percentage of the children described as having conduct problems in previous research actually had both conduct problems and ADHD.

Secondly, children with ADHD are highly rejected; indeed, there is evidence that children with ADHD are even more highly rejected than children with more severe conduct problems (Frankel & Feinberg, 2002; Gaub & Carlson, 1997; Milich & Landau, 1982), suggesting that it is important to examine social information processing in this group to determine whether the same deficits observed in aggressive children exist.

Third, children with ADHD have been found to have other cognitive deficits, such as low IQ (Moffitt, 1993), academic underachievement and learning disabilities (Moffitt

& Silva, 1988; Molina & Pelham, 2001). Finally, children with ADHD have also been found to exhibit decreased inhibition on information processing tasks such as the stop-task (C Overtoom et al., 2002; Schachar, Mota, Logan, Tannock, & Klim, 2000) and the continuous performance task (C Overtoom et al., 1998). Given that children with ADHD are known to exhibit a range of cognitive and information processing deficits, it is plausible that deficits in social cognition/social information processing are also present in this group, thereby leading to the aggressive and socially inappropriate behaviour observed in these children.

Indeed, it has been suggested that social difficulties in children with ADHD are a result of deficient social information-processing mechanisms (Hoza et al., 2005; Milich & Dodge, 1984), yet studies of this possibility are quite rare. Furthermore, the limited number of studies that have been conducted have yielded mixed results. The majority of social cognitive studies of children with ADHD have failed to produce conclusive evidence that a social information processing deficit exists in this group (Henker & Whalen, 1989). For example, Milich and Landau (1982) reviewed studies of social-perspective taking and found that hyperactive children are as competent as typical children in the area of social perspective taking. Corroborating this finding is evidence that there are no group differences between children with ADHD and typical children in terms of detecting both appropriate and inappropriate social behaviours; when asked to judge behaviours of children in a videotaped task as good or bad, children with ADHD did not differ from comparison children (Whalen, Henker, & Granger, 1990).

Given that some studies have found no or minimal differences in the social-cognitive abilities of children with ADHD when compared to typically developing

children, it follows that other factors may, in fact, be responsible for the social deficits observed in these children. Deficits in *on-line processing* have been suggested as one possible explanation of the social difficulties of children with ADHD (Milch-Reich, Campbell, Pelham, Connelly, & Geva, 1999). Unlike traditional models of social information processing (e.g., Crick & Dodge, 1994), which focus on "what" is being processed, on-line processing refers to "how" this information is being processed (Milch-Reich et al., 1999). In a study examining the material encoded and the organization of this material in children with and without ADHD, Milch-Reich et al. (1999) found that children with ADHD differ from children without ADHD in that they showed less integrated on-line representations of social information, which led to poorer recall and reasoning. It is suggested that this difference in on-line processing is the underlying deficit contributing to the poor social behaviour of children with ADHD.

Despite inconclusive evidence regarding social information processing deficits in children with ADHD, interesting results have emerged from studies examining social cognition in boys with co-morbid ADHD and conduct problems. In a study of boys with and without disruptive behaviour disorders (Control, ADHD-only, ODD/CD-only, and ADHD+ODD/CD) (Matthys, Cuperus, & van Engeland, 1999), it was found that, when exposed to videotaped vignettes of hypothetical social situations, the boys with disruptive behaviour disorders differed significantly from typically developing children in terms of social information processing. Boys with ADHD-only displayed social information processing deficits at the level of cue encoding and response generation in that they encoded fewer cues and generated fewer responses than typical children. However, boys with ODD/CD-only and ADHD+ODD/CD more often selected aggressive responses to

social situations and expressed more confidence in their ability to carry out an aggressive response.

Similarly, a study of social information processing in a sample of psychiatrically referred children (Milich & Dodge, 1984) found that hyperactive/aggressive boys displayed a unique social information processing pattern when compared to control boys and to other psychiatrically referred boys. Hyperactive/aggressive boys were shown to encode fewer social cues, were more likely to attribute hostile intent to peers, and were more likely to choose to retaliate aggressively to provocation when compared to control boys. When compared to other psychiatrically referred boys, hyperactive/aggressive boys were deficient in cue utilization and chose to retaliate more aggressively.

Despite conflicting evidence regarding the differences between children with ADHD and typically developing children on measures of social information processing, the fact remains that violation of social norms as a result of aggressive and impulsive behaviour is a serious problem for many children with ADHD. Furthermore, non-aggressive children with ADHD show many of the same social difficulties as their aggressive counterparts for reasons that are unclear (Henker & Whalen, 1989).

Whereas few studies have directly examined specific social information processing mechanisms in children with ADHD, there is some evidence suggesting that these children are not as socially competent as their typically developing peers. For example, when children with ADHD are asked questions about what they *should* do (as opposed to what they *would* do) in hypothetical social situations, their responses to questions regarding friendship *initiation* do not differ from those of typical children, suggesting that children with ADHD do, indeed, possess the skills necessary to initiate

social interactions with peers (Grenell, Glass, & Katz, 1987). However, children with ADHD differ from typical children when asked what they should do to *maintain* a friendship or to resolve an interpersonal conflict. Children with ADHD tend to rely on strategies that are less friendly, more impulsive, and less enhancing to the relationship than typical children (Grenell et al., 1987), suggesting that social information processing could be deficient in some areas for children with ADHD.

It is evident that children with ADHD experience a number of social difficulties when compared to their typically developing peers; these social difficulties may be the result of deficits in social information processing mechanisms. There are several potential areas in which social cognitive deficits could exist in children with ADHD. First, children with ADHD may lack the necessary social information-processing skills to engage in appropriate social interactions. A deficit at this level could manifest itself in the form of poor encoding skills or poor interpretation skills. Second, children with ADHD may differ from typical children at the level of behavioural enactment; that is, they may be unable to inhibit their impulsivity to the point that they act aggressively or disruptively when interacting with other individuals in social situations, thus causing others to respond aggressively or to reject the child. Third, the social difficulties experienced by children with ADHD may be the result of an interaction between deficient social information processing and impulsive/aggressive behaviour.

Aggression and ADHD. It is important to consider the presence of aggression in children with ADHD, as this behaviour may be an overt expression of the underlying social information processing deficits in this group of children. A link between social information processing and aggression has been suggested and there is evidence that the

two constructs are related. Specifically, it has been hypothesized that distinct social-cognitive processes are associated with various subtypes of aggression (Dodge & Coie, 1987). This association is hypothesized to occur as a result of the linkages formed between mental processes involved in social information processing and the behaviours that accompany them (Dodge, 1993). Specifically, it has been hypothesized that aggressive behaviour results when maladaptive mental processing is linked to habitual deviant behaviour (Dodge, 1993). For example, Dodge and Coie (1987) posit that individuals who tend to perceive the intentions and actions of others as overly hostile are more inclined to use aggression with the intent of retaliating against or physically harming another individual. Conversely, individuals who attribute positive outcomes to the use of aggression tend to engage more in aggression for the purpose of goal attainment. Given the high rate of overlap between ADHD and conduct problems, further study of the link between specific types of social information processing and specific types of aggressive behaviour may provide important information as to why children with ADHD experience pervasive social difficulties.

It is also important to note that the deviant social behaviour, including aggressive behaviour, observed in children with ADHD is not simply a spurious occurrence due to overlap with other disruptive behaviour disorders; rather, problems with aggression have been shown to be specific to ADHD itself. The conceptualization of ADHD as a disorder characterized by aggressive behaviour is not a new one; for almost 30 years, two distinct types of children with ADHD have been recognized: (1) those in whom aggressive behaviour is salient and (2) those in whom aggressive behaviour is not salient (e.g., Loney, Langhorne, & Paternite, 1978). Whereas hyperactive-impulsive and inattentive

symptoms are considered to be the primary symptoms of the disorder, the importance of aggressive behaviour is recognized in that aggression is considered to be a common secondary symptom of ADHD (Loney et al., 1978; Pelham & Bender, 1982). The importance of aggressive symptoms is highlighted by research suggesting that presence and severity of aggressive symptoms in children with ADHD often impacts long-term prognosis more so than primary symptoms (e.g., Atkins & Stoff, 1993; Milich & Loney, 1979; Moffitt, 1990, 1993; Pelham & Bender, 1982).

Basic Definition and Subtypes of Aggression

Human aggression can be broadly defined as any behaviour that has the immediate goal of injuring or irritating another individual (C. A. Anderson & Bushman, 2002; Eron, Walder, & Lefkowitz, 1971; Huesmann, 1998). Furthermore, the aggressor must believe that the behaviour will be harmful to the target and that the target will be motivated to avoid the behaviour (Bushman & Anderson, 2001). Using this definition, accidental harm would not be considered to be aggressive, as the perpetrator of the action does not *intend* to harm another individual. Similarly, harm that occurs as a result of a helpful action (e.g., pain incurred as part of a medical procedure) would not be considered aggressive since the immediate goal of the action was not to produce pain (C. A. Anderson & Bushman, 2002).

This definition of aggression is specific in that it successfully differentiates between behaviours intended to produce harm and those that are ultimately intended to help. However, the above definition of aggression is limited by the fact that not all acts of aggression are functionally equivalent. Specifically, some acts of aggression appear to be motivated by the attainment of non-aggressive goals, whereas others appear to be

motivated by the mere act of simply injuring another individual or object (Feshbach, 1964). These and similar differences have prompted efforts to draw meaningful distinctions among aggressive behaviours. Currently, the most widely used method for discriminating aggression in children is drawing a distinction between reactive and proactive aggression.

Reactive vs. Proactive Aggression. Reactive aggression, sometimes referred to as hostile aggression (Bushman & Anderson, 2001), is typically defined as impulsive, angry aggression (Crick & Dodge, 1996; Waschbusch et al., 2002) and can be conceptualized as a defensive response to a perceived threat, fear, or provocation (Brown, Atkins, Osborne, & Milnamow, 1996). Ethological evidence from studies of lower animals suggests that reactive aggression is characterized by intense autonomic activation, hostile attacks, and defensive posturing in response to minor threats; reactive aggression can, therefore, be classified as "hot blooded" anger (Reis, 1974, as cited in Dodge, Lochman, Harnish, Bates, & Pettit, 1997). In humans, reactive aggression has an angry, impulsive quality and is often associated with "negatively affectively-charged, high conflict relationships" (Dodge, 1991, p. 205). Reactive aggression has its theoretical roots in the frustration-aggression model (Dollard, Miller, Doob, Mowrer, & Sears, 1939).

The frustration-aggression model proposed by Dollard et al. (1939), along with a revised model (Berkowitz, 1990), suggests that frustration always precedes aggression, as frustration serves as an unexpected barrier to goal attainment. Furthermore, it is hypothesized that the individual possesses a set of associations or linkages between negative affect and aggression-related ideas, memories, and motor reactions, as well as a set of internal schema pertaining to anger and aggression; anger and expression of anger

are then influenced by the individual's associations and schema (Berkowitz, 1990). Creation of these affect-aggression associations leads to construction of networks in which specific thoughts and memories are linked together; activation of one component in a network would, correspondingly, result in the activation of other parts as well (Berkowitz, 1990). Using this framework, frustration would arguably lead to the activation of a network of associations that ends in aggression.

Unlike reactive aggression, proactive aggression, sometimes referred to as instrumental aggression, does not occur in response to perceived provocation and it is not characterized by the anger and impulsiveness associated with reactive aggression. Instead, proactive aggression occurs with the intention of attaining a specific goal (Crick & Dodge, 1996; Dodge, 1991). Proactive aggression is used for the purpose of acquiring objects, territory or privilege or for the purpose of intimidating or dominating a peer (e.g., bullying) (Dodge & Coie, 1987; Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001). For example, a proactively aggressive child may decide to punch another child to gain access to a desired toy rather than becoming friends with the other child and asking to share the toy. In children, proactive aggression is associated with more disruptive behaviours in peer groups; however, it is also associated with strong leadership skills and a sense of humour (Dodge, 1991). The theoretical underpinnings of proactive aggression can be found in social learning theory.

The social learning theory of aggression stresses the importance of experience in the enactment of aggressive expression (Eron et al., 1971). This theory of aggression attempts to account for aggressive actions that are primarily intended to inflict pain or injury as well as aggressive actions in which the infliction of pain or injury serves a

secondary purpose in the attainment of a goal (Bandura, 1973). Social learning theory challenges the belief that primary causes of behaviour originate from within the individual. Bandura (1973) notes that internal motivators cannot entirely account for the variation of behavioural responses to different situations and to different people at different times. Unlike the position posited by proponents of drive theories such as the frustration-aggression model, the social learning model hypothesizes that psychological functioning, including aggressive responding, is best understood in terms of continuous interactions between behaviours and the environmental conditions that control them. Proactive aggression, then, is based on the assumption that the individual has learned, through observation (e.g., watching a parent use aggression as a means to achieve a goal) and/or practice (e.g., being reinforced for using aggression to achieve a goal), that aggression is an effective way to achieve object- or person-related goals.

Both reactive and proactive aggression have been found to be valid indices of the aggressive behaviours typically exhibited by children (Brown et al., 1996; Dodge, 1991; Waschbusch, Willoughby, & Pelham, 1998). Evidence for the validity of the distinction between these subtypes of aggression comes from research finding that reactive and proactive aggression have significant but different associations with various aspects of behaviour and cognition (e.g., Dodge & Coie, 1987; Dodge et al., 1997; Waschbusch, Willoughby et al., 1998). For instance, Dodge et al. (1997) demonstrated the validity of the distinction between reactive and proactive aggression using a series of studies designed to investigate developmental history, social information processing patterns, and adjustment in school children and psychiatrically referred children. A history of physical abuse, early onset of behavioural difficulties, peer relationship problems, as well

as social information processing deficits in the areas of encoding were all predictive of a propensity towards reactive aggression later in childhood. In contrast, children who engaged in proactive aggression generally anticipated positive outcomes for the use of aggressive behaviour.

Further support for the distinction between reactive and proactive aggression is offered by Waschbusch et al. (1998) in a study examining the criterion validity and utility of reactive and proactive aggression. The criterion validity of reactive and proactive aggression was further supported, as both subtypes were found to be significantly associated with more diverse aspects of externalizing behaviour (i.e., overall impairment, classroom behaviour, and peer adjustment). Additionally, both subtypes of aggression were significantly correlated with criterion measures after controlling for each other, an indication of the incremental validity or utility of each subtype. Again, reactive aggression was more highly correlated with poor functioning in childhood than was proactive aggression.

In summary, researchers have reliably distinguished two subtypes of aggression: reactive aggression and proactive aggression. Reactive aggression can be defined as "hot-blooded" or impulsive aggression, whereas proactive aggression can be defined as aggression used for the purpose of obtaining a goal. Reactive and proactive subtypes of aggression are thought to have their origins in the frustration-aggression model and the social learning model, respectively. Aside from being used to distinguish between high- and low-functioning children and potential long-term outcomes for such children, the reactive and proactive subtypes of aggression have proven useful in understanding important individual differences between children with disruptive behaviour disorders

(i.e., children with ADHD, ODD, and/or CD) on measures of behaviour and social cognition.

These findings suggest that the distinction may be useful in elucidating the individual differences in behaviour and social cognition between typical children and children with ADHD. In fact, preliminary research (e.g., Atkins & Stoff, 1993; Waschbusch et al., 2002) suggests that subtyping aggression is useful for distinguishing between typically developing children and children with ADHD on behavioural and social measures; however, more research is needed. Specifically, research examining whether these factors are influenced by treatment is essential for further development of this area.

Treatment of ADHD

An important consideration in any study of behaviour in children with ADHD is that of treatment. The pervasive behavioural and social difficulties associated with ADHD have resulted in numerous concerted efforts to treat this disorder effectively. Attention-deficit hyperactivity disorder is most commonly treated with psychostimulant medications such as methylphenidate (MPH, Ritalin, Concerta), dextroamphetamine (Dexedrine), and Adderall (Hinshaw, Henker, Whalen, Erhardt, & Dunnington, 1989; Pelham, 1993; Spencer et al., 1996). Approximately 80-90 % of all children diagnosed with ADHD have been treated with a psychostimulant at some point in their life, with methylphenidate being the most commonly used (Conner et al., 2002; Pelham, 1993; Spencer et al., 1996).

Psychostimulants are favoured in the treatment of ADHD for a number of reasons, including the fact that the behavioural effects can be observed within 30-90

minutes of ingestion, with the effects of methylphenidate and dextroamphetamine peaking two hours after ingestion and dissipating about two to four hours later (Pelham, 1993). An additional benefit offered by the psychostimulants is that the maximum effects of the drug are typically seen on the first day of administration (i.e., no build-up is required to attain maximum effects when the medication is active) (Pelham, 1993). These medications have been shown to have positive effects on many of the behavioural symptoms associated with ADHD, yet it is unclear whether these treatments are able to effectively treat the social difficulties experienced by these children.

General Effects of Methylphenidate on ADHD. It is well established that administration of psychostimulant medication, such as methylphenidate, typically results in cross-situational (e.g., home and school) improvement in the behavioural symptoms of ADHD when the medication is active (Greenhill, 2001; Wigal, Swanson, & Regino, 1999). In the classroom, psychostimulants decrease interrupting and fidgeting and increase on-task behaviours (Greenhill, 2001), reduce non-compliance, classroom interference, and excessive gross motor movement (Abikoff & Gittelman, 1985), and increase on-task classroom behaviour and increased accuracy in academic work (Pelham, 1993). On the playground, psychostimulants reduce overt aggression (e.g., punching, kicking, hitting), covert aggression (e.g., stealing), and signs of conduct disorder (Greenhill, 2001), increase on-task behaviour in recreational activities (i.e., baseball) (Pelham et al., 1990), and decrease oppositional behaviour (Klorman, Brumaghim, Fitzpatrick, & Borgstedt, 1990). The effect(s) of methylphenidate on measures of peer relationships, social cognition, and aggression are less clear, however. Given the importance of these factors in ADHD, research in this area is certainly warranted.

Some research has examined the relationship between treatment with methylphenidate and social difficulties, largely by means of observational studies. In general, results indicate that, whereas methylphenidate is effective at treating the core symptoms of ADHD (i.e., inattention, hyperactivity, and impulsivity) and facilitating improved classroom performance, the drug does not significantly improve the peer relations experienced by children with ADHD. For example, despite treatment with methylphenidate, children with ADHD still experience rejection by their peers, often within seconds of entering into a group social interaction (Pelham & Bender, 1982). Hinshaw et al. (1989) also noted that, despite being effective at reducing overt behaviour problems, treatment with methylphenidate has no effect on the frequency of prosocial behaviours exhibited by children with ADHD. Similarly, Pelham et al. (1988) found that a combination of medication and social skills training did not improve social standing among children with ADHD.

A recent study using data from the Multimodal Treatment Study of Children with ADHD (MTA) (Hoza et al., 2005) found similar results. Children with ADHD who participated in this study were assigned to four treatment conditions: medication management, behavioural treatment, combined medication and behavioural treatment, and community care. Classmates of children participating in the MTA study were asked to rate the participants on three sociometric measures: (1) the classmates they considered to be their best friends; (2) the classmates with whom they did not wish to be friends; and (3) a rating of each child in the class on a 5-point scale ranging from 1 (really like) to 5 (really do not like). Results indicated that children in the two medication treatment groups received lower (i.e., better) liking ratings from their peers and also received higher

scores in positive peer nominations than did children in the two other conditions. No treatment condition, however, was successful in normalizing peer relationships in children with ADHD; all children experienced significant peer relationship problems compared to their typically developing classmates.

Given that the nature of the social difficulties experienced by children with ADHD are somewhat unclear and understudied, it is difficult to hypothesize upon the effect(s) of methylphenidate on this facet of the disorder. Indeed, Pelham, Waschbusch, Hoza, Pillow, and Gnagy (2001) note that it is still unclear whether methylphenidate is actually effective at alleviating the social difficulties experienced by children with ADHD and that further research is needed to resolve this issue.

The current investigation is therefore concerned with the relationship between ADHD, social information processing, and aggression. Specifically, the effects of stimulant medication on social information processing and aggression in children with and without ADHD was studied. The first study was designed to test the effects of methylphenidate on a social information processing task in children with and without ADHD. Children were asked to interpret and generate responses to various peer entry and peer provocation scenarios. It was hypothesized that children with ADHD would interpret scenarios that had a negative outcome for unclear reasons in a more hostile fashion than typically developing children and that they would also generate more hostile responses to these scenarios than typically developing children. Secondly, it was hypothesized that children with ADHD who received methylphenidate would generate less hostile responses than children with ADHD who received a placebo. The purpose of the second study was to measure aggressive social behaviour using a laboratory provocation task. It

was hypothesized that children with ADHD would be more likely to use reactive aggression strategies when compared to typically developing children. Again, it was hypothesized that children with ADHD who received methylphenidate would be less aggressive than children with ADHD who received a placebo, but more aggressive than children in the control group.

CHAPTER TWO

Social Information Processing in Children with and without ADHD

Introduction

As discussed previously, a social information processing framework has been widely used to study the social difficulties experienced by aggressive children and, to a lesser extent, children with ADHD. Studies have demonstrated that, when identified by classroom peers and teachers, aggressive children show differences in social information processing patterns when compared to non-aggressive children; it has been hypothesized that this difference is cognitively mediated and may lead to the socially incompetent behaviour exhibited by this group of children. Specifically, when compared to non-aggressive children on responses to hypothetical social problems, aggressive children have been found to assume that a peer is acting in a hostile manner, to generate more aggressive and incompetent solutions to social problems, and to encode less information before making a decision regarding a peer's intentions (Dodge, 1980; Milich & Dodge, 1984; Rubin et al., 1991). Given the high overlap between aggressive behaviour and ADHD and the relationship between impulsive behaviour and aggression (Newcorn et al., 2001; Wolraich et al., 1998), it is possible that the social difficulties experienced by children with ADHD are a result of social information processing deficits similar to those seen in aggressive children.

Elementary school-aged aggressive children show deficits in social problem solving with respect to conflict resolution, object acquisition, and friendship initiation. Whereas the cognitive inflexibility of these children has been shown to contribute to their difficulties in this type of problem solving (Rubin et al., 1991), it has also been suggested

that aggressive children make erroneous attributions regarding a peer's intent in hypothetical social situations (e.g., Dodge & Frame, 1982; Dodge & Newman, 1981; Dodge & Price, 1994; Milich & Dodge, 1984) and that this cognitive error may contribute to the maladaptive way in which aggressive children interact with others in social situations.

Cognitive theory of personality suggests that it is an individual's interpretation of an incoming stimulus rather than the stimulus itself that predicts subsequent responses to a given situation (Nasby et al., 1980). According to Berkowitz (1977, as cited in Nasby et al., 1980), any review of the personal and situational factors contributing to an act of aggression or anger must consider the individual's cognitive appraisals of events. Furthermore, cognitive theory suggests that it is necessary for an individual to attribute aggressive intent to an aversive stimulus for this stimulus to invoke an aggressive reaction (Berkowitz, 1990). It has been hypothesized that, throughout the course of development, an individual's patterns of aggressive responding become increasingly linked to internalized patterns of cognition (Eron et al., 1971; Slaby & Guerra, 1988). Using this theory as a guide, it follows that internal patterns of cognitions and expectations regarding the intentions of others and outcomes of social situations would influence a child's behavioural responding in social situations.

Dodge (1980; Dodge & Frame 1982) notes that aggressive children tend to attribute hostility to peer provocateurs in ambiguous social situations that have negative outcomes. Based on evidence suggesting that aggressive children alter their retaliatory actions as appropriately as non-aggressive children when the provocateur's intention is clearly stated, Dodge (1980) posits that a *hostile attribution bias* is present in ambiguous

social situations. That is, when faced with a social situation in which the provocateur's intent is unclear and the outcome of the other child's action is negative for the aggressive child, the aggressive child will assume that the other child's intent was hostile and will act accordingly. Dodge and Frame (1982) note that this bias is pervasive and stable across situations, as aggressive boys continue to expect peers to act with hostile intent toward them in future social interactions.

The pervasiveness of the hostile attribution bias extends beyond peer interaction to teacher interactions, possibly accounting for some of the inappropriate classroom behaviours exhibited by aggressive children (Bickett, Milich, & Brown, 1996). In a study in which aggressive and non-aggressive boys were asked open-ended questions about how they would respond to ambiguous and hostile provocations from peers, teachers, and their mothers, aggressive boys were more likely to make hostile attributions about their teachers' intent as well as their peers' and to report that they would retaliate accordingly (Bickett et al., 1996). These findings suggest that noncompliant, aggressive classroom behaviour may originate from the fact that aggressive boys see their teachers as being "out to get them", without considering alternative explanations for the teacher's actions, such as the situational constraints imposed on the teacher or the contribution of their own behaviour to the teacher's actions (Bickett et al., 1996).

Apart from being evident in ambiguous social situations, the hostile attribution bias is also observed when aggressive children respond to situations quickly, disregarding available social cues (Dodge & Newman, 1981). For example, when presented with social stories in which aggressive and non-aggressive children were asked to come to a decision as to whether a character in the story had committed a certain act, aggressive

boys chose to hear 30% fewer testimonies before making a decision as to the character's guilt or innocence than did non-aggressive children (Dodge & Newman, 1981). Dodge and Newman (1981) suggest that this quick response in social situations may cause aggressive children to selectively recall hostile social cues and ignore valuable non-hostile cues, thereby causing biased responding. This finding has relevance for children with ADHD, as these children tend to act impulsively (i.e., respond quickly, without adequate consideration of the situation); therefore, it is conceivable that the same hostile attribution bias exists in this group.

In addition to the response bias exhibited by aggressive children, this group of children has been shown to differ from typical children in terms of response generation and decision. When faced with hypothetical social problems, aggressive children have been found to generate a higher number of aggressive solutions than their non-aggressive peers, especially if the hypothetical situation has an ambiguous outcome (Dodge, 1980; Milich & Dodge, 1984). The practice of generating a high proportion of aggressive solutions to hypothetical social problem situations is referred to as a *response decision bias* and has been identified in several studies of social cognition and aggressive behaviour in children. Aggressive children consistently choose aggressive strategies such as bribery, affect manipulation or antagonism over prosocial strategies when faced with social dilemmas (Rubin et al., 1991).

In a study using object possession dilemmas, grade one children rated as aggressive by their teachers were not found to produce fewer problem-solving strategies than their non-aggressive peers; however, the content of their strategies was much different from that of non-aggressive children (Rubin, Moller, & Emptage, 1987).

Aggressive children were more likely to suggest bribery and manipulation as viable strategies to achieve a goal and were less likely to suggest prosocial strategies. Additionally, aggressive children were more likely to generate bizarre or abnormal strategies when faced with friendship initiation dilemmas; when informed that these strategies would not work in such situations, aggressive children had difficulty producing alternative solutions to these dilemmas, suggesting that these children may exhibit a certain degree of cognitive inflexibility compared to non-aggressive children (Rubin et al., 1991).

Similarly, in a study of elementary school children faced with hypothetical social situations involving object possession, peer group initiation, and peer provocation, it was shown that not only do aggressive children generate largely aggressive responses to hypothetical social situations, but these responses also appear to be their *primary* responses in a given situation; that is, aggression takes precedence over all other types of responding for this group of children (Walters & Peters, 1980, as cited in Rubin et al., 1991). The authors also note that aggressive responding in these situations is not limited to verbal aggression, but that physical aggression is also suggested as a viable response, especially in social situations involving peer provocation.

These findings are not limited to adult-rated aggressive children. Peer-rated aggressive children are also more likely to suggest aggressive responses as primary responses to hypothetical social dilemmas involving resolution of peer conflicts (Deluty, 1981). In a Canadian study of peer-rated aggressive children in grades one and two, aggressive children were found to generate less prosocial responses to social dilemmas, were more likely to suggest bribery as a solution to object acquisition dilemmas, and

were more likely to generate abnormal or bizarre solutions to friendship initiation dilemmas (e.g., "I'd buy him a belt"; "I'd sneak into her room at night") (Rubin et al., 1991).

Whereas studies have shown that deficits related to knowledge of appropriate social behaviour characterize children with disruptive behaviour disorders such as ADHD, ODD, and CD, it has also been shown that domains of social information processing are not necessarily equally affected within children with these disorders. In a study examining cue encoding, response generation, and response selection in response to social problems, it was found that children with ADHD differed from control children only in terms of the number of cues encoded and the number of responses generated, in that children with ADHD encoded fewer cues and generated fewer responses to social problems (Matthys et al., 1999). Children with ODD/CD and ADHD + ODD/CD, however, not only encoded fewer social cues and generated fewer responses than control children, but they were also more likely to display confidence in their ability to enact an aggressive response and to select an aggressive response when given a choice (Matthys et al., 1999).

The results noted above echo the results of previous studies (e.g., Bloomquist, August, Cohen, & Doyle, 1997). Bloomquist et al. (1997) found similar results to Matthys et al. (1999) with respect to response generation to social problems in hyperactive-aggressive (HA) and nonhyperactive-aggressive (N-HA) children; however, this study also demonstrated differences in controlled processing between HA and N-HA children. That is, when children were asked to generate focused solutions and consequences to social problem solving vignettes, HA children were less able than N-HA

children to anticipate consequences, and generally chose more aggressive solutions to problems (Bloomquist et al., 1997). This work suggests that HA children differ from N-HA children both in how and what they think when faced with social dilemmas.

Whereas fairly extensive knowledge regarding the social information processing abilities of children with both ADHD and aggressive behaviour has been gained from the studies noted above, less is known about social information processing patterns unique to ADHD. Children with ADHD share many of the same social difficulties as the aggressive children described above. Indeed, it has been estimated that approximately 50% of children with ADHD have significant peer relationship difficulties, including peer rejection (Frankel & Feinberg, 2002; Guevremont & Dumas, 1994; Milich & Landau, 1982). Children with ADHD are frequently nominated by their peers as "least liked" and have few friends, despite making numerous (although unsuccessful) attempts to engage with other children (Landau et al., 1998). Additionally, social problems also emerge within a very short time of meeting new people (Pelham & Bender, 1982). It has been suggested that the social rejection and socially incompetent behaviours seen in children with ADHD may represent a core deficit leading to self-esteem problems, depression, and increased risk for antisocial behaviours later in life (Guevremont & Dumas, 1994); however, it is not clear if this core deficit is a manifestation of deviant social information processing, just as it appears to be in aggressive children.

Studies of social information processing in children with ADHD suggest that individuals with the disorder exhibit biases and deficits in social-cognitive skills such as social knowledge, attention to social cues, and interpretation of social information. For example, in a study examining knowledge of appropriate social behaviour in hyperactive

and typically developing children, it was found that hyperactive participants' social knowledge, as assessed by the Social Knowledge Interview, was deficient when compared to that of their typically developing peers (Grenell et al., 1987). When presented with social vignettes and asked what they *should* do in various situations, hyperactive children gave responses that were less friendly, more assertive, less effective, and less relationship-enhancing than responses given by typically developing children (Grenell et al., 1987). Additionally, these authors demonstrated that greater social knowledge was associated with more positive social behaviour and less rejection of the partner during unstructured dyadic play. Results such as these suggest that children with ADHD exhibit skills deficits related to knowledge of appropriate social behaviour (Grenell et al., 1987; Landau et al., 1998; Stormont, 2001).

One area in which children with ADHD may have a lack of skill is in the realm of social communication, particularly as it relates to reciprocity in social interactions (Guevremont & Dumas, 1994; Landau et al., 1998). Children with ADHD have been observed to have difficulty alternating between roles as "interviewer" and "guest" in laboratory "TV Talk Show" experiments in which children are asked to engage in dyadic interactions with a typically developing child (Landau & Milich, 1988). This suggests that children with ADHD may adopt a communication strategy and use it broadly, rather than applying it to specific situations. However, whereas some researchers have interpreted this deficit as a skills deficit (e.g., Guevremont & Dumas, 1994), others have noted that studies of social perspective taking have not shown reliable group differences in this skill when hyperactive children are compared with typically developing children (Landau et al., 1998; Milich & Landau, 1982). These findings are more suggestive of a

performance deficit in that children with ADHD have access to the skills necessary to engage in social interactions; however, they are unable to use these skills appropriately. Indeed, more recent evidence suggests that the social and behavioural difficulties observed in children with ADHD are likely the result of a performance deficit rather than a skills deficit (Smith, Barkley, & Shapiro, 2006).

Evidence in favour of a performance deficit comes from the work of Milich and Dodge (1984), in which they provide evidence that children with ADHD and CD are able to recognize socially appropriate responses to peer interaction situations, but are not able to spontaneously recall the appropriate response when asked. Additionally, Grenell et al. (1987) note that children with ADHD are unable to explain how to keep a friend once a friendship has been established, another indication that children with ADHD may possess sufficient knowledge to initiate social interactions but that they may not be able to apply this knowledge appropriately or flexibly after the initial interaction.

While these studies are illuminating, the exact deficit leading to the social difficulties exhibited by children with ADHD is not yet clear, despite the fact that several studies have attempted to elucidate the underlying mechanisms of these difficulties. Behavioural problems associated with the disorder appear to play an important role in the severity of the social problems of at least some children with ADHD, particularly when these behaviours are exhibited in the presence of peers. For example, children with ADHD exhibit aversive behaviours in organized activities such as team sports (e.g., Pelham et al., 1990), no doubt frustrating their peers and increasing their chances of being rejected. Interestingly, the response style used by children with ADHD has been shown to have a reciprocal effect on their typically developing peers such that these peers

will adjust their response style to fit with that used by children with ADHD (Landau & Milich, 1988). Children with ADHD are observed to engage in highly aversive behaviour in the presence of peers- they are boisterous, explosive, overly critical, and often aggressive (Guevremont & Dumas, 1994; Landau et al., 1998).

Theoretically, the social problems experienced by children with ADHD may be the result of social information processing deficits related to the core symptoms of the disorder. It is possible that children with ADHD are not able to attend to and encode the details of social interactions, resulting in the creation of a limited database of responses to peer interactions and inappropriate social behaviour in subsequent interactions with peers. Thus, it is possible that peer rejection and other social consequences experienced by children with ADHD are, at least in part, related to their deficient attention and impulse control skills. However, few studies have examined this possibility empirically.

If, as suggested above, the symptoms of ADHD are related to deviant social information processing and social performance, then it follows that treatment of the hyperactive, impulsive, and inattentive symptoms of ADHD may also lead to decreased social difficulties in addition to decreased behavioural difficulties. Methylphenidate (MPH), which is better known by the brand name Ritalin, has been shown to decrease negative behaviours such as hyperactivity, impulsivity, and inattention in children with ADHD and is currently the most commonly used psychostimulant in the treatment of ADHD (Waschbusch, Kipp, & Pelham, 1998).

Methylphenidate has been found to have some effect on the overt social behaviours of children with ADHD in that both the rate and intensity of aversive behaviours such as aggression are significantly lower when children are treated with the

drug (Hinshaw, 1991; Whalen et al., 1990). It has been suggested that these changes in response to treatment may be cognitively mediated (Murphy, Pelham, & Lang, 1992). That is, it is possible that methylphenidate facilitates changes in certain social information processing steps, thereby reducing aggression. However, just as research is inconclusive as to the precise nature of the social difficulties experienced by children with ADHD, studies of the effects of medication on social processing are equally inconclusive (Whalen et al., 1990). When treated with methylphenidate, children with ADHD are more likely to engage in positive social exchanges and to be more pleasant when interacting with others, yet these behavioural changes do not typically translate into greater acceptance by peers, and possible changes in the cognitions accompanying these behavioural changes are understudied (Henker & Whalen, 1989).

Very little research has been carried out to examine the effects of methylphenidate on the social information processing skills of children with ADHD. In fact, only one study exists that examines social information processing variables (along with aggressive behaviour) in children with ADHD on and off methylphenidate (Murphy et al., 1992). The authors of this study argued that methylphenidate might have an effect on social information processing in children with ADHD, due to the drug's effects on the CNS pathways regulating attention and impulsivity. In particular, the authors posited that medication would lead to greater regulation of attention and impulse control, which in turn would lead to more complete encoding of social cues and more appropriate responses to ambiguous social situations. However, results indicated that, with respect to social information processing, methylphenidate had no significant effects except for allowing for increased cue recall.

Murphy et al. (1992) argued that the lack of significant drug effects on their social information processing tasks suggests that "[methylphenidate] probably does not influence social information processing as it relates to aggression" (Murphy et al., 1992, p. 463). However, this conclusion is tempered by the fact that the study had a small sample, with just 10 or 11 children per group. Additionally, an examination of effect sizes also revealed that, in the low aggressive subgroup, there was a large effect size (Cohen's D = .91) in the expected direction (i.e., decreased hostile attributions in the methylphenidate group), whereas in the high aggressive subgroup, there was a large effect size (Cohen's D = -0.7) in the opposite direction (i.e., increased hostile attributions in the methylphenidate group). These facts, combined with the overall dearth of research investigating the effects of methylphenidate on social information processing in children with ADHD, and the potential importance of understanding these effects, strongly argues that more research in this area is warranted.

The current study examined whether the social information processing skills of children with ADHD differed from those of typical children and whether children with ADHD differed as a function of whether or not they received stimulant medication. Based on previous literature (e.g., Dodge & Frame, 1982) (e.g., Pelham & Bender, 1982), it was hypothesized that: (1) when asked to interpret ambiguous social vignettes, children with ADHD in the placebo group would show a greater hostile attribution bias when compared to typically developing children; (2) children with ADHD in the placebo group would choose more aggressive, unfriendly responses when asked to generate responses to the social situations depicted in the vignettes when compared to typically developing children; (3) methylphenidate would not significantly affect social information

processing in children with ADHD, such that the responses of this group to the picture stories would be similar to children in the placebo group.

Method

Participants

Participants were 83 children (62 boys, 21 girls) between the ages of 6 and 12 years ($M = 9.07$ $SD = 1.99$), including 49 children with ADHD and 34 typically developing children who participated in the study as controls. Approximately one-half the children with ADHD ($n = 21$) were randomly assigned to participate after receiving methylphenidate (medication and randomization procedures described below) and the remaining children with ADHD ($n = 28$) participated after receiving a placebo. A majority of the children with ADHD also met criteria for ODD or CD ($n = 36$; 73.4%) but none of the typically developing children met criteria for ADHD, ODD or CD. Table 1 summarizes demographic and rating scale measures for the ADHD and control groups.

The majority of children with ADHD ($n = 43$) were enrolled in or had previously been enrolled in an eight-week comprehensive summer treatment programme (STP) for children with ADHD (see Pelham, Greiner, & Gnagy, 1998 for a description). The remaining children with ADHD ($n = 6$) were recruited from the community. ADHD was evaluated using DSM-IV criteria (American Psychiatric Association, 2000) as determined by parent and teacher ratings on the Disruptive Disorders Rating Scale (DBD) (Pelham, Gnagy, Greenslade, & Milich, 1992) and a structured diagnostic interview with parent(s) on the Computerized Diagnostic Interview Schedule for Children (C-DISC) (Shaffer, 1997; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). Diagnoses were made by doctoral level clinicians based on both rating scale and interview information.

Control children (n = 34) were recruited from two sources. Eight children who participated in the current study were enrolled as control children in the STP (for research purposes only), two children had been enrolled as controls in a previous STP and were contacted to participate in the study, and the remaining control children (n = 24) were recruited from the community using radio and television advertising, as well as flyers posted in local grocery stores and health centres. Control children were screened for behaviour and other adjustment difficulties using parent ratings on the DBD (Pelham et al., 1992), Aggression Scales (Dodge & Coie, 1987), and the C-DISC (NIMH-DISC Editorial Board, 1999; Shaffer, 1997; Shaffer et al., 2000). Control children with evidence of clinically significant behaviour problems, defined as having a score above the published norms on one or more of the measures, were excluded from participation[1].

Parents of all children gave informed written consent for their children to participate in the study and children gave verbal assent to participate (See Appendices A and B). All participants were treated in accordance with the requirements of the Research Ethics Board of the IWK Hospital and the Child and Youth Institutional Review Board of the State University of New York at Buffalo.

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[1] In total, 49 participants ($N_{ADHD\ Placebo}$ = 20; $N_{ADHD\ MPH}$ = 21; $N_{Control}$ = 8) were recruited from the Buffalo STP and 34 participants ($N_{ADHD\ Placebo}$ = 8; $N_{Control}$ = 26) were recruited from Halifax. Groups did not differ on age (t (81) = 1.74, $p > .05$) or sex (χ^2 (1) = 1.52, $p > .05$). There was a higher incidence of ODD/CD (χ^2 (1) = 19.27, $p < .05$) and ADHD (t (81) = -4.44, $p < .05$) in the Buffalo sample.

Table 1.

Means (Standard Deviations) for Participant Characteristics.

	No diagnosis N = 34	ADHD Placebo N = 28	ADHD Methylphenidate N = 21
Number (%) boys	22 (64.7%)	21 (75.0%)	19 (90.5%)
Age in years	8.91 (1.93)	9.37 (2.06)	8.93 (2.04)
Average # of symptoms endorsed by parent on DBD			
Inattentive	0.32 (0.77) (Range: 0-3)	6.43 (2.74) (Range: 0-9)	7.10 (1.84) (Range: 2-9)
Hyperactive/Impulsive	0.21 (0.59) (Range: 0-2)	5.75 (2.25) (Range: 2-9)	6.43 (1.94) (Range: 1-9)
ODD	0.15 (0.36) (Range: 0-1)	4.11 (2.57) (Range: 0-8)	4.52 (2.34) (Range: 0-8)
CD	0 (Range: 0)	0.93 (1.27) (Range: 0-5)	1.10 (1.14) (Range: 0-4)
Average # of symptoms endorsed by parent on C-DISC			
Inattentive	0	6.62 (2.76) (Range: 0-9)	6.63 (2.87) (Range: 0-9)
Hyperactive/Impulsive	0	6.42 (2.82) (Range: 0-9)	7.20 (1.82) (Range: 2-9)
ODD	0	4.04 (2.76) (Range: 0-8)	4.25 (2.49) (Range: 0-8)
CD	0	0.96 (1.48) (Range: 0-5)	1.00 (1.17) (Range: 0-3)
# of participants meeting criteria for Conduct Problems (CP)	0	21	15

Notes: Values in Tables are means, with standard deviations in parentheses, except as noted. Conduct problems were defined as ODD or CD.

Materials

Behavioural Measures

Revised Disruptive Behavior Disorders Rating Scale (DBD, Pelham et al., 1992). The DBD is a 45-item rating scale comprised of the DSM-IV diagnostic criteria for ADHD, ODD, and CD (See Appendix C). Raters are required to evaluate the presence

or absence of a specific symptom by using a four-point Likert scale ranging from 0 (not at all) to 3 (very much). Parents of children recruited from the community were given a package of questionnaires (including the DBD) to complete while their children were taking part in the experimental protocol. Parents of children in the STP completed the DBD as part of the clinical assessment conducted prior to treatment. Reliability of the DBD has been demonstrated in other samples (Massetti, Pelham, & Gnagy, 2005, June; Owens & Hoza, 2003; Pelham et al., 1992; Wright, Waschbusch, & Frankland, under review). Reliability in the current sample was adequate ($\alpha_{placebo}$ = .59; $\alpha_{methylphenidate}$ = .58; $\alpha_{control}$ = .61). Means and standard deviations for the DBD can be found in Table 1.

Aggression Scales (Dodge & Coie, 1987). Reactive and proactive aggression were measured by averaging together three items drawn verbatim from previous research (Dodge & Coie, 1987) (See Appendix D). Items were rated using Likert scales that ranged from 0 ("not at all") to 3 ("very much"). The items on the reactive aggression scale were: (1) when teased, strikes back; (2) blames others in fights; and (3) overreacts angrily to accidents. The items on the proactive aggression scale were: (1) uses physical force to dominate; (2) gets others to gang up on peers; and (3) threatens and bullies others. These scales have been widely used and have demonstrated reliability and validity (e.g., Dodge & Coie, 1987; Dodge et al., 1997). With respect to the current study, reliability coefficients for the reactive scale were high ($\alpha_{Placebo}$ = .81; $\alpha_{Methylphenidate}$ = .86; $\alpha_{Control}$ = .82), whereas they were somewhat lower for the proactive scale ($\alpha_{Placebo}$ = .73; $\alpha_{Methylphenidate}$ = .42; $\alpha_{Control}$ = .29).

Computerized Diagnostic Interview Schedule for Children Version IV (C-DISC-IV, Shaffer, 1997). The C-DISC is a highly structured diagnostic tool designed for

use by non-clinicians (Shaffer et al., 2000). The instrument is based on diagnostic criteria drawn from DSM-IV (American Psychiatric Association, 2000) and ICD-10 (World Health Organization, 1993) and was designed to assess more than 30 psychiatric disorders occurring in children and adolescents. Questions on the C-DISC-IV are all relatively short and responses are generally limited to "yes" or "no", although some questions have a "sometimes" or "somewhat" option. Questions are read from the computer screen by the interviewer, the interviewee (i.e., the parent) indicates his or her response, and the examiner notes this response.

In total, the C-DISC-IV contains almost 3 000 questions, including 358 "stem" questions (Shaffer et al., 2000). These stem questions broadly describe the essential aspects of each symptom and are asked of all respondents. Respondents are asked to respond as accurately and honestly as possible, using "yes" or "no". If a stem question is answered in the affirmative, it is followed by a contingent question, which probes further regarding frequency, intensity, and duration of the symptom. For the current study, only the sections probing anxiety disorders, elimination disorders, tic disorders, ADHD, ODD, and CD were administered. To date, there have been no studies of reliability or validity carried out on the C-DISC-IV; however, the agreement between earlier versions of the C-DISC and clinician ratings has been moderate to very good, with the exception of parent report of separation anxiety and youth report of ADHD, neither of which was included in this study. Means and standard deviations on the C-DISC can be found in Table 1.

Experimental Measures

Picture Stories (Dodge, 1980; Dodge, Laird, Lochman, & Zelli, 2002). A series of eight picture stories were used to measure social information processing in

participants. Picture stories consisted of a cartoon picture (See Appendix E) and a short story (See Appendix F) about at least two children participating in various social interactions and were based on the social information processing model proposed by Dodge (Crick & Dodge, 1994; Dodge, 1980). Stories depicted either peer entry or peer provocation situations, with four stories of each type included in this task. The experimenter related the story to the child and the child was asked to pretend he or she was one of the children portrayed in the scenario. Examples of situations included in this series are being hit in the back with a ball thrown by another child (peer provocation) and asking to join a baseball game and being denied the opportunity (peer entry). Immediately after each picture/story was presented to the child, he or she was asked (a) why he or she thought the other child(ren) in the picture behaved the way they did (Interpretation) and (b) what he or she would do in the same situation (Generation).

Responses to parts (a) and (b) of the social information processing scenarios were recorded and coded immediately by the research assistant. Responses to part (a) were coded as either 1 (accommodating) or 2 (hostile) and responses to part (b) were coded as 0 (don't know), 1 (nothing), 2 (ask again/ask why), 3 (command), 4 (seek adult punishment), or 5 (retaliate). Responses to each question were averaged over the stories after excluding "don't know" responses. Therefore, scores indexing interpretation of scenarios ranged from 1 (accommodating) to 2 (hostile) and scores indexing response generation ranged from 1 (nothing) to 5 (retaliate). Higher scores represent more aggressive responding.

Before replacing missing values in the data set, correlations were performed between items for each scenario type to determine whether it was appropriate to calculate

mean scores for peer entry interpretation, peer entry generation, peer provocation interpretation, and peer provocation generation. Correlations between items were generally positive; therefore, it was appropriate to calculate mean scores for each child as in previous research (e.g., Dodge, 1980). Reliability analyses were performed for peer entry interpretation, peer provocation interpretation, peer entry generation, and peer provocation generation questions. Cronbach's alpha values were adequate, with values of .55, .51, .50, and .73, respectively. Finally, responses from the peer entry and peer provocation scenarios were averaged separately such that each child was given four mean scores: mean peer entry interpretation score, mean peer provocation interpretation score, mean peer entry response generation score, and mean peer provocation response generation score.

A second coder, blind to the condition of the participants, coded 22 of the interviews (26 %) for reliability purposes. Inter-rater correlations for peer entry interpretation of intent and peer provocation interpretation of intent were .77 and .73, respectively. Inter-rater correlations for peer entry response generation and peer provocation response generation were .80 and .96, respectively.

Procedure

Medication Procedure. As part of a larger study, all children who met the diagnostic criteria for ADHD participated in a placebo controlled, randomized medication assessment where medication condition varied on a day-to-day basis (see Pelham, 1993, for a description). In the current study, 21 children with ADHD were randomly assigned to participate after receiving medication and 20 children with ADHD were randomly assigned to participate after receiving a placebo. An additional 8 children

with ADHD (n = 8) were tested on placebo but were not randomly assigned due to constraints imposed by other, unrelated research[2]. Children who were randomly assigned to be tested on medication received a dose of methylphenidate equivalent to 0.3 mg/kg of body weight, rounded to the nearest 1.25 mg dose. Children assigned to the placebo condition received an inactive capsule. Medication and placebo were identically encapsulated in opaque pills so that neither staff members nor children were aware of the medication condition. An STP staff member administered medication to ensure that children received the correct pill at the correct time each day. Testing took place at least 30 minutes and not more than three and a half hours after administration of the pill. All children with ADHD had previous experience with medication.

Experimental Procedure. After giving assent to participate in the study, children accompanied a research assistant to a small office where they completed the Picture Stories. Children were presented with eight cartoon pictures of children engaging in various social situations; these pictures were black and white, with the exception of one child in the picture who was coloured in using a yellow highlighter. Children were asked to pretend that they were the highlighted child and to pretend that they were taking part in the pictured social situation. The research assistant then read a short paragraph describing the scene to the child. Following this description, the participant was asked two short questions regarding the social situation: (a) why do you think the other child acted this way? (Interpretation) and (b) what would you do if you were in this situation? (Generation). Responses were recorded verbatim and coded.

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[2] The randomly assigned and non-randomly assigned placebo groups did not differ on Age (F (1, 26) = 3.61, $p > .05$), Sex (χ^2 (1) = 0, $p > .05$) or presence of co-morbid Conduct Problems (χ^2 (1) = 0.933, $p >$ .05).

Results

Overview

Data were examined using two 2 (Scenario: Entry vs. Provocation) x 3 (Group: Control vs. ADHD methylphenidate vs. ADHD Placebo) mixed analyses of variance (ANOVAs), with Scenario as a within subjects factor and Group as a between subjects factor. The first ANOVA examined group differences in interpretation of intent; therefore, the dependent measure was average response to part (a) over the eight stories (maximum score of 2). The second ANOVA examined response generation to each scenario; therefore, the dependent measure was average response to part (b) over eight stories (maximum score of 5). Significant interactions were followed up with simple effects tests and Tukey honestly significant difference (HSD) post hoc tests, and by examining means, standard deviations, and effect sizes (eta-squared).

Sex, age, and conduct problems (CP, defined as presence of ODD or CD) were considered as covariates in these analyses. As shown in Appendix G, results indicated that CP and its interactions were not significant, thus leaving the results of the overall analysis unchanged. Similarly, as shown in Appendix G, sex and its interactions were not significant and did not change the results of the overall analysis. Therefore, these variables were not included as covariates in the final analyses.

Age was not used as a covariate due to the fact that the relationship between age and the dependent variables changed in magnitude and direction as a function of group. As shown in Appendix G, when age was entered into both analyses (i.e., scenario interpretation and response generation) as a covariate, the main effect of scenario type was no longer significant, nor was the effect of age and its interactions; however, when

age was used as a full variable instead of as a covariate, it became clear that an age x condition interaction existed. The age x condition interaction term indicated that the function relating age to interpretation is different across the three groups. Specifically, typically developing children showed more range in interpretation with increasing age, whereas children with ADHD in both the placebo and methylphenidate groups were not showing this trend. This pattern of responding was evident when both scenario interpretation and response generation were examined; however, caution should be used when interpreting these results, given the small sample size used and the difference in degrees of freedom in the ANCOVA as opposed to the ANOVA. Given these factors, it was decided that age would not be entered into the analysis as a covariate or as a full variable.

Missing Values

If a participant was missing two or fewer values on picture story responses, the score for these values was replaced by the mean of responses to either the peer entry or peer provocation scenarios. Only six (7.2%) of participants had missing values; however, "don't know" responses on either part (a) or part (b) were coded as missing values due to the fact that "don't know" does not represent the same category as the other possible responses to the social information processing questions. Five participants were missing three scenario interpretation values and were therefore excluded from analysis.

Picture Stories

Interpretation of Intent. As shown in Table 2 and Figure 1, results of the 2 (Scenario) x 3 (Group) ANOVA indicated a significant main effect of scenario (F (1, 75) = 6.67, $p < .05$, $\eta^2 = .082$) such that children interpreted the provocation ($M = 1.63$, $SE =$

0.03) scenarios in a more hostile manner than the entry (M = 1.53, SE = 0.04) scenarios, regardless of group. Neither the main effect of group (F (2, 75) = 0.43, p = .65, η^2 = .011) nor the group x scenario interaction (F (2, 75) = 1.19, p = .31, η^2 = .031) were significant.

Table 2.

Mean (Standard Deviation) Interpretation Scores Between Groups.

	Placebo	Methylphenidate	Control
Peer Entry Interpretation	1.61 (0.32)$_a$	1.46 (0.30)$_a$	1.52 (0.32)$_a$
Peer Provocation Interpretation	1.68 (0.26)$_b$	1.62 (0.27)$_b$	1.60 (0.32)$_b$
Marginal Mean (SE)	1.65 (0.05)	1.54 (0.05)	1.56 (0.04)
Cohen's D	0.24	0.56	0.25

Notes: Means in the same row that do not share a subscript differ at the .05 level. Means in the same column that do not share a subscript differ at the .05 level.
Cohen's D was calculated using the pooled standard deviation operationalized as the standard deviation of the full sample.

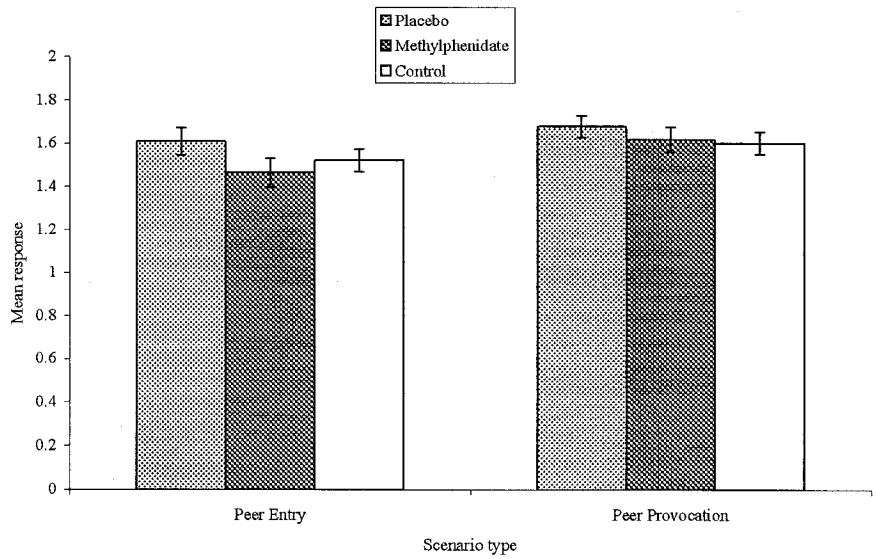

Figure 1. Interpretation of peer entry and peer provocation scenarios across experimental groups. Vertical lines depict standard errors of the means.

Generation of Responses. As shown in Table 3 and Figure 2, results of the 2 (Scenario) x 3 (Group) ANOVA indicated a significant main effect of scenario (F (1, 80) = 42.98, $p < .05$, $\eta^2 = .35$), such that all children generated more hostile responses to the provocation scenarios ($M = 2.49$, $SE = 0.13$) than to the entry ($M = 1.78$, $SE = 0.09$) scenarios, regardless of group. Additionally, a significant interaction between scenario and group was found (F (2, 80) = 4.30, $p < .05$, $\eta^2 = .10$). This interaction was followed up by examining the simple effects of group at each level of scenario. Results indicated a significant group difference in the peer provocation condition, F (2, 80) = 3.76, $p < .05$, $\eta^2 = .09$, but not in the peer entry condition. Examination of means and Tukey HSD tests showed that children in the methylphenidate group generated more hostile responses to

peer provocation scenarios than children in the control group. No significant main effect of group was found, F (2, 80) = 2.06, p = .13, η^2 = .05.

Table 3.

Mean (Standard Deviation) Response Generation Scores Between Groups.

	Placebo	Methylphenidate	Control
Peer Entry Generation	1.70 (0.80)$_a$	1.86 (0.94)$_a$	1.77 (0.61)$_a$
Peer Provocation Generation	2.46 (1.26)$_b$	2.92 (1.30)$_c$	2.07 (0.83)$_b$
Marginal Mean (SE)	2.08 (0.16)	2.39 (0.18)	1.92 (0.14)
Cohen's D	0.73	0.95	0.42

Notes: Means in the same row that do not share a subscript differ at the .05 level. Means in the same column that do not share a subscript differ at the .05 level.
Cohen's D was calculated using the pooled standard deviation operationalized as the standard deviation of the full sample.

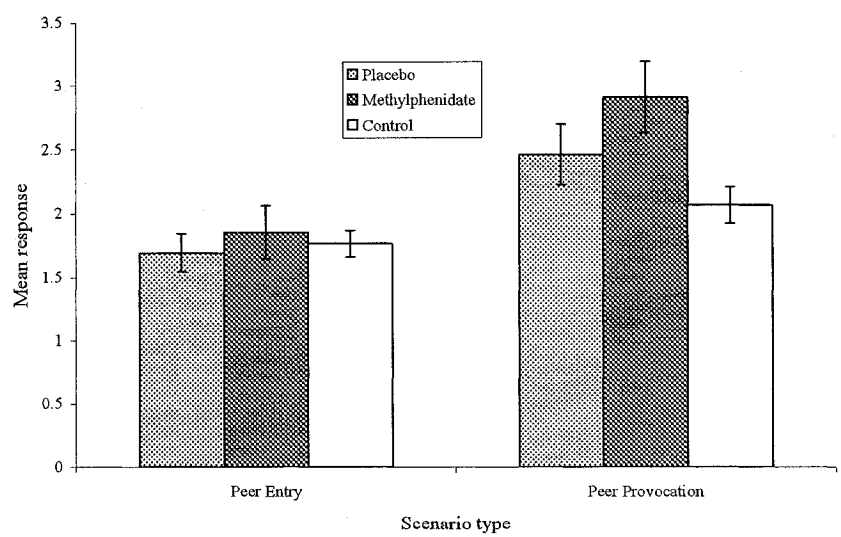

Figure 2. Response generation to peer entry and peer provocation scenarios across experimental groups. Vertical lines depict standard errors of the means.

Discussion

The goal of the current study was to determine whether children with ADHD have social information processing deficits in comparison to typically developing children, and, if so, whether methylphenidate (0.3 mg/kg) influenced these skills. It was hypothesized that ADHD children in the placebo group would show a hostile attribution bias on social information processing measures (i.e., children with ADHD would interpret scenarios in a more hostile manner when compared to typically developing children). It was additionally hypothesized that children with ADHD on placebo would generate aggressive, unfriendly responses to peer entry and peer provocation scenarios. Results showed mixed support for these hypotheses in that groups did not differ on the measure of hostile bias, but did differ on the measure of response generation. Results also showed that type of social situation – peer entry or peer provocation – also influenced responding. Each of these results is discussed below.

Results indicated a significant main effect of scenario type for both interpretation and generation measures such that peer provocation scenarios led to more hostile interpretation of intent and to generation of more hostile responses to the actions of a peer. This result is somewhat intuitive; given that the provocation scenarios involved an act with seemingly aggressive intent, children could be expected to respond in a more hostile manner. Indeed, these results suggest that the task was valid in that it clearly distinguishes between peer entry and peer provocation scenarios. Additionally, the results highlight the importance of provocation in eliciting an aggressive response from an individual.

Children with ADHD did not exhibit a hostile attribution bias compared to typically developing children. That is, neither medicated nor un-medicated children differed from controls on the measure of hostile attributions when interpreting peer entry and peer provocation scenarios. This finding is in contrast to the hypothesis that un-medicated children with ADHD would show a hostile bias similar to aggressive children, and that this difference would be partially ameliorated by medication. These findings suggest that the hostile bias may be specific to aggression.

Results from the measure of response generation also failed to support the hypotheses. It was hypothesized that children with ADHD on placebo would generate more hostile responses than controls, and that this would be partially ameliorated by medication. However, the results showed a very different pattern -- ADHD children in the methylphenidate group generated more hostile responses to peer provocation situations than typically developing children, whereas ADHD children on placebo did not differ from controls. There is mixed support for these results in the existing literature. Despite non-significant results, examination of effects sizes in the Murphy et al. (1992) study indicate that methylphenidate increased aggressive responding in low aggressive children with ADHD. Similarly, Hinshaw, Heller, and McHale (1992) found that a dose of 0.3 mg/kg of methylphenidate increased covert aggression in boys with ADHD; these authors suggest that methylphenidate provides enhanced motivation to engage in aggressive behaviour. Conversely, in their review of medication effects on aggression, Connor et al. (2002) suggest that treatment with methylphenidate improves aggression.

The current results, while not entirely consistent with past research, highlight some important differences between children with ADHD and children who are

aggressive. One salient difference between the current sample and those used in previous studies of social information-processing (e.g., Dodge, 1980; Dodge & Frame, 1982; Steinberg & Dodge, 1983) is the fact that the children who participated in previous studies were all selected on the basis of their high scores on teacher and peer aggression measures, whereas the participants in the current study were selected on the basis of meeting criteria for ADHD. It is possible then, that the hostile attribution bias described previously is a robust finding only in samples distinguished based on aggression level and is therefore less apparent in samples distinguished primarily on the basis of an ADHD diagnosis. One caveat to this suggestion is that many of the children with ADHD in the current sample also met diagnostic criteria for CP; however, it should be noted that CP and aggression are not interchangeable terms, meaning that it is theoretically possible for an individual to meet criteria for CP without necessarily exhibiting excessive amounts of aggressive behaviour. Indeed, half of the children meeting criteria for CP in the current sample did not meet criteria for aggressive behaviour as measured by the aggression Scales and the DBD. Additionally, children with CP often engage in high amounts of covert aggressive behaviour as opposed to overt aggressive behaviour, meaning that it is difficult to determine how aggressive these children actually are. Therefore, it is possible, based on the results of the current study, that the hostile attribution bias is specific to overt aggression rather than to CP.

These results suggest that there may be salient differences in aggression usage between children with ADHD and aggressive children, leading to the development of disparate social information processing patterns in these two groups of children. Specifically, children with ADHD may be more likely to act in a seemingly aggressive

manner toward their peers due to their impulsive actions, not necessarily because they wish to harm the other individual. Indeed, there is evidence that reactive aggression is linked to impulsivity (Dodge et al., 1997), suggesting that the aggression exhibited by children with ADHD may be of a more reactive/impulsive nature. However, the hostile attribution bias has also been linked to impulsivity (Dodge & Newman, 1981), a finding not consistent with the current results. However, whereas impulsivity has been shown to be an important component of aggression in previous research (e.g., Dodge & Newman, 1981), many individuals exhibit impulsive behaviour without being aggressive, suggesting that other factors (e.g., poor socialization, poor moral development) are involved in the manifestation of aggression. It is possible, therefore, that the hostile attribution bias is only linked to impulsivity in children selected on the basis of aggressive behaviour, rather than in children selected on the basis of meeting criteria for ADHD.

Indeed, the nature of the tasks employed in the current study could be more suitable for investigating the social information processing in purely aggressive children rather than those who meet criteria for ADHD. The hostile attribution bias and response generation are both likely related to past learning history; in contrast, encoding of social cues may be more strongly correlated with information processing abilities and impulsivity. Therefore, the above results should not be considered as evidence that children with ADHD do not have any deficits in social information processing; rather, children with ADHD may be impaired in other domains of social information processing, such as cue encoding and response enactment. Future research should consider this possibility.

Whereas the current results do not fully support findings that children with ADHD tend to generate more hostile responses to social situations compared to typically developing children (e.g., Grenell et al., 1987), results indicated that children in the methylphenidate group generated more hostile responses to peer provocation scenarios compared to children in the other groups. It is not clear why the children in this group appear to generate more hostile responses than control children and children given placebo, as it was hypothesized that children in the placebo group would generate more hostile responses than other children. Studies of medication effects on social information processing in children with ADHD are rare; however, increased aggressive behaviour has been observed in both children and adults following methylphenidate administration (e.g., Alioto, 1999; Hinshaw et al., 1992; Murphy et al., 1992), an indication that the current results are not spurious and that the drug may have a somewhat paradoxical effect on aggression.

One possible explanation for the finding that children in the methylphenidate group generated more hostile responding to peer provocation scenarios is that methylphenidate may have also allowed children to focus on select cues (i.e., hostile/negative cues) in the presented vignettes, thereby prompting them to generate hostile responses. It has been suggested that the social cognitive difficulties associated with ADHD are, at least in part, due to an inability to focus on cues and deliberate appropriately on a response (Waschbusch, Andrade, & King, 2006). Indeed, Dodge and Newman (1981) note that hostile responses are typically generated when children attend selectively to hostile cues and that in order to reduce hostile responding, aggressive children must be taught to attend to all interpersonal cues in a given situation

nonselectively. In this case, therefore, methylphenidate may have allowed children to focus selectively on the hostile cues in the vignettes, thereby resulting in increased hostile response generation.

Interestingly, response generation has been shown to be associated with reduced impulsivity and increased proactive aggression; therefore, to the extent that methylphenidate decreases impulsivity, the above finding is consistent. That is, by reducing impulsivity in children with ADHD (i.e., by administering methylphenidate), it is conceivable that their reactive aggressive instincts would be suppressed and their proactive aggressive instincts would become more prominent (Hinshaw & Lee, 2000). In this case, it is possible that the decreased impulsivity afforded the ADHD children in the methylphenidate group resulted in an increase in planned aggressive behaviour, meaning that more aggressive responses were generated.

Hinshaw and Lee (2000) note methylphenidate significantly decreases covert antisocial behaviours such as stealing and property destruction; however, cheating behaviour has been shown to increase with methylphenidate administration. Increased cheating may be a result of "pharmacologic enhancement of achievement motivation" (Hinshaw & Lee, 2000, p. 241). In the present study, children may have been motivated to achieve a social goal, such as achieving dominance/power over a peer. If so, administration of methylphenidate may have allowed children to focus on achieving this goal, as suggested by Melnick and Hinshaw (1996). As a result, children treated with methylphenidate may have been more likely to choose highly aggressive responses to peer provocation. Conversely, children who were not taking methylphenidate were less likely to do so and therefore chose their responses more impulsively.

However, despite the findings and theoretical explanations presented above, most research in the field suggests that methylphenidate decreases aggressive behaviour. Taken together, this suggests that further research in this area is needed for two reasons: (a) to determine whether stimulant medication such as methylphenidate actually does have a negative impact on social cognition, as suggested by the current results and (b) to determine why aggressive behaviour seemingly decreases despite decrements in social information processing. It is not clear why aggressive behaviour would decrease in response to methylphenidate despite possible decrements in social information processing associated with the drug; however, it could be hypothesized that aggression is not being measured properly. Rating scales are currently the most common method of treatment response, but it is possible that these scales are not able to detect subtle changes in aggression, especially if the aggression is covert. Alternatively, these scales may not be good measures of aggressive behaviour in response to provocation.

Additionally, different pathways could mediate the behavioural and cognitive correlates of aggressive behaviour; that is, medication effects on aggressive behaviour may be independent of medication effects on social cognition. If this is the case, it is possible that a social cognitive decrement has a different effect on behaviour that has not been examined in the current investigation. For example, a social cognitive decrement as a result of medication administration may lead to increased covert aggressive behaviour. Given that this question is beyond the scope of the current study, further research should attempt to carefully delineate the effects of medication on various aspects of behaviour and cognition to determine whether the preceding speculative discussion is useful.

It is perhaps not unusual that social information processing differences between the three groups of children in this study were not large and that methylphenidate administration did not differentiate between the clinical groups on the measure of hostile attribution bias, as similar results have been reported previously. In their study of high- and low-aggressive boys taking methylphenidate, Murphy et al. (1991) found that the drug was only useful in decreasing behavioural symptoms of ADHD, such as nonverbal aggression (i.e., physical aggression, destruction of property, and stealing), verbal aggression (i.e., name calling, teasing, and swearing), and aggressive responding during a laboratory provocation task. In contrast to the behavioural findings, methylphenidate had no significant effect on social information processing measures in these children; however, an examination of effect sizes revealed that methylphenidate increased the incidence of the hostile attribution bias in high aggressive children and decreased the incidence of the hostile attribution bias in low aggressive children. Effect sizes were small for all other social information processing measures. These results suggest that "[methylphenidate]-induced improvement in aggression is apparently independent of changes in these social information processing measures" (Murphy et al., 1992, p. 463). This finding, combined with the current results, aids in confirming studies suggesting that the use of methylphenidate as a treatment for ADHD should be in conjunction with other treatments (e.g., social processing re-training and/or behaviour modification) (e.g., Hinshaw & Lee, 2000), as the drug is not necessarily effective in changing the social information processing patterns of children with ADHD.

Treatment may have had an effect on the outcome of the current study, however. As noted previously, most of the clinical participants in the present study were part of a

summer treatment programme designed to deliver intensive behavioural treatment in the areas of peer relationships, social skills, and academic difficulties. Therefore, it is possible that this ongoing treatment impacted children's responses to the social information processing scenarios. Indeed, research has shown that interventions using social skills training and social problem solving skills are successful in increasing social competence and decreasing aggressive behaviour in aggressive and "hard-to-manage" children (e.g., Fraser et al., 2005; Nangle, Erdley, Carpenter, & Newman, 2002; van Manen, Prins, & Emmelkamp, 2004). In a study by Fraser et al. (2005), social skills training significantly increased cue encoding and goal formulation in treatment groups, suggesting that participants in the current study may have been able to attend to more cues in the picture stories and subsequently formulate appropriate responses to the various social situations as a result of their training. It has been suggested that children with ADHD experience social difficulties due to their lack of social knowledge; it is possible that exposure to social skills training increased the social knowledge of this sample, thereby allowing them to interpret the pictures stories similarly to typically developing children.

It should be noted, however, that both groups of children with ADHD, those who received placebo and those who received medication, were largely comprised of children receiving treatment. That is, children receiving ongoing behavioural treatment were not differentially placed in one group relative to the other. Therefore, ongoing behavioural treatment may be an explanation for the failure to find differences between the ADHD and control groups, but it is not likely related to the differences between medicated and un-medicated ADHD groups.

The above interpretation of the results, however, does not appear to explain group differences in response generation. Response generation is a process that relies on encoded memory for social situations and successful responses to these situations (Crick & Dodge, 1994; Dodge et al., 2002); the fact that these responses are encoded into a long-term memory store implies that they are somewhat immutable. Response decision biases, on the other hand, may not be as strongly linked to past events and, consequently, may be more amenable to change by way of social skills training.

Dodge and Newman (1981) offer support for the notion that hostile attribution biases may be amenable to change, as they note that the hostile attribution bias observed in aggressive children does not appear to be present if children are given ample time to respond to hypothetical scenarios, suggesting that (1) the hostile attribution bias is not necessarily stable across all conditions and (2) impulsivity does, indeed, play a role in the decision to interpret a peer's intent as hostile, in that aggressive children will only show a hostile bias when they ignore relevant social cues and respond quickly. The task administered in the current study gives participants as much time as needed in order to respond to the examiner's questions regarding the hypothetical situation; therefore, it is possible that group differences in hostile attribution bias were not observed for this reason. The effect of scenario was likely found due to the fact that the peer provocation scenarios posed more of a threat to all children, thereby increasing the incidence of aggressive responses.

One caveat to these suggestions is that the current study used a between subjects design, whereas studies of medication effects are more powerful if a within-subjects design is used. A between subjects design was chosen due to the fact that there are no

suitable within-subjects measures of social information processing exist (that we are aware of) and it would not have been appropriate to lengthen the medication study used in the current investigation, as any effects due to medication would then be confounded with effects due to time in the treatment programme. Also, children attended the STP for only eight weeks; it is unlikely that the social information processing measure used in the study would have been valid if children were tested twice over a short period of time, as is required of a within subjects medication assessment.

A second caveat to these findings is that the current sample consisted of children ranging in age from 6 to 12 years and this may have affected responding to the social information processing scenarios. Children move through a wide variety of developmental stages between these ages and would, consequently, be expected to differ in terms of their responses to various social dilemmas. For example, younger children are more likely to choose an instrumental or object-focused response to a provocation scenario, whereas older children are more likely to choose a person-oriented response (Hartup, 1974).

Some research has found that development may, indeed, affect responding to social information processing. In a study of social information processing in a group of 9-12 year old children, Crick and Dodge (1996) found that no hostile attribution biases existed in the youngest children in their sample (i.e., children in grades three and four). The current study included 43 children in this age group; therefore, it is possible that hostile attributional biases were not evident for this reason. However, Crick and Dodge (1996) note that their finding is in contrast to that of Dodge and Coie (1987), who found hostile attributional biases in younger children (i.e., children in grades one and three).

Children in the current study were randomly assigned to their experimental groups and the resulting groups did not differ as a function of age; however, preliminary covariate analyses indicated a possible effect of age on the results in that children in the control group showed more range in responding with increasing age than children with ADHD. Although the covariate analysis was not employed for reasons cited earlier, the contradictory findings in this area of research suggest that it would be advisable to replicate and extend the current study using several homogeneous age groups of children in order to determine the developmental correlates of social information processing (Nangle et al., 2002).

In summary, there were three main findings in the current study. First, there was a significant main effect of scenario type, in that all children used more reactive aggression in response to peer provocation. Second, children with ADHD (regardless of whether they were or were not on medication) did not exhibit a hostile attribution bias compared to typical children when groups were compared on interpretation of scenarios. This suggests that the aggression observed in children with ADHD may be due to factors other than a hostile attribution bias. For example, the impulsive, erratic behaviour observed in children with ADHD may instead reflect a performance deficit manifested in certain ambiguous social situations. This also suggests that methylphenidate does not influence (either positively or negatively) ADHD children's interpretations of peer intent. Third, methylphenidate appears to increase the generation of aggressive responses to ambiguous social situations. Very little work has been done in this area; however, it is possible that methylphenidate decreases impulsivity in children with ADHD such that they are able to attend to generating more aggressive responses to social situations, as others have

suggested (e.g., Hinshaw & Lee, 2000). Additionally, methylphenidate may have enhanced motivation to achieve a social goal, making children in this group more likely to choose an aggressive response in an ambiguous social situation.

The results of this study provide insight into the social cognitive abilities of children with ADHD, but the manner in which these abilities relate to overt social behaviour remains unclear. More importantly, these results raise an important question about the nature of aggression use in children with ADHD. It would be relevant, therefore, to further investigate aggressive behaviour in children with ADHD. Of particular interest is the nature of aggressive behaviour in this group; for example, research investigating whether children with ADHD are more likely to engage in reactive or proactive aggression and whether or not methylphenidate influences aggression use in this group would be a useful extension of the current findings. The second study will focus on elucidating the nature of aggression use in children with ADHD and whether medication influences use of aggression in children.

CHAPTER THREE

Subtypes of Aggression in Children with and without ADHD

Introduction

Aggressive behaviour has a significant impact on the social development of children. Use of aggression in social interactions is often predictive of negative long-term outcomes such as school difficulties (Brown et al., 1996; Day, Bream, & Pal, 1992), and violent and antisocial behaviour (Cornell et al., 1996; Tremblay et al., 2004). These negative outcomes have prompted much research as to the origins, nature, and treatment of aggressive behaviour in children.

As discussed previously, human aggression can be defined as a behaviour with the proximate (i.e., immediate) intent of causing harm to another individual (C. A. Anderson & Bushman, 2002; Bushman & Anderson, 2001). Additionally, the target of the aggressive act must be motivated to avoid the behaviour (C. A. Anderson & Bushman, 2002). Given that the goal of aggression is not consistent across situations, researchers have developed a taxonomic system to better reflect the heterogeneous nature of this construct. Finer distinctions in the conceptualization of aggression may ultimately lead to development of more streamlined treatment for aggressive individuals and also to a more unified theory of aggressive behaviour. Aggressive behaviour is typically broken down into two main subtypes, reactive aggression and proactive aggression (e.g., Dodge, 1991).

Reactive and proactive aggression can be defined in terms of the motivation to engage in aggressive behaviour; that is, the type of aggression used by an individual is determined by the presence or absence of an antecedent provocation. Reactive aggression

can be defined as impulsive, angry, "hot" aggression (Crick & Dodge, 1996; Dodge, 1991; Waschbusch et al., 2002) in response to an actual or inferred provocation (Brown et al., 1996; Waschbusch, Willoughby et al., 1998). Conversely, proactive aggression can be defined as non-angry, goal-oriented aggression (Crick & Dodge, 1996; Dodge, 1991; Waschbusch, Willoughby et al., 1998). The validity of the distinction between reactive and proactive aggression has been shown both in studies of large groups (e.g., Waschbusch, Willoughby et al., 1998) and in studies of dyadic peer relationships (e.g., Dodge, Price, Coie, & Christopoulos, 1990).

Evidence for the distinction between reactive and proactive aggression has been shown in studies of social functioning, as each subtype of aggression has been found to correlate with a different set of social skills and difficulties. For example, in a study of Canadian elementary school boys, teachers were able to reliably distinguish between reactive and proactive boys, attributing distinct social characteristics to boys in each group (Day et al., 1992). Day et al. (1992) noted that children rated as low on measures of both reactive and proactive aggression were perceived by their teachers to have the fewest social difficulties when compared to aggressive children. Reactive aggressive boys, on the other hand, were perceived to be less popular, less happy, and less competent at problem solving than their non-aggressive and mixed aggressive (i.e., boys rated high on both reactive *and* proactive aggression) peers. Mixed aggressive children were perceived as having the most difficulty keeping out of fights in comparison to other children, but were also perceived as being relatively happy and popular. A lack of effects for the proactive group was likely due to the fact that so few children were classified by their teachers as proactive aggressive (Day et al., 1992).

Teachers may also be more likely to punish reactive aggressive children for their behaviour. In a study designed to develop and evaluate a teacher rating scale for aggression (Brown et al., 1996), it was found that reactive aggression was uniquely related to in-school detentions, suggesting that it is the over-reactive aspects of this subtype of aggression that are directly related to the disruptive classroom behaviour exhibited by reactive aggressive children (Brown et al., 1996). Indeed, Day et al. (1992) suggest that reactive aggressive children are perceived as having social difficulties in and out of the classroom because they are unable to control their aggressive impulses. Conversely, proactive aggressive children are often rewarded for their aggressive behaviour (i.e., they attain a goal as a result of using aggression) and seem to have more developed social skills than reactive aggressive children, meaning that they are perceived as being less impulsive and more socially accepted than reactive aggressive children (Day et al., 1992).

Studies of peer perceptions of aggressive behaviour provide insight into the nature of goal-oriented aggression in children. Reactive and proactive subtypes of aggression have been found to be differentially related to classroom peer status (Price & Dodge, 1989). Peers of reactively aggressive children tend to reject and negatively evaluate these children (Price & Dodge, 1989); however, some research has found that children actually rate reactive aggression as being the most tolerable type of aggression (Lancelotta & Vaughn, 1989). It is possible that, although peers do not wish to be friends with reactively aggressive children, they tolerate reactive aggression more than other types because they understand the need to retaliate towards an aggressor and feel that this action is somewhat justified. Conversely, proactive aggression has been associated with

positive peer status and strong leadership qualities, possibly because children perceive this type of behaviour as assertive rather than aggressive (Price & Dodge, 1989). Additionally, proactive aggression has been shown to be predictive of long-term antisocial behaviour (Pulkkinen, 1996).

In addition to defining the characteristics of each subtype of aggression and the potential social ramifications of using aggression, it is also important to consider the event preceding the behaviour when defining aggression. As shown in Figure 3, one key component of the reactive/proactive aggression distinction is the presence or absence of provocation. Given that reactive aggression is described as a response to an actual or perceived threat, this subtype occurs following provocation. For example, if a child hits a peer in response to a verbal taunt on the playground, this behaviour would be considered to be reactive aggression, as the behaviour occurred in response to provocation. Conversely, if a child hits a peer on the playground in order to obtain a toy, this act would be considered to be proactive aggression, as the behaviour occurred in the absence of any provocation.

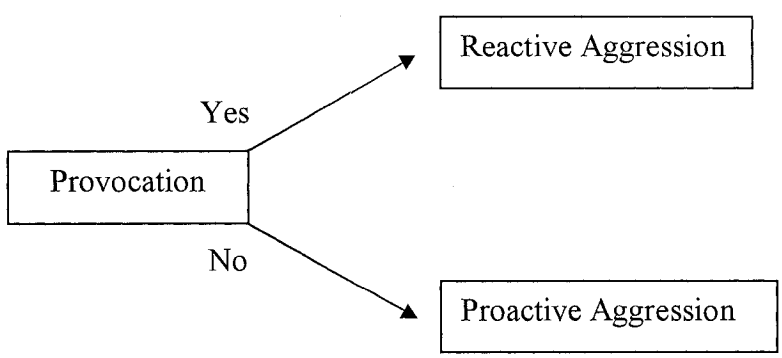

Figure 3. Aggression subtypes as a function of the motivation to engage in aggressive behaviour (i.e., in response to provocation).

Whereas the reactive/proactive distinction is useful and valid, many researchers define aggression as being either instrumental or hostile (e.g., Atkins & Stoff, 1993; Bushman & Anderson, 2001). Reactive and proactive aggression can be defined in terms of the motivation to engage in aggressive behaviour; that is, the type of aggression used by an individual is determined by the presence or absence of an antecedent provocation. Instrumental and hostile aggression can be defined in terms of the target of the aggressive behaviour; that is, the target of the behaviour can be a person or it can be to achieve a goal. Instrumental aggression can be defined as aggression that provides some reward or advantage to the aggressor and is unrelated to the victim's discomfort, whereas hostile aggression can be defined as aggression that is intended to inflict injury or pain on the victim with little or no advantage to the aggressor (Atkins & Stoff, 1993; Bushman & Anderson, 2001). The distinction between instrumental and hostile aggression has also been shown experimentally to be valid (e.g., Atkins, Stoff, Osborne, & Brown, 1993).

The instrumental/hostile distinction bears a strong resemblance to the reactive/proactive distinction; indeed, the terms are often used interchangeably (e.g., Price & Dodge, 1989). However, the two classification systems do not define aggression in identical ways and are not necessarily interchangeable. Whereas reactive and proactive subtypes of aggression are distinguished by the presence of an antecedent provocation (see Figure 3), hostile and instrumental aggression are distinguished by the effects of the aggressive act. That is, instrumental aggression consists of behaviours such as pushing, hitting, or grabbing another individual with the goal of obtaining an object, whereas hostile aggression is person-directed (i.e., the goal of aggression is to hurt another person)

(Dodge, 1991). Therefore, it follows that either hostile or instrumental aggression can occur regardless of whether or not an individual has experienced provocation.

Historically, the instrumental/hostile dichotomy has been used to define subtypes of proactive aggression; Price and Dodge (1989) suggest that there is evidence supporting the validity of this classification. However, it is proposed here that the motivation behind aggression use, as well as the target of aggression, should be more carefully considered when defining both reactive and proactive aggressive behaviour. In other words, as shown in Figure 4, it is plausible that both reactive and proactive aggression can be either person- or goal-oriented. Specifically, person-oriented aggression of either the reactive or proactive subtype could be considered hostile, whereas goal-oriented aggression of a either reactive or proactive subtype could be considered instrumental.

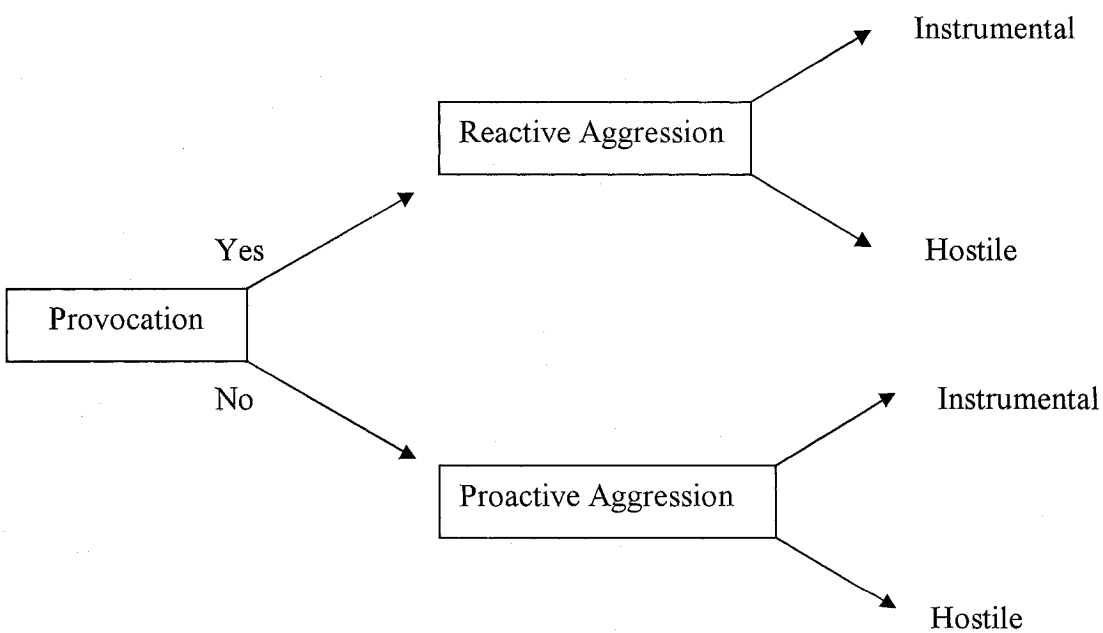

Figure 4. Subtypes of aggression as a function of motivation (i.e., provocation) and target (i.e., goal or person)

Provocation may or may not exacerbate the likelihood of using the two categories of aggressive responses. For example, some children may have a propensity to be indiscriminately aggressive towards others whereas others may have a propensity to be aggressive only when trying to achieve a goal; these propensities may, in turn, differ depending on whether or not the child is provoked by his or her peers. As of yet, no research has examined these two classification systems in a single sample of children; however, based on findings suggesting that there are salient differences in the use of aggression in children with various disruptive behaviour disorders, it seems plausible that further examining these differences would lead to a more streamlined conceptualization of these disorders.

Laboratory tasks are useful for studying aggression, as they allow for the precise manipulation of factors influencing aggressive behaviour, such as presence or absence of provocation and presence or absence of goals. Indeed, laboratory provocation tasks are frequently used to distinguish between subtypes of aggression (e.g., Atkins, Osborne, Bennett, Hess, & Halperin, 2001; Atkins & Stoff, 1993; Murphy et al., 1992; Waschbusch et al., 2002). In a study of aggression during a laboratory analogue task (Atkins & Stoff, 1993), aggressive boys with and without ADHD were informed that they would play a video pinball game against an opponent in an adjacent room. In reality, there was no opponent and all responses from this "opponent" were predetermined. Motivation for instrumental aggression was manipulated by telling boys that they could block their opponent's game by pressing a "tilt" button that would make it more difficult for the opponent to gain points. This response was presumed to be a measure of instrumental aggression, as the participant could gain from enacting this response.

Motivation for hostile aggression was manipulated in that boys were told they could press a button that would send a burst of white noise to their opponent. This measure was presumed to be a measure of hostile aggression, as the participant did not stand to gain from enacting this response but it was unpleasant to the opponent (Atkins & Stoff, 1993). The opponent had the same opportunities to send a tilt or a noise to the participant; it was presumed that these actions from the opponent would serve as provocation to the participant.

Results indicated that aggressive boys with and without ADHD evidenced higher rates of instrumental aggression (i.e., tilting their opponent's game) than controls, but only the aggressive boys with ADHD showed higher rates of hostile aggression (i.e., sending a burst of noise to their opponent). These results are consistent with findings suggesting that boys with co-morbid ADHD and conduct problems tend to have more difficulties and poorer long-term outcomes than children who do not have the co-morbid condition (Atkins & Stoff, 1993). Additionally, Atkins and Stoff (1993) found that noise responses (i.e., hostile aggression) were significantly greater when participants were experiencing provocation (i.e., the "opponent" was using the noise and tilt functions) than when they were not. Similarly, there was a non-significant tendency for increased tilt responses when the participants were experiencing provocation.

This study, aside from distinguishing between subtypes of disruptive behaviour, also addressed the relationship between provocation and response in that children were exposed to provocation but were given a choice as to how they could respond to this provocation. It should be noted, however, that Atkins and Stoff (1993) chose to label aggression as instrumental and hostile, despite the fact that children were exposed to

provocation from their opponents. Extending this work to include studies in which children are exposed to varying levels of provocation would perhaps aid in clarifying the distinction between the reactive/proactive and instrumental/hostile nomenclatures as well as delineating the precise behaviour patterns of children with ADHD and other disruptive behaviour disorders.

One recent study aimed to investigate the effects of low and high provocation on aggression use in a sample of boys with disruptive behaviour disorders. Waschbusch et al. (2002) used a laboratory analogue task to investigate the use of reactive aggression in a sample of typical boys and boys who met diagnostic criteria for ADHD-only, ODD/CD-only, and ADHD/ODD/CD. In this study, boys were exposed to two different levels of verbal and behavioural provocation (low and high) from an opponent in another room with whom they were playing a game. Similar to Atkins and Stoff (1993), there was no opponent; instead, the "opponent's" responses were audiotaped messages broadcast over a loudspeaker and therefore constant across participants. Results indicated that all boys, including controls, responded aggressively to high provocation from their "opponent." However, only boys with co-morbid ADHD/ODD/CD responded aggressively to low levels of provocation and also tended to hold a grudge longer than all other boys (i.e., continuing to respond aggressively in the absence of provocation). Waschbusch et al. (2002) suggest boys with co-morbid disruptive behaviour disorders may be especially prone to using reactive aggression and that this characteristic may distinguish them from typical children and from children who meet criteria for ADHD-only or ODD/CD-only.

Determining whether aggression can be conceptualized as a broader concept than just reactive or proactive as described above could provide insight into the specific behavioural difficulties of children with ADHD. Making finer distinctions in aggressive behaviour could potentially aid researchers and clinicians to develop and implement more streamlined approaches to treatment in this group of children. Additionally, examining aggressive behaviour in children with ADHD would aid researchers in determining the exact contribution of ADHD, meaning that treatment could be streamlined with respect to children with ADHD and those with co-morbid disruptive behaviour disorders such as ODD and CD. More streamlined approaches to treatment could, in turn, lead to better long-term outcomes for these children.

In addition to developing treatments for disruptive behaviour disorders based on subtypes of aggression, it is essential to consider the role of more traditional treatments such as stimulant medication when developing new treatment protocols for children with disruptive behaviour disorders. Historically, it was thought that administration of stimulant medications to aggressive individuals would increase aggression (Allen, Safer, & Covi, 1975). However, this has been shown to occur only in the event of amphetamine psychosis, following high doses (Allen et al., 1975). Allen et al. (1975) note that low to moderate doses of stimulants have not been shown to increase aggression. Indeed, treatment with stimulant medication has been shown to decrease aggression in children with ADHD (e.g., Barkley, McMurray, Edelbrock, & Robbins, 1989; Hinshaw, Henker et al., 1989).

Effects of Methylphenidate on Aggressive Behaviour

In addition to improving the behavioural symptoms and reducing some of the academic difficulties of children with ADHD, treatment with methylphenidate has also been found to reduce more serious aggressive behaviour exhibited by these children (e.g., Conner et al., 2002). The suggestion that methylphenidate is also effective at treating aggression refutes earlier research suggesting the drug is only useful in the treatment of the "biological" symptoms of ADHD (i.e., inattention, hyperactivity, and impulsivity) and that family-oriented psychosocial treatments are best for treating associated symptoms such as aggression (e.g., Milich & Loney, 1979).

At the same time, relatively few studies have examined the effect(s) of methylphenidate on aggression (Conner et al., 2002) and those studies that have reported medication effects on aggression have used very specific definitions of the construct (Hinshaw, 1991). For example, in a recent meta-analysis of stimulant effects on overt (i.e., physical violence, noncompliance, teasing, hostility) and covert (i.e., lying, stealing, vandalizing) aggressive behaviour in children with ADHD, Conner et al.(2002) found that stimulants decrease both overt and covert aggressive behaviours in children with ADHD independently of their effects on ADHD symptoms. One caveat to this finding, however, is that stimulant medication may have a differential effect that depends on the subtype of aggression. Specifically, results of this meta-analysis suggested that treating overt aggression with stimulant medication might not be as effective if the child meets criteria for Conduct Disorder in addition to ADHD. Connor et al. (2002) point to evidence from a study by Biederman et al. (1991) suggesting that there may exist a

subtype of co-morbid CD and ADHD with overt aggressive features that is especially resistant to treatment.

On the other hand, methylphenidate has been found to reduce aggression in children with aggressive conduct disorder and DSM-III defined ADDH (Kaplan, Busner, Kupietz, Wassermann, & Segal, 1990). Parents were asked to participate in a structured diagnostic interview about their child's behaviour (the Diagnostic Interview for Children and Adolescents [DICA]) and to rate their child's behaviour using the Adolescent Antisocial Behavior Checklist (AABC); teachers were asked to complete the Conners Teacher Rating Scale (CTRS). Parents reported significantly less aggressive behaviour in the methylphenidate condition than in the placebo condition. Teachers also reported less aggression; however, this finding was not significant, perhaps due to small sample size (Kaplan et al., 1990).

Similar reductions in aggression in response to methylphenidate have been found in observational studies. In an observational study in a naturalistic camp setting, Hinshaw et al (1989) measured three broad categories of children's social behaviour: appropriate social behaviour, negative social behaviour (including aggression), and non-social behaviour. Results indicated that low to moderate doses of methylphenidate (i.e., 0.3 mg/kg-0.6 mg/kg) significantly reduced aggression in a selected sample of boys with ADHD. Additionally, no interaction was found between diagnostic subgroup (ADHD-only vs. ADHD + Aggression) and methylphenidate, suggesting that there is no differential pattern of responsiveness between subgroups (Hinshaw, Henker et al., 1989).

In another naturalistic study of the effects of methylphenidate on aggressive behaviour and ADHD, methylphenidate (0.3. mg/kg) was found to reduce instances of

negative verbalizations (defined as verbal abuse to adults and teasing other children) and conduct problems (defined as physical aggression, stealing, and lying) (Murphy et al., 1992). These results echo those of a previous laboratory study of children's playgroups in which children in the methylphenidate group exhibited a reduction in negative non-verbal behaviour (i.e., hitting, non-compliance, interrupting); the greatest behavioural gains were found in the 0.6 mg/kg condition (Pelham & Bender, 1982).

Studies involving laboratory tasks have been less conclusive with respect to the effects of methylphenidate on aggression. Pelham, Milich, Cummings, Murphy, Schaughency, and Greiner (1991) examined the effects of background anger, provocation, and methylphenidate on aggressive responding in a sample of high-and low-aggressive boys with ADHD in a Summer Treatment Program (STP) setting. Boys were exposed to an angry and a friendly interaction between an STP administrator and their favourite counsellor before participating in a computer provocation task against an imaginary opponent who provoked the children by taking points from them. Results indicated that exposure to the angry situations did not increase aggressive responding in children, as had been expected. Additionally, methylphenidate had no effect on any of the variables examined in this study. That is, administration of methylphenidate did not significantly decrease aggressive responses to provocation on the computer task. However, despite non-significant group differences and small effects sizes, suggesting perhaps that the measure was not sufficiently sensitive, the means were in the anticipated direction in that children in the methylphenidate group exhibited less aggressive responding than children in the placebo group.

As part of the naturalistic study described previously, Murphy et al. (1992) also examined the effect of methylphenidate on aggression in the context of a laboratory provocation task. Again, high- and low-aggressive boys with ADHD took part in a reaction time task against an imaginary opponent in which the players could punish each other by sending a burst of white noise after winning a trial. In contrast to the results of the naturalistic observation component of this study, results of the provocation task indicated that methylphenidate had no effect on high-aggressive boys with ADHD and actually significantly *increased* aggressive responding to high provocation in low-aggressive boys. Methylphenidate also increased aggressive responding in low aggressive boys following medium and low provocation; although the results were not statistically significant, effect sizes were moderate to large (Cohen's D = -0.72 and –0.56, respectively), an indication that this finding was not spurious. Murphy et al. (1992) suggest that the discrepant results might be due to the fact that naturalistic observations of aggression took all types of aggression (i.e., accidental, intentional, self-initiated, and reactive) into account, whereas the provocation task was a measure of intentional response to provocation only. The authors go on to suggest that lower doses of methylphenidate may be enough to reduce impulsively initiated or unintentional aggression, whereas higher doses may be required to reduce aggression in response to provocation.

In summary, methylphenidate appears to be effective at reducing aggressive behaviour in naturalistic settings in children with ADHD; however, the drug may not be effective at reducing aggression in response to provocation in these children. Importantly, few studies have directly examined the effects of methylphenidate on laboratory

provocation task in children with ADHD; therefore more research is warranted. It is also possible that the effects of methylphenidate on aggressive behaviour could differ as a function of type of aggression; however, there is a dearth of research in this area. The present study attempted to expand on previous studies of aggression in that it examined the effects of stimulant medication on reactive, proactive, instrumental, and hostile aggressions in children with ADHD. The study also attempted to elucidate the nature of the relationship between these subtypes of aggression and the conditions under which they are used in this group of children.

Based on previous research, it was hypothesized that children who received placebo would exhibit increased rates of reactive aggression compared to children in the control group. Additionally, it was hypothesized that children who received methylphenidate would exhibit reactive aggression levels intermediate between those of children in the placebo group and control children, given the drug's effects on impulsivity. Given the lack of research in the area of proactive and instrumental aggression in this population, it was unclear as to which group of children would be more inclined to use these types of aggression. If children with ADHD tend to attribute positive outcomes to the use of aggression, as has been suggested by previous studies, then it is conceivable that this group would show a tendency to engage in proactive and instrumental aggression when compared to typically developing children, regardless of medication, because this type of aggression has not been linked to impulsivity. Based on previous findings (e.g., Waschbusch et al., 2002) it was hypothesized that children with ADHD would show less dissipation of aggression at the end of the experimental session when compared to controls. Given that little research has examined the effects of

methylphenidate in this context, the examination of medication effects on dissipation of aggression was largely exploratory.

Method

Participants

Participants were the 83 children described previously. Due to three computer malfunctions ($N_{Placebo} = 1$; $N_{Methylphenidate} = 1$; $N_{Control} = 1$) and three refusals to continue with the task ($N_{Placebo} = 2$; $N_{Methylphenidate} = 1$), the data from six children were dropped from the study, resulting in a final sample of 77 children ($N_{Placebo} = 25$; $N_{Methylphenidate} = 20$; $N_{Control} = 32$).

Procedure

Custom software was written for this experiment to be run on a Windows compatible computer. Children were told they would be playing a computer game against another child over the Internet. The methodology for this task was similar to that of previous examinations of provocation and aggression (e.g., Atkins & Stoff, 1993; Cherek, Steinberg, Kelly, & Robinson, 1986; Taylor & Gammon, 1975; Waschbusch et al., 2002; Zeichner & Pihl, 1979), but used a simulated internet "instant messenger" programme to deliver provocation associated with loss trials to the participant.

The computer game consisted of two separate conditions, hostile and instrumental, presented in a counterbalanced order across participants. The game was a reaction time task in which participants thought they were competing against another child of the same age and sex over the Internet in order to win points that would later be exchanged for small toys. In reality, however, there was no opponent and all wins and losses were determined by the computer programme *a priori*. Furthermore, instant

messages that appeared on the computer screen (ostensibly from the opponent) were pre-programmed and constant across all children.

Task Design

Instrumental Condition. Participants were seated at a computer and told that they would be playing a game with another child over the Internet and that they were to press a red button on a joystick as fast as possible when a bull's eye target appeared on the screen. Children were told that if they pressed the button faster than the other child, they would win 10 points and would be given the opportunity to: (1) take between 0 and 10 points away from their opponent, (2) send their opponent a message over instant messenger, (3) both or (4) nothing. In this condition, children were given the following instructions:

"We are going to play a computer game now. You will be playing this game with a boy/girl *(match opponent's gender to participant's gender)*. Our computers will be hooked up on the internet and you will be able to talk to the other kid over instant messenger. The other kid will also be able to talk to you.

In this game, you will both see some pictures flashing quickly on the screen. Sometimes a bull's-eye will appear on the screen. When you see the bull's eye it is your job to press the red key on your joystick as quickly as you can so that you can win points. If you win, you will have the chance to send the other kid a message and take between 0 and 10 points away from him/her. If you take points from the other kid, it will make it harder for him/her to win the game. If the other kid presses his/her button before you do, he/she will win points and will get the chance to send you a message and take between 0 and 10 points from you, so it is really important for you to press the button as quickly as

you can. Before each time you play, I will ask you to tell me how you feel by looking at some pictures of happy faces.

If you win and you want to take points away from the other kid or send him/her a message, just let me know and I will type the message for you and type in the number of points you want to take away. When the other kid sends you a message, I will read it for you. Do you understand?"

Following these instructions, children were asked a series of questions to verify that they understood the instructions (See Appendix H). In the instrumental condition, high provocation losses consisted of a loss accompanied by an aversive message (e.g., "Nice try, speedo! What's the matter- is your hand stuck in cement? You lose another 10!") and a loss of 8, 9 or 10 points, whereas low provocation losses consisted of a loss accompanied by a neutral message (e.g., "You lost, but you're getting better. I'll take 2 points") and loss of 0, 1 or 2 points. A complete list of standardized provocation responses can be found in Appendix I.

Hostile Condition. The methodology for the hostile task was identical to that of the instrumental task with the exception that, instead of having the opportunity to take points from their opponents, participants were given the opportunity to: (1) send a "buzz" (white noise) lasting from 0 to 10 seconds to their opponent, (2) send a message to their opponent, (3) both or (4) nothing. In this condition, children were given the following instructions:

"We are going to play a computer game now. You will be playing this game with a boy/girl *(match opponent's gender to participant's gender)*. Our computers will be

hooked up on the internet and you will be able to talk to the other kid over instant messenger. The other kid will also be able to talk to you.

In this game, you will both see some pictures flashing quickly on the screen. Sometimes a bull's-eye will appear on the screen. When you see the bull's eye it is your job to press the red key on your joystick as quickly as you can so that you can win points. If you win, you will have the chance to send the other kid a message and send a buzzing noise from 0 to 10 seconds to him/her. If you send a buzz to the other kid, it won't make it harder for him/her to win the game, but it really bugs other kids. If the other kid presses his/her button before you do, he/she will win points and will get the chance to send you a message and a buzzing noise, so it is really important for you to press the button as quickly as you can. Before each time you play, I will ask you to tell me how you feel by looking at some pictures of happy faces.

If you win and you want to send a buzzing noise to the other kid or send him/her a message, just let me know and I will type the message for you and type in the number of seconds you want to buzz for. When the other kid sends you a message, I will read it for you. Do you understand?"

Again, before commencing the task, children were asked a series of questions to verify that they understood the instructions (See Appendix H). In the hostile condition, high provocation losses consisted of a loss accompanied by an aversive message (e.g., "Are you even trying? You can't really be trying. I'm buzzing for 10 seconds") and a buzz of 8, 9 or 10 seconds, whereas low provocation losses consisted of a loss accompanied by a neutral message (e.g., "I'm not sure how I won that one, but I did, so I'll buzz for 2

seconds") and buzz of 0, 1, or 2 seconds. A complete list of standardized provocation responses can be found in Appendix I.

The game was rigged such that each child played five trials at the beginning of the game and five trials at the end of the game in which they won, thereby ensuring that every child ended the interaction with a positive experience. All participants ended up winning the game. Between these sets of win trials, children played 18 more trials (for a total of 28 trials); children won 10 and lost eight of these trials. Of the eight loss trials, four were designated as high provocation losses and four were designated as low provocation losses. The two types of loss trials were randomly distributed throughout the game, with one or two wins between each loss.

Instant Messenger messages accompanying high and low provocation loss trials were based on verbal provocation messages used in Waschbusch et al. (2002). To select eight high provocation and eight low provocation responses for use in the final task, lists of 16 possible high provocation responses and 16 possible low provocation responses were distributed to 10 graduate students and research assistants with instructions to rank each response in order of aversive qualities (with 1 being most aversive and 16 being least aversive). The eight most aversive messages from the list of possible high provocation messages and the eight least aversive messages from the list of possible low provocation messages were selected as the final instant messages to be used in the provocation task. During task administration, the investigator or a research assistant was present at all times to type and read messages in a neutral voice so that young children or children with reading difficulties were not at a disadvantage.

Dependent Measures. Reactive aggression was operationalized as aggressive behaviour that occurred on the trials immediately following provocation; that is, the number of points taken or the length of buzz sent immediately following a high or low provocation loss trial. Proactive aggression was operationalized as aggressive behaviour that occurred in the absence of provocation; that is, aggressive behaviour that occurred in the first five trials of the hostile condition and the first five trials of the instrumental condition. Dissipation of aggression was operationalized as aggressive responding in the last six trials of the task. The last six trials were used for the purpose of comparing responding on the sixth last trial with the subsequent five unprovoked trials that followed. This condition is analogous to the "holding a grudge" component of the study by Waschbusch et al. (2002).

Results

Overview

Three analyses of variance (ANOVAs) were computed to examine aggression use in this sample. The first analysis examined reactive aggression, the second examined proactive aggression, and the third examined dissipation of aggression. To remain consistent with the analyses used in Study 1, no covariates were used in these analyses. Significant interactions were followed up using simple effects tests and Tukey Honestly Significant Difference (HSD) pairwise comparisons, and by examining means, standard deviations, and computing effect sizes (eta-squared).

Reactive Aggression

Reactive aggression was examined using a 3 (Group: Control vs. ADHD methylphenidate vs. ADHD placebo) x 2 (Provocation Level: Low vs. High) x 2

(Aggression Condition: Instrumental vs. Hostile) ANOVA. As shown in Fig. 5, results indicated significant main effects of Aggression Condition (F (1, 74) = 58.88, $p < .05$, $\eta^2 = .44$) and Provocation Level (F (1, 74) = 267.51, $p < .05$, $\eta^2 = .78$), such that all children were more reactively aggressive in the instrumental condition and following high provocation. Results also indicated a significant Aggression Condition x Group interaction (F (2, 74) = 6.38, $p < .05$, $\eta^2 = .15$), a significant Provocation Level x Group interaction (F (2, 74) = 3.37, $p < .05$, $\eta^2 = .08$), a significant Aggression Condition x Provocation Level interaction (F (1, 74) = 6.04, $p < .05$, $\eta^2 = .08$), and a significant Aggression Condition x Provocation Level x Group interaction (F (2, 74) = 3.15, $p < .05$, $\eta^2 = .08$).

The significant Aggression Condition x Group interaction was followed up in two ways. First, the effect of Group was examined at each level of Aggression Condition. Results indicated significant group differences in the hostile condition, F (2, 74) = 5.46, $p < .05$, $\eta^2 = .13$, but not in the instrumental condition. Examination of means and Tukey HSD tests showed that both the placebo and control groups were more reactively aggressive than the methylphenidate group. Second, the effect of Aggression Condition was examined at each level of Group. Results indicated that all groups exhibited more reactive aggression in the instrumental condition compared to the hostile condition (Control: F (1, 74) = 4.63, $p < .05$, $\eta^2 = .06$; Placebo: F (1, 74) = 20.55, $p < .05$, $\eta^2 = .22$; Methylphenidate: F (1, 74) = 38.36, $p < .05$, $\eta^2 = .34$); however, the difference in aggressive behaviour between instrumental and hostile conditions was greatest for children with ADHD (both placebo and methylphenidate).

The significant Provocation Level x Group interaction was also followed up two ways. First, the effect of Group was examined at each level of Provocation Level. Tukey HSD pairwise comparisons indicated that, following low provocation, children in the control group were more aggressive than children in the methylphenidate group (Pairwise significance < .05); however, the univariate test was not significant. Next, the effect of Provocation Level was examined for each Group. Results indicated that children in all groups were more reactively aggressive following high provocation (Control: F (1, 74) = 71.93, $p < .05$, $\eta^2 = .49$; Placebo: F (1, 74) = 103.01, $p < .05$, $\eta^2 = .58$; Methylphenidate: F (1, 74) = 93.84, $p < .05$, $\eta^2 = .56$).

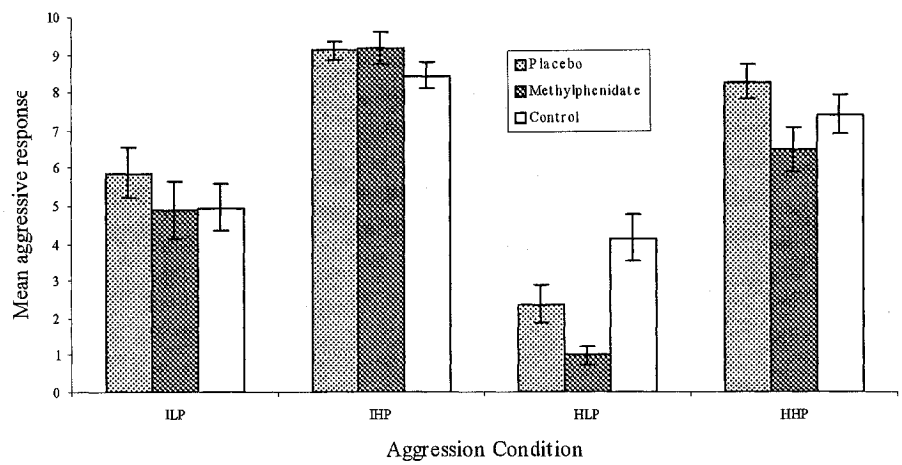

Figure 5. Reactive aggression use in instrumental low provocation (ILP), instrumental high provocation (IHP), hostile low provocation (HLP), and hostile high provocation (HHP) conditions across experimental groups. Vertical lines depict standard errors of the means.

The significant Aggression Condition x Provocation Level interaction was followed up in the same way as the other interactions. First, the effect of Aggression Condition was examined at each level of Provocation Level. Results indicated that more

instrumental aggression was used following low provocation, F (1, 74) = 44.54, $p < .05$, $\eta^2 = .38$, and following high provocation, F (1, 74) = 21.37, $p < .05$, $\eta^2 = .22$. Second, the effect of Provocation Level was examined at each level of Aggression Condition. Results indicated that more instrumental aggression was used following high provocation (F (1, 74) = 101.65, $p < .05$, $\eta^2 = .58$) and more hostile aggression was used following high provocation (F (1, 74) = 190.00, $p < .05$, $\eta^2 = .72$).

The significant Aggression Condition x Provocation Level x Group interaction was followed up by decomposing the interaction. Results indicated a significant Provocation Level x Group interaction in the hostile condition, F(2, 75) = 6.34, $p < .05$, $\eta^2 = .15$, but not the instrumental condition. Next, simple effects tests examined the effect of Group at each level of Provocation in the hostile condition. Results indicated that groups differed in aggression use following low provocation, F(2, 75) = 8.49, $p < .05$, $\eta^2 = .19$, but not following high provocation. Finally, pairwise comparisons and examination of means showed that, in the hostile condition, children in the control group were more reactively aggressive than children in the placebo and methylphenidate groups following low provocation (Pairwise comparisons < .05) and children in the placebo group were more reactively aggressive than children in the methylphenidate group following high provocation (Pairwise comparison < .05).

Proactive Aggression

Proactive aggression was examined using a 3 (Group: Control vs. ADHD methylphenidate vs. ADHD placebo) x 2 (Aggression Condition: Instrumental vs. Hostile) ANOVA. As shown in Fig. 6, results indicated a significant main effect of Aggression Condition, F (1, 74) = 43.31, $p < .05$, $\eta^2 = .37$, such that all children exhibited

more proactive aggression in the instrumental condition as opposed to the hostile condition.

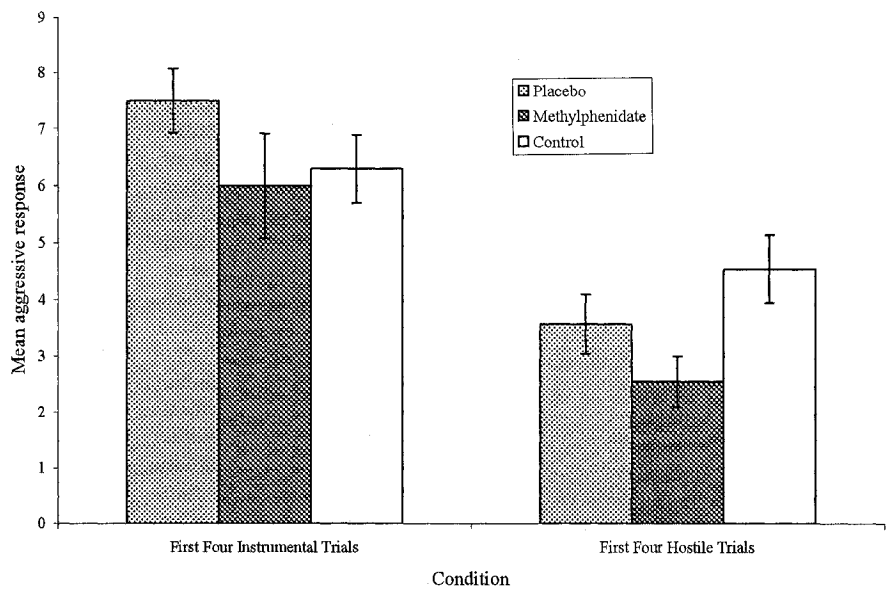

Figure 6. Proactive aggression use in instrumental and hostile conditions across experimental groups. Vertical lines depict standard errors of the means.

Dissipation of Aggression

Dissipation of aggression was examined using a 3 (Group: Control vs. ADHD methylphenidate vs. ADHD placebo) x 2 (Aggression Condition: Instrumental vs. Hostile) x 6 (Trial: 23 vs. 24 vs. 25 vs. 26 vs. 27. vs. 28) ANOVA. As shown in Fig. 7, results indicated a significant main effect of Trial, F (5, 360) = 4.43, $p < .05$, $\eta^2 = .06$, and a significant Aggression Condition x Trial x Group interaction, F (10, 360) = 2.25, $p < .05$, $\eta^2 = .06$.

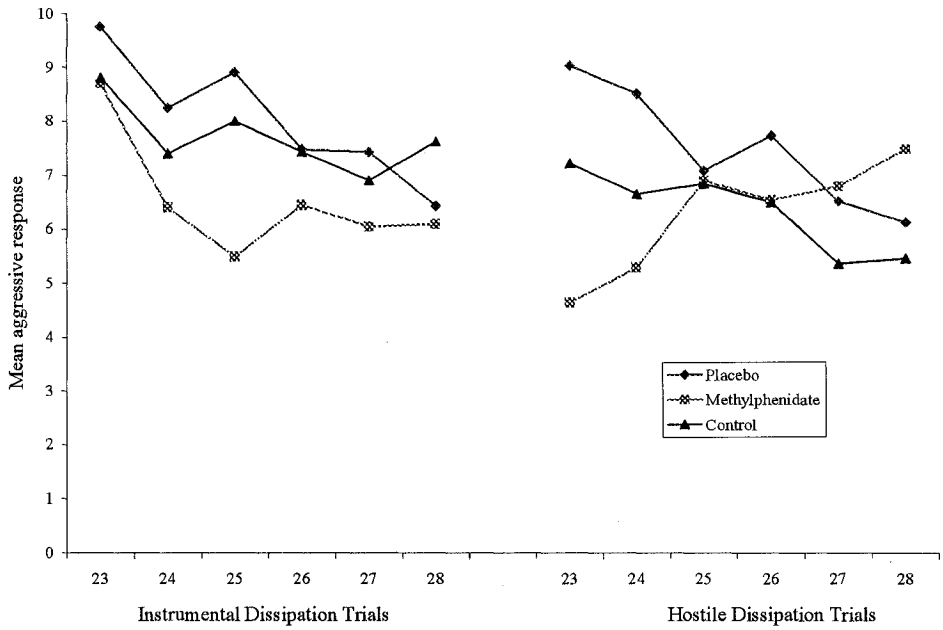

Figure 7. Dissipation of aggression use in instrumental and hostile conditions across experimental groups.

Decomposition of the significant interaction indicated that there was a significant Trial x Group interaction in the hostile condition, F (10, 365) = 2.48, $p < .05$, $\eta^2 = .06$, but not in the instrumental condition. The significant Trial x Group interaction in the hostile condition was followed up in two ways. First, the effect of Trial was examined separately for each group. Results showed a crossover effect such that children in the methylphenidate group *increased* aggression use over the dissipation trials, whereas children in the control and placebo groups *decreased* aggression use over the dissipation trials. The effect of Trial, however, was not significant for any group. Second, the effect of Group was examined at each consecutive dissipation trial. These results showed a significant effect of Group at the first hostile dissipation trial, F (2, 73) = 7.15, $p < .05$, η^2

= .16, and at the second dissipation trial, $F(2, 73) = 3.18, p < .05, \eta^2 = .08$, but not at any of the subsequent trials. Pairwise comparisons and examination of means (see Figure 7) showed that, at the first dissipation trial (immediately after high provocation), children in the control and placebo groups used more hostile aggression than children in the methylphenidate group, whereas, at the second dissipation trial (after more time had passed since the high provocation loss), children in the placebo group used more hostile aggression than children in the methylphenidate group but the control group did not differ from either ADHD group.

Discussion

The goal of the current study was to examine the use of subtypes of aggressive behaviour in children with and without ADHD and to examine the effects of methylphenidate on aggression. It was hypothesized that children with ADHD treated with methylphenidate would show reactive aggression levels intermediate between control children and children in the placebo group, given this subtype's association with impulsivity. The examination of proactive aggression was largely exploratory, as little research has examined this subtype in children with ADHD. Based on previous findings, it was hypothesized that children with ADHD would show less dissipation of aggression over the last six trials of the provocation task when compared with controls.

Reactive Aggression

Results indicated that all children, regardless of group and provocation level, engaged in more reactive aggression in the instrumental condition than in the hostile condition. This finding suggests that the child's motivation, along with the salience of the reward associated with engaging in each type of aggression, may determine whether or

not a child chooses to engage in the behaviour. In this case, it could be hypothesized that all children were motivated to win the game, as they had been promised a prize. If this was the case, then the reward associated with engaging in instrumental aggression would be more salient than the reward associated with hostile aggression, as the instrumental condition afforded children the opportunity to take points from their opponent, thereby making winning more likely. Given that children were told that taking points from their opponents would make it easier to win the game, these results are not unexpected.

In general, children were more aggressive in response to high provocation, a developmentally appropriate response consistent with previous findings (Coie & Benenson, 1983, as cited in Coie, Dodge, & Kupersmidt, 1990; Waschbusch et al., 2002). The low provocation condition likely did not pose a threat to the participants in that the messages accompanying the point loss and the buzzes were somewhat apologetic, meaning that participants likely did not feel the need to respond with increased aggression. However, results indicated that, following low provocation, all participants engaged in more instrumental aggression than hostile aggression, a finding supporting the earlier suggestion that motivation to win the game and salience of the reward influence the child's choice to engage in aggression. Even in the low provocation condition, participants lost points, meaning that they may have felt threatened and therefore used more aggression on the next win trial in an attempt to compensate for the loss in the previous trial.

Perhaps the most interesting finding with respect to reactive aggression was that children in the control group behaved in a similar manner to children in the placebo group in that they engaged in more reactive hostile aggression than children in the

methylphenidate group and were more reactively aggressive than children in the methylphenidate group following low provocation. Whereas the finding that children in the placebo group engaged in more hostile reactive aggression than children in the methylphenidate group is not unexpected, the finding that control children were more reactively aggressive in the hostile condition is unusual.

One explanation of these results is that methylphenidate was effective at reducing reactive aggression in children with ADHD. Methylphenidate is known to increase inhibition in children with ADHD; therefore, it is possible that children in the methylphenidate group inhibited their impulses to react aggressively in the hostile condition. Whereas this suggestion may partially explain the results, it likely does not completely account for the findings. For example, although the results were not significant, children in the placebo group exhibited a similar trend as the children in the methylphenidate group in that they also used less hostile reactive aggression following low provocation than children in the control group. If methylphenidate were solely responsible for the pattern of results in the hostile condition, it could be expected that children in the placebo group would show increased hostile reactive aggression compared to control children, due to their decreased inhibition.

Closer examination of means in all groups reveals two trends. First, despite the finding that children in the control group exhibited more reactive aggression than children in the methylphenidate group following low provocation, it should be noted that this trend was likely driven by the hostile condition, as there were no significant group differences in the instrumental condition. Second, children in the control group actually responded more consistently across conditions compared to children with ADHD.

Specifically, reactive aggression use by children in the methylphenidate group decreased quite dramatically in the hostile condition as compared to the instrumental condition, as did reactive aggression use by children in the placebo group. Children in the control group, however, continued to respond at a more consistent level across conditions, a pattern that would lead to the finding that control children engaged in more overall hostile reactive aggression and more reactive aggression following low provocation. It is not entirely clear why children with ADHD engaged in less hostile reactive behaviour than control children. One possible explanation is that reinforcement contingences and task salience played a bigger role in determining the aggressive responses of children with ADHD than controls. In fact, there is a sizable literature documenting the effects of reinforcement contingencies on children with ADHD as well as typical children (see Luman, Oosterlaan, & Sergeant, 2005 for a review). Generally, reinforcement contingencies have a positive impact on overall task performance and motivation to perform in both typical children and in children with ADHD (Luman et al., 2005). Further, there is some evidence that reinforcement contingencies have a bigger impact on the task performance of children with ADHD than of children without ADHD (Luman et al., 2005). Specifically, some research has shown that reward (R) and response cost (RC) are especially important in understanding the response to reward in children with ADHD (Carlson, Mann, & Alexander, 2000; Carlson & Tamm, 2000).

Despite some conflicting findings in this area, Carlson and Tamm (2000) found that, when performing computerized tasks, both R and RC contingencies improved the performance of children with ADHD, but RC had the greatest benefit on performance. The instrumental condition in the current study relates somewhat to previous studies of

reinforcement contingencies in that a point loss is analogous to the RC condition; despite the presence of a reward (earning points), there is also the possibility of losing points to the opponent (RC). The hostile condition did not contain an RC-analogous component; therefore, it is possible that the instrumental condition was more salient and more intrinsically motivating for the children with ADHD. The hostile component of the task was perhaps not as salient for the children with ADHD, as the absence of an RC element (and, therefore, the absence of threat) meant that there was no motivation to perform at a high level.

In keeping with the reinforcement contingency explanation of these results, the concepts of immediate and delayed reward must be considered. Several studies have shown that, when compared to typical children, children with ADHD are more likely to prefer immediate rewards to delayed rewards (e.g., Rapport, Tucker, DuPaul, Merlo, & Stoner, 1986; Sonuga-Barke, Taylor, Sembi, & Smith, 1992; Tripp & Alsop, 2001). These findings can be related to the present study in that the instrumental condition provided a large immediate reward to the participant (i.e., earning points coupled with watching his or her opponent lose points). The hostile condition, on the other hand, did not provide the same immediate reward; the participant earned points, but the opponent did not lose points. The reward in the hostile condition was largely delayed in that the participant eventually won, but there were not as many immediate rewards throughout the task. These findings highlight the importance of considering immediate and delayed responses along with reinforcement contingencies when examining aggression in children with ADHD.

The finding that children with ADHD prefer immediate over delayed rewards may work in combination with the finding that children with ADHD are more responsive to RC contingencies to explain, in part, why children in the control group used significantly more hostile reactive aggression and more overall reactive aggression following low provocation than children in the methylphenidate group. Given that typical children tend to prefer delayed as opposed to immediate rewards (e.g., Luman et al., 2005; Tripp & Alsop, 2001), it is possible that they were able to remain more motivated to perform the task than children in the ADHD groups during the hostile task. As mentioned previously, the hostile task did not offer the immediate reward of taking points from the opponent and the low provocation condition did not serve as a threat; therefore, children in the ADHD groups may have become less motivated to perform, whereas typical children were perhaps able to recognize that continuing motivation to perform the task would eventually lead to winning the game.

Furthermore, Carlson and Tamm (2000) found that children with ADHD perform relatively better on tasks that interest them, as opposed to typical children, whose responding is more consistent across tasks of varying interest levels. This finding may help explain why children in the control group exhibited more reactive aggression following low provocation than children with ADHD; the lack of reward in the hostile task, especially in the low provocation condition, may simply have caused children with ADHD to lose interest in the game, whereas children in the control group remained interested. One caveat to the preceding discussion is that aggression is highly dependent on contextual and environmental cues (Hinshaw, 1991); therefore, it is important to note that children with ADHD may not be less likely to use hostile reactive aggression in

naturalistic contexts (e.g., the schoolyard), as the outcome of using this type of aggression may be more salient in this setting.

Proactive Aggression

All children were more proactively aggressive in the instrumental condition. This finding may reflect the fact that children in all groups were eager to start off the game with as many points as possible, and to decrease the points of their opponent as much as possible, to increase their chances of winning the game in the end. This speaks to the salience of winning for all children; participants knew that they would be able to win a prize at the end of the game if they had more points than their opponents, therefore, earning as many points as possible would have made winning more likely. Gaining points may simply be more salient to children that annoying their opponent. Indeed, research has shown that younger children typically exhibit higher levels of instrumental aggression (Dodge, 1991); given the mean age of the current sample, it is possible that this type of aggression was simply a more compelling choice.

It should be noted that, even though all children were more proactively aggressive in the instrumental condition, the change in aggressive responding between the instrumental and hostile conditions was greater for children with ADHD. Again, these results appear to be consistent with the hypothesis that earning points is more salient and motivating for children with ADHD. Engaging in more proactive instrumental aggression increased the odds that the participant would have more points than the "opponent", whereas engaging in proactive hostile aggression did not increase the participants' chances of winning the game. Children with ADHD may have reduced their levels of proactive responding in the hostile condition simply because they did not perceive any

advantage in this strategy. Typical children, on the other hand, may have wished to use hostile aggression for the purposes of distracting their opponent, thereby making him or her less likely to win the next trial; indeed, children in the control group engaged in more proactive hostile aggression than children in the methylphenidate group. This strategy may have been too complex for children with ADHD to develop, meaning that they did not attempt to use hostile aggression as a strategy to win the game.

Dissipation of Aggression

In terms of dissipation of aggression, all groups showed similar dissipation patterns in the instrumental condition, in that children engaged in the greatest amount of aggression in Trial 23 (i.e., immediately after they had received high provocation from their "opponent") and aggression use steadily decreased thereafter. This finding is consistent with past research showing that children tend to react aggressively immediately after high provocation, with decreasing levels of aggression as the provocation becomes more distal (Waschbusch et al., 2002). If participants were not exposed to provocation, then it is not necessarily appropriate to continue taking points from one's opponent. Additionally, participants may have felt no need to take points from their opponents, given that, at this point in the game, scores were heavily in favour of the participant, meaning that it was clear they would win the game and a prize.

Dissipation of aggression in the hostile condition, however, followed a different pattern for ADHD children who received medication. That is, control children and ADHD children who received a placebo showed the same general pattern as in the instrumental condition, in that they exhibited high aggression immediately after high provocation, with generally decreasing aggression thereafter. However, ADHD children

who received medication showed the opposite pattern – low levels of aggression immediately after high provocation, with increased levels of aggression as the provocation became more distal. This finding is surprising for at least two reasons. First, as noted above, previous research has shown that aggression use typically dissipates if no provocation is present (Waschbusch et al., 2002). Second, most – but not all – research suggests methylphenidate tends to decrease aggression in children. In fact, in the current study the same group (ADHD children who received methylphenidate) exhibited less hostile reactive aggression in response to low provocation than other children.

It is not entirely clear why children in the methylphenidate group did not show the same dissipation pattern as children in the control and placebo groups or why they did not show the same pattern as observed in the instrumental condition. However, the finding is not without precedent. For instance, Murphy et al. (1992) found that low aggressive children with ADHD were markedly more aggressive (Cohen's d effect size of 0.7 for the increase in aggression) in response to high provocation in this same task after they had received medication as compared to when they had done the same task on placebo. Further, Hinshaw and colleagues reported increases in covert antisocial behaviour in response to methylphenidate in children with ADHD (Hinshaw et al., 1992). In a chapter discussing the impact of methylphenidate on aggression, Hinshaw and Lee (2000) note that the vast majority of research on this topic has used measures of aggression that actually capture antisocial behaviour globally and therefore little is known about the impact of methylphenidate on aggression. In the present study it may be that methylphenidate increased aggression use in the final hostile aggression trials by allowing the children in this group to think through an aggressive response and the

possible outcomes of continuing to use aggression, even though the opponent was no longer provoking them. Alternatively, as Hinshaw and Lee (2000) also suggest, methylphenidate may enhance achievement motivation. With regards to the present study, winning the game may have been more important during the last six trials of the task due to the fact that scores between the participant and the "opponent" were much closer and the participant may have felt threatened by the prospect of losing the game; this fact could have led the medicated children to be more motivated to continue playing the game to win, despite the absence of peer provocation.

Children in the placebo group, on the other hand, may not have had the ability to attend to developing a complex strategy to win the game and may not have been as motivated to keep playing, thereby reducing their aggressive behaviour over the last six trials of the game. Again, it should be noted that this type of response pattern might not be identical in a more naturalistic setting, such as the schoolyard. When faced with the possibility of a more aversive response to hostile aggression use from a peer (e.g., being hit), the child with ADHD may refrain from continuing to use aggression as a response; however, given that the most aversive response from the opponent was a buzz, children in the methylphenidate group may have felt that the "ends justified the means".

Another explanation of increased aggression use by children in the methylphenidate group over dissipation trials is that methylphenidate actually increased the physiological and affective cues that normally precede aggression use. In a study of the effects of methylphenidate on aggression use in adults with and without ADHD, participants with ADHD who received a dose of methylphenidate prior to completing a competitive reaction time task against an imaginary opponent exhibited increased

aggression during the task and also reported feeling more angry and more stimulated as compared to participants who did not receive a dose of methylphenidate (Alioto, 1999). The author suggests that methylphenidate actually enhances the affective and physiological cues normally associated with the onset of aggression, thereby leading to increased aggression use in the methylphenidate group.

The dissipation scores in the hostile condition were different than the instrumental condition in that the scores were much closer between the participant and the opponent, as the instrumental condition offered the opportunity to take points from the opponent. The similar scores in the hostile condition may have increased the threat of ultimately losing the game. With respect to the current results, it is possible that heightened affective and physiological cues, combined with the threat of losing the game in the hostile dissipation condition influenced children in the methylphenidate group to continue to act aggressively in the absence of provocation in the hostile condition but not in the instrumental condition.

Interestingly, some animal research has found that the physiological cues associated with aggression manifest differently in animals that have been defeated in a social stress/aggression paradigm. Miczek, Covington, Nikulina, and Hammer (2004) note that animal work shows large sympathetic and adrenocortical activation following defeat in a brief aggressive encounter; attacking and defending animals are tachycardic, hypertensive, and hyperthermic but these changes endure for a much longer period of time in defeated animals. Extrapolating to the current study, it is possible that the combination of feeling defeated over the course of the task (and especially in the last high provocation trial before the dissipation trials) and heightened affective and physiological

cues in the methylphenidate group increased aggression use over the last six trials of the game.

While some of the results of the current study are surprising, they also raise other possibilities about the nature of aggression use and competitiveness in children with ADHD. Based on the findings noted above, it would be worthwhile to examine more closely the nature of competitive play in children with ADHD, as it may play a key role in determining aggression use in these children. Children with ADHD may be so focused on winning a game at all costs that they do not attend to other cues exhibited by their opponents, nor do they attempt to develop alternative game strategies that would allow them to both (a) win the game and (b) develop or maintain a friendship. Future studies of this nature should include post-game questionnaires in which children are asked about their motives for using certain strategies and about the importance of winning the game.

The current study also raises issues regarding the effects of methylphenidate on the affective and physiological cues associated with aggressive behaviour. If, as Alioto (1999) suggests, methylphenidate actually increases these cues, then it would be advisable to carefully consider this factor when administering methylphenidate to an individual who may already be prone to exhibiting increased levels of aggression. Future research should include a within-subjects component in order to develop a more conclusive theory as to the effects of methylphenidate on aggression use in children with ADHD.

Some limitations of this study should be noted in order to inform future research. First, a between studies design was used to examine the effects of methylphenidate on aggression use in this sample. A within subjects design would be advisable for future

research to further examine the effects of the drug on aggression. A between subjects design was used in the current study largely due to the fact that deception was involved. Even though children were not debriefed immediately following their session, participation in a second session may have increased the chances of children discovering that their opponent was not real, thereby adversely affecting motivation to perform the task. Additionally, the provocation task was long and it would have been very difficult to ask the participants to invest even more time to the research.

The length of the task may also be a limitation in the current study. The entire task took between 30 and 50 minutes to complete, depending on the child and the responses they chose after each trial. While most children seemed to enjoy the task and participated fully, it is possible that some children became bored with the procedure and became stuck in a response set in order to finish the task sooner. Again, it was not possible to split the task into separate sessions, due to the deception involved; the task may not have been believable if children were asked to come back for a second session. However, every effort was made to ensure that the task was as short as possible and that children were able to take breaks if they became bored with the task.

The current study, while not entirely consistent with past research in the area, raises some important questions about the nature of aggression in children with ADHD. It is clear that aggression use in this group of children depends on many factors and may be influenced by context and reinforcement contingencies. Further research is needed to investigate not only the types of aggression used by children with ADHD but also their reasons for using aggression in social situations and the influence of reinforcement in determining continued use of aggressive behaviour.

In summary, few differences in aggression use existed between children with ADHD and their typically developing peers and methylphenidate had few effects on aggressive behaviour in children with ADHD. Findings suggest that aggression used by children with ADHD is influenced by impulsivity and an inability to attend to environmental cues. The presence of provocation and threat appear to be important predictors of aggressive behaviour in all children and may be especially important factors in predicting aggressive behaviour in children who are taking stimulant medication. Future research should examine these factors as possible predictors of aggressive behaviour in order to elucidate their effects in various samples of children.

CHAPTER FOUR

Conclusion

Summary of Findings

The objective of the current investigation was to examine social information processing abilities and aggressive behaviour in children with and without ADHD and to examine the effects of stimulant medication (methylphenidate) on these constructs. As mentioned previously, deficits in social information processing, along with the propensity to act aggressively in social situations, have been suggested as possible causes of the peer rejection so often experienced by children with ADHD. Further examination of the underlying mechanisms related to this social rejection, such as social information processing deficits and use of aggressive behaviour may lead to a more streamlined theory of social behaviour in children with ADHD, thereby leading to more effective and specialized treatments for the social difficulties associated with the disorder.

Results of the current investigation suggest that children with ADHD process social cues and enact aggressive behaviour in similar ways to their typically developing peers. Findings from the social information processing component of the current study indicated no significant differences between children with ADHD and typical children at the Interpretation step of the Crick and Dodge (1994) social information processing model. Group differences in social information processing were found at the Response Generation step of the model in that children in the methylphenidate group generated more hostile responses to social scenarios involving peer provocation than children in the other groups.

Results from the aggression component of the current study indicated that all children used more reactive instrumental aggression than reactive hostile aggression and more used more reactive aggression in response to high provocation than to low provocation. Additionally, children in the control group were more reactively aggressive overall following low provocation and more reactively aggressive in the hostile condition than children in the methylphenidate group. No significant effects of group were found for proactive aggression, although results indicated that all children engaged in higher levels of instrumental proactive aggression as opposed to hostile proactive aggression. Aggression use dissipated in all groups over the last six trials of the instrumental task; however, children in the methylphenidate group exhibited increased aggression use over the last six trials of the hostile task.

Several themes emerge based on the results noted above. First, based on the social information processing patterns observed in both children with ADHD and typically developing children, it does not appear as though children with ADHD exhibit an increased hostile attribution bias in comparison to typical children when interpreting ambiguous social situations. Second, children with ADHD and typical children show similar patterns of aggressive behaviour in a controlled laboratory environment. Third, results indicate that methylphenidate may not necessarily decrease aggressive behaviour in children with ADHD in situations in which the child feels threatened and/or provoked, given that children in the methylphenidate group generated more hostile responses in the peer provocation condition of the social information processing task and also exhibited increased aggressive responding in the dissipation condition of the hostile task. Taken together, these findings suggest that the aggressive behaviour often observed in children

with ADHD is likely a complex construct and may be the result of several factors such as impulsivity, inattention, provocation, motivation, and threat.

The Hostile Attribution Bias in Children with ADHD

Typically, a hostile attribution bias is inferred if children interpret ambiguous social scenarios in a hostile manner (e.g., Dodge, 1980). However, the current results show no group differences in responding at the Interpretation step of Crick and Dodge's (1994) social information processing model, an indication that children in the ADHD groups interpreted ambiguous social scenarios in much the same way as typical children. There are two possible explanations of these results. First, it is possible that these results support the assertion that the social difficulties experienced by children with ADHD are a result of a performance deficit rather than a knowledge deficit, in that children with the disorder are aware of how to behave in various social situations but have difficulties enacting appropriate responses when interacting socially. Second, it is possible that the seemingly aggressive and disruptive behaviour observed in children with ADHD is the result of the disinhibition and impulsivity associated with the disorder, rather than a tendency to act aggressively.

The current results lend some support to the assertion that children with ADHD exhibit a performance deficit when required to enact a certain behavioural response (e.g., Grenell et al., 1987; Milich & Dodge, 1984), as there were no group differences at the Interpretation step of the Crick and Dodge's (1994) social information processing model. The lack of group differences at this step of social information processing suggests that children with ADHD have similar knowledge regarding responses to peers in social situations when compared to their typically developing peers; however, they may not be

able to apply this knowledge in *in vivo* situations (e.g., the playground or the classroom) or when asked to spontaneously recall their knowledge, as is required in many social situations (Milich & Dodge, 1984).

The lack of group differences between children in the medication and placebo groups is an interesting finding and speaks to the importance of using combined treatment (i.e., medication combined with behavioural interventions) when working with children with ADHD. Despite the current findings suggesting that the children with ADHD in this particular sample did not exhibit an increased hostile attribution bias when compared to typical children, it is likely that some children with ADHD, especially those who are aggressive, exhibit this bias. The current findings, therefore, are clinically important, as they strongly argue in favour of using either behavioural treatment (i.e., changing behaviour in order to change cognitions) or cognitive treatment (i.e., changing cognitions in order to change behaviour) when treating children with ADHD. This suggestion is in contrast to other findings suggesting that medication alone is the most appropriate modality for the treatment of ADHD. This area, however, is somewhat understudied and more research is warranted to determine the most appropriate treatment course for children with ADHD.

Aggression Use in Children with ADHD

Results of the current study suggest that aggression use in children with ADHD is very similar to that of their typically developing peers in a controlled laboratory setting. In most areas of the provocation task, children with ADHD expressed aggression in much the same way as children in the control groups; that is, they used more reactive aggression in response to high provocation, used more instrumental aggression than

hostile aggression in both reactive and proactive conditions, and decreased their aggression use over the last six trials of the task. One interesting exception to this pattern was the finding that children in the methylphenidate group exhibited increased aggression over the last six trials of the hostile task.

Provocation has been shown to be an important determinant of aggressive behaviours by other researchers (see Atkins et al., 1993; Murphy et al., 1992; O'Connor, Archer, & Wu, 2001; Waschbusch et al., 2002 for examples) and the current study highlights the importance of this factor. All children, regardless of experimental group, exhibited higher rates of both instrumental and hostile aggression following high provocation; indeed, children in each of the three groups did not differ in their use of reactive aggression in the high provocation conditions of both tasks. High levels of provocation from a peer clearly implies the desire to hurt or insult the individual and it is therefore not surprising that all children would choose to react to this level of provocation with high rates of aggression.

Provocation differentially affected the use of instrumental and hostile aggression in all children, further highlighting the importance of this factor in determining aggressive behaviour. Specifically, all levels of provocation led to instrumental aggression, whereas only high levels of provocation led to hostile aggression in all children. This suggests that, when provocation is paired with threat (i.e., losing points), the likelihood of enacting an aggressive response is greater. Reacting to high provocation with high rates of aggressive behaviour serves a protective factor in this case, as the opponent is clearly posing a threat to the participant.

The presence of threat in the current task further illustrates the complex nature of aggressive behaviour in children, especially in children with ADHD. Results in the current study suggested that the presence of a threat might be an important determinant of aggression use for children with ADHD. Children with ADHD significantly reduced their aggression use in the provocation task in conditions that posed no threat to them, in contrast to children in the control group, who responded consistently across conditions. All children used more reactive aggression in the instrumental condition, an indication that the threat of losing their points to the opponent combined with provocation to increase aggression use. Children with ADHD used less hostile aggression than children in the control group following low provocation, a finding that contrasts with Waschbusch et al. (2002), who found that children with ADHD were more reactively aggressive than typical controls following low provocation. The current finding suggests that the motivation to use reactive hostile aggression following low provocation was significantly reduced for the ADHD group in the absence of a serious threat from the opponent. This may also explain why group differences did not exist in response to low provocation in the instrumental condition; given that a serious threat to winning the game existed, all children were more motivated to respond aggressively following both low and high provocation trials.

Additionally, group differences in social information processing were only observed when children were asked to generate possible responses to ambiguous situations involving peer provocation, an indication that children with ADHD may feel particularly threatened if provoked and therefore engage in more aggressive behaviour than typically developing children. This finding is supported by the suggestion by Dodge

(1991) that reactive aggression is impulsive in nature and occurs in response to a perceived provocation or threat. It follows that, when provocation and/or threat is removed, the individual no longer acts impulsively and aggressively. This theory may explain why children with ADHD do not engage in reactive aggression in situations where no provocation or threat is present; however, it is difficult to explain why typical children continued to engage in reactive aggression following low provocation in the hostile condition. As mentioned previously, it is possible that typical children were responding more consistently across all trials, in an effort to gain as much of an advantage as possible over their "opponent", whereas children with ADHD were not as engaged in the task if it did not offer a clear advantage to them.

Similarly, no group differences in hostile attribution bias were found in the social information processing task, an interesting finding, given the results of the provocation task. As noted previously, the hostile attribution bias is hypothesized to be the underlying mechanism of reactive aggression in response to provocation (e.g., Dodge, 1980); therefore it is unclear why group differences did not emerge with respect to social information processing but differences were found in the provocation task. More research is warranted to delineate the exact mechanisms of reactive aggression along with the situational factors that may influence the use of this type of aggression in typical children as well as children with ADHD.

The behaviour observed in the proactive condition of the provocation task also highlights the importance of threat and motivation as precursors to aggressive behaviour. Given that this part of the study was largely exploratory, the results with respect to the behaviour of children with ADHD are interesting. It has been suggested that children

with ODD and CD may engage in more proactive aggression than typical children and children with ADHD-only, as this type of aggression is thought to be more covert and goal-oriented. It appears, though, that children with ADHD do not engage in higher rates of this type of aggression when compared to typical children, suggesting that children with ADHD engage in aggressive behaviour largely in response to a threat, similarly to children without ADHD.

This finding is important, as it suggests that children with ADHD, if placed in a situation that allows for an evaluation of a possible response before enacting it, may be capable of altering their behaviour in order to interact more appropriately with their peers; this suggestion is strengthened by the fact that results from the social information processing study indicated no processing differences between children with ADHD and typically developing controls. These results further support the suggestion that the aggressive behaviour observed in children with ADHD is the result of impulsivity and the inability to properly attend to and evaluate multiple environmental cues in situations in which a quick response is necessary.

The current study also highlights the importance of reinforcement contingencies in aggression use and supports previous findings that children with ADHD may be particularly sensitive to reward cost contingencies and that this may predict their use of aggressive behaviour, especially in competitive play situations. Children with ADHD showed more reactive and proactive aggression in the instrumental conditions for both low and high provocation trials, suggesting that the prospect of losing their points to their opponent was much more salient than receiving a buzz. The cost of losing points acted as a motivating factor for children with ADHD and, subsequently, they engaged in higher

rates of aggressive behaviour; receiving a buzz from the opponent did not provide the motivation necessary to engage in aggressive behaviour and children with ADHD appeared less motivated than control children in this condition.

It should be stressed that the preceding discussion regarding the possible precursors to aggressive behaviour in children with ADHD applies strictly to the experimental protocol used in the current study and not necessarily to naturalistic settings in which aggression typically occurs (e.g., the playground). For example, it was noted earlier that the response style of children with ADHD has a reciprocal effect on their peers, such that typical children adjust their response style to fit that of the child with ADHD (Landau & Milich, 1988). It is possible that this reciprocal effect occurs in the reverse pattern as well, such that following an adjusted response from a peer, the child with ADHD continues to act in an overly aggressive manner. The results of the current study may indicate that this reciprocal communication is an important determinant of aggression in children with and without ADHD; the fact that there was no face-to-face contact involved may have caused children to engage in aggressive behaviour much differently than if they had been in a naturalistic setting. This lack of face-to-face communication may help explain some of the surprising results with respect to aggression in typical children.

Overall, the findings noted above suggest that aggression use in children with ADHD may be a result of their inability to attend to environmental cues, combined with the presence of provocation, threat, the motivation for using aggression, and possible reinforcement associated with using aggression. While not entirely applicable to

naturalistic settings, these results have important implications for the treatment of aggressive behaviour in children who exhibit aggressive behaviour in addition to ADHD.

Implications for Treatment. The finding that children with ADHD do not seem to differ from their typically developing peers in terms of hostile attribution bias and aggression use suggests that treatment is not needed for the peer relationship difficulties normally associated with the disorder. However, it is clear that children with ADHD exhibit inappropriate behaviour in social situations and that they are often rejected by their peers (e.g., Pelham & Bender, 1982). The current results suggest that training focused on recognizing and interpreting environmental cues may not necessarily be effective for children with ADHD. Instead, it may be advisable to focus treatment on general behaviour modification; indeed, part of the STP treatment protocol focuses on modifying behaviours such as swearing, interrupting, whining, and inattention to details when playing sports in children with ADHD. Perhaps treatment protocols such as this would increase peer acceptance and social functioning in children with ADHD. However, more research examining the exact mechanisms of social information processing in children with ADHD is certainly warranted before making a conclusive statement regarding the treatment implications of the current results.

Methylphenidate in the Treatment of Aggressive Behaviour

The current study also suggests that methylphenidate, while an important tool in the treatment of ADHD, may actually increase aggression in some situations, namely when generating responses to peer provocation and in situations in which hostile aggression is used. Again, both of these findings occurred in situations in which there was a threat to the individual; in the social information processing task, there was the

threat of an altercation with a peer and in the provocation task, there was a threat of possibly losing the game. Whereas it is necessary to replicate these results, the finding that methylphenidate increased aggression in some instances in extremely important, given that the drug is the most frequently used pharmacological agent in the treatment of ADHD. As Alioto (1999) suggested, it is possible that the heightened feeling of arousal associated with methylphenidate, along with the physiological cues associated with the onset of aggression combined to create this effect.

This finding also supports assertions that little is known about the relationship between aggressive behaviour and methylphenidate (Hinshaw, 1991; Hinshaw & Lee, 2000). Hinshaw (1991) and Hinshaw and Lee (2000) argue that little is known about this relationship because rating scales are typically used to measure aggressive behaviour. The current investigation, however, used a controlled laboratory task to measure aggression in a sample of children (rather than relying on parent or teacher rating scales) and results indicated that methylphenidate increased aggression in certain situations, a somewhat unexpected finding. It was suggested earlier that methylphenidate might allow children to consider more responses to a given situation and subsequently to choose an aggressive response. The increased aggression in the hostile condition may be a result of the decrease in impulsivity associated with methylphenidate combined with the threat of losing the game. Children in the methylphenidate group may have been able to control their impulsivity such that they were able to take a more tactical approach to the task over the last six trials; that is, aggression was used not simply as a reaction to an event, but rather as a way of ensuring victory.

The finding that children in the methylphenidate group showed increased aggressive behaviour in both the social information processing task and in the provocation task is not new; two previous studies have found similar results (Alioto, 1999; Murphy et al., 1992), suggesting that this finding is not spurious and must be considered in the interpretation of the results, as well as investigated further. As noted previously, the use of aggression by children with ADHD seems to be determined by several factors; the finding that methylphenidate actually increased aggression in children with ADHD in certain components of the task suggests that the effects of the drug may combine with these other factors to produce increased aggressive behaviour.

It should be noted that methylphenidate only increased aggressive responding in situations that included a threat or a provocation (i.e., ambiguous peer provocation situations and in the dissipation component of the hostile condition of the provocation task) and increased ambiguity (e.g., the lack of verbal component in the dissipation condition); therefore, it is possible, as Alioto (1999) suggests, that methylphenidate actually increases the physical and affective arousal associated with the onset of aggression use and combines with the provocation and threat cues to increase aggression in this group of children.

Given that methylphenidate is the most commonly prescribed medication for the treatment of ADHD in children and in adults (Pelham, 1993), it would be prudent to consider the current findings in this context. Clearly, methylphenidate has been, and will likely continue to be, highly successful in treating this disorder; therefore, it would be unwise to imply that the current results suggest otherwise. However, if methylphenidate has the potential to increase aggressive behaviour under some conditions in children with

ADHD by increasing physiological and affective arousal (Alioto, 1999), caution should be exercised when prescribing the medication. Psychoeducation regarding the potential effects of methylphenidate on aggressive behaviour should be offered to both patients and parents as a first step in treating any aggression associated with the drug. As previously mentioned, treatment programmes aimed at teaching children how to recognize and deal with potentially aggressive social situations should be implemented to aid children in reducing aggression.

Implications for Aggression Theory

One of the goals of the current investigation was to attempt to streamline and, ideally, simplify aggression theory as it pertains to children with and without ADHD. As noted earlier, aggression theory, while informative and well researched, is often discussed from two perspectives; that is, the instrumental/hostile perspective (e.g., Atkins & Stoff, 1993) and the reactive/proactive perspective (e.g., Dodge, 1991). The goal of the current study was to determine whether both of these dichotomies could be useful in describing aggressive behaviour in typical children and in children with ADHD.

The most interesting finding in the current investigation was that children, regardless of diagnostic group, tended to use more of both types of instrumental aggression as compared to hostile aggression, a finding that contrasts with that of Atkins and Stoff (1993), who found increased instrumental aggression in children with ADHD when compared to controls. The current finding could be related to the developmental stage of the children who served as participants; as mentioned previously, younger children have been found to use more instrumental aggression than hostile aggression (Dodge, 1991). It is possible, then, that the majority of children did not consider hostile

aggression to be a viable means of achieving a goal (i.e., winning points and, ultimately, the game). Children at later developmental stages may have been more apt to consider hostile aggression as a means to achieve a goal in that sending a buzz may have distracted the opponent, thereby making him or her less likely to react quickly on the next trial. A slower reaction by the opponent would be more likely to ensure a win for the participant.

Instrumental aggression was used at higher rates than hostile aggression in both reactive and proactive conditions and after high and low provocation. Hostile aggression was typically only used at low levels, unless the participant was provoked at a high level. This suggests that both instrumental and hostile aggressions are viable subtypes of reactive and proactive aggression; however, hostile aggression seems to be used only when justified (i.e., following high levels of provocation). Whereas the provocation task used in the current investigation suggests that both dichotomies for aggression classification are useful, it only shows this in a controlled laboratory setting. It is not clear whether the same pattern of aggression use would occur in a naturalistic setting. In this case, children were told the benefits of using each type of aggression and were therefore able to make a decision based on these instructions. It would be helpful to administer the same task to another sample of children without explaining the benefits of each type of response. It is possible that more distinctions between children with ADHD and typical children would emerge.

Limitations

The current investigation used a between subjects design to investigate social information processing and aggressive behaviour in children with and without ADHD; a within subjects design would have been more statistically powerful and could have

helped in determining medication effects on these constructs. As stated previously, a within subjects design was not possible as part of the current study, as it would not have been possible, given the time frame involved, to test children twice using the Dodge picture stories. In addition to this, deception was employed as part of the provocation task; therefore asking participants to complete this task twice would have been a threat to the validity of the task. Thus, the decision to use a between-subjects design was made with a view to increasing the validity of the task.

One shortcoming of the present investigation that is often considered in studies of this nature is the lack of co-morbid subgroups in the sample. Previous studies have often divided samples into ADHD, ADHD + aggression/ADHD + CP, and control groups in order to produce more streamlined results. In this case, however, it was not possible to create diagnostic subgroups of children, as groups would have been too small to detect meaningful differences. It is possible, therefore, that the presence of co-morbid disorders such as ODD or CD may have affected the current results.

The provocation task used in the current investigation was somewhat different than previous tasks used to investigate aggression in children; therefore, some limitations should be noted. The most salient difference between this task and other analogue aggression tasks is the addition of a virtual component in the form of instant messages to deliver provocation messages to the participant. Whereas other tasks of this nature have used tape-recorded voices of confederate children, the present task included an instant messenger component, as children are increasingly familiar with this type of technology and use it frequently.

The instant messenger component, while in keeping with advances in technology, perhaps influenced the results of the current task such that they were not entirely consistent with previous findings. Virtual communication is somewhat different from real-life communication, in that it can be difficult to discern the meaning of the messages, especially such elements as irony and sarcasm (Hancock, 2004). Given that many of the messages used in the current study contained some sarcastic comments, it is possible that they were not fully understood by the participants. Indeed, qualitative observations of participants as they performed the task suggested that this was perhaps the case. Children often stopped the examiner or the research assistant to ask what a statement meant and for help interpreting it. It is possible that sarcasm and aggression were not conveyed via the instant messenger component of the task in the same manner as a tape-recorded message featuring a real voice with real inflection. Therefore, it is possible that the current results differ from those of previous studies in that a real voice, rather than an instant message would have been more provocative

Future Directions

The current investigation provides a starting point for future studies of social cognition and aggressive behaviour in children with and without ADHD and the effects of stimulant medication on these behaviours. Future directions for research in this field include administering both tasks and correlating results with measures of naturalistic observations of behaviour. A study such as this would serve to highlight the differences between laboratory and naturalistic aggression and would aid in further streamlining aggression research and theory. Another useful method of understanding the nature of aggressive behaviour as it relates to social cognition would be to correlate results from

the social information processing and aggression components of the current study; indeed, plans to undertake this study are being developed and will likely involve collecting data from more children before calculating correlations. Some researchers have suggested that varying doses of methylphenidate may affect expression of aggressive behaviour in children with ADHD (e.g., Hinshaw, 1991; Hinshaw, Buhrmester, & Heller, 1989); therefore it would perhaps be useful to replicate the provocation task using a higher dose of methylphenidate (e.g., 0.6 mg/kg). Finally, it would be useful to attempt to tease apart the effects of the verbal and behavioural provocations in the provocation task, as it is possible that verbal taunts from peers affect aggression.

Conclusion

The current investigation raises important questions about the nature of social information processing, aggression use, and the relationship between the two in children with and without ADHD. On many levels, children with ADHD do not appear to differ from their typically developing peers, regardless of whether or not they are taking methylphenidate. This is an encouraging finding, as it suggests that treatment can be developed to address the aggressive behaviour often observed in children with ADHD such that they are able to develop better responses to peers in potentially volatile situations. Most importantly, these results suggest that the aggressive behaviour observed in children with ADHD may be qualitatively different from that observed in children with ODD or CD. Children are often diagnosed with ADHD when a parent, teacher or clinician observes aggressive behaviour; it is important to realize that, while ADHD and aggression overlap frequently, aggression is not part of the diagnostic criteria for ADHD and should not be treated as such. Aggression in ADHD may be an entirely different

construct from aggression observed in ODD or CD; therefore, when making important diagnostic decisions, aggression should be considered separately from ADHD to ensure the best quality treatment and outcome for the child.

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Appendix A
IWK Consent and Assent Forms

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Information and Consent Form

Study Title: Reactive and Proactive Aggression in Response to provocation in Children with Disruptive Behaviour Disorders.

Investigator: Sara King, B.Sc., Ph.D. Student, Department of Psychology, Dalhousie University.

Supervisor: Daniel A. Waschbusch, Ph.D., Department of Psychology, Dalhousie University.

Introduction

Your child is being invited to take part in the research study named above. It is important that you and your child understand the purpose of the study, how it may affect your child, the risks and benefits of taking part, and what your child will be asked to do before you decide if it is in your child's best interest to take part in this study. Your child does not have to take part in this study. Taking part is entirely voluntary (your choice). If you have any questions that this form does not answer, a research assistant, the study Investigator, or the Investigator's supervisor will be happy to give you further information.

Purpose of the Study

Children with Disruptive Behaviour Disorders (DBDs) such as Attention Deficit/Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD) are often more aggressive than typical children of the same age. Children who are more aggressive than other children tend to have more trouble making and keeping friends, more trouble at school, and often more trouble relating to other people as adults. Children who have multiple DBDs are often more likely to have more serious problems than children who only have one disorder; it is for this reason that many researchers believe that children who have two disorders may be a distinct group.

One way of studying the differences between children who have one disorder (for example, ADHD only) and children who have more than one disorder (for example, ADHD + ODD) is to study the types of aggression they use when interacting with others. Research has shown that children usually use two types of aggression when interacting with others: reactive aggression and proactive aggression. Reactive aggression is aggression that happens in response to another person's actions, while proactive aggression is aggression that is more carefully thought out and is not necessarily a response to an action.

By studying these types of aggression, it may be possible to learn more about the situations in which certain children use certain types of aggression. It is thought that children who have DBDs may use these two types of aggression at different times and d in response to less threatening actions when compared with other children. By investigating these differences, we may be able to learn more about the differences between children who have DBDs and those who do not. This research will help us to develop better treatments for children who have DBDs. We would like 72 healthy children to volunteer to participate in a research study to continue to study aggression in children.

The study is under the direction of Dr. Daniel Waschbusch, Department of Psychology at Dalhousie University.

Study Design

Children with and without Disruptive Behaviour Disorders between the ages of 7 and 12 are invited to participate in this research study involving a computer game designed to measure aggressive actions in children.

Before your child participates in this study, this information and consent form will be explained and signed if you and your child agree to participate. You will be asked a few questions about your child's behaviour before he or she is enrolled in the study in order to obtain more background information about your child's behaviour.

Taking part in this study will involve two sessions lasting no more than 60 minutes each in which your child will be asked to answer some questions about pictures of social situations that will be shown to him or her and play a computer game with another child in the room next door.

Your child will be asked to look at eight cartoon pictures of children interacting in social situations (such as a child getting hit by a ball while playing catch with another child). After looking at the pictures, your child will be asked two questions about the picture, such as "Why do you think the child in the picture hit the other child with the ball?" and "What would you have done if this had happened to you?" This part of the study takes approximately 15 minutes.

When playing the computer game, your child will be asked to press a button as fast as he or she can in order to win points to save up for a prize at the end of the game. In the first

session, if your child wins, he or she will earn 50 points and will be allowed to send a message using MSN Messenger to the other boy. Your child will also be given the chance to take points away from the other boy. However, if your child loses, the other boy will have the same opportunity to send a message and take points from your child. The second session will be identical to the first except that, if your child wins, he or she will win points and will be given the chance to send an aversive "buzz" to the other boy. Again, the other boy will have the same opportunities should he win. After each trial of the game, your child will be asked to indicate his or her mood by telling a research assistant to click on one of five happy faces that will appear on the computer screen.

In reality, however, there will be no other boy. All game results will be determined beforehand and a research assistant in another room will control the game. We ask that you do not tell your child about this until he/she has completed the study, as it has been shown that other research participants may be affected if they are made aware of deception.

We ask that you consider whether or not your child will be able to cope with deception before agreeing to allow him or her to participate in the study. We do not believe that children will become angry as a result of the deception in this study; however, in order to ensure that your child has a pleasant experience, he or she will win the game and will be given a small prize.

Potential Harms

There is minimal harm associated with participation in this study. As mentioned above, it is possible that your child will become angry or distrustful when he or she learns that he or she has been deceived. We believe that this will not be the case and have arranged for all children to win their games. If your child does become angry, however, the principal investigator and her supervisor will discuss the task with your child in order to help him or her understand why deception is sometimes used in experiments such as this one.

Your child may also become tired during the sessions and breaks will be taken if this is the case. We have tried to design this study so that it takes as little time as possible for your child to participate. In this way, he or she will not become too tired.

Potential Benefits

While your child may not benefit directly from participation in this study, what we learn may help other children.

Alternatives to the Study

Before deciding to enrol your child in this study, you should know that you do not have to take part in this study.

Withdrawal from Participation

Participation in this study is entirely voluntary (your choice). You may decide not to enrol your child or you (or your child) may choose to withdraw from this study at any time. Your child's participation in the study may be ended if, in the opinion of the study

staff, it is not safe of reasonable for him or her to continue. If the study is changed in any way which could affect your decision to continue your child's participation, you will be told about the changes and you may be asked to sign a new informed consent.

Costs and Reimbursement
You will be paid at a rate of $7 an hour for about two hours. Should you choose to withdraw from the study, you will be paid for your time up until that point; the minimum amount you will receive will be $7.

Confidentiality
Any information that is learned about you or your child will be kept private. Study staff will have access to your child's study and intake records. In addition, the records may be shown to personnel of the Research Services Office at the IWK Health Centre and Dalhousie University, and the regulatory authorities in Canada. If the results of the study are published in a journal the publication will not contain any information which would identify you or child. Study records (including videotapes) will be stored in a locked area and will be kept for 10 years past the age of majority as required by the IWK Research Ethics Board.

Research Rights
Your signature and your child's signature (if possible) will show that you have understood to your satisfaction the information about the research study.

By signing this document you are not waiving any of your legal rights, nor are you releasing the investigator(s) or the institution(s) from their legal and professional responsibilities.

If you have any questions at any time during or after the study about these legal rights or about research in general and you would like an independent opinion, you may contact the Research Office of the IWK Health Centre at 470-8765, Monday to Friday between 9 am to 5 pm.

Following completion of the study, study results can be made available to you upon request. Please contact the researcher, Sara King, at 494-2956 if you wish to have a copy of the results.

Contact Person
The Primary Investigator is Sara King. If you have any questions or concerns following your enrolment, you may call the Child Behaviour Laboratory at Dalhousie University at 494-2956 and leave a message.

Study title: Reactive and Proactive Aggression in response to Provocation in Children with Disruptive Behaviour Disorders.

Participant ID:_____
Participant INITIALS:_____

Parental or Guardian Authorization- **if participant living in the care of parent or guardian.**
I have read or had read to me this information and authorization form and have had the chance to ask questions which have been answered to my satisfaction before signing my name. I understand the nature of the study and I understand the potential risks. I understand that I have the right to withdraw my child from the study at any time without affecting my child's care in any way. I have received a copy of the Consent Form for future reference. I freely agree to have my child participate in this research study.

_____ _____
Name of Participant (Print) Signature of Participant (if possible)

_____ _____
Name of Parent/Guardian (Print) Signature of Parent/Guardian

Date:_____ Time:_____

STATEMENT OF PERSON PROVIDING INFORMATION ON STUDY
I have explained the nature and demands of the research study and judge that the Parent/Guardian/Participant named above understands the nature and demands of the study.

Name (Print):_____ Position:_____

Signature:_____ Date:_____ Time:_____

STATEMENT OF PERSON OBTAINING CONSENT
I have explained the nature of the consent process to the person authorized and judge that they understand that participation is voluntary and that they/their child may withdraw at any time from participating.

Name (Print):_____ Position:_____

Signature:_____ Date:_____ Time:_____

Other people present at time of signing:

Name (Print):_____ Position:_____

Signature:_____ Date:_____ Time:_____

Assent Form for Children

Study Title: Reactive and Proactive Aggression in Response to provocation in Children with Disruptive Behaviour Disorders.

Investigator: Sara King, B.Sc., Ph.D. Student, Department of Psychology, Dalhousie University.

Supervisor: Daniel A. Waschbusch, Ph.D., Department of Psychology, Dalhousie University.

Some kids are more competitive than others and this sometimes affects the way they play with other kids. We are interested to find out how different kids play games that involve earning and losing points with other kids.

What Will Happen

Taking part in this study means that you will come to play a game two times, including this one. When you come to play the first time, this form will be explained to you and you will be asked to sign the same form your parent or guardian signed saying that you want to be in the study. You will be asked to play a computer game with another kid the same age as you who is playing in a different room. You will have to press a button on the keyboard as fast as you can so that you can win points. You'll be able to exchange your points for a prize at the end of the game. If you press the button faster than the other boy, you will be able to take between 0 and 100 points away from him or her; this will make it harder for him or her to win the game. You will tell him or her how many points you want to take by sending him or her a message over MSN Messenger. You'll also tell the research assistant how you're feeling by looking at some pictures of faces on the computer screen each time you play the game. The other kid will be doing the same thing, so when he or she wins, he or she will get the chance to take points and send a message to you.

The second time you come to play the game will be almost exactly the same as the first time, except this time, instead of taking points away from the other kid if you win, you'll get to send him or her a buzz over the computer lasting between 0 and 10 seconds. Sending the other kid a buzz won't stop him or her from winning the game, but it will bug him or her. You'll also get to send him or her a message over MSN and you'll have to tell the research assistant how you're feeling each time you send a buzz.

You'll also be asked to look at some pictures of kids playing with each other and then answer two questions about each picture.

If you get tired during the games, you'll be able to take breaks to stretch and have a drink or a snack. Just let the researcher know when you feel you need a rest.

All the information you give to the researcher will be kept private. Your name will not be on any study papers and no one but the people helping with the study will know that it was you who was in the study.

Contacts

The researcher who plays the game with you is named Sara King and she can be reached at her lab at Dalhousie University if you or your parents have any questions. Her phone number is 494-2956 and you should feel free to contact her or her supervisor, Dr. Dan Waschbusch, at any time.

Appendix B
SUNY Buffalo Consent and Assent Forms

UNIVERSITY AT BUFFALO, STATE UNIVERSITY OF NEW YORK

Information and Consent Form

Study Title: Subtypes of Aggressive Behavior in Elementary Age Children With and Without Attention-Deficit/Hyperactivity Disorder (ADHD)

Principal Investigators

William E. Pelham Jr., PhD	Daniel A. Waschbusch, PhD	Sara King, BSc
Professor	Associate Professor	Graduate Student
Department of Psychology	Center for Children and	Department of Psychology
University at Buffalo SUNY	University at Buffalo SUNY	Dalhousie University
716-829-2244 ext. 29	716-829-2244 ext. 14	902-494-2956

It is the principle of medical ethics that the human subjects of a research project be informed of the purpose and benefits of the project; the research methods used; the potential risks and hazards of participation; the right to ask for further information at any time during the research procedure. You have the right to know whether medical treatment or compensation is available for physical injuries incurred as a result of participation in the project. Your choice to participate is a voluntary one, and you are free to withdraw from the research project at any time. Your signature below will indicate that the principal investigator, or his/her agent, has answered all your questions and that you voluntarily consent to participate in this investigation.

Introduction
Your child is being invited to take part in the research study titled "Subtypes of aggressive behavior in elementary age children with and without attention-deficit/hyperactivity disorder (ADHD)." This study is being conducted by Sara King under the supervision of Drs. Daniel Waschbusch and William Pelham in the Department of Psychology, University at Buffalo, during the Buffalo Summer Treatment Program (STP). It is important that you and your child understand the purpose of the study, how it may affect your child, the risks and benefits of taking part, and what your child will be asked to do before you decide if it is in your child's best interest to take part in this study.

Please note that this study involves deception; this means that we will be telling your child something that is not really true. In this study, your child will be told that he or she is playing a computer game with another child over the Internet using Instant Messenger; however, your child will not really be playing against another child and will not actually be connected to the Internet. The Instant Messenger part of this study is part of a computer programme, so all the messages your child receives have been programmed and will be controlled by the researcher. The deception used in this study is necessary so that we can control the types of messages your child receives and to make the study as believable as possible for him or her.

Purpose
Children who are aggressive often have trouble making and keeping friends, problems at school, and often more trouble relating to other people as adults. Because of these problems, researchers have often studied the types of aggression that children use. One type of aggression is called reactive aggression. This is the type of aggression that children use when they get angry after someone teases them. Another type of aggression is called proactive aggression. This type of aggression is used even if they are not angry or not being teased. A third type of aggression is called instrumental aggression. This type of aggression is used when kids want to get something, like when they push another kid to get their toy. A fourth type of aggression is called hostile aggression. This type of aggression is used just to be mean. Lots of research has studied each of these types of aggression on their own, but almost no research has examined how these four types of aggression are related to each other. The main purpose of this study is to examine how these four types of aggression are related to each other in elementary school children.

A second purpose of this study is to examine aggression in children with Attention Deficit/Hyperactivity Disorder (ADHD) as compared to children without ADHD. This is important because children with ADHD tend to be more aggressive than other children of the same age.

A third purpose of this study is to examine the thinking styles that may lead to children being aggressive. Past research has shown that that some children see things that their peers do as more threatening to them than other children do, and these children tend to be more aggressive.

Our overall goal for this study is to learn more about aggression in children. In the long run, we hope to use the results of this study to develop better treatments for children who are aggressive.

Procedures
This study will include 60 children (both boys and girls) between the ages of 7 and 12 years. Forty of the 60 children will have ADHD and the remaining 20 children will not.

Taking part in this study will involve showing your child some pictures of social situations and asking him or her some questions about them as well as asking your child to play a computer game with another child over the Internet.

First, your child will be asked to look at eight (8) cartoon pictures of children in social situations (such as a child getting hit by a ball while playing catch with another child). After looking at the pictures, your child will be asked two questions about the picture, such as "Why do you think the child in the picture hit the other child with the ball?" and "What would you have done if this had happened to you?"

Second, your child will play a computer game. When playing the computer game, your child will be asked to press a button as fast as he or she can in order to win points to save up for a prize at the end of the game. In the first session, if your child wins, he or she will earn 10 points and will be allowed to send a message using MSN Messenger to the other child. Your child will also be given the chance to take points away from the other child. If your child loses, the other child will have the same chance to send a message and take points from your child. The second part of the game will be the same as the first part except that, if your child wins, he or she will win points and will be given the chance to send a message and a "buzz" to the other child. Again, the other child will have the same opportunities if he wins. After each trial of the game, your child will be asked to say how he or she feels by telling a research assistant to click on one of five happy faces

on the computer screen. When the entire task is over, each child will receive a small prize for participating in the study.

There will really be no other boy. All game results will be programmed into the computer and will be the same for all children. It is necessary to tell children they are playing against another child for two reasons. First, aggressive behaviour often happens in response to the actions of another person; therefore, to make the game as real as possible, your child must think he or she is playing against another child. Secondly, by rigging the game, we are able to control the type of comments made by the other child so that none of them will be offensive or rude. If your child was playing against a real other child, we would not be able to control the messages sent over Instant Messenger.

We will not be telling your child that he or she did not really play against another child for two reasons. First, because your child is in camp with other children he or she may inform other children who have not yet done the study, thereby making it more difficult to complete the experiment. Second, telling children about the deception used in studies like this may do more harm than good. For example, it is possible that children could become angry when they learn about the task that we used. It is your decision whether or not we tell your child about the deception we used in the study after summer camp ends in August.

Time Commitment
The study will take about one hour to complete.

Risks
One risk is that your child will learn of the deception used in the study and then become angry or distrustful and feel like he or she has been tricked. Based on past research using this same task, it is very unlikely that this will occur. However, if your child does become angry the principal investigator (Sara King) and her supervisors will discuss the task with your child in order to help him or her understand why tricks and dishonesty are sometimes used in experiments like this one.

A second risk is that your child may also get tired during the session. To address this concern we will offer your child frequent breaks during the tasks. We have tried to design this study so that it takes as little time as possible for your child to participate.

A third risk is that your child may get angry or sad when he or she loses a turn in the game. To minimize this possibility we have designed that task that children have more wins than they have losses (20 wins as compared to 8 losses). Further, we have designed the task so that all children end with a number of wins in a row and so that all children receive a prize and positive feedback. We have also included a measure of anger in the task so that we can monitor her or his emotions. If your child does get overly angry during the task, the researcher will stop the game and have a discussion with your child about anger management.

A fourth risk is that your child may use some of the statements used by the other boy in his or her STP group or at home. In order to address this concern, the researcher will have a discussion with your child when he or she has finished the game. The researcher will tell your child that the statements used in the task were not appropriate and that they should not use them in the STP or at home. Your child's lead counsellor will be told about the type of statements that will be used to provoke your child and will tell the researcher if they are used in the STP.

Benefits
While your child may not benefit directly from participation in this study, what we learn may help us learn about aggression in children and this may benefit other children in the future.

Alternate Treatment
Taking part in this study is voluntary; you and your child do not have to take part in this study as part of your child's treatment at the STP.

Costs and Payments
You do not have to pay to take part in this study; you and/or your child will not be paid for taking part.

Compensation and Medical Care
In the event of injury from this research project, acute medical care will be provided by the investigator, but payment for hospitalization and financial compensation are not available.

Confidentiality
All information we get from you, your child, your child's teacher, and the STP will be kept strictly confidential or will be disclosed only with your permission. Your child will be given a code number that will identify all of his/her project materials and your child's name will not be written on any of the project materials. You agree that scientific data not identifiable with you or your child from this study may be presented at meetings and published so that the information from the study can be useful to others. While not anticipated, the principal investigators and staff are required to break confidentiality if safety issues arise (e.g., child is at risk for harming self or others, child abuse is discovered).

Volunteer Status
Your child's participation is voluntary (his or her choice). Your refusal to allow your child to participate will involve no penalty or loss of benefits to which you or your child is entitled to at the Summer Treatment Program. You have the right to refuse to answer particular questions. You have the right to terminate your child's participation at any time. If you have any questions about your child's rights as a subject in a research project, you should contact (anonymously, if you wish) the Child and Youth Institutional Review Board, Women and Children's Hospital of Buffalo, 219 Bryant Street, Buffalo NY 14222 or by phone 716-878-7859. Please contact Dr. William Pelham (716-829-2244 ext 29) with direct questions about this study.

VOLUNTARY CONSENT

My signature below means that I have voluntarily agreed to have my child take part in this project. I certify that I have read and understand the above information and have had all of my questions answered to my satisfaction.

I voluntarily agree to have my child, _____, of whom I am legal guardian, participate in the research described. I agree that the known risks to my child have been explained to my satisfaction. Further, I acknowledge that no compensation is available from SUNY Buffalo or the Summer Treatment Program and its employees for any injury resulting from my child's participation in this research. Finally, I certify that my child's participation in this research is given voluntarily and my child may discontinue participation at any time without penalty or loss of any benefits to which he/she may otherwise be entitled. I have the right to withdraw my child's data at anytime even after the data has been collected. I have given permission for my child's teacher and the Summer Treatment Program to release any and all information regarding my child's behavior and academic performance. I have been given a copy of this consent form.

Child's Name - print	Today's Date
Parent's Name –print	Parent's Signature
Principal Investigator Name - print	Principal Investigator Signature
Witness Name - print	Witness Signature

Provocation Statements to be Used During the Study

High Provocation Responses

1. Gotcha! Let's see…I think I'll take 8 points from you this time.
2. Hey! You're not very good at this. I'll take 9 points.
3. Na na na na na! I'm taking 9 points this time!
4. You're a basket case at this game! Minus 10!
5. Nice try, speedo! What's the matter? Is you hand stuck in cement? You lose another 10!
6. You're so slow my grandmother could beat you! That's gonna cost you 10 points!
7. A two year old plays faster that you! I'll take 10 points again.
8. I beat you again, dork! You lose another 8 points!

Low Provocation Responses

1. I won, but I'll give you a break. I'll just take 1 point.
2. You almost won that time. I guess I won't take any points from you.
3. Nice try. I'll be cool. I'll only take 1.
4. You lost, but you're getting better. I'll take 2 points.
5. I'll let you slide on that one. I won't take any points.
6. Better luck next time. Let's take off 2.
7. I'll go easy on you this time. I'll only take 2 points again.
8. I won, but I'll be nice. I won't take any points from you this time.

University at Buffalo
ASSENT TO BE IN A RESEARCH STUDY

Who are we?

My name is Sara King and I am a researcher at the University at Buffalo. I work in the Department of Psychology.

Why are we meeting with you?

We want to tell you about a study that involves children like yourself. We want to see of you would like to be in this study too.

Why are we doing this study?

We want to find out how kids act when they play games with other kids and what kinds of things make them mad or unhappy when they are playing with other kids.

What will happen to you if you are in the study?

You will have to do two things if you are in the study; looking at some pictures of kids playing with other kids and playing a computer game against another kid over the Internet.

The researcher will show you some cartoon pictures of kids playing with other kids and will ask you some short questions about what you think about the way these kids are playing. This part of the study will take about 15 minutes.

Next, you will play a computer game against another kid over the Internet. In the first part of the game, you will have to press a button as fast as you can as soon as you see a bull's eye on the screen. If you press the button faster than the other kid, you will win 10 points and you will be given the chance to send a message to the other kid, take points away from the other kid, both, or nothing. If the other kid wins, he or she will be able to do the same things to you.

In the second part of the computer game you will have to press a button as fast as you can as soon as you see a bull's eye on the screen. If you press the button faster than the other kid, you will win 10 points and you will be given the chance to send a message to the other kid, send a buzzing noise to the other kid, both, or nothing. If the other kid wins, he or she will be able to do the same things to you. The whole computer game will take about 45 minutes.

Who will know that you are in the study?

Sara King and her supervisors, Dr. Waschbusch and Dr. Pelham, will know that you are in the study. Also, some of the people helping with the study will know you are in it. None of the things you tell Sara or the helpers will be shared with anyone else and we will keep all the things you tell us locked up in a cabinet.

Do you have to be in this study?

No, you don't. No one will ever get angry or upset you if you don't want to do this. Just tell us if you don't want to be in the study. And remember, you can change your mind later if you decide you don't want to be in the study anymore.

Do you have any questions?

You can ask questions at any time. You can ask now. You can ask later. You can talk to me or you can talk to someone else at any time during the study. Here are the telephone numbers to reach us:

Sara King Department of Psychology 829-2244 ext 29

IF YOU WANT TO BE IN THE STUDY, SIGN YOUR NAME ON THE LINE BELOW

Signature of the Child

Date

Signature of the Researcher

Date

Debriefing Form

Dear Parents:

Thank you for allowing your child to participate in our study. Your child's participation is greatly appreciated and the information we obtained is important. There are several purposes to this study. First, the study investigates the association between different types of aggression. Second, the study investigates how the different components of aggression relate to the way children think about social situations with other children. Finally, we aim to investigate whether child factors such as a diagnosis of ADHD or another disruptive behaviour disorder influence the use of aggression and response to treatment. We greatly appreciate your child's participation in this study. We believe that children and families will benefit from the knowledge gained from this study. If you have any questions or concerns regarding your child's participation in this study, now or in the future, please feel free to contact Dr. William Pelham 740-829-2244 ext 29. If you have any questions about your child's rights as a participant in research, you may contact the Child and Youth Institutional Review Board, Women and Children's Hospital of Buffalo at 716-878-7406. Thank you once again.

Sincerely,

Sara King, B.Sc.
Research Assistant, University at Buffalo, SUNY
Graduate Student, Dalhousie University

William E. Pelham, Jr., Ph.D.
Professor and Faculty Supervisor
University at Buffalo, SUNY

Daniel A. Waschbusch, Ph.D.
Associate Professor and Supervisor
Center for Children and Families
University at Buffalo, SUNY

Appendix C
Revised Disruptive Behavior Disorders Rating Scale

INSTRUCTIONS: Check the column that best describes this child. You may put DK next to any item that you don't know or don't wish to answer.

	Not At All	Just A Little	Pretty Much	Very Much
1. Often interrupts or intrudes on others (e.g. butts into conversations or games)				
2. Has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period)				
3. Often argues with adults.				
4. Often lies to obtain good or favors or to avoid obligation (i.e. 'cons' others)				
5. Often initiates physical fights with other members of his or her household				
6. Has been physically cruel to people				
7. Often talks excessively				
8. Has stolen items of non-trivial value without confronting a victim (e.g. shoplifting, but without breaking or entering; forgery)				
9. Is often easily distracted by extraneous stimuli				
10. Often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill seeking) e.g. runs into street without looking				
11. Often truant from school, beginning before age 13 years				
12. Often fidgets with hands or feet or squirms in seat				
13. Is often spiteful or vengeful				
14. Often swears or uses obscene language				
15. Often blames others for his or her mistakes or misbehavior				
16. Has deliberately destroyed others' property (other than by fire setting)				
17. Often actively defies or refuses to comply with adults requests or rules				
18. Often does not seem to listen when spoken to directly				
19. Often blurts out answers before questions have been completed				
20. Often initiate physical fights with others who do not live in his or her household (e.g. peers at school or in the neighborhood)				
21. Often shifts form one uncompleted activity to another				
22. Often has difficulty playing or engaging in leisure activities quietly				
23. Often fails to give close attention to details or makes careless mistakes in schoolwork, work or other activities				
24. Is often angry and resentful				
25. Often leaves seat in classroom or in other situations in which remaining seated is expected				
26. Is often touchy or easily annoyed by others				
27. Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behavior or failure to understand instructions				
28. Often loses temper				
29. Often has difficulty sustaining attention in tasks or play activities				
30. Often has difficulty awaiting turn				
31 Has forced someone into sexual activity				

INSTRUCTIONS: Check the column that best describes this child. You may put DK next to any item that you don't know or don't wish to answer.

	Not At All	Just A Little	Pretty Much	Very Much
32. Often bullies, threatens, or intimidates others				
33. Is often 'on the go' or acts as if 'driven by a motor'				
34. Often loses things necessary for tasks and activities (e.g. toys, school assignments, pencils, books, or tools)				
35. Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents o0r adults, may be limited to subjective feelings of restlessness)				
36. Has been physically cruel to animals				
37. Often avoids, dislikes, or is reluctant to engage in tasks that require mental effort (such as schoolwork or homework)				
38. Often stays out at night despite parental prohibitions, beginning before age 13 years				
39. Often deliberately annoys people				
40. Has stolen while confronting a victim (e.g. mugging, purse snatching, extortion, armed robbery)				
41. Has deliberately engaged in fire setting with the intention of causing serious damage				
42. Often has difficulty organizing tasks and activities				
43. Has broken into someone else's house, building, or car				
44. Is often forgetful in daily activities				
45. has used a weapon that can cause serious physical harm to other (e.g. a bat, brick, broken bottle, knife, gun)				
46. Daydreams (often gets lost in his/her thoughts)				
47. Under active: slow moving/lacks energy				
48. Slow to complete work or tasks				
49. Responds to directions slowly				
50. Socially withdrawn				
51. Quiet or shy				
52. Apathetic or unmotivated				

Appendix D
Aggression and Related Behavior Ratings

Child's Name: _____ **Child's Age**_____

Child's Grade:_____ **Child's Sex (circle one): Boy Girl** **Today's Date:** _____

Your relationship to child (circle one): Mother Father Homeroom Teacher Other_____

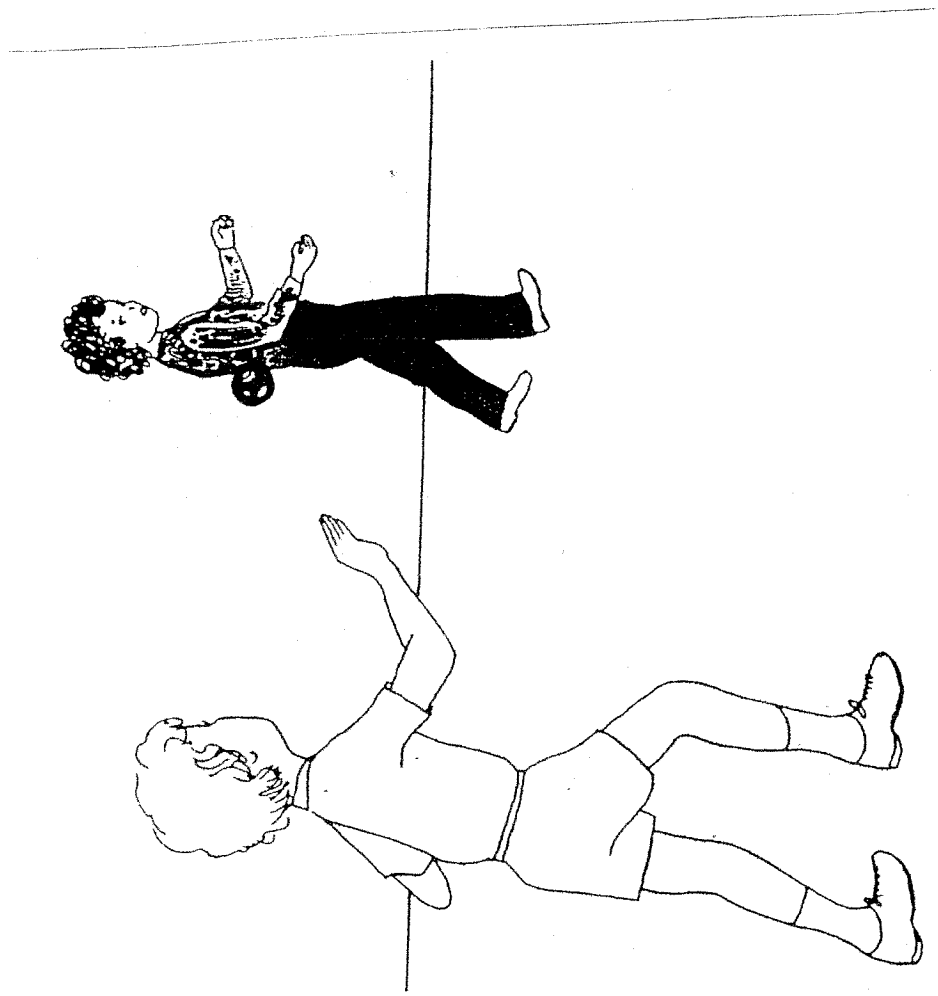
INSTRUCTIONS: Read each item carefully and decide how much you think the items describe this child at *this time.* ~ may put OK next to any item that you do not know or do not wish to answer.

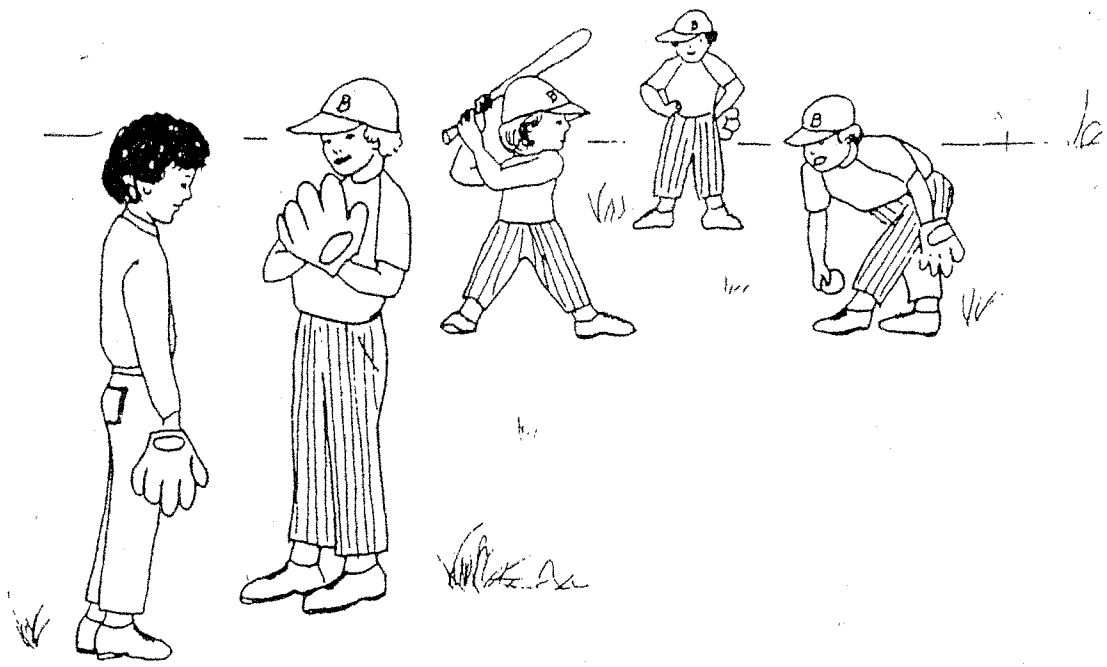
	Not at all	Just a little	Pretty Much	Very Much
1. Tries to get back at other kids				
2. Holds a grudge for a long time				
3. Stays angry for a long time				
4. Gets others to reject a peer				
5. Gossips about other children				
6. Purposely excludes other kids				
17. Uses physical force to dominate				
18. Gets others to gang up on peers				
19. Threatens and bullies others				
20. When teased, strikes back				
21. Blames others in fights				
22. Overreacts angrily to accidents				
23. Lacks remorse				
24. Seems to enjoy being mean				
25. Is cold or uncaring				

26. Please mark the ONE box that best describes this child:
    - [ ] Is actively rejected by peers
    - [ ] Is simply ignored by peers
    - [ ] Is actively rejected by some peers but is popular with other peers
    - [ ] Is average in peer popularity
    - [ ] Is high in peer popularity
27. Regardless of whether this child is popular or unpopular, does she or he have a special, close, "best friend"? [ ] No [ ] Yes

	Not At All True	Sometimes True	Definitely True
1. Is concerned about how well he/she does at school			
2. His/Her emotions seem shallow and not genuine			
3. Is good at keeping promises			
4. Brags excessively about his/her abilities, accomplishments or possessions			
5. Uses or cons other people to get what he/she wants			
6. Teases, makes fun of other people			
7. Feels bad or guilty when he/she does something wrong			
8. Can be charming at times, but in ways that seem insincere or superficial			
9. Seems to think that he/she is better than other people.			
10. Is concerned about the feelings of other people			
11. Does not show feelings or emotions.			
12. Keeps the same friends			

Appendix E
Dodge Picture Stories





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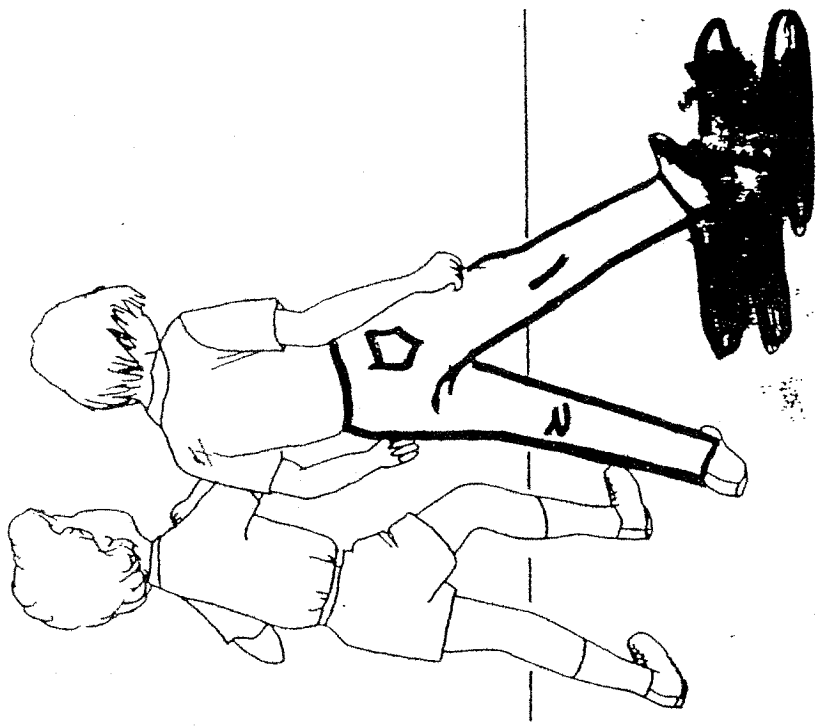

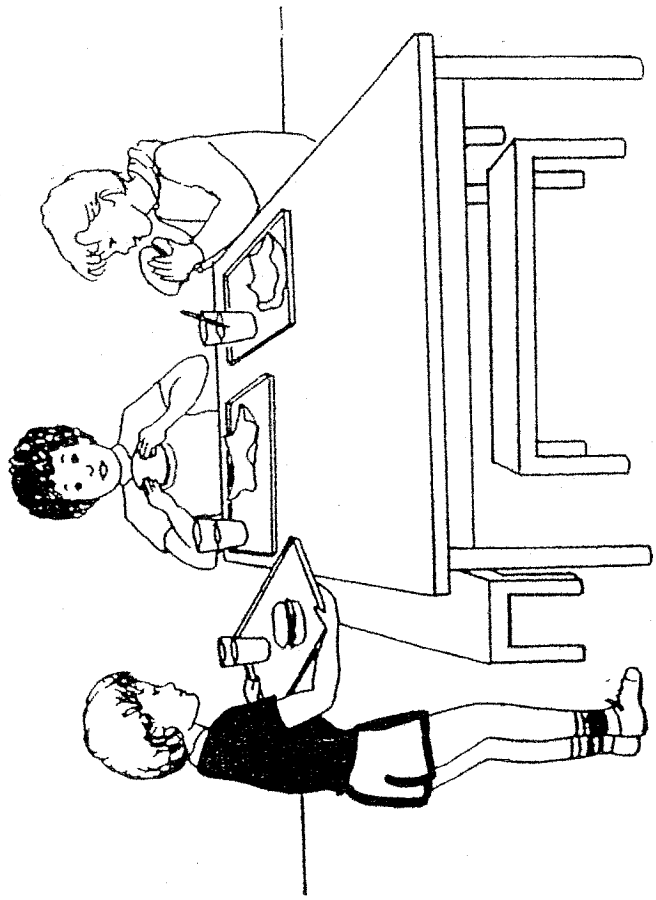

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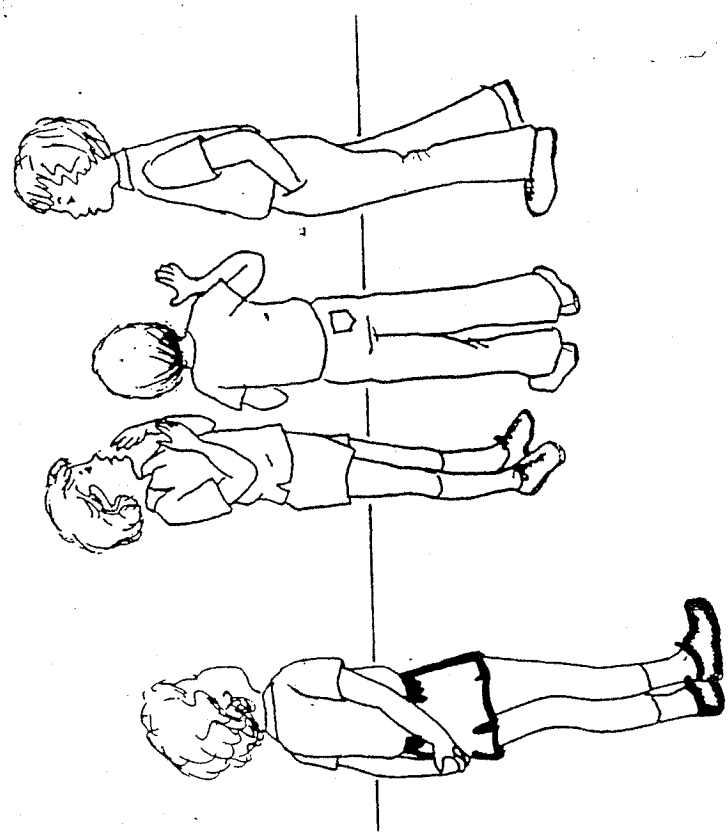
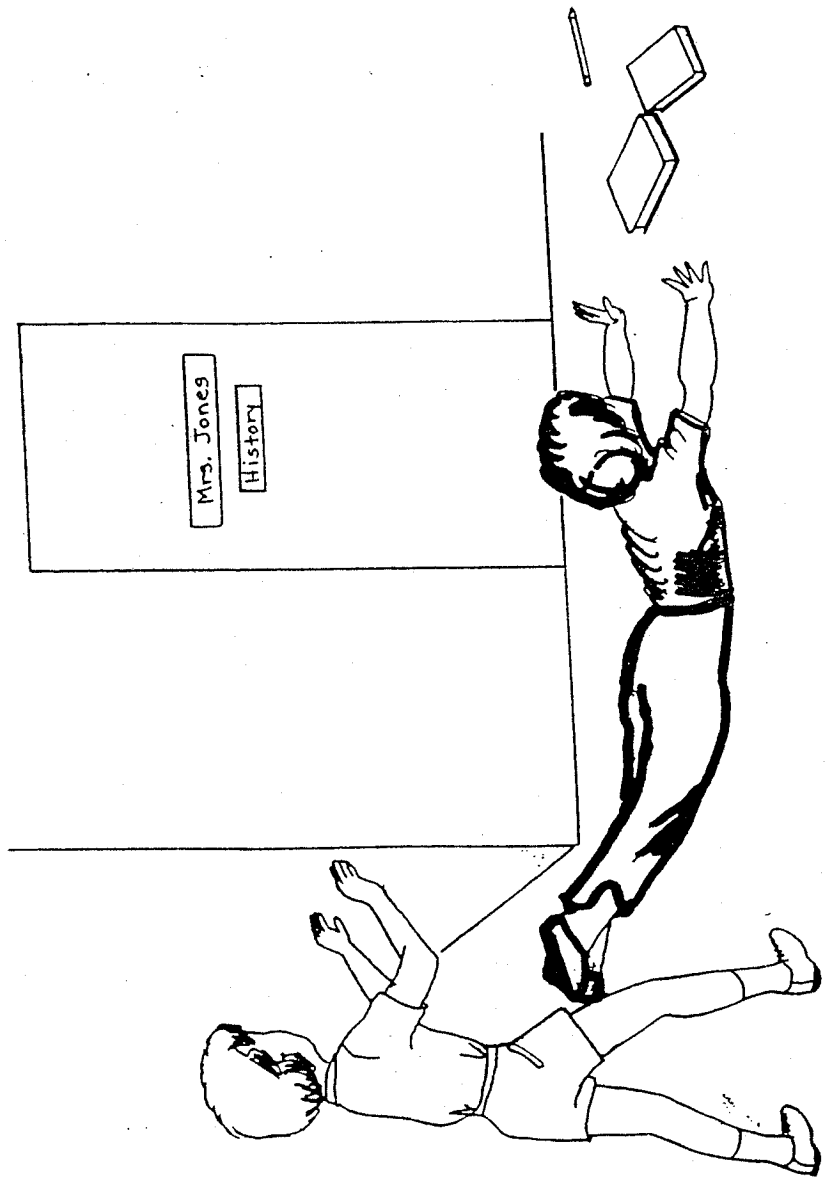
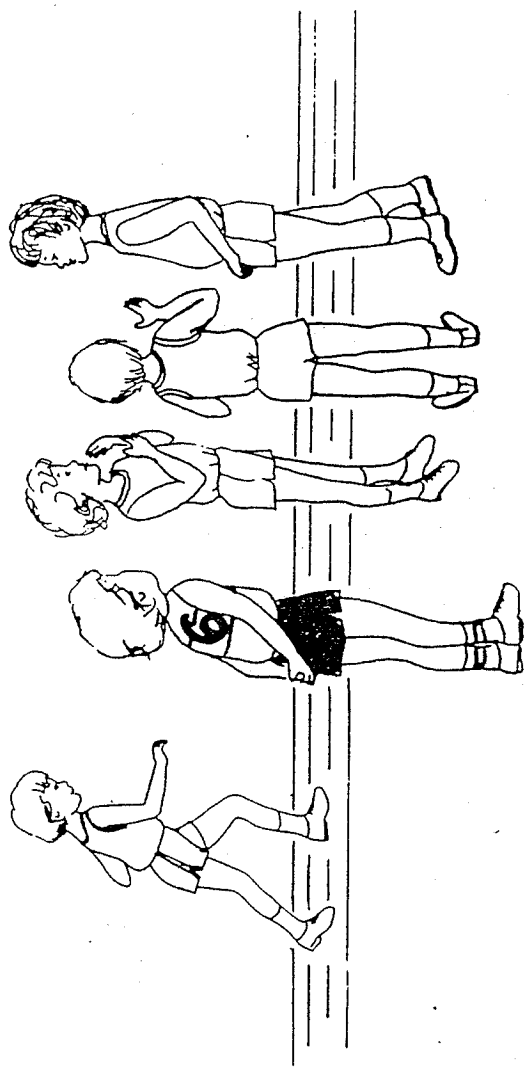



Mrs. Jones
History



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Appendix F
Picture Story Interview

Date: _____ Initials:_____ ID:_____

1. Pretend that you are standing on the playground playing catch with a kid named Todd/Jessica. You throw the ball to Todd/Jessica and he/she catches it. You turn around, and the next thing you realize is that Todd/Jessica has thrown the ball and hit you in the middle of your back. The ball hits you hard, and it hurts a lot.

a) Why do you think Todd/Jessica hit you in the back?

_____

_____

1	2
ACC	HOS

b) What would you do about Todd/Jessica after he/she hit you?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

2. Pretend that you see some kids playing on the playground. You would really like to play with them, so you go over and ask one of them, a kid named Alan/Leah, if you can play. Alan/Leah says no.

a) Why do you think Alan/Leah said no?

_____

_____

1	2
ACC	HOS

b) What would you do about Alan/Leah after he/she said no?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

3. Pretend that you are walking to school and you're wearing brand new sneakers. You really like your new sneakers and this is the first time you have worn them. Suddenly, you are bumped from behind by a kid named John/Lisa. You stumble into a mud puddle and your new sneakers get muddy.

a) Why do you think John/Lisa bumped you?

_____

_____

1	2
ACC	HOS

b) What would you do about John/Lisa after he/she bumped you?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

4. Pretend that you are a new kid in school and you would really like to make friends. At lunchtime you see some kids you would like to sit with and you go over to their table. You ask if you can sit with them and a kid named Carl/Carolyn says no.

a) Why do you think Carl/Carolyn said no?

_____

_____

1	2
ACC	HOS

b) What would you do about Carl/Carolyn after he/she said no?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

5. Pretend that you go to the first meeting of a club you want to join. You would like to make friends with the other kids in the club. You walk up to some of the other kids and say "Hi!", but they don't say anything back.

a) Why do you think the other kids didn't answer you?

_____

_____

1	2
ACC	HOS

b) What would you do about the other kids after they didn't answer you?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

6. Pretend that you are walking down the hallway in school. You're carrying your books in your arm and talking to a friend. Suddenly, a kid named Brett/Wendy bumps you from behind. You stumble and fall and your books go flying across the floor. The other kids in the hall start laughing.

a) Why do you think Brett/Wendy bumped into you?

_____

_____

1	2
ACC	HOS

b) What would you do about Brett/Wendy after he/she bumped into you?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

7. Pretend that it is your first day on the track team. You don't know a lot of the other kids and you would like to make friends with them. During practice, you walk up to a group of kids on the team and say "Hi!", but no one answers you.

a) Why do you think the other kids on the team didn't answer you?

_____

_____

1	2
ACC	HOS

b) What would you do about the other kids after they didn't answer you?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

8. Pretend that you and your class went on a field trip to the zoo. You stop to buy a coke. Suddenly, a kid named David/Allison bumps your arm and spills your coke all over your shirt. The coke is cold and your shirt is all wet.

a) Why do you think David/Allison bumped into you?

_____

_____

1	2
ACC	HOS

b) What would you do about David/Allison after he/she bumped into you?

_____

_____

0	1	2	3	4	5
DK	NOTHING	ASK WHY, ASK AGAIN	COMMAND	ADULT PUNISH	RETALIATE

Appendix G
ANCOVA Source Tables

ANCOVA source table for scenario interpretation using CP as covariate

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	4.85	.03	.06
CP	1	1.86	.18	.03
Group	2	1.11	.34	.03
Scenario Type x CP	1	0.79	.38	.01
Scenario Type x Group	2	0.77	.47	.02
Error	74			

ANCOVA source table for response generation using CP as covariate

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	7.20	.01	.08
CP	1	1.07	.30	.01
Group	2	.95	.39	.02
Scenario Type x CP	1	2.03	.16	.03
Scenario Type x Group	2	1	.37	.03
Error	79			

ANCOVA source table for scenario interpretation using sex as covariate

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	5.78	.02	.07
Sex	1	.39	.53	.00
Group	2	1.22	.30	.03
Scenario Type x Sex	1	.11	.74	.00
Scenario Type x Group	2	.35	.71	.00
Error	74			

ANCOVA source table for response generation using sex as covariate

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	25.15	.000	.24
Sex	1	.02	.90	.00
Group	2	1.86	.16	.04
Scenario Type x Sex	1	3.02	.09	.03
Scenario Type x Group	2	5.40	.01	.12
Error	79			

ANCOVA source table for scenario interpretation using age as covariate

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	.96	.33	.01
Age	1	.22	.64	.003
Group	2	1.05	.35	.03
Scenario Type x Age	1	.21	.65	.00
Scenario Type x Group	2	.38	.68	.01
Error	74			

ANCOVA source table for response generation using age as covariate

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	1.80	.18	.02
Age	1	.10	.75	.001
Group	2	2.04	.14	.05
Scenario Type x Age	1	.01	.95	.00
Scenario Type x Group	2	4.23	.02	.09
Error	79			

ANOVA source table for scenario interpretation using age as full variable

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	0.89	.35	.12
Age	1	.04	.85	0
Group	2	3.27	.04	.08
Scenario Type x Age	1	1.80	.67	0
Scenario Type x Group	2	0.09	.99	0
Group x Age	2	3.10	.05	.08
Scenario Type x Group x Age	2	0.05	.95	0
Error	72			

ANOVA source table for response generation using age as full variable

Source	*df*	*F*	*p*	η^2
Scenario Type (Entry vs. Provocation)	1	1.41	.239	.02
Age	1	0.12	.73	0
Group	2	0.35	.71	.01
Scenario Type x Age	1	0.05	.83	0
Scenario Type x Group	2	0.29	.75	.01
Group x Age	2	0.29	.75	.01
Scenario Type x Group x Age	2	0.44	.64	.01
Error	77			

Appendix H
Task Instructions

Instructions for Instrumental Task

We are going to play a computer game now. You will be playing this game with a boy/girl **(match opponent's gender to participant's gender)**. Our computers will be hooked up on the internet and you will be able to talk to the other kid over instant messenger. The other kid will also be able to talk to you.

In this game, you will both see some pictures flashing quickly on the screen. Sometimes a bull's-eye will appear on the screen. When you see the bull's eye 'rit is your job to press the red key on your joystick as quickly as you can so that you can win points. If you win, you will have the chance to send the other kid a message and take between 0 and 10 points away from him/her. If you take points from the other kid, it will make it harder for him/her to win the game. If the other kid presses his/her button before you do, he/she will win points and will get the chance to send you a message and take between 0 and 10 points from you, so it is really important for you to press the button as quickly as you can. Before each time you play, I will ask you to tell me how you feel by looking at some pictures of happy faces.

If you win and you want to take points away from the other kid or send him/her a message, just let me know and I will type the message for you and type in the number of points you want to take away. When the other kid sends you a message, I will read it for you. Do you understand?

What do you do when you see the bull's-eye picture? **Press the red button as fast as possible.**
What happens when you win? **Take points and send a message.**
What happens when the other kid wins? **He can take points and send a message to me.**
What happens before each time you play? **I tell you how I feel by looking at happy faces.**

Now I will show you what you will be seeing and hearing when you play the game. Are you ready?

Set up task demonstration for the child.

Proceed to experimental task after child has completed the demonstration and has made it clear that he/she understands what to do.

Instructions for Hostile Task

We are going to play a computer game now. You will be playing this game with a boy/girl **(match opponent's gender to participant's gender)**. Our computers will be hooked up on the internet and you will be able to talk to the other kid over instant messenger. The other kid will also be able to talk to you.

In this game, you will both see some pictures flashing quickly on the screen. Sometimes a bull's-eye will appear on the screen. When you see the bull's eye it is your job to press the red key on your joystick as quickly as you can so that you can win points. If you win, you will have the chance to send the other kid a message and send a buzzing noise from 0 to 10 seconds to him/her. If you send a buzz to the other kid, it won't make it harder for him/her to win the game, but it really bugs other kids. If the other kid presses his/her button before you do, he/she will win points and will get the chance to send you a message and a buzzing noise, so it is really important for you to press the button as quickly as you can. Before each time you play, I will ask you to tell me how you feel by looking at some pictures of happy faces.

If you win and you want to send a buzzing noise to the other kid or send him/her a message, just let me know and I will type the message for you and type in the number of seconds you want to buzz for. When the other kid sends you a message, I will read it for you. Do you understand?

What do you do when you see the bull's-eye picture? **Press the red button as fast as possible.**
What happens when you win? **Send a buzz and send a message.**
What happens when the other kid wins? **He can send a buzz and send a message to me.**
What happens before each time you play? **I tell you how I feel by looking at happy faces.**

Now I will show you what you will be seeing and hearing when you play the game. Are you ready?

Set up task demonstration for the child.

Proceed to experimental task after child has completed the demonstration and has made it clear that he/she understands what to do.

Appendix I
Standardized Responses for Provocation Task

Hostile Task

High provocation responses

1. Are you even trying? You can't really be trying. I'm buzzing for 10 seconds
2. If you keep losing, I'll keep buzzing you. This is fun! 10 seconds!
3. Sucks to be you! 9 second buzz!
4. I really feel sorry for you. Not! 10 second buzz.

Low provocation responses

1. I think I got lucky, so I won't buzz you
2. I'm not sure how I won that one, but I did, so I'll buzz for 2 seconds
3. This is kind of fun, I like winning. I'll buzz for 1 second
4. I'll only buzz for 1 second this time

Instrumental Task

High provocation responses

1. Gotcha! Let's see... I think I'll take 8 points from you this time.
2. Na na na na na! I'm taking 9 points this time!
3. You're a basket case at this game! Minus 10!
4. Nice try, speedo! What's the matter? Is your hand stuck in cement? You lose another 10!

Low provocation responses

1. Nice try, I'll be cool. I'll only take 1.
2. I'll let you slide on that one, I won't take any points.
3. You lost, but you're getting better. I'll take 2 points.
4. I won, but I'll give you a break. I'll just take 1 point.