

**LOOKING FOR TROUBLE: RELATIONS BETWEEN THE HOSTILE ATTENTIONAL  
BIAS AND AGGRESSION IN BOYS**

by

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## **Abstract**

The social information-processing model argues that preferentially attending to hostile cues (hostile attentional bias) predisposes children to behave aggressively. However, the attentional processes involved in this bias are not well specified and research following from the model has produced inconsistent results, suggesting a possible moderating variable. To address these issues, the current study examined the relation between a hostile attentional bias and aggression in a community sample of 113 boys (9-12 years). The hostile attentional bias was measured using three attention tasks (a dot-probe, a temporal order judgment, and an attention shifting task) designed to assess attentional biases within different attentional processes. Bias scores were calculated by comparing boys' performance in response to hostile versus neutral stimuli (e.g., photos of angry versus neutral peer faces). Aggression was measured using parent- and child-reports, combined into a composite variable. Based on previous research of attentional biases within the anxiety literature, effortful control was identified as a possible moderating variable and was measured in the current study using parent-report. The findings from this study were mixed. In support of the hypotheses, bias scores computed from the temporal order judgment task were positively related to aggression. Effortful control moderated this relation, which was attenuated as levels of effortful control increased. Conversely, bias scores computed from the dot-probe and attention shifting tasks were not significantly related to aggression, and effortful control was not a significant moderator. Interestingly, in follow-up analyses using bias scores contrasting response to neutral versus happy stimuli in the attention shifting task, being distracting by neutral stimuli was positively related to aggression; this relation was moderated by effortful control. Post-task emotion ratings of these stimuli revealed that aggression was associated with a tendency to rate neutral stimuli as appearing angrier. Given these findings, the

attentional salience of neutral stimuli is discussed. These results highlight the importance of considering multiple attentional processes in the measurement of attentional biases, and extend previous research by demonstrating a link between aggression and a hostile attentional bias within certain attentional processes. These results also suggest that effortful control may exert some protective effects against the bias.

## **Preface**

This dissertation is original, unpublished, independent work by the author, N. V. Miller, and was approved by the UBC Research Ethics Board (certificate #H13-03002).

# Table of Contents

<b>Abstract.....</b>	<b>ii</b>
<b>Preface.....</b>	<b>iv</b>
<b>Table of Contents .....</b>	<b>v</b>
<b>List of Tables .....</b>	<b>ix</b>
<b>List of Figures.....</b>	<b>x</b>
<b>Acknowledgements .....</b>	<b>xi</b>
<b>Dedication .....</b>	<b>xii</b>
<b>Chapter 1: Introduction .....</b>	<b>1</b>
1.1    Aggression .....	3
1.2    The Hostile Attentional Bias and Aggression.....	4
1.2.1    Measurement of attention allocation.....	7
1.2.1.1    Dot-probe tasks .....	8
1.2.1.2    Attention shifting tasks .....	9
1.2.1.3    Temporal order judgment tasks .....	9
1.2.1.4    Differences among tasks.....	11
1.2.2    Review of studies.....	13
1.2.2.1    Studies using dot-probe tasks.....	14
1.2.2.2    Studies using attention shifting tasks.....	18
1.2.2.3    Studies using temporal order judgment tasks .....	20
1.2.3    Summary.....	21
1.3    Contributions of the Current Study to Assessing Attentional Bias.....	21
1.4    Effortful Control .....	23

1.4.1	A model of attentional biases, effortful control, and anxiety .....	26
1.5	Hypotheses .....	28
<b>Chapter 2: Methods .....</b>		<b>30</b>
2.1	Participants .....	30
2.2	Measures .....	31
2.2.1	Demographic information .....	31
2.2.2	Hostile attentional bias .....	32
2.2.2.1	Photo stimuli .....	32
2.2.2.2	Video stimuli .....	34
2.2.2.3	Dot-probe task .....	36
2.2.2.4	Temporal order judgment task .....	39
2.2.2.5	Attention shifting task .....	42
2.2.3	Aggression .....	44
2.2.4	Effortful control .....	47
2.3	Procedures .....	47
<b>Chapter 3: Results .....</b>		<b>51</b>
3.1	Descriptive Information .....	51
3.1.1	Demographic characteristics .....	51
3.1.2	Hostile attentional bias .....	52
3.1.3	Effortful control .....	54
3.1.4	Aggression .....	54
3.2	Main Analyses .....	56
3.2.1	Dot-probe task model .....	57

3.2.2	Temporal order judgment task model .....	59
3.2.3	Attention shifting task models .....	62
3.2.3.1	Attention shifting task model (angry – happy) .....	63
3.2.3.2	Attention shifting task model (angry – neutral) .....	64
3.2.3.3	Attention shifting task model (neutral – happy) .....	68
<b>Chapter 4: Discussion .....</b>		<b>73</b>
4.1	Hostile Attentional Bias .....	74
4.1.1	Associations among measures of the hostile attentional bias .....	74
4.1.2	Mean levels of the hostile attentional bias .....	76
4.2	Aggression .....	76
4.2.1	Associations among measures of aggression .....	76
4.2.2	Relation between aggression and effortful control .....	77
4.3	The Hostile Attentional Bias and Aggression .....	77
4.4	Effortful Control as Moderator of the Hostile Attentional Bias .....	78
4.4.1	Findings using a dot-probe task .....	79
4.4.2	Findings using a temporal order judgment task .....	80
4.4.3	Findings using the angry – happy attention shifting task .....	82
4.4.4	Findings using the angry – neutral attention shifting task .....	84
4.4.5	Findings using the neutral – happy attention shifting task .....	86
4.5	Summary .....	89
4.6	Contributions of the Current Study to the Social Information Processing Model .....	89
4.7	Strengths and Limitations .....	93
4.8	Clinical Implications .....	98

4.9	Future Directions .....	99
<b>References</b> .....		<b>104</b>
<b>Appendices</b> .....		<b>119</b>
Appendix A Recruitment Flyer.....		119
Appendix B Family Information Questionnaire .....		120
Appendix C Instruction Screens for the Dot-Probe Task .....		124
Appendix D Instruction Screens for the Temporal Order Judgment Task .....		131
Appendix E Statistical Calculations for the Point of Perceived Simultaneity (PSS).....		136
Appendix F Instruction Screens for the Attention Shifting Task .....		138
Appendix G Eligibility Screening Questions.....		142
Appendix H Parent Consent Form.....		143
Appendix I Child Assent Form.....		147
Appendix J Procedure Manual.....		148
Appendix K Descriptive Statistics for Attention Allocation Tasks' Response Times (ms)...		155

## List of Tables

Table 1	Descriptive Statistics for the Variables of Interest .....	53
Table 2	Pearson Correlations among Measures of the Hostile Attentional Bias .....	54
Table 3	Pearson Correlations among Measures of Boys' Aggression.....	56
Table 4	Summary of Regression Analysis for the Dot-Probe Task.....	59
Table 5	Summary of Regression Analysis for the Temporal Order Judgment Task .....	61
Table 6	Summary of Regression Analysis for the Attention Shifting Task (Angry – Happy)...	64
Table 7	Summary of Regression Analysis for the Attention Shifting Task (Angry – Neutral)..	66
Table 8	Summary of Regression Analysis for the Attention Shifting Task (Neutral – Happy).	70

## List of Figures

Figure 1 Interaction Between the Temporal Order Judgment Task (TOJ) Hostile Attentional Bias and Effortful Control in Relation to Child Aggression.....	62
Figure 2 Interaction Between the Attention Shifting Task (AST) Hostile Attentional Bias (Angry – Neutral) and Effortful Control in Relation to Child Aggression.....	67
Figure 3 Interaction Between the Attention Shifting Task (AST) Hostile Attentional Bias (Neutral – Happy) and Effortful Control in Relation to Child Aggression .....	71

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**To Maggie and Rudy  
for making me smile**

## **Chapter 1: Introduction**

Approximately 10% of children are chronically aggressive and this is associated with impaired functioning across several domains, including social and academic functioning (e.g., Broidy et al., 2003; Fergusson & Horwood, 1998; Lahey et al., 1999). Childhood aggression also is a risk factor for multiple negative developmental trajectories, including the development of externalizing behaviours (e.g., substance abuse, delinquency, antisocial behaviour) and internalizing behaviours (e.g., depression, anxiety) in adolescence and adulthood (Cleverley, Szatmari, Vaillancourt, Boyle, & Lipman, 2012; Tremblay, Masse, Vitaro, & Dobkin, 1995). Given these dire consequences, it is imperative to further our understanding of mechanisms underlying the development and maintenance of aggression, as these may be targeted in preventative and intervention efforts (Tremblay, 2000).

The ways children perceive and evaluate social situations may be important mechanisms contributing to aggressive behaviour. According to theory, there are multiple ways that children process social information (Crick & Dodge, 1994), and a large literature has linked several of these processes to aggressive behaviour (e.g., de Castro, Slot, Bosch, Koops, & Veerman, 2003; Fontaine, 2006; Samson, Ojanen, & Hollo, 2012; Yoon, Hughes, Gaur, & Thompson, 1999). One of the ways children process social information is through attending to different cues within social situations (i.e., allocation of attention towards certain stimuli over others). Relative to other processes, the ways children attend to social situations is understudied within the childhood aggression literature (de Castro, Veerman, Koops, Bosch, & Manshouwer, 2002). Some theorists have argued that children who demonstrate higher levels of aggression allocate their attention towards hostile stimuli (i.e., cues indicating potentially physically, socially, or emotionally threatening interpersonal situations) to a greater extent than other children, and that this

attentional bias contributes to their aggressive behaviour (Crick & Dodge, 1994; Dodge, 1991). However, the few existing studies have provided relatively weak empirical evidence in support of this assertion (e.g., Gouze, 1987; Schippell, Vasey, Cravens-Brown, & Bretveld, 2003), which I have termed the ‘hostile attentional bias hypothesis.’ Nonetheless, it can be argued that this hypothesis has not been adequately examined within the current literature, as most studies have methodological limitations that restrict the interpretability of their results. For instance, as will be discussed in detail later, some studies may have confounded results through the use of aggression-irrelevant stimuli in measures of the hostile attentional bias. Further, most studies have relied upon single measures of both aggression and the hostile attentional bias, and have failed to differentiate aspects of attention.

The current study aims to test the hostile attentional bias hypothesis by examining the relations between children’s attention processing and aggression. As summarized above, the hostile attentional bias hypothesis is not yet well studied, and existing studies suffer from methodological limitations. The current study expands on previous research by addressing several of these limitations. First, the study uses a multi-informant multi-method measurement approach, and includes multiple measures of both aggression and the hostile attentional bias. Of note, the current study assesses the hostile attentional bias using several tasks that incorporate a range of attentional processes, each of which may contribute to the hostile attentional bias but which have been largely neglected in previous research. Second, the current study assesses the hostile attentional bias using stimuli that are exclusively relevant to aggression, such as angry faces, which cue potential interpersonal conflict and the possible need for an aggressive response (Saarni, Campos, Camras, & Witherington, 2006). Third, it is possible that an unexamined moderator contributed to the weak and inconsistent results of previous studies. In the child

internalizing disorder literature, effortful control (the “ability to inhibit a dominant response to perform a subdominant response” p. 137, Rothbart & Bates, 2006) has been shown to mitigate against the effects of attentional biases on the severity of anxiety symptoms (Lonigan, Vasey, Phillips, & Hazen, 2004). Effortful control also may mitigate the relation between the hostile attentional bias and aggression, but this possibility has not been empirically investigated.

Therefore, the current study examines the moderating role of effortful control on the relation between the hostile attentional bias and aggression. With these goals in mind, this dissertation begins by defining aggression, followed by a review of studies investigating the relations between children’s hostile attentional bias and aggression, a literature review and discussion of the moderating role of effortful control on the relation between the hostile attentional bias and aggression, and concludes with the study’s hypotheses.

## **1.1 Aggression**

Aggression is a heterogeneous construct and encompasses many kinds of behaviours. These behaviours are commonly conceptualized based on two dimensions: form and function. In terms of forms, aggressive behaviour can be physical/overt (e.g., hitting) or relational/social (e.g., gossip, name-calling). With respect to function, aggressive behaviour can be classified as serving either reactive or proactive functions. Reactive aggression describes behaviour occurring in response to a perceived social threat, slight, or provocation, and serves a retaliatory function (Dodge, 1991; Dodge & Coie, 1987). Proactive aggression is a goal-directed behaviour, and functions to eliminate obstacles impeding progress (Dodge, 1991; Dodge & Coie, 1987). In this dissertation, I use the term aggression to encompass and refer to all variants of form and function. Most aggressively behaved boys demonstrate a range of aggressive behaviours, including physical and relational forms with reactive and proactive functions (Card, Stucky,

Sawalani, & Little, 2008). In contrast, girls who behave aggressively primarily rely on relational aggression, and rarely are observed being overtly/physically aggressive (Card et al., 2008; Crick & Grotpeter, 1995). Therefore, the current study uses general aggression measures to assess a wide range of possible aggressive behaviours, and an all male sample to maximize the variation of aggressive behaviour<sup>1</sup>.

## **1.2 The Hostile Attentional Bias and Aggression**

The social information processing model (SIP; Crick & Dodge, 1994) provides a useful framework for understanding the importance of attention in relation to aggression. The SIP model is constituted by six interconnected steps of cognitive processing, beginning with initial attending to and encoding of social cues (Step 1), followed by interpretation and evaluation of these cues (Steps 2 and 3), and concluding with generating, selecting, and enacting a chosen response (Steps 4 to 6). According to the SIP model, aggressive behaviour results from biased cognitive processing, which may occur at any step – including the hostile attentional bias at Step 1. Although, in the model, aggressive behaviours also contribute to the formation of biased cognitive processing (i.e., there is a bidirectional relation between aggression and biased cognitive processing), the model has been primarily used to understand how biased cognitive processing contributes to the development and maintenance of aggressive behaviours (e.g., Dodge, Godwin, & The Conduct Problems Prevention Research Group, 2013), and I use the model from this perspective throughout the dissertation. Nonetheless, I acknowledge that the relation between these cognitive processes, including the hostile attentional bias, and aggression

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<sup>1</sup> The male pronoun is used throughout the Introduction to illustrate examples given the exclusively male sample used in the study.

is transactional: increasing levels of aggression may exacerbate the hostile attentional bias, just as the hostile attentional bias may contribute to the development/maintenance of aggression.

Aggression research to date has primarily focused on biased processing during the interpretation, response generation, and response selection steps (i.e., Steps 2, 4, and 5), and there is strong empirical evidence for links between aggression and cognitive biases during these interpretation (i.e., hostile attribution bias; de Castro et al., 2002), response generation (Dodge, Lochman, Harnish, Bates, & Pettit, 1997), and response selection steps (Crick & Dodge, 1996; Fontaine, Yang, Dodge, Pettit, & Bates, 2009). However, Step 1 remains one of the least studied of the SIP steps, and even within studies of Step 1 only a handful of studies have examined attention allocation in relation to aggression, as most research has been devoted to the encoding of information at this step (encoding describes individual differences in short-term memory of social situations; e.g., Dodge et al., 1997). This omission is surprising as the ways children allocate their attention constrain the stimuli-driven information available for encoding and subsequent SIP steps. Thus, attention allocation is crucial to the SIP model because it sets the foundation for the other steps and subsequent behavioural responses, and therefore, is worthy of study in its own right.

It is within Step 1 of the SIP model that the hostile attentional bias hypothesis is premised to function, and to contribute to child aggressive behaviour. Specifically, the SIP model argues that children who are aggressive are particularly sensitive to and attend more to hostile threat cues, such as angry faces, because such cues are predictive of conflict that potentially warrant an aggressive response (Crick & Dodge, 1994). Unfortunately, the mechanisms underlying this bias are poorly specified within the SIP model. In particular, it is not clear from the model what attentional processing mechanisms contribute to the hostile attentional bias.

Before discussing the attentional mechanisms that may underlie the hostile attentional bias, it is acknowledged that some degree of attending to hostile cues is adaptive and one would expect that all children should preferentially attend to these cues as a means of self-protection (e.g., quickly noticing an angry face approaching in a crowd provides more opportunity to react – and possibly reduce potential harm – than slowly noticing or ignoring such a cue). Evidence supports this assertion, and, on average, typically developing children demonstrate preference for attending to clearly hostile cues over neutral or positive social cues (Dudeney, Sharpe, & Hunt, 2015). Although adaptive at moderate levels, this attentional bias may become problematic in the extreme (e.g., persistently allocating attention to hostile cues even when they are irrelevant to the situation, thus reducing processing resources available for other cues). In particular, because aggression is one way of responding to hostile cues, children who experience more extreme forms of this attentional bias may engage in higher levels of aggression than children with lesser forms of this bias (Crick & Dodge, 1994; Lemerise & Arsenio, 2000).

To more fully understand how a hostile attentional bias may operate, I turn to explanations offered in cognitive psychology. Given that aggression is often seen as elicited by perceived potential physical, social, or emotional interpersonal threats (i.e., hostile stimuli), these stimuli must logically exert a strong enough effect on attention in order to signal the need for a potentially aggressive behavioural response. It is possible that hostile stimuli are particularly behaviorally relevant to more aggressively behaved children compared to less aggressively behaved children, and this differential relevance could impact the salience of hostile stimuli across a range of attentional processes (Corbetta & Shulman, 2002).

Attentional processing involves an initial shift of attention towards a stimulus, engagement with that stimulus, and concludes with disengagement or shifting of attention away

from a stimulus (Posner, 1980). Therefore, it is possible that both the initial capturing of and the subsequent holding of attention by hostile stimuli both contribute to the hostile attentional bias. Put another way, it may be that having attention become ‘stuck’ on hostile stimuli contributes to aggression just as do higher rates of initial attention to these stimuli.

Accounting for different attentional processes, one can see how the hostile attentional bias may take various forms. Nevertheless, almost all of the few studies that have examined the relations between attention and aggression have measured the hostile attentional bias without regard to these distinctions in attention allocation. Thus, in addition to addressing the methodological limitations of previous research of the hostile attentional bias hypothesis, the current study aims to extend previous research by including attention measures sensitive to the initial capturing and subsequent holding of attention.

In the following sections, I review existing studies with a specific focus on the methodological limitations that might account for null results. Additionally, I report on how attentional biases are conceptualized within each of these studies and the potential confounding of different aspects of attention. However, in order to provide a background to this methodological consideration of previous studies, I begin by briefly describing the ways the hostile attentional bias has been operationalized within the childhood aggression literature.

### **1.2.1 Measurement of attention allocation**

The most common measures of attention allocation for children evaluate their ability to simultaneously attend to multiple stimuli, and specifically the degree to which children allocate their attention to certain types of stimuli over others (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007; Cisler, Bacon, & Williams, 2009). The assumption is that children who have an attentional bias towards certain stimuli should perform better on tasks

where these stimuli assist with task completion, and worse on tasks where these stimuli interfere with task completion, relative to their performance in response to neutral stimuli. Within the childhood aggression literature, two types of tasks have been used to assess attention allocation: dot-probe tasks and attention shifting tasks. I also outline a third type of attention allocation task, the temporal order judgment task, although this task has not yet been used within the childhood aggression literature.

### **1.2.1.1 Dot-probe tasks**

A dot-probe task is a computer-based task that assesses response time for identifying the location of a probe when the probe is presented in the same location as previously presented stimuli. The hostile attentional bias is assessed by pairing a hostile and a neutral stimulus on a screen for a short period of time (e.g., 500 ms) and measuring children's response time to identify subsequent probes in either the hostile or neutral location. This task assumes that children with greater hostile attentional bias will respond quicker on trials when the probe is positioned in the same location as the hostile stimulus (i.e., children's response is facilitated because their attention was already directed toward the probe's location; children's attention was engaged with the hostile stimulus), and slower on trials when the probe is positioned in the same location as the neutral stimulus (i.e., children have difficulty disengaging from the hostile stimulus' location to respond to the probe in the neutral location). Therefore, (in keeping with terminology commonly used to describe dot-probe task trials), trials in which the probe is positioned in the hostile stimulus' location are termed congruent trials, to denote the congruency between where attention was directed and the location of the probe (MacLeod, Mathews, & Tata, 1986). Conversely, trials in which the probe is positioned in the neutral stimulus' location are termed incongruent trials (MacLeod et al., 1986). The hostile attentional bias is measured by the

average response time across incongruent trials minus the average response time across congruent trials. Congruent and incongruent trials involve different attentional processes (i.e., engagement on congruent trials versus disengagement on incongruent trials) and children must shift their attention from the stimulus to the probe on all trials, therefore the dot-probe task's measure of the hostile attentional bias incorporates several attentional processes.

### **1.2.1.2 Attention shifting tasks**

In attention shifting tasks, children are instructed to perform a computer task that requires their attention (e.g., pressing a button when a red light goes on), however, at the same time the children are presented with hostile or neutral distracting stimuli (e.g., a video of children fighting or children discussing their weekend). The hostile attentional bias is measured by a comparison of children's task performance under the hostile versus neutral distraction conditions. It is assumed that worse performance (e.g., slower time to press a button when a red light goes on) during the hostile distracting stimuli presentation relative to the neutral stimuli presentation is indicative of a stronger hostile attentional bias. Because the hostile attentional bias is measured in terms of how much the hostile distracting stimuli worsen children's performance compared to the neutral distractor, the attention shifting task primarily provides a measure of children's difficulty disengaging their attention from hostile stimuli.

### **1.2.1.3 Temporal order judgment tasks**

Temporal order judgment tasks are another way to assess attentional biases, and are premised on the assumption that attention is selectively deployed or prioritized to certain stimuli over others based on their relevance to an individual. Relevant stimuli are perceived faster than stimuli that are less relevant and relevance is determined by the given situation and the given

individual's history (e.g., key-shaped objects are allocated more attention when searching for missing keys, hostile cues may have greater salience for aggressive children).

During computer-based temporal order judgment tasks, two stimuli are presented sequentially and children are asked to judge which of the two stimuli appeared first. The interval between the presentation of the first and second stimuli varies, making it more or less difficult to determine which stimulus appeared first (e.g., ranging between 10 and 100 ms). Biases in attention allocation are measured by the point of perceived stimulus simultaneity (PSS). The PSS describes the time interval between the presentation of two sequentially-presented stimuli at which children perceive them as occurring simultaneously (Shore, Spence, & Klein, 2001). At the PSS, children are equally likely to judge either stimulus as appearing first. If attention is deployed equally to both stimuli, then the PSS will be zero (stimuli are only perceived simultaneously if presented simultaneously) and there would be no attentional bias. However, if attention is deployed more to one stimulus than the other, the stimulus with greater attention deployed will be perceived more quickly than the other and the PSS would be non-zero, indicating an attentional bias towards the prioritized stimulus (this value could be negative or positive depending on how the task is structured). The larger the time gap between the prioritized and non-prioritized stimuli that still generates a perception of simultaneous presentation, the larger the attentional bias.

The hostile attentional bias is measured by the extent to which attention is deployed more to hostile stimuli relative to neutral stimuli, and is operationalized by non-zero PSS scores. That is, because individuals with this bias prioritize allocation of attention to hostile stimuli, a neutral stimulus must be presented several milliseconds before a hostile stimulus to be perceived as appearing simultaneously among these individuals. Attentional biases have been studied in adult

samples using temporal order judgment tasks; however – given that this task procedure is relatively new – to my knowledge studies have not yet been conducted with children.

Nonetheless, my aim is to obtain a comprehensive measure of the hostile attentional bias incorporating multiple dimensions of attentional processing, and a temporal order judgment task helps to accomplish this aim by assessing selective attentional deployment as the measure of hostile attentional bias, an attentional process that is not captured as cleanly by either dot-probe or attention shifting tasks.

#### **1.2.1.4 Differences among tasks**

The three types of attention tasks each measure different aspects of attention as they contribute to attentional biases. Dot-probe tasks are the broadest of the three tasks in terms of the types of attention they are likely to tap. On the one hand, quicker response times during congruent trials (when the probe is presented in the same location as a hostile stimulus) suggest that attention was selectively deployed towards and captured by hostile stimuli relative to neutral stimuli. On the other hand, slower response times during incongruent trials (when the probe is presented in opposite location as a hostile stimulus) reflect a difficulty disengaging and shifting attention away from hostile stimuli. Given that the hostile attentional bias is measured by the difference in response times between incongruent and congruent trials, this measure must include several aspects of attention within its index of the hostile attentional bias (e.g., Cisler et al., 2009).

In contrast to dot-probe tasks, attention shifting tasks and temporal order judgment tasks provide more focused measures of the hostile attentional bias because fewer aspects of attention are directly required to perform these tasks. Attention shifting tasks are premised on the assumption that certain stimuli are more difficult to disengage or shift attention away from

relative to other stimuli. Slower response times during trials when hostile distracting stimuli are presented compared to trials when neutral distracting stimuli are presented indicate a greater difficulty disengaging attention from hostile stimuli relative to neutral stimuli (Gouze, 1987).

Nonetheless, it is possible that other attentional processes also are involved in the performance of this task. For instance, attention may be deployed faster to hostile distracting stimuli compared to neutral distracting stimuli, meaning that after children have responded to a probe, children with a greater hostile attentional bias may be quicker to return their attention to hostile distracting stimuli than to neutral distracting stimuli. In effect, individual differences in attentional deployment could contribute to the speed that children are ready to begin the next trial. However, these differences are usually in the order of milliseconds and attention shifting task trials are usually separated by several seconds. Therefore, individual differences in attentional deployment are unlikely to be measured with the same sensitivity as individual differences in disengaging attention in the attention shifting task.

Conversely, in temporal order judgment tasks, stimuli are presented extremely quickly (less than 300 ms) with the aim of determining patterns in how attention is deployed to different types of stimuli (West, Anderson, & Pratt, 2009). Thus, in these tasks, it would be difficult for children to shift their attention between stimuli during the brief presentation time. Therefore, it is assumed there are limited opportunities for other kinds of attentional processes beyond deployment to contribute to an attentional bias measure derived from a temporal order judgment task. In addition, because of the short presentation times, children have to react to stimuli often before they are fully perceived. This means that more automatic attentional processes may contribute to children's performance on this task to a greater extent than within the other two attention allocation tasks. (In the other tasks, it is likely that both automatic and voluntary

processes contribute to attention allocation patterns, but the structure of these tasks makes it difficult to distinguish these processes (Cisler et al., 2009)). In particular, in temporal order judgment tasks it has been argued that certain stimuli are prioritized by attention because they fit within a pre-tuned attentional set that assists with the attentional capture of behaviorally relevant stimuli (West et al., 2009).

In addition to differences in which attentional processes are primarily involved with each, the three types of tasks also differ in terms of the stimuli to which children are responding. In dot-probe tasks, children respond to a probe that is presented in the location of the stimulus-of-interest (e.g., hostile stimuli) and in attention shifting tasks children respond to a probe located away from the stimulus-of-interest. In contrast, in temporal order judgment tasks children respond to the stimuli themselves. No study, of which the author is aware, has examined the concurrent validity of these three tasks as measures of attentional biases, in either adults or children. However, given the conceptual and structural differences among these tasks, it seems unlikely they would provide strongly converging or overlapping measures of the hostile attentional bias. Therefore, the current study uses these tasks as three independent measures of the hostile attentional bias, allowing the benefit of assessing the hostile attentional bias as it may appear across a range of attentional processes.

### **1.2.2 Review of studies examining the relations between the hostile attentional bias and aggression**

The following section reviews results of studies testing the hostile attentional bias hypothesis in children using dot-probe tasks or attention shifting tasks and highlights both methodological and conceptual issues arising in each study. As previously noted, temporal order

judgment tasks have not been used as measures of the hostile attentional bias, and have not yet contributed to the testing of the hostile attentional bias hypothesis.

### **1.2.2.1 Studies using dot-probe tasks**

The weakest evidence for the hostile attentional bias hypothesis in children comes from studies using dot-probe tasks. Indeed, none of the four existing studies using these tasks has found support for the hostile attentional bias hypothesis. However, the results of these studies must be considered in light of methodological limitations, which will be reviewed in turn.

Schippell and colleagues (2003) completed the first study of attention and aggression in youth using dot-probe tasks. Participants (11 to 16 years; 52% male), recruited from schools, completed several dot-probe tasks in which pairs of words were presented on a computer screen followed by a probe in the location of one of the words. First, youth were instructed to read the word appearing at the top of the screen (following from the original dot-probe task instructions designed by MacLeod et al., 1986), then they were to press a button indicating the location of the probe, and response times to this button press were measured. The authors calculated an attentional bias score using response times to probes in the location of neutral or negative social words. Children's aggression was measured through teacher-report. Consistent with the idea that attentional biases towards negative stimuli may be normative, the authors reported a positive mean for the attentional bias scores; suggesting that, on average, children preferentially attended to negative social words over neutral words. The authors had predicted that aggression would be positively related to an attentional bias for the negative social words, but contrary to prediction, aggression was *negatively* related to this attentional bias. That is, children who were slower to respond to probes in the location of the negative social words compared to probes in the location of neutral words were rated as more aggressive by their teachers.

However, these contradictory results should be interpreted cautiously, primarily due to the nature of the stimuli used in the dot-probe tasks. Specifically, the negative social words used by Schippel and colleagues (2003) were not exclusively representative of hostile stimuli (defined as cues indicating potentially physically, socially, or emotionally threatening interpersonal situations). Instead they used a broader category of negative stimuli – words with negative social connotations (e.g., “lonely,” “flunk,” and “hated”) – that were presented paired with neutral words. These words were adopted from studies of threat perception and anxiety, with no modifications to make the words more relevant to the types of threat that would be most operative in childhood aggression. Thus, the negative social words were heterogeneous, and although some words contained themes consistent with hostile stimuli (e.g., “teased” and “hated”), others were more anxiety related (e.g., “test” and “failure”). In sum, Schippell et al.’s study’s procedures preclude a direct test of the hostile attentional bias hypothesis in relation to aggression in boys, as the measure of attentional bias did not focus exclusively on hostile stimuli.

Unfortunately, the same methodological issue reoccurs in a second study testing the attentional bias hypothesis in relation to child aggression (Reid, Salmon, & Lovibond, 2006). These authors used the same methodology and stimuli (a heterogeneous group of negative words, such as “hospital” and “hurt”) as Schippell et al. (2003) in another community sample of children (8-14 years; 54% male). Child aggression was measured again using teacher-report. In contrast to the unexpected negative association reported by Schippell et al., Reid and colleagues found no relation between an attentional bias towards negative words and teacher-reported aggression. The authors did not report a mean value for the attention bias scores so it is not possible to compare the overall levels across the two studies.

In a third study, Kimonis, Frick, Fazekas, and Loney (2006) examined attentional biases in a community sample of children (6 to 13 years; 54% male) using a dot-probe task with photos described as threatening stimuli (e.g., dog attacking). Similar to the results of Schippell et al. (2003), on average, they found children preferentially attended to threatening stimuli over neutral stimuli (i.e., the mean attentional bias score was positive). This study had a notable strength in that the authors included multiple measures of aggression through parent- and child-reports. Consistent with other studies' findings, there was no relation between the hostile attentional bias and child aggression. Unfortunately, the authors did not provide further information regarding the nature of the threatening stimuli used in the dot-probe task (i.e., the extent that each stimulus represented hostile interpersonal content) making these results difficult to interpret in the context of the hostile attentional bias hypothesis.

Finally, Salum and colleagues (2013) measured the hostile attentional bias in a clinical sample of children (6-12 years; 63% male) with behavioural disorders (i.e., attention-deficit/hyperactivity (ADHD), oppositional defiant disorder, conduct disorder) and a community control sample of children (6-12 years; 52% male). Improving upon the methodological limitations of the previous studies, the authors measured the hostile attentional bias using a dot-probe task with hostile stimuli, which were pictures of angry child faces and these were paired with neutral child faces. Parallel to the other dot-probe studies' findings, the authors reported a positive mean for the attentional bias scores. Unfortunately, child aggression was not measured directly in this study, and instead behavioral disorder status was used as a proxy of aggression. The study found no group difference between the children with behavioural disorders and community controls on measures of the hostile attentional bias (measured by the difference in response times between incongruent and congruent trials). Again, I believe these results should

be interpreted cautiously with respect to the hostile attentional bias hypothesis because of this study's lack of a clear measure of aggression. Although children with behavioural disorders often demonstrate higher levels of aggression compared to typically developing children (Card & Little, 2006), using this assumption to interpret these results is tenuous given the heterogeneity of the behavioural disorder group in the Salum et al. study. For example, the authors did not distinguish ADHD by subtype, which is unfortunate as children with ADHD constituted 78% of the behavioural disorder group. It is possible that many of these children had the inattentive subtype of ADHD, and such children would not be expected to show high levels of aggression (Connor, Chartier, Preen, & Kaplan, 2010). In sum, it is encouraging that Salum et al. assessed the hostile attentional bias using only hostile stimuli, however their null results remain only a tentative test of the hypothesis because aggression was not explicitly measured.

In summary, results of studies using dot-probe tasks have not supported the hostile attentional bias hypothesis, in that none of the few existing studies has reported a positive association between attentional bias and aggression in children. These results are contrary to the SIP model's hypothesis and suggest that there is no relation between a hostile attentional bias and aggression. However, there are methodological issues that confine the interpretation of existing findings. In particular, three of the four studies may have confounded anxiety- and hostile themes in their dot-probe stimuli, such that the hostile attentional bias was never adequately measured. And, in the case of Salum et al. (2013), aggression was not measured directly. Thus, it remains an empirical question whether children with higher levels of aggression would demonstrate an attentional bias towards clearly hostile stimuli in a dot-probe task.

### **1.2.2.2 Studies using attention shifting tasks**

Only two studies have measured the hostile attentional bias using attention shifting tasks as a means of testing the relation between this bias and aggression in children. In contrast to studies using dot-probe tasks, both of these studies found evidence in support of the hypothesis. In the first study, Gouze (1987) assessed male preschoolers' ability to complete tasks while being presented with hostile or neutral distractor stimuli, and compared performance on the attention tasks to classroom observations of aggression. As per the hostile attentional bias hypothesis, Gouze predicted that boys who had more difficulty completing tasks while hostile distracting stimuli were presented relative to neutral stimuli also would behave more aggressively in the classroom (i.e., they predicted that difficulty disengaging attention from hostile stimuli would be positively related to aggression). Boys completed two attention shifting tasks. The first involved monitoring a light and turning it off when it turned on. Response time to turn off the light was the dependent measure. Simultaneously, boys watched puppet shows featuring either hostile stimuli or positive stimuli (i.e., puppets yelling, hitting, teasing one another or puppets sharing, complimenting, cooperating with one another). In support of her prediction, Gouze found that boys who took longer to turn off the light during the hostile compared to the positive puppet show were more aggressive. Similar results were found using a second attention shifting task, in which boys completed a tossing game while watching a cartoon containing either hostile or non-hostile actions. Again, boys who were more aggressive were more distracted by the hostile cartoon and performed worse during the tossing game compared to the non-hostile cartoon. Overall, these results are consistent with the hostile attentional bias hypothesis, and suggest that boys with higher levels of aggression have more difficulty disengaging their attention from hostile stimuli relative to boys lower on aggression.

Similar results were reported by Arsenault and Foster (2012) in a community sample of school-aged children ( $M = 10.93$  years; 53% male), using teacher- and peer-reports of aggression. The hostile attentional bias was measured by children's response time to press a button when a red light went on while simultaneously watching videos depicting one child aggressing against another (e.g., a child excludes another child from an activity, a child punches another). The authors also measured children's response times while they watched videos of prosocial interactions (e.g., a child helps another complete homework). Overall, there was a larger mean response time during the aggressive video condition compared to the prosocial video condition – suggesting that on average, children were more distracted by the aggressive video compared to the prosocial video. In contrast to Gouze (1987), to index the hostile attentional bias the authors did not calculate a difference score between children's response time while watching aggressive versus prosocial interactions. Instead, in examining response times to the hostile stimuli, they statistically controlled for children's response times while watching prosocial interactions (i.e., times were entered as a covariate in their regression models) to account for children's general attentional processing abilities. As predicted, they found significant positive relations between children's response times while watching aggressive interactions and children's aggression (both teacher and peer-reported).

The results of Gouze (1987) and Arsenault and Foster (2012) provide evidence in support of the hostile attentional bias hypothesis. It is encouraging that both studies supported this hypothesis in spite of several methodological differences. These converging results suggest that the relation between the hostile attentional bias (as measured using attention shifting tasks) and aggression is relatively robust. As previously discussed, attention shifting tasks primarily measure difficulty with disengaging attention from distracting stimuli (e.g., attention is 'stuck'

on hostile distracting stimuli). Therefore, the findings from these studies suggest that difficulty with disengaging attention from hostile stimuli may be an important component of the hostile attentional bias as it relates to aggression. Although there is a clear need to replicate this effect beyond two studies, especially using control measures of attention that are not as strongly positively-valenced to rule-out the possibility that more aggressively behaved children attentionally avoid positive stimuli rather than have difficulty disengaging from hostile stimuli.

### **1.2.2.3 Studies using temporal order judgment tasks**

As previously mentioned, no study has used a temporal order judgment task to measure the hostile attentional bias in children. However, temporal order judgment tasks have been used to measure attentional biases in adults. For example, in a study using an undergraduate sample, West, Anderson, and Pratt (2009) investigated whether participants preferentially attended to photos of angry faces compared to neutral photos using a temporal order judgment task. On average, they found participants perceived angry faces faster than neutral faces, even when angry faces were presented after neutral faces; these results suggest that participants had an attentional set for angry faces (i.e., angry faces were more relevant to participants and attention was preferentially deployed to these stimuli over neutral faces) (West et al., 2009). Parallel to the results of the previously reviewed studies, these results are consistent with the idea that there is normative tendency to preferentially attend to hostile stimuli over neutral stimuli; these uniform results support the validity of temporal order judgment tasks as a measure of the hostile attentional bias. However, because the authors did not include any behavioral measures it is not clear how aggression might be related to the hostile attentional bias derived through this task.

### **1.2.3 Summary**

Previous research examined the links between aggression and the hostile attentional bias measured using dot-probe and attention shifting tasks. On the one hand, results from studies based on the dot-probe tasks have consistently failed to support the hypothesis but these findings are compromised by serious measurement limitations. On the other hand, results from the two studies based on attention shifting tasks have provided consistent support for the hypothesis. Attention shifting tasks focus their measure of the hostile attentional bias on how difficult it is to disengage attention from hostile stimuli, and the results from these two studies suggest that difficulty with disengagement may be an important component of the hostile attentional bias. However, there is need for replication and further study to expand and strengthen this evidence. No study has examined the hostile attentional bias hypothesis using a measure of attention allocation that focuses on initial patterns of attention allocation (e.g., using temporal order judgment tasks to assess attention allocation patterns within the first few milliseconds of attending to a stimulus). This omission is a substantial gap in understanding the links between the hostile attentional bias and aggression, especially in terms of how more automatic, pre-tuned patterns of attention might be related to aggressive behaviours. Finally, although the link between the hostile attentional bias and aggression is variable across these studies, the results of the studies across all three of the types of attention allocation tasks provide consistent evidence that, on average, all children attend to hostile stimuli over neutral/positive stimuli.

### **1.3 Contributions of the Current Study to Assessing Attentional Bias**

In the current study, I test the hostile attentional bias hypothesis that boys who are more aggressive attend more to hostile stimuli. This study extends the literature in several important ways. First, the current study uses three computer task measures of the hostile attentional bias: a

dot-probe task, an attention shifting task, and a temporal order judgment task. Across the three tasks, different attentional processes are required for performance. Including the three tasks provides measures of the hostile attentional bias across a range of attentional processes (i.e., from initial attentional deployment to disengagement of attention) presumed to occur at Step 1 of the SIP model. A notable strength of the current study is the expansion to include a temporal order judgment task. This task primarily focuses on differences in attention allocation during attentional deployment, which provides a more direct measure of automatic patterns of attention allocation than the other two tasks, and has not been used in previous studies testing the attentional bias hypothesis in relation to child aggression.

Second, to avoid the potential confounds inherent in the heterogeneous “threat” stimuli used in several previous studies (e.g., the inclusion of anxiety-themed stimuli), clearly hostile stimuli are used in the measures of attentional bias in this study. Specifically, pictures of children with angry facial expressions are used in the temporal order judgment and dot-probe tasks as hostile stimuli, and videos of children appearing angry are used as the hostile distractors in the attention shifting task. In addition to being more relevant to aggression, these stimuli have higher levels of external validity compared to stimuli used in some previous studies (e.g., written words, cartoons or videos of aggressive interactions not involving the child).

Third, in this study, hostile stimuli are paired with neutral stimuli (as opposed to positive stimuli) in the temporal order judgment and dot-probe tasks, and children’s responses during the presentation of distracting hostile stimuli are compared to their responses during presentation of distracting neutral stimuli in the attention shifting task. (In addition, distracting videos of children appearing happy are used to allow full replication of the methods of previous studies using attention shifting tasks (Arsenault & Foster, 2012; Gouze, 1987)). Contrasting children’s

responses during hostile versus neutral distracting stimuli allows the measure of the hostile attentional bias to avoid confounding by the possibility that aggressively behaved children are avoiding positive stimuli rather than allocating their attention towards hostile stimuli.

Fourth, the current study uses multiple measures and informants to assess child aggression, including several parent-report measures and one child-report measure. In sum, the current study addresses methodological limitations of previous studies, and extends the literature by including a new measure of the hostile attentional bias (i.e., the temporal order judgment task). I now turn to the further way in which this study expands our understanding of the hostile attention bias, consideration of the role of effortful control as a moderator of the relation between the hostile attentional bias and aggression.

#### **1.4 Effortful Control**

As previously reviewed, past research has produced inconsistent evidence in support of a positive relation between the hostile attentional bias and aggression in children. These differences may be explained in part by the differences and deficiencies in methodology across studies. However, given other consistencies across the studies (i.e., when reported, mean levels of attentional bias scores were always positive), it is also possible that something other than methodological differences may account for the diverging patterns of results. In particular, the inconsistencies suggest the possibility of moderation of the relation between hostile attentional bias and child aggression. One theoretically meaningful moderator is child effortful control. Effortful control is a component of the self-regulatory system and describes children's ability to modulate their spontaneous and reactive response to stimuli (these spontaneous/reactive responses are termed 'reactivity') (Rothbart & Bates, 2006). Children with higher levels of effortful control are better able to manage their reactivity and appropriately adjust their

behaviour to meet both their needs and the demands of their surroundings compared to children with lower levels of effortful control (Rothbart, Sheese, & Posner, 2007). Effortful control is a well-established protective factor against the development of aggression (Caspi, Henry, McGee, Moffitt, & Silva, 1995; Eisenberg et al., 2004; van der Voort, Linting, Juffer, Bakermans-Kranenburg, & van Ijzendoorn, 2013; Wang, Chassin, Eisenberg, & Spinrad, 2015). There are many pathways through which effortful control might mitigate against the development of aggression, such as through helping children to regulate emotion in arousing/frustrating situations, or by overriding urges to behave impulsively. A review of these pathways is beyond the scope of this dissertation, and the links between effortful control and aggression are discussed in several published reviews (Eisenberg, Spinrad, & Eggum, 2010; Frick & Morris, 2004; Nigg, 2006). What is consistent across these reviews is that lower levels of effortful control contribute to higher levels of aggressive behaviors. However, aside from its direct protective effect on child aggression, it is possible that effortful control also mitigates against the effects of other aggression-contributing factors, such as the hostile attentional bias, on behavioral outcomes. Heretofore untested, this possibility is a focus of the current study.

Conceptually, effortful control is comprised of three components: inhibitory control, activation control, and attentional control (Eisenberg & Spinrad, 2004; Rothbart, Ellis, Rueda, & Posner, 2003), and it is conceivable that each of these components may play a role in either dampening or amplifying the relation between children's attention to hostile stimuli and their aggressive responding. Inhibitory control and activation control involve the regulation of behaviours, and attentional control involves the regulation of attention. Inhibitory control refers to the ability to inhibit a prepotent behavioural response in favor of a more considered response. For instance, a child may have an impulse to hit when another child in a cafeteria line jostles

him. If he has lower levels of inhibitory control, he is more likely to act on this impulse compared to a child with higher levels of inhibitory control. Activation control refers to the ability to activate a behavioural response appropriate to the situation. For example, a child with higher levels of activation control may be able to remain calm when being teased; in contrast, a child with lower levels of activation control may have more difficulty accessing a calm response.

Attentional control refers to ability to consciously direct and re-direct the focus of attention depending on self-regulatory demands. Children with higher levels of attentional control are better able to use their attention to self-regulate compared to children with lower levels of attentional control. For instance, a child with higher levels of attentional control may deliberately shift his attention away from a violent scene in a movie if the scene arouses the potential for aggressive activation. In the same situation, a child with lower levels of attentional control would have more difficulty deliberately shifting his attention away from the movie scene, and consequently may be unable to prevent the unwanted activation of aggressive behaviors. Attentional control is similar to attentional biases, in that both refer to the engagement and disengagement of attention with various stimuli. However, conceptually, these are distinct constructs: attentional control refers to a top-down regulatory strategy under conscious control and attentional biases describe bottom-up stimulus-driven patterns of attention allocation (Cisler & Koster, 2010; Eysenck, Derakshan, Santos, & Calvo, 2007; Lonigan et al., 2004).

This potential for effortful control to moderate the effects of other aggression-related risk factors – in particular, the hostile attentional bias – has not been examined within the child aggression literature. One study examined the link between encoding hostile information (the other part of step 1 in the SIP model) and aggression, and found that this relation was attenuated among children with greater levels of inhibitory control (a component of effortful control) (Ellis,

Weiss, & Lochman, 2009). However, it remains empirically untested how the relation between the hostile attentional bias and aggression would be moderated by effortful control. Nonetheless, predictions of this effect may be informed by previous studies demonstrating a moderating protective role of effortful control on attentional biases in relation to the development of other psychopathologies. Specifically, in the following section, I briefly review a model incorporating attentional biases and effortful control as contributing and interacting factors in the development and maintenance of anxiety in children.

#### **1.4.1 A model of attentional biases, effortful control, and anxiety**

There is an established link between threat-related attentional biases and anxiety in children, and evidence that this attentional bias is a risk factor in the development and maintenance of anxiety. However, this is not a universal effect (i.e., not all children with this attentional bias become anxious), and several researchers have argued that effortful control mitigates the effects of a threat-related attentional bias. For example, Lonigan and colleagues (2004) posited that effortful control allows children with a threat-related attentional bias to override the effects of this bias on subsequent cognitive processing and to respond adaptively to threatening stimuli. They propose that children with lower levels of effortful control are likely to engage in maladaptive patterns of responding to threats because they do not have the self-regulatory capacity to generate alternate responses beyond the fight-or-flight response to the incoming stimuli. For instance, threatening stimuli may trigger increased physiological arousal or avoidance behaviours among children with low effortful control regardless of whether circumstances warrant this type of response (e.g., Susa, Benga, Pitică, & Miclea, 2014). In contrast, children with greater effortful control may be able to respond to threatening stimuli more discriminately, even if they are biased to attend more to the stimuli. That is, their greater

self-regulatory strategies may allow them to inhibit urges to flee or avoid perceived threats, may activate calming thoughts or behaviours, or may allow them to deliberately re-direct attention away from the threatening stimulus. These arguments are empirically supported. For example, using a community sample of children (9 to 14 years; 55% male), Susa, Pitică, Benga, and Miclea (2012) found more threat-related attentional bias (preference to attend to angry faces versus neutral faces using a dot-probe task) was positively related to anxiety, but only among children with lower levels of effortful control.

In summary, both anxious and aggressively behaved children demonstrate attentional biases towards threatening stimuli (for aggressive children, specifically hostile stimuli). And, evidence supports that effortful control moderates the effect of threat-related attentional biases on the development and maintenance of anxiety through several mechanisms, including re-directing attention away from threatening stimuli and promoting appropriate behavioural responses. Therefore, I propose that similar mechanisms may operate to attenuate the effect of the hostile attentional bias upon aggressive behaviours. For example, among children with more hostile attentional bias, greater effortful control ability could reduce the intensity of an incoming hostile signal or could interfere the translation of hostile information into aggressive responses. Children high in hostile attentional bias, but who lack effortful control, would not have access to these self-regulatory strategies, and, as a result, would be more likely to behave aggressively when confronted with hostile social information. In sum, what likely places children at most risk for aggression is the interactive combination of the hostile attentional bias and low effortful control. To investigate this possibility, the current study tests the moderating role of effortful control on the relation between the hostile attentional bias and child aggression.

## 1.5 Hypotheses

In summary, the current study extends research on the hostile attentional bias and aggression, by examining this relation using a multi-informant, multi-method approach, including three different attention allocation tasks to measure the hostile attentional bias, as well as parent- and child-report measures of aggression in a sample of 9 to 12 year old boys. The primary goal of the study is to test the hostile attentional bias hypothesis by examining the relation between the hostile attentional bias and aggression. As the three attention allocation tasks are noted to involve different attentional processes, they are tested separately. In all cases, aggression is measured using parent- and child-reports. The primary hypotheses are summarized below:

- 1) Boys' hostile attentional bias, as measured by the response time difference between incongruent and congruent trials of a dot-probe task, will be uniquely positively related to aggression.
- 2) Boys' hostile attentional bias, as measured using the point of perceived simultaneity derived from a temporal order judgment task, will be uniquely positively related to aggression.
- 3) Boys' hostile attentional bias, as measured by the response time difference between angry and neutral trials of an attention shifting task will be uniquely positively related to aggression.
  - a. In an effort to replicate previous research, a subsidiary hypothesis is that boys' hostile attentional bias, as measured by the response time difference between angry and *happy trials* of the attention shifting task, will be uniquely positively related to aggression.

As a secondary goal, I examine the moderating role of effortful control on the relation between the hostile attentional bias and aggression. It is predicted that, using each of the four measures of the hostile attentional bias, the positive relation between the hostile attentional bias and aggression will be stronger at lower levels of effortful control.

## **Chapter 2: Methods**

### **2.1 Participants**

One-hundred-and-nineteen boys, aged 9 to 12 years, were recruited from the community, elementary schools, and the UBC Parenting Lab's past participant registry. The registry is a list of families who have previously participated in studies and agreed to be contacted by the UBC Parenting Lab about future studies. Over the course of 10 months, flyers were distributed to elementary schools (approximately 2,000 flyers) and community centres/coffee shops (approximately 50 flyers). Of the recruited sample, 98 were recruited through flyers, and 18 were recruited through the UBC Parenting Lab's volunteer registry. In order to recruit boys who demonstrated a range of aggressive behavior, flyers emphasized that the study focused on boys with and without difficulties getting along with peers (see Appendix A for a copy of the flyer).

Boys with intellectual disability, autism spectrum disorder, a pervasive developmental disorder, or uncorrected poor vision, as reported by parents, were excluded from the sample. Three families were interested in the study but were excluded because their sons had been diagnosed with autism spectrum disorder (one family) or a pervasive developmental disorder (two families). Study participation required English language, and one family was excluded because their son could not speak or understand English. Finally, two participants were excluded because their performance on one of the attention tasks (temporal order judgment task) was substantially different than other participants, suggesting they did not complete the task as directed. Eight pairs of brothers participated and their data was included as removing them would result in a loss of power in the analyses. Further, dependency effects due to brothers participating were mitigated because the study's measures focused on individual-level variables (e.g., aggression, attention) rather than environmental-level variables (e.g., parenting, home life).

Brothers also completed the study sequentially, with the second brother participating immediately after the first brother, meaning that the first brother was not able to communicate information about the study to the second brother. Nonetheless, the primary analyses were compared to analyses conducted excluding the second participating brothers and no difference in the results was found.

Following the exclusions noted above, the final sample included 113 boys ranging in age between 8.7 and 12.8 years ( $M = 10.6$ ;  $SD = 1.0$ ). Parents reported the ethnicity of participating boys, and 23.9% were Asian (mostly Chinese-Canadian), 52.2% were North American/European, 20.4% were mixed ethnicity (primarily Asian and North American/European), and 3.5% were Middle Eastern. Most families were two-parent (84% married; 15% divorced or single) upper-middle-class families, with an average yearly income of \$75,000. The mean score on the Hollingshead Four Factor Index of Social Status (Hollingshead, 1975) was 51.52 (ranging from 20 to 66). In all families, participating parents were biological parents, and in most families mothers participated (86.7%). As this was a community sample, few boys were diagnosed with psychiatric conditions; however, according to parent-report, six boys were diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD), and five other boys had some form of learning disorder. Two boys were classified as gifted.

## **2.2 Measures**

### **2.2.1 Demographic information**

The Family Information Questionnaire (FIQ), developed by the UBC Parenting Lab, was completed by parents and used to collect information about family background, including family income, child age, child psychiatric diagnoses (if any), family composition, ethnicity, and parents' education levels. A copy of this measure is contained in Appendix B.

## **2.2.2 Hostile attentional bias**

The hostile attentional bias in the boys was assessed using three attention allocation measures: a dot-probe task, a temporal order judgment task, and an attention-shifting task. The ordering of these tasks was counter-balanced across boys. Boys completed all tasks on a 13-inch laptop (Macbook Air) using Inquisit software (Inquisit 4.0), and sat approximately 50 centimeters from the screen. A plastic cover was placed over the keyboard with the ‘Z’ and ‘/’ keys painted blue and red respectively. Boys pressed either the blue or red key during each trial of the attention allocation tasks to indicate their response. For all tasks, stimuli (i.e., hostile or neutral photos or videos) were presented in grey scale, other task-relevant stimuli (e.g., fixation crosses, probes) were presented in black, and the background screen was white.

### **2.2.2.1 Photo stimuli**

For the dot-probe task and the temporal order judgment task, hostile stimuli were photos of boys expressing anger, and neutral stimuli were photos of the same boys with neutral expressions; these photos were selected from the NIMH Child Emotional Faces Picture Set (NIMH-ChEFS; Egger et al., 2011). The NIMH-ChEFS contains 482 photos of boys and girls with angry, happy, sad, or neutral expressions. The NIMH-ChEFS photos were validated by adult raters as representative of each emotion ( $\kappa = .94$ ; Egger et al., 2011). Photos of 19 boys displaying both angry and neutral expressions were selected from the NIMH-ChEFS (38 photos in total). These boys were 10 to 16 years old ( $M = 13.4$ ;  $SD = 1.7$ ) and predominantly Caucasian in appearance. Backgrounds were removed from the photos, leaving cutouts of boys’ faces as the stimuli. As an additional validity check, 10 members of the UBC Parenting Lab rated the intensity of anger for each of the 38 photos (0 = *not at all*; 4 = *extremely*). On average, angry

faces were rated as *very* angry ( $M = 2.58$ ;  $SD = .67$ ), and neutral faces were rated as *not at all* angry ( $M = .27$ ;  $SD = .29$ ).

After they completed all computer tasks, as another check on the photo stimuli, participating boys also rated the intensity of anger and happiness displayed in each photo (0 = *not at all*; 4 = *extremely*; Emotion Faces Rating Scale). Similar to the UBC Parenting Lab ratings, on average, angry faces were rated as *very* angry ( $M = 2.74$ ;  $SD = .53$ ) and *not a -all* happy ( $M = .32$ ;  $SD = .33$ ), and neutral faces were rated as *a little* angry ( $M = .63$ ;  $SD = .42$ ) and *a little* happy ( $M = 1.04$ ;  $SD = .60$ ). Boys' ratings of anger for the angry faces were significantly higher than ratings of anger for the neutral faces,  $t(112) = 55.20$ ,  $p < .001$ . Ratings of happy for the angry faces were significantly lower than ratings of happy for the neutral faces,  $t(112) = -17.27$ ,  $p < .001$ . Taken together, these results suggest that the photos of angry faces were clear examples of anger, but photos of neutral faces were perceived as containing some level of anger and happiness. All pictures were presented to boys in grey scale for the task and ratings.

The dot-probe task used all 38 photos. Each dot-probe task trial used two photos of the same boy; photos of the boys with angry expressions were used as hostile stimuli and photos of the boys with neutral expressions were used as neutral stimuli. The temporal order judgment task used 10 of the 38 NIMH-ChEFS photos (five boys with angry and neutral facial expressions). These 10 photos were selected because they were the angry faces with the highest anger intensity as rated by members of the UBC Parenting Lab. Lab members rated the angry faces as *very* angry ( $M = 3.28$ ;  $SD = .37$ ; range: 2.8-3.7) and neutral faces as *not at all* angry ( $M = .04$ ;  $SD = .05$ ; range 0 to .1). Participating boys' ratings were consistent with those of the UBC Parenting Lab: the five angry photos selected for this study were rated among the most intensely angry of the 38 photos (range: 2.9- 3.8). Each temporal order judgment task trial used an angry and

neutral photo of the same boy for a total of five different combinations for the trials (i.e., there were five angry and neutral photo pairs). Because performance on the temporal order judgment task is particularly sensitive to contrast differences (West et al., 2009), the 10 photos used for this task were presented at -50% contrast in grey scale to minimize contrast between angry and neutral photos (using Microsoft Powerpoint 2011 to format).

#### **2.2.2.2 Video stimuli**

The attention shifting task used video stimuli. Nine boys (aged 9 to 14 years, 100% Caucasian) were recruited from the community to create the videos of hostile, neutral, and positive social stimuli. These boys, referred to here as actors, were filmed individually as they made either angry or neutral expressions and read a script (e.g., “Hello my name is \_\_\_\_\_. Today is Monday and it is sunny outside”). The goal was to create videos in which it appeared the actors were speaking directly to the participants. Actors were coached on how to make the facial expressions. For instance, they were told to furrow their eyebrows and tense their jaw during the angry condition. Footage from each actor was edited to create 25-second videos for each condition (angry, happy, neutral). These videos were cropped at the actors shoulders to create portrait shots, converted from colour to black and white, and the corresponding audio tracks were muted. Videos were rated by 13 members of the UBC Parenting Lab for how representative they were of each emotion (i.e., anger, happiness, neutral; 0 = *not at all representative*; 4 = *extremely representative*). Based on these ratings and lab member feedback, one actor’s videos were dropped. The remaining eight actors’ videos were used as stimuli in the attention shifting task (total 24 videos). On average, lab members rated the angry videos as *very* representative of anger ( $M = 2.72$ ;  $SD = .58$ ), neutral videos as *very* representative of neutral ( $M = 2.94$ ;  $SD = .53$ ), and happy videos as *very* representative of happiness ( $M = 2.75$ ;  $SD = .45$ ).

As with the photos of faces, as an additional check, after completing the computer tasks, the participating boys also rated the intensity of anger and happiness displayed by each actor in the videos (0 = *not at all*; 4 = *extremely*; Emotion Video Rating Scale). On average, angry videos were rated as *medium* angry ( $M = 2.37$ ;  $SD = .63$ ) and *not at all* happy ( $M = .37$ ;  $SD = .40$ ), neutral videos were rated as *a little* angry ( $M = .82$ ;  $SD = .56$ ) and *a little* happy ( $M = 1.07$ ;  $SD = .59$ ), and happy videos were rated as *not at all* angry ( $M = .11$ ;  $SD = .23$ ) and *very* happy ( $M = 2.93$ ;  $SD = .64$ ).

Given that participant ratings (not lab member ratings) were pertinent to the research questions, I examined whether there were significant differences among boys' ratings across the different videos. There were significant differences in the boys' ratings of anger in the videos,  $F(2, 224) = 1161.42$ ,  $p < .001$ . As expected, angry videos were rated as significantly angrier than neutral and happy videos,  $t(112) = 35.14$ ,  $p < .001$  and  $t(112) = 41.17$ ,  $p < .001$ . Interestingly, neutral videos also were rated as significantly angrier than happy videos,  $t(112) = 15.62$ ,  $p < .001$ , suggesting that boys perceived the neutral videos as containing some anger. There also were significant differences in the happy ratings of videos,  $F(2, 224) = 1379.00$ ,  $p < .001$ . Consistent with expectation, happy videos were rated as significantly happier than angry or neutral videos,  $t(112) = 43.37$ ,  $p < .001$  and  $t(112) = 38.08$ ,  $p < .001$ . Unexpectedly, neutral videos also were rated as significantly happier than angry videos,  $t(112) = 16.60$ ,  $p < .001$ , suggesting that boys perceived neutral videos as also containing some happiness. Overall these ratings suggest that the angry and happy videos demonstrate clear examples of these emotions. However, the neutral videos appeared more ambiguous, and were perceived as containing some level of both anger and happiness. This concludes the section discussing the stimuli used in the attention allocation tasks. In the subsequent sections I describe how a dot-probe task, a temporal

order judgment task, and an attention shifting task were used to measure the hostile attentional bias.

### **2.2.2.3 Dot-probe task**

As described in the Introduction, the dot-probe task is a computer-based method for assessing attentional biases, and involves several attentional processes including engagement and disengagement (MacLeod et al., 1986). The dot-probe task involves the brief presentation of a pair of stimuli, on the right and left side of the screen, followed by a probe at one of the stimulus locations (“:” or “.”). Boys were instructed to identify the shape of the probe by pressing one of two keys as soon as they saw the probe (“:” = red key or “. ” = blue key). Instructions for this task are contained in Appendix C. Attention allocation was measured by comparing response times for different configurations of probed and unprobed stimuli. The dot-probe task is premised on the assumption that boys respond faster to a probe when their attention is already directed towards the probe’s location.

The current study assessed the hostile attentional bias using hostile and neutral stimuli in the form of pictures of angry and neutral child faces (described above); it was assumed that boys with more hostile attentional bias would preferentially attend to angry child faces over neutral child faces to a greater extent than other boys. There were three types of probed trials: 1) congruent trials in which an angry face was presented with a neutral face and the location of the angry face was probed, 2) incongruent trials in which an angry face was presented with a neutral face and the location of the neutral face was probed, and 3) trials with two neutral faces in which the location of one of the neutral faces was probed. The hostile attentional bias was measured by the difference in response time between incongruent and congruent trials, with faster response times during congruent relative to incongruent trials indicative of a greater attentional bias

(MacLeod et al., 1986). Neutral-neutral face pair trials were used to balance the task so that not every trial contained an angry face (e.g., Pérez-Edgar et al., 2011), however, responses to these trials were not used in the analyses.

Following procedures used by Kimonis et al. (2006), boys completed one block of practice trials (16 trials), in which they had to obtain 80% accuracy before proceeding to the three experimental blocks (48 trials each). Instructions were presented on the computer screen and read aloud to participants. Practice trials involved presentations of soccer balls and softballs to help boys become familiar with the task. Participants received feedback on their performance during practice trials. When they correctly identified the probe, a green checkmark appeared in the centre of the screen and when they responded incorrectly, a red X appeared. Each experimental block contained 32 hostile-neutral trials with angry-neutral face pairs and 16 neutral-neutral trials with neutral-neutral face pairs. The position of the angry face (right or left), probe position (right or left), and probe type (“:” or “. .”) were fully-crossed across the hostile-neutral trials within each experimental block. That is, the angry face appeared in the right portion of the screen on half the trials, of which half were probed with either “:” or “. .”, and the angry face appeared in the left portion of the screen on the other half of trials, of which half also were probed with either “:” or “. .”. For the remaining hostile-neutral trials, the neutral face was probed (i.e., incongruent trials). Similarly, the probe appeared with equal chance on the right and left portion of the screen during the neutral-neutral trials, with equal chance of either “:” or “. .” shaped probe. For the hostile-neutral trials, a 2 (angry face location) x 2 (probe location) x 2 (probe type) within-subjects factorial design was produced, with four trials in each condition. Each trial consisted of a 500 ms fixation cross in the centre of the screen, followed by a 500 ms presentation of the stimulus pair of faces, and concluded with one of the two dot-probes (“:” or

“.”) presented in either the right or left face location. The probe remained on the screen until boys responded. The inter-trial interval was 1,300 ms. Stimuli were centrally displayed on a white background, the right and left stimuli positions were separated by a seven-centimeter distance, and the dot-probe appeared in black at the vertical centre of either the right or left position. In terms of size, the fixation cross and dot-probes were presented in size 25 Arial font, and the hostile and neutral stimuli subtended visual angles of  $7.4^\circ$  in height and  $5.2^\circ$  in width.

Response time and accuracy data were collected for each trial. Trials were removed if response times were less than 100 ms or greater than three standard deviations from the individual participant's mean response time for each condition (i.e., incongruent trials outlier removal separate from congruent trials outlier removal). On average, one congruent trial was removed ( $SD = .63$ ) and one incongruent trial was removed ( $SD = .58$ ) for each boy due to extreme response times. Incorrect responses also were excluded and on average boys made three mistakes for congruent trials ( $SD = 2.57$ ) and three mistakes for incongruent trials ( $SD = 2.64$ ). Boys completed an average of 44 valid congruent trials ( $SD = 2.70$ ) and 44 valid incongruent trials ( $SD = 2.67$ ).

Finally, reliability statistics were computed for boys' response times in congruent and incongruent trials, and for the difference scores between boys' mean responses on incongruent versus congruent trials (i.e., hostile attentional bias measure) using split-half reliability with Spearman-Brown correction. For response times, reliability was excellent:  $\rho = .77$  (incongruent) and  $\rho = .91$  (congruent). For the hostile attentional bias measure, reliability was low,  $\rho = .12$ . This result is consistent with previous research finding; across studies the dot-probe task's measure of attentional bias using response time differences has produced low reliability ranging from  $-.18$  to  $.35$  (Gibb, McGeary, & Beevers, 2016). Low reliability sets an upper limit on the

validity of these tasks as measures of attentional bias. However, despite its low reliability in the literature (using split-half or test-retest measures), attentional bias measures using this task have demonstrated validity. For example, bias scores towards threatening stimuli are positively correlated with anxiety, and reductions in these bias scores (through attentional training) are related to reductions in anxiety (Bar-Haim et al., 2007; Hakamata et al., 2010). Although split-half and test-retest reliability are the current standard for assessing reliability of these tasks, the discrepancy between the low reliability and the demonstrated validity of these measures suggests that these indices of reliability are underestimating the true reliability of these tasks. Therefore, despite the low reliability of the current study's dot-probe task measure of the hostile attentional bias, this measure was retained as it has demonstrated validity within the literature.

#### **2.2.2.4 Temporal order judgment task**

The current study used a computer-based temporal order judgment following the procedures outlined by West et al. (2009) (described in the Introduction). During this task, an angry face and a neutral face were presented on either side of the screen (vertically centered, horizontally positioned to the left and right). The presentation of these faces was staggered, and for half the trials an angry face was presented first, and for the other half a neutral face was presented first. The difference in time between the presentations of the faces was randomly selected across trials, with stimulus onset asynchronies (SOA) of 16, 32, 48, 80, or 112 ms.

Boys were instructed to determine the temporal order of the faces after each trial by pressing the blue key (on the left side of the screen) if the face on the left side appeared first, and the red key (on the right side of the screen) if the face on the right side appeared first. Appendix D contains the instructions for this task. Boys completed at least 30 practice trials and 200 experimental trials.

Boys completed two blocks of practice trials. To familiarize them with the task, the first block of practice trials had an SOA of 500 ms and corrective feedback was provided. A green check mark appeared when a boy correctly identified the location of the stimulus that appeared first, and a red X appeared when he incorrectly identified the location. Boys completed at least 10 trials of 500 ms SOA trials; if boys achieved less than 80% accuracy, more trials were administered until they met this benchmark. The second practice block contained 20 trials with equal proportion of 16, 32, 48, 80, and 112 ms SOAs. Boys did not receive feedback during these trials. A picture of a softball and a picture of a soccerball were used as the stimuli during practice trials.

Experimental trials were distributed across five blocks with breaks between blocks. Parallel to the second practice block, each experimental block contained 40 trials with an equal proportion 16, 32, 48, 80, and 112 ms SOAs. Angry and neutral faces appeared with equal likelihood on the right- and left-hand sides of the screen; different angry face-neutral face photo pairs were used for each block. Pairs of angry and neutral faces (i.e., same actor) were presented within the same block, and each block featured a different pair of angry and neutral face.

Following from West et al. (2009), two rectangular boxes (white fill with black outline) were used to cue participants to the location of the angry and neutral faces, and the faces were presented within the rectangular boxes. Each trial began with the presentation of a central fixation cross (size 20 Arial font) and two rectangular boxes (size: visual angle of  $7.4^\circ$  width and  $5.7^\circ$  height,) for 900 ms. The boxes were vertically centered, and separated by 7 centimeters horizontally ( $4.3^\circ$  to left or right of horizontal centre). The rectangular boxes remained on the screen, and the first stimulus face (all faces were  $7.4^\circ$  in width and  $5.2^\circ$  in height) was presented in one of the boxes at 900 ms. After a specified SOA, the second stimulus face was presented in

the other rectangular box. Both faces and rectangular boxes remained on the screen for another 64 ms, followed by a white screen until a response was made. The inter-trial interval was 1,300 ms.

Trials with response times less than 100 ms were removed because such a response time is too fast to represent a response initiated following the stimuli presentation. Similarly, trials with response times greater than three standard deviations from the participant's mean response time for that condition were excluded, because the long response time suggests a lapse in attention or failure to respond (Vasey, El-Hag, & Daleiden, 1996). Excluding two participants (discussed below), all participants completed at least 150 valid trials ( $M = 194$ ;  $SD = 7$ ). Participant responses (i.e., identifying either angry or neutral face as appearing first) on valid trials were used for further calculations.

A logistic function was calculated for each child that described their responses as a function of various SOAs ranging from -112 ms to 112 ms; this function was defined as the proportion of “neutral face first” responses on valid trials. Negative SOAs indicate that an angry face was presented first, and positive SOAs indicate that a neutral face was presented first. A prioritization score was calculated for each child at the point of perceived stimulus simultaneity (PSS), which is the SOA required for the child to perceive that both faces appeared simultaneously (i.e., 50% of responses are “neutral face first” at this SOA). Greater PSS times indicate greater prioritization of hostile stimuli. For example, a PSS of 7 ms means that a neutral stimulus had to be presented 7 ms before a hostile stimulus for the child to perceive them as being simultaneously presented. Refer to Appendix E for a statistical description of the PSS. Two participants were excluded because their PSS values were greater than +/- 3 standard deviations from the group mean PSS ( $M = .77$ ;  $SD = 16.74$  including these values;  $M = .09$ ;  $SD =$

6.25 excluding these values; outlier values were -72 and 149). For both boys, their SOA regression coefficient was .001 meaning that their accuracy in correctly identifying the temporal order of faces did not improve as the task became easier (i.e., increasing SOA did not improve the probability of responding correctly). To maintain a consistent sample across all analyses, these participants also were excluded from the final data set (as described in the participant section).

Finally, reliability analyses were conducted for boys' PSS scores. In contrast to the dot-probe task, there was no published precedent to guide reliability analyses for the temporal order judgement task. Given that the temporal order judgment task assesses boys' identification of angry or neutral faces on trials rather than their response latencies on trials (i.e., answer on a trial is correct or incorrect versus a reaction time), reliability was assessed using internal consistency. There were 100 different types of trials across the five blocks (i.e., ten SOA trial options x two presentation options (right/left presentation of angry face) x five sets of angry and neutral face pairs), and each boy completed two trials for type of trial (200 trials in total). Two groups of trials were created, with one trial of each type in each group. Cronbach's alpha was calculated by comparing boys' responses (correct/incorrect) for the two groups of equivalent trials, and was  $\alpha = .32$ . Although this is low compared to questionnaire-based expectations of internal consistency, it is similar to reliability results from other cognitive tasks (e.g., Price et al., 2015). Therefore, the temporal order judgement's hostile attentional bias measure was retained and used in the main analyses.

#### **2.2.2.5 Attention shifting task**

The current study used an attention shifting task based on the task used by Arsenault and Foster (2012), which was described in the Introduction. Parallel to Arsenault and Foster's task,

our task measured boys' difficulty disengaging their attention from videos of hostile, neutral, or positive social stimuli (described above). To avoid the confounding effects of auditory stimuli, the videos were played without audio. Videos were centrally positioned on the screen and were rectangular in shape (visual angles: 11.1° width by 7.8° height). A cue (i.e., black plus sign; presented in size 20 Arial font) appeared for 500 ms at variable times (once every 3 seconds  $\pm$  1 second), and participants were instructed to identify the location of the cue on the screen by pressing either the blue or red key on the keyboard. The cue appeared on the right and left sides of the screen with equal frequency (presented at vertical centre and horizontally 7.4° to right or left from centre). Boys' responses were measured as the average amount of time it took to press the appropriate key while watching hostile, neutral, or positive social stimuli videos. In counterbalanced order across boys, boys were presented with eight hostile stimuli videos, eight neutral stimuli videos, and eight positive stimuli videos. There were five probe trials for each video, for a total of 40 trials per video condition. Instructions for this task are presented in Appendix F. Prior to beginning the task, participants completed five practice trials while watching a video of boys playing soccer. They received feedback during the practice trials for their accuracy (i.e., green check mark for a correct response, red X for an incorrect response). After practice, the experimental trials began and the videos played continuously, one after another, for the duration of the task.

Trials in which boys responded with a time less than 100 ms or greater than three standard deviations from their individual mean in a particular condition were excluded from calculations (angry video condition  $M = .69$ ,  $SD = .67$ ; happy video condition  $M = .53$ ,  $SD = .58$ ; neutral video condition  $M = .68$ ,  $SD = .60$ ). Trials in which boys responded incorrectly also were excluded from calculations (angry video condition  $M = 1.85$ ,  $SD = 1.96$ ; happy video condition

$M = 2.18$ ,  $SD = 2.11$ ; neutral video condition  $M = 2.10$ ,  $SD = 1.93$ ). Overall, boys completed an average of 37 valid trials for the angry video condition ( $SD = 1.97$ ), 37 valid trials for the happy video condition ( $SD = 2.09$ ), and 37 valid trials for the neutral video condition ( $SD = 1.98$ ).

The hostile attentional bias was measured in two different ways: 1) By the difference between average response times to detecting the probe during the angry videos and the average response times to probe detection during the neutral videos, and 2) by the difference between average response times during the angry versus happy videos. In both cases, higher scores indicated greater hostile attentional bias. Finally, reliability statistics were computed for boys' response times in each of the three conditions, and for the difference scores between conditions using split-half reliability with Spearman-Brown correction. For response times, reliability was excellent:  $\rho = .94$  (angry),  $\rho = .92$  (neutral), and  $\rho = .95$  (happy). For attentional bias scores, reliability was  $\rho = .44$  for both difference score measures of the hostile attentional bias. Parallel to the other tasks, although these estimates of reliability were low, the attention shifting task's measures of the hostile attentional bias were retained for two reasons: 1) these reliability measures are consistent with other cognitive task's reliabilities (e.g., Price et al., 2015), and 2) it is unclear from the literature whether questionnaire-based methods of assessing reliability are the best way to assess reliability of cognitive tasks (Gibb et al., 2016).

### **2.2.3 Aggression**

To support a multi method-multi informant approach to measurement<sup>2</sup>, aggression was assessed using parent- and child-reports across multiple measures. Parents and boys completed

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<sup>2</sup> To broaden the scope of aggression measures, boys also completed a competitive game against a fictitious peer that was hoped to be an analog measure of aggression. This measure was

parallel versions of the Peer Conflict Scale (PCS; Marsee & Frick, 2007). The PCS is a 40-item questionnaire with four subscales based on aggression function and form, including physical and relational forms of reactive and proactive aggression. Function is often confounded by form on aggression measures, and the major advantage of the PCS is that scales include items that measure both overt/physical aggression and social/relational aggression with reactive and proactive functions. Each item assesses how well the item describes the child and is rated on a four-point Likert scale (0 = *not at all true*; 3 = *definitely true*). The internal consistency coefficient for the subscales ranges from .77 to .88 for child-report (Cronbach alpha) (Marsee et al., 2011). The child-report PCS also has demonstrated construct validity (Kimonis, Frick, Munoz, & Aucoin, 2008; Munoz, Frick, Kimonis, & Aucoin, 2008), and has been used for boys aged 6 to 17 (Marsee, Weems, & Taylor, 2008). Psychometric data has not been reported for the parent-report version of this measure. The internal consistencies for the child- and parent-report in the current study were good ( $\alpha = .91$  and  $\alpha = .92$  respectively). Item scores were averaged for both the parent- and child-report, with higher scores indicating higher levels of aggression.

Parents also completed the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) and the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008). The Aggressive behaviors subscale of the CBCL and the Self-Control subscale of the SSIS also were

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experimental and had not been previously validated as a measure of aggression in boys. Boys' performance on this task did not correlate with any of the validated measures of aggression used in the current study. Given these results, it was not included in any analyses because it did not appear to measure boys' aggression.

used as measures of child aggression. The CBCL is a 112-item questionnaire that assesses a range of psychological and behavioral difficulties. The Aggressive Behaviors subscale is 18-items; items describe a diverse range of aggressive acts (e.g., teasing, meanness, attacking, fighting, threatening). Parents are asked to report how true statements are for their child on a three-point scale (0 = *not true*; 2 = *very true or often true*). The CBCL is a widely used measure with excellent psychometric properties, and has been validated for use with youth between 6 and 18 years, and the Aggressive Behaviors subscale is frequently used as a clinical screen for aggression (Achenbach & Rescorla, 2001). The average item rating on the Aggressive Behaviors subscale was used as a measure of aggression in this study, with higher scores indicating higher levels of aggression. This measure had good internal consistency in the study ( $\alpha = .88$ ).

The SSIS is a 46-item broadband measure of social functioning. The Self-Control subscale contains 7-items that assess responding appropriately in aggression-provoking or conflict situations. Parents are asked to rate how often a particular behaviour occurs on a four-point scale (0 = *never*; 3 = *almost always*). The SSIS has demonstrated construct validity and has been used for boys aged 3 to 18 (Gresham & Elliot, 2008). In contrast to the other measures of aggression, the Self-Control subscale's items are phrased from a positive perspective (e.g., "responds appropriately when teased"). This is a potential advantage and may mitigate social desirability bias to a greater extent than the negatively worded items on the other aggression scales (i.e., reporting less of a positive characteristic may be easier than reporting more of a negative characteristic). The internal consistency for this subscale is strong ( $\alpha = .84$ ; Gresham & Elliot, 2008), and also was strong within the current sample ( $\alpha = .83$ ). Items on this scale were reverse-scored, and the average of these item ratings was used as a measure of aggressive behavior, with higher scores indicating higher levels of aggression.

#### **2.2.4 Effortful control**

Parents completed the Effortful Control scale of the Early Adolescent Temperament Questionnaire – Revised (EATQ-R; Putnam, Ellis, & Rothbart, 2001), which measures their child’s activation control, attentional control, and inhibitory control. This scale contains 18 items describing behaviors reflecting difficulties with effortful control (e.g., forgets what was about to say when interrupted; has a hard time waiting for turn to speak). Parents rate how well each item describes their child on a five-point scale (1 = *almost always untrue*; 5 = *almost always true*). Some items are reversed scored. This scale has strong internal consistency, and is correlated with other measures of behavioural and attentional dysregulation (Oldehinkel, Hartman, De Winter, Veenstra, & Ormel, 2004). Internal consistency for Effortful Control in the current study was strong ( $\alpha = .91$ ). The average rating of items on this scale was used as a measure of effortful control, with higher scores indicating higher levels of effortful control.

#### **2.3 Procedures**

This study was approved by The University of British Columbia’s Research Ethics Board. Recruitment flyers provided information about the study to prospective participant families, and interested parents were instructed to contact the UBC Parenting Lab. When parents contacted the lab, they were given more information about the study and asked a series of screening questions to determine their child’s eligibility for the study (Appendix G). Parents on the UBC Parenting Lab’s participant registry were contacted by telephone or email about the study and, if interested, completed the same screening questions.

The eligibility screen questions asked about the possibility of child intellectual disability, autism spectrum disorder or pervasive developmental disorders, and uncorrected poor vision. These questions also provided an informal assessment of the spoken English skills of the parents,

and questions were asked about the boys' spoken, written, and English comprehension abilities. When prospective families met eligibility criteria and the parent provided verbal or written (in email) consent for their child's participation, an appointment to participate in the study was scheduled. Depending on each family's preference, appointments were scheduled as either a home visit or a visit to the UBC Parenting Lab (80% were home visits). Location of the visit was not significantly related to any of the variables of interest.

During the home/lab visit, boys completed questionnaires and five computer tasks, and parents (one parent for each participating child) completed questionnaires. The visits took approximately 2 to 2.5 hours for boys to complete all measures. Parents required 30-45 minutes to complete questionnaires. At the beginning of the visit, consent and assent were obtained from parents and boys, respectively (these forms are contained in Appendices H and I). The investigator explained the study to boys while their parents reviewed the consent form. As part of informed consent, families were told they are free to withdraw from participation at any point and that all information collected would be kept confidential.

As much as possible, the investigator attempted to have boys complete the study in a quiet room where they are unlikely to be disturbed during home visits. In most cases, boys completed the study at their dining room or kitchen table with minimal disturbances. During lab visits, boys completed the study in a quiet room without disturbance.

Once consent and assent were obtained, the parent was asked to complete his/her questionnaires in an area separate from the child. Boys were seated in front of the computer, approximately 50 cm from the screen (measured using measuring tape, and adjusted when boys

were too far or too close). Boys completed the attention allocation tasks<sup>3</sup>, and the PCS during the first half of the visit. In most cases, boys completed the PCS with the investigator (i.e., investigator read items and boys responded with their ratings). The PCS was completed between the attention allocation tasks, and the order of the tasks counterbalanced across participants. During the second half of the visit, boys completed emotion ratings of the photos and videos used in the attention allocation tasks.

To examine additional research questions, boys also completed a computer task and two questionnaires that were not used in the current study. One of these questionnaires was administered during the first half of the study and its administration order was counterbalanced with the PCS. The computer task and the other questionnaire were administered the same order for all participants in the second half of the visit: Emotion Faces Rating Scale, computer task, questionnaire, and Emotion Video Rating Scale. At the end of the lab/home visit, boys were given \$20 plus whatever they earned during one of the computer tasks (up to \$5; data from this task not used in the current study).

Parents completed the FIQ, PCS, CBCL, SSIS, and EATQ-R, in addition to three other questionnaires that were not used in the current study. The order they completed these questionnaires was randomized, with the exception that the FIQ was always completed first. All parents completed all questionnaires, and almost all parents did so during the lab/home visit.

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<sup>3</sup> A visual search task also was used as a measure of the hostile attentional bias. Unfortunately, there were errors in the administration of this task and its results were not interpretable. Therefore, the results of this task are not reported. This task was presented to boys in a counterbalanced order with the other three attention allocation tasks.

However, one parent requested the questionnaires be mailed ahead of time as she was unable to complete them during the home visit, and another parent did not complete the questionnaires during the home visit and instead mailed them to the lab with a self-addressed stamped envelope that was provided. Appendix J contains the Procedure Manual.

## Chapter 3: Results

All data analyses were performed using SPSS 23.0 and RStudio 0.98.1018. Pearson correlations were conducted to investigate the relations among measures of aggression. As is discussed below, aggression measures were significantly correlated and were combined into one composite variable; the composite variable was used to measure aggression throughout the analyses. Pearson correlations also were conducted on the primary variables (i.e., hostile attention bias, aggression composite measure, and effortful control) and potential covariates (i.e., demographic characteristics). Covariate variables that were significantly related to aggression and either the hostile attentional bias or effortful control ( $p < .05$ ) were controlled in subsequent analyses. The study's main hypotheses were examined in bivariate correlations and then in a series of hierarchical regression models, and significance testing was conducted at  $\alpha = .05$ . Fortunately, all parent- and child-report measures were completed and there were no missing data at the summary level for any questionnaire. Summary scores were pro-rated for missing items using mean imputation, and no more than two items were missing on any questionnaire.

### 3.1 Descriptive Information

#### 3.1.1 Demographic characteristics

The demographic characteristics of the sample are summarized in a previous section. With one exception, no demographic characteristics (i.e., socioeconomic status, child age, or child ethnicity) were significantly related to the hostile attentional bias measures ( $ps > .05$ ). As the exception, child age was significantly positively related to the attention shifting task's hostile attentional bias measure (angry – happy version),  $r(111) = .27, p = .003$ . Effortful control was significantly positively correlated with socioeconomic status (Hollingshead raw score),  $r(111) = .23, p = .02$ ; no other demographic characteristics were significantly related to effortful control

( $ps > .05$ ). Finally, no demographic characteristics were significantly related to aggression ( $ps > .05$ ). Given these results, no demographic characteristics were covaried in the main analyses.

### **3.1.2 Hostile attentional bias**

Table 1 contains the descriptive statistics for children's hostile attentional bias using the dot-probe, temporal order judgment, and attention shifting tasks. The measures were approximately normally distributed excepting two measures derived from the attention shifting task. These measures had positively skewed leptokurtic distributions. In these cases, transformations can be applied to measures to improve their distribution (Tabachnick & Fidell, 2007); however, for ease of interpretation across the three measures of the hostile attentional bias, these two measures' scores were not transformed. Instead, as is discussed later, regression coefficients were estimated using bootstrapping, which provides less biased estimates under non-normal conditions. Consistent with previous research, the mean levels across all hostile attentional bias measures were greater than zero, suggesting that, on average, boys demonstrated some degree of attentional bias towards hostile stimuli. As expected, none of the hostile attentional bias measures were significantly correlated with one another – excepting the two measures derived from the attention shifting task, which shared variance from boys' response times while watching angry videos (Table 2). The lack of significant association among tasks is consistent with the suggestion that they are measuring different aspects of attention allocation. Descriptive statistics for the mean response times for each type of trial within each task are reported in Appendix K.

**Table 1 Descriptive Statistics for the Variables of Interest**

	M	SD	Range	Skew <sup>a</sup>	Kurtosis <sup>b</sup>
<b>Hostile Attentional Bias</b>					
Dot-probe <sup>c</sup>	-1.20	74.38	-255 to 188	-.38	1.29
Temporal order judgment <sup>d</sup>	.01	6.28	-14.91 to 20.56	.41	.13
Attention shifting <sup>e</sup> (angry – neutral)	.47	44.97	-144 to 168	.62	3.11
Attention shifting (angry – happy)	3.13	41.94	-99 to 167	1.04	3.29
Effortful control	3.41	.67	1.56 to 4.72	-.59	-.17
<b>Aggression</b>					
Composite <sup>f</sup>	.00	.75	-1.25 to 3.08	1.40	3.08
PCS Parent	.16	.19	0 to .98	1.89	4.00
PCS Child	.29	.28	0 to 1.48	1.72	3.59
CBCL Aggressive Behaviors	4.62	5.08	0 to 27	1.89	4.48
SSIS Self Control <sup>g</sup>	1.18	.49	0 to 2.29	.11	-.36

<sup>a</sup> Standard error for skew = .23

<sup>b</sup> Standard error for kurtosis = .45

<sup>c</sup> Difference in mean response time between incongruent and congruent trials

<sup>d</sup> Point of perceived simultaneity

<sup>e</sup> Difference in mean response time between angry video and neutral video trials

<sup>f</sup> Mean of standardized scores from the Peer Conflict Scale Parent-Report (PCS Parent), Peer Conflict Scale Child-Report (PCS Child), Child Behavior Checklist (CBCL) Aggressive Behaviors scale, and Social Skills Improvement System (SSIS) Self Control scale

<sup>g</sup> Reverse scored

**Table 2 Pearson Correlations among Measures of the Hostile Attentional Bias**

	2.	3.	4.
1. Dot-probe	-.04	-.16	-.12
2. Temporal order judgment		-.04	-.06
3. Attention shifting (angry – happy)			.52**
4. Attention shifting (angry – neutral)			

\*\* Correlation significant at  $p < .01$

### 3.1.3 Effortful control

As seen in Table 1, parent-report of children's effortful control was approximately normally distributed, and covered nearly the full range of the measure. The mean level of effortful control was slightly above the mid-point on the scale, and was similar to mean levels of effortful control reported in another study using a community sample (Ellis, 2002).

### 3.1.4 Aggression

Descriptive statistics for the four measures of boys' aggression are reported in Table 1. Three of the four measures of aggression had positively skewed leptokurtic distributions; on average parent and child ratings fell below the mid-point on each of these scales. In contrast, parent ratings on the SSIS Self Control scale (reverse scored) had a normal distribution with responses nearly covering its full range and a ratings' average closer to the mid-point of this scale. Consistent with the community nature of this sample, parent and child ratings of aggression were, on average, at normative levels. Nonetheless, a wide range of aggression severity was represented by the sample. For example, on the CBCL Aggressive Behaviors scale, the average of parent ratings was equivalent to a T score of 54 (SD = 6.8; range = 50 to 86).

As seen in Table 3, the mean scores on the four aggression measures were significantly correlated; all parent-report measures were moderately to strongly positively correlated, and the child-report measure were weakly-to-moderately correlated with the parent-report measures. To provide a comprehensive measure of aggression, incorporating both parent and child perspective, all four measures' scores were standardized and averaged to form an aggression composite variable that was used in the main analyses. As a measure of the composite's reliability, and internal consistency value was calculated using the four measures' scores as items, and compared to internal consistency values if different measures were removed from the scale. The internal consistency of the four-measure composite was  $\alpha = .74$ , indicating adequate internal consistency. Removal of any parent-report measure resulted in a decrease in internal consistency (ranging from  $\alpha = .61$  to  $\alpha = .66$ ), in contrast removal of the child-report measure resulted in a small increase in internal consistency ( $\alpha = .78$ ). Given that the child-report was the only measure from another informant, this pattern of results is not surprising. All four measures were retained in the composite measure because this composite had demonstrated reliability and assessed a range of aggressive behaviors from multiple perspectives.

Descriptive statistics for the composite measure are reported in Table 1 and like its constituent measures it also had a positively skewed leptokurtic distribution. Different transformations were performed on the composite variable to reduce its non-normality, including square-root, reciprocal, and logarithmic transformations (Tabachnick & Fidell, 2007). However, none of these transformations improved the normality of this variable (i.e., all transformed variables continued to have positively skewed leptokurtic distributions). Therefore, the original variable was retained for the main analyses to ease interpretation. Consistent with expectation, aggression was significantly negatively correlated with effortful control,  $r(111) = -.57, p < .001$ .

**Table 3 Pearson Correlations among Measures of Boys' Aggression**

	2.	3.	4.	5.
1. Peer Conflict Scale Parent-Report	.30**	.64***	.46***	.80***
2. Peer Conflict Scale Child-Report		.25**	.27**	.61***
3. CBCL Aggressive Behaviors <sup>a</sup>			.55***	.82***
4. SSIS Self Control (reverse scored) <sup>b</sup>				.76***
5. Composite <sup>c</sup>				

\*\* Correlation significant at  $p < .01$

\*\*\* Correlation significant at  $p < .001$

<sup>a</sup> CBCL = Child Behavior Checklist

<sup>b</sup> SSIS = Social Skills Improvement System

<sup>c</sup> Mean of standardized scores from the four aggression measures

### 3.2 Main Analyses

Given that no demographic covariates were included in the main analyses, a series of correlations tested the studies' primary hypotheses that the hostile attentional bias would be positively related to boys' aggression (using four separate measures of the hostile attentional bias). Regarding the secondary hypotheses, a series of hierarchical regression models were developed to test the moderating role of effortful control on the relation between the hostile attentional bias and boys' aggression. In these models, step one contained the hostile attentional bias and effortful control as predictors of aggression. Step two contained the interaction term between the hostile attentional bias and effortful control. The scores of the hostile attentional bias and effortful control were centered, and the interaction term was created by multiplying the scores of the centered measures. A different measure of the hostile attentional bias was used in each of the hierarchical regression models.

Assumption testing revealed that all models violated the assumption of normality of residuals. Violations of normality result in biased standard errors. Bootstrapped confidence intervals produce unbiased standard errors, and mitigate against possible biases from this violation (DiCiccio & Efron, 1996). Therefore, bootstrapped confidence intervals are reported for all models, in addition to significance testing results. For all models, the results from bootstrapped confidence intervals and significance testing using  $p$  values converged indicating that the normality violation did not affect the overall interpretation of these results. No other assumptions were violated for any of the models.

Each model was inspected for multivariate outliers, and outliers were identified using Cook's distance, with a threshold value of .04 (set using the equation  $4/(N - k - 1)$ ; Fox, 2008). Depending on the model, between five and eight outliers were identified. Analyses were conducted with and without these cases; results were consistent between these analyses across all models. Therefore, to maximize power, outlier cases were retained for all analyses.

### **3.2.1 Dot-probe task model**

Contrary to primary hypothesis, that the hostile attentional bias would be positively related to boys' aggression, at the bivariate level, the hostile attentional bias, as measured using the dot-probe task, was not significantly related to child aggression,  $r(111) = .08, p = .40$ . A hierarchical regression model tested the secondary hypothesis that this relation would be moderated by effortful control. As described by Table 4, step one of this model, which included effortful control and the dot-probe task hostile attentional bias, accounted for 33% of the variance in child aggression,  $F(2, 110) = 27.06, p < .001$ . Inspection of the standardized coefficients indicated that effortful control was uniquely negatively related to child aggression, but the dot-probe task hostile attentional bias was not significantly related to child aggression. At

step two, the interaction term between the dot-probe task hostile attentional bias and effortful control did not account for a significant amount of variance in child aggression  $F_{change}(1, 109) < 1$ . Overall this model accounted for a significant amount of variance in child aggression,  $F(3, 109) = 18.21, p < .001$ , and this was driven primarily through the relation between effortful control and aggression. In summary, the results from the dot-probe task hostile attentional bias analyses failed to support both the primary hypothesis, that this bias is positively associated with boys' aggression, and the secondary hypothesis, that this relation is moderated by effortful control.

**Table 4 Summary of Regression Analysis for the Dot-Probe Task (DPT) Hostile Attentional Bias and Effortful Control as Predictors of Child Aggression ( $n = 113$ )**

Variable	b	SE b	$\beta$	CI 95% $\beta^a$	p
Step 1					
Effortful control	-.63	.09	-.57	-.70 to -.42	< .01
DPT hostile attentional bias	< .01	< .01	.05	-.06 to .18	.50
Step 2					
Effortful control <sup>b</sup>	-.64	.09	-.58	-.70 to -.43	< .01
DPT hostile attentional bias <sup>b</sup>	< .01	< .01	.04	-.09 to .15	.63
Effortful control x DPT hostile attentional bias <sup>c</sup>	< .01	< .01	-.07	-.29 to .10	.41

<sup>a</sup> Based on 5,999 bootstrapped samples; bias-corrected and accelerated confidence intervals

<sup>b</sup> The values on these scales have been centered around the means

<sup>c</sup> Interaction term using product of centered effortful control and hostile attentional bias measures

### 3.2.2 Temporal order judgment task model

Consistent with the primary hypothesis, at the bivariate level, the hostile attentional bias, assessed by the temporal order judgment task, was significantly positively correlated with child aggression,  $r(111) = .21, p = .02$ . That is, boys who more quickly perceived the angry compared to neutral faces were those with higher aggression scores. A hierarchical regression model tested the secondary hypothesis that this relation would be moderated by effortful control (Table 5). At step one, effortful control and the temporal order judgment task hostile attentional bias accounted for 33% of the variance in child aggression,  $F(2, 110) = 26.85, p < .001$ . Inspection of the standardized coefficients revealed that effortful control was a significant negative predictor of child aggression, whereas the temporal order judgment task hostile attentional bias was not

uniquely significantly related to aggression with effortful control in the model. The interaction term between the temporal order judgment task hostile attentional bias and effortful control was entered at step two, and accounted for an additional 4% of variance in child aggression,  $F_{change}(1, 109) = 6.44, p = .01$ . Overall this model accounted for a significant amount of variance in child aggression,  $F(3, 109) = 20.93, p < .001$ .

Further examination of the interaction using simple slope analysis revealed that the temporal order judgment task hostile attentional bias was a marginally significant predictor of child aggression among children with relatively low levels of effortful control (i.e., one standard deviation below the mean on effortful control),  $\beta = .20$  with  $CI_{.95} [-.12, .57], t(109) = 1.93, p = .06$ . Similarly, the temporal order judgment task hostile attentional bias was not significantly related to child aggression at a higher level of effortful control (i.e., one standard deviation above the mean on effortful control),  $\beta = -.20$  with  $CI_{.95} [-.39, .001], t(109) = -1.63, p = .10$ . Although neither of these relations were significant at the  $\alpha = .05$  level, the simple slope analyses did reveal a pattern in the expected direction: as children's levels of effortful control decreased, the relation between the temporal order judgment task hostile attentional bias and their aggression became increasingly positive (Figure 1). Overall, the results of these analyses supported the primary hypothesis that the temporal order judgment task hostile attentional bias is positively related to aggression and the secondary hypothesis that this relation is moderated by effortful control.

**Table 5 Summary of Regression Analysis for the Temporal Order Judgment Task (TOJ) Hostile Attentional Bias and Effortful Control as Predictors of Child Aggression ( $n = 113$ )**

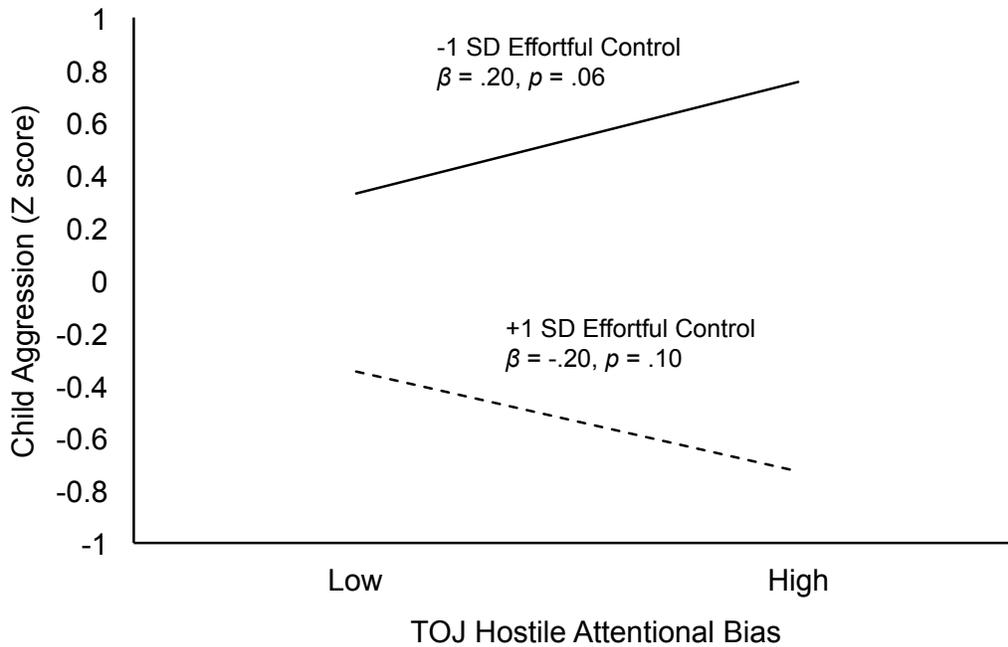
Variable	b	SE b	$\beta$	CI 95% $\beta^a$	p
Step 1					
Effortful control	-.62	.09	-.56	-.71 to -.37	< .01
TOJ hostile attentional bias	< .01	.01	.04	-.14 to .31	.67
Step 2					
Effortful control <sup>b</sup>	-.61	.09	-.54	-.70 to -.37	< .01
TOJ hostile attentional bias <sup>b</sup>	< .01	.01	< .01	-.17 to .22	.98
Effortful control x TOJ hostile attentional bias <sup>c</sup>	-.04	.01	-.20	-.40 to -.003	.01

<sup>a</sup> Based on 5,999 bootstrapped samples; bias-corrected and accelerated confidence intervals

<sup>b</sup> The values on these scales have been centered around the means

<sup>c</sup> Interaction term using product of centered effortful control and hostile attentional bias measures

**Figure 1 Interaction Between the Temporal Order Judgment Task (TOJ) Hostile Attentional Bias and Effortful Control in Relation to Child Aggression**



### 3.2.3 Attention shifting task models

The hostile attentional bias was measured in two ways using the attention shifting task by contrasting boys' mean response times for different types of trials: (1) response times while watching distracting angry videos – response times while watching distracting happy videos (i.e., angry – happy), and (2) response times while watching distracting angry videos – response times while watching distracting neutral videos (i.e., angry – neutral). The current study used both neutral and happy videos as separate control measures of boys' attention shifting patterns (i.e., their response times during these trials were assumed to reflect how easily they could shift their attention from one stimulus to another on average). Although previous research used positively valenced stimuli as control measures of attention shifting (Arsenault & Foster, 2012; Gouze, 1987), there is concern that such stimuli make it difficult to know whether children are attending more to hostile or less to prosocial/positive events. The current study aimed to replicate and

extend these findings by using both happy videos (to replicate past studies' measures) and neutral videos (which might provide better estimates of baseline attention shifting patterns than positively valenced stimuli) as control conditions.

Separate analyses were conducted for each of these measures. For each analysis, it was predicted that the hostile attentional bias would be positively correlated with boys' aggression (primary hypothesis), and that effortful control would moderate this relation (secondary hypothesis). In particular, it was expected that the positive relation between the hostile attentional bias and boys' aggression would strengthen as levels of effortful control decreased.

### **3.2.3.1 Attention shifting task model (angry – happy)**

Contrary to the primary hypothesis, at the bivariate level, the hostile attentional bias, assessed using the attention shifting task (angry – happy), was not significantly correlated with child aggression,  $r(111) = .15, p = .11$ . Parallel to the other analyses, a hierarchical regression model tested the secondary hypothesis that effortful control would moderate the relation between the attention shifting task (angry – happy) hostile attentional bias and boys' aggression (Table 6). As with the other models, effortful control and the attention shifting task (angry – happy) hostile attentional bias were entered in step one and accounted for 34% of the variance in child aggression,  $F(2, 110) = 27.87, p < .001$ . Inspection of the standardized coefficients revealed that effortful control was negatively related to child aggression, but that the attention shifting task (angry – happy) hostile attentional bias was not significantly related to child aggression. The interaction term between effortful control and the attention shifting task (angry – happy) hostile attentional bias was entered at step two and did not account for additional variance in child aggression,  $F_{change}(1, 109) < 1$ . Overall this model accounted for a significant amount of variance

in boys' aggression, and this was driven through the relation between effortful control and aggression,  $F(3, 109) = 18.61, p < .001$ .

**Table 6 Summary of Regression Analysis for the Attention Shifting Task (AST) Hostile Attentional Bias (Angry – Happy) and Effortful Control as Predictors of Child Aggression ( $n = 113$ )**

Variable	b	SE b	$\beta$	CI 95% $\beta^a$	p
Step 1					
Effortful control	-.63	.09	-.56	-.68 to -.41	< .01
AST hostile attentional bias	< .01	< .01	.10	-.03 to .21	.22
Step 2					
Effortful control <sup>b</sup>	-.63	.09	-.57	-.69 to -.41	< .01
AST hostile attentional bias <sup>b</sup>	< .01	< .01	.10	-.03 to .23	.19
Effortful control x AST hostile attentional bias <sup>c</sup>	< .01	< .01	.05	-.11 to .25	.53

<sup>a</sup> Based on 5,999 bootstrapped samples; bias-corrected and accelerated confidence intervals

<sup>b</sup> The values on these scales have been centered around the means

<sup>c</sup> Interaction term using product of centered effortful control and hostile attentional bias measures

### 3.2.3.2 Attention shifting task model (angry – neutral)

Contrary to the primary hypothesis, the hostile attentional bias, as measured using the attention shifting task (angry - neutral), was not significantly correlated with child aggression at the bivariate level,  $r(111) = -.07, p = .46$ . The results from a hierarchical regression model testing the secondary hypothesis were somewhat consistent with this nonsignificant relation, but also suggested an unexpected direction of moderation of the relation by effortful control (Table 7). At step one, effortful control and the attention shifting task (angry - neutral) hostile attentional bias

accounted for 34% of the variance in child aggression,  $F(2, 110) = 28.32, p < .001$ . Inspection of the standardized coefficients revealed that effortful control was negatively related to child aggression, but the attention shifting task (neutral-happy) hostile attentional bias was not significantly related to child aggression. At step two, the interaction term between the attention shifting task (neutral-happy) hostile attentional bias and effortful control was marginally significant, and accounted for an additional 2% of the variance in child aggression,  $F_{change}(1, 109) = 3.15, p = .08$ . Overall this model accounted for a significant amount of variance in child aggression,  $F(3, 109) = 20.30, p < .001$ . However, examination of the interaction using simple slope analysis revealed that the attention shifting task (neutral-happy) hostile attentional bias was a significant negative predictor of child aggression among children with a relatively low level of effortful control,  $\beta = -.21$  with  $CI_{.95} [-.46, -.007]$ ,  $t(109) = -2.24, p = .03$ . In contrast, the attention shifting task (neutral-happy) hostile attentional bias was not significantly related to child aggression at higher levels of effortful control (i.e., one standard deviation above the mean on effortful control),  $\beta = .04$  with  $CI_{.95} [-.16, .24]$ ,  $t(109) = .34, p = .73$ . Figure 2 illustrates these results.

**Table 7 Summary of Regression Analysis for the Attention Shifting Task (AST) Hostile Attentional Bias (Angry – Neutral) and Effortful Control as Predictors of Child Aggression ( $n = 113$ )**

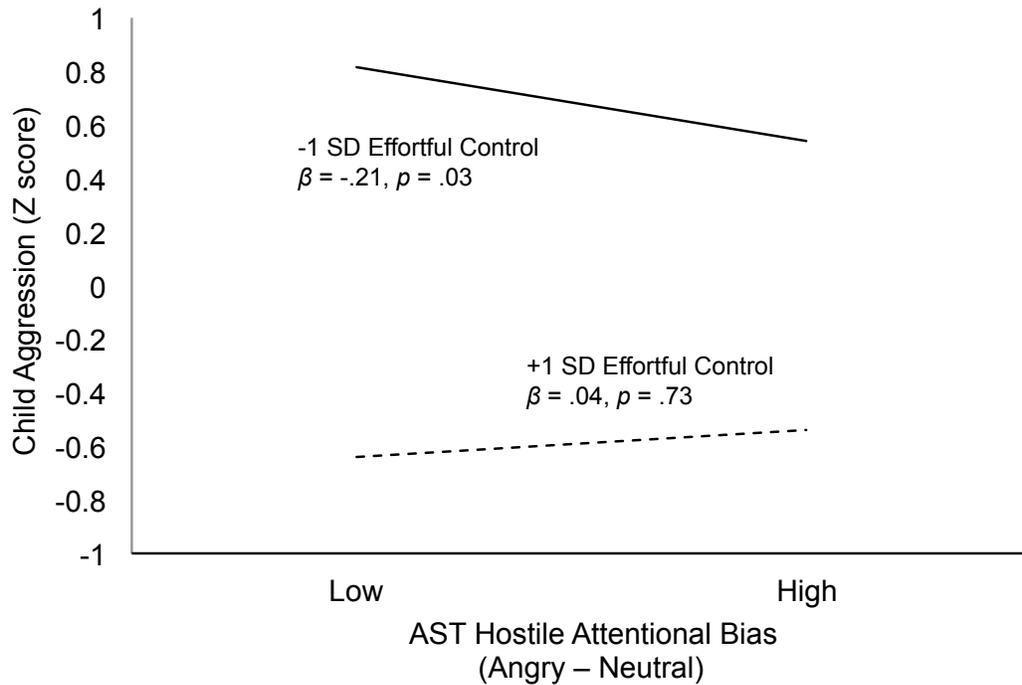
Variable	b	SE b	$\beta$	CI 95% $\beta^a$	p
Step 1					
Effortful control	-.65	.09	-.58	-.70 to -.43	< .01
AST hostile attentional bias	< .01	< .01	-.11	-.23 to .01	.15
Step 2					
Effortful control <sup>b</sup>	-.65	.09	-.59	-.70 to -.44	< .01
AST hostile attentional bias <sup>b</sup>	< .01	< .01	-.09	-.22 to .06	.27
Effortful control x AST hostile attentional bias <sup>c</sup>	< .01	< .01	.14	-.03 to .30	.08

<sup>a</sup> Based on 5,999 bootstrapped samples; bias-corrected and accelerated confidence intervals

<sup>b</sup> The values on these scales have been centered around the means

<sup>c</sup> Interaction term using product of centered effortful control and hostile attentional bias measures

**Figure 2 Interaction Between the Attention Shifting Task (AST) Hostile Attentional Bias (Angry – Neutral) and Effortful Control in Relation to Child Aggression**



This interaction result was opposite to what was predicted, which was that at lower levels of effortful control, greater difficulty disengaging attention from angry videos relative to neutral videos would be positively related to aggression. Instead, these results suggest that, among children with less effortful control, greater difficulty disengaging attention from *neutral videos* relative to angry videos was positively related to levels of aggression. Because this hostile attention bias is computed as the difference in response time during angry vs. neutral videos, there are two possible explanations for these unexpected results. At lower levels of effortful control, aggression may be positively related to: (1) a tendency to avoid or easily disengage attention from the angry videos (i.e., faster response times during angry videos), or (2) difficulty disengaging attention from neutral videos (i.e., slower response times during neutral videos).

That is, at low levels of effortful control, children who are more aggressive may either be faster in disengaging from hostile stimuli or they may, for some reason, have greater difficulty disengaging from the neutral videos.

Regarding the first possibility, if aggression was positively related to faster response times during angry videos (the angry part of the difference score), one would also expect a negative relation between the attentional bias measure calculated using angry – happy video trials and aggression (i.e., more aggressively behaved boys should respond faster to angry trials relative to happy trials). However, as noted above, the results from the angry-happy bias score from the attention shifting task fail to support this prediction. The angry – happy hostile attentional bias was not significantly associated with boys’ aggression at the bivariate level or within the hierarchical regression model. Therefore, I conclude that aggression is not related to attentional avoidance of angry videos. The alternate possibility, that aggression is related to difficulty disengaging attention from neutral videos, was examined through exploratory analyses described in the following section.

### **3.2.3.3 Attention shifting task model (neutral – happy)**

Exploratory analyses using a measure of attentional bias contrasting boys’ response times during neutral trials with their response times during happy trials were conducted to test the possibility that aggression was related to difficulty disengaging attention from neutral videos. If this was the case, one would expect that the attention shifting task (neutral – happy) attentional bias would be positively correlated with boys’ aggression, especially at lower levels of effortful control where the link between attentional biases and aggression should be strongest.

Before conducting these analyses, descriptive statistics and correlational analyses were run on this new measure of attentional bias. This measure was normally distributed, with similar

average levels as the other attention shifting task measures ( $M = 42.58$ ;  $SD = 2.66$ ; range -101 to 106). The split-half reliability of this measure was adequate,  $\rho = .60$ . It was not correlated with either temporal order judgment task or dot-probe task hostile attentional bias measures. It was significantly negatively correlated with the attention shifting task (neutral-happy) hostile attentional bias measure,  $r(111) = -.54, p < .001$ , and significantly positively correlated with the attention shifting task (neutral – happy) hostile attentional bias measure,  $r(111) = .43, p < .001$ . These results were expected, given this measure shares variance from either neutral or happy video response times with the other two attention shifting task hostile attentional bias measures.

Consistent with the possibility that aggression is related to difficulty disengaging from neutral videos, the attention shifting task (neutral – happy) attentional bias measure was significantly positively correlated with child aggression,  $r(111) = .22, p = .02$ . Parallel to the other models, a hierarchical regression model tested this hypothesis, and the secondary hypothesis of effortful control as a moderator (Table 8). Effortful control and the attention shifting task (neutral – happy) attentional bias were entered in step one and accounted for 37% of the variance in child aggression,  $F(2, 110) = 32.75, p < .001$ . In this case, both effortful control and the attention shifting task (neutral – happy) attentional bias were significant negative predictors of boys' aggression. In addition, the interaction term between effortful control and the attention shifting task (neutral – happy) attentional bias, entered in step two, accounted for an additional 3% of variance in child aggression,  $F_{change}(1, 109) = 4.58, p = .04$ . I note, however, that this effect was not significant using 95% bootstrapped confidence intervals for significance testing, but was significant using 90% bootstrapped confidence intervals. Overall this model accounted for a significant amount of variance in child aggression,  $F(3, 109) = 24.07, p < .001$ .

**Table 8 Summary of Regression Analysis for the Attention Shifting Task (AST) Hostile Attentional Bias (Neutral – Happy) and Effortful Control as Predictors of Child Aggression ( $n = 113$ )**

Variable	b	SE b	$\beta$	CI 95% $\beta^a$	p
Step 1					
Effortful control	-.63	.08	-.57	-.69 to -.42	< .01
AST hostile attentional bias	< .01	< .01	.22	.09 to .33	< .01
Step 2					
Effortful control <sup>b</sup>	-.62	.08	-.56	-.69 to -.42	< .01
AST hostile attentional bias <sup>b</sup>	< .01	< .01	.22	.19 to .34	< .01
Effortful control x AST hostile attentional bias <sup>c</sup>	< .01	< .01	-.16	-.36 to .01 <sup>d</sup>	.03

<sup>a</sup> Based on 5,999 bootstrapped samples; bias-corrected and accelerated confidence intervals

<sup>b</sup> The values on these scales have been centered around the means

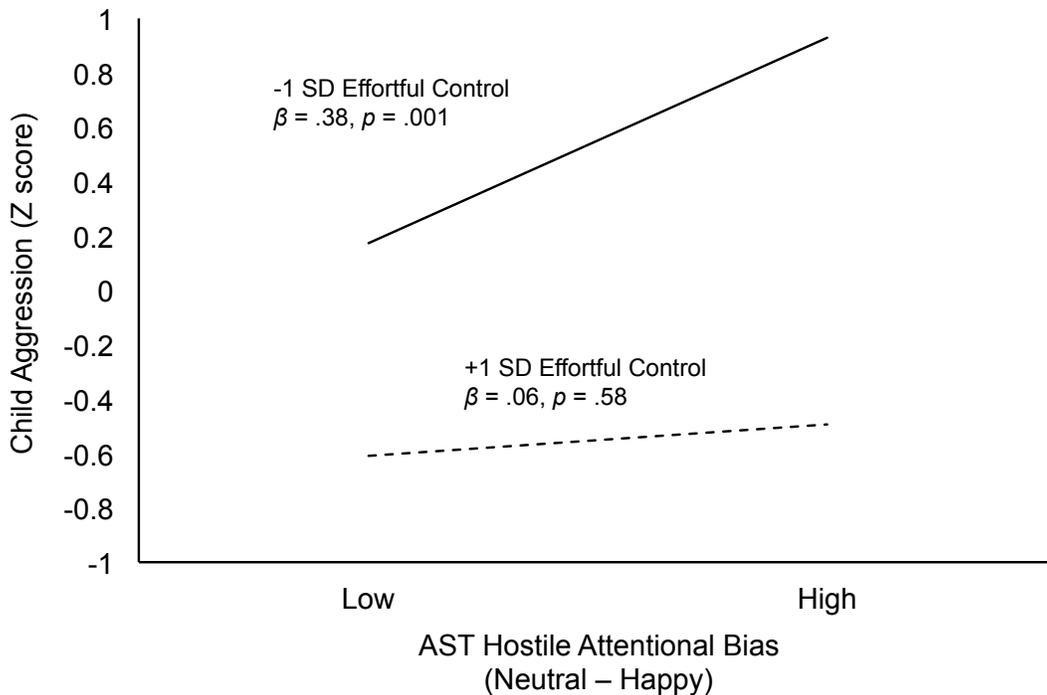
<sup>c</sup> Interaction term using product of centered effortful control and hostile attentional bias measures

<sup>d</sup> CI 90%  $\beta$  [-.32, -.02]

Further examination of this interaction using simple slope analysis revealed that the neutral-happy hostile attentional bias was a significant positive predictor of aggression among children with relatively low levels of effortful control (i.e., one standard deviation below the mean on effortful control),  $\beta = .38$  with  $CI_{.95} [.14, .64]$ ,  $t(109) = 3.54$ ,  $p = .001$ . At relatively higher levels of effortful control (i.e., one standard deviation above the mean on effortful control), the relation between the hostile attentional bias and child aggression was non-significant,  $\beta = .06$  with  $CI_{.95} [-.12, .25]$ ,  $t(109) = .06$ ,  $p = .58$ . These results indicate that boys who had more difficulty disengaging their attention from neutral videos relative to happy videos

were more aggressive, but only if they also had relatively low levels of effortful control. Figure 3 illustrates these results.

**Figure 3 Interaction Between the Attention Shifting Task (AST) Hostile Attentional Bias (Neutral – Happy) and Effortful Control in Relation to Child Aggression**



These results aid in the interpretation of the unexpected attention shifting task (angry - neutral) hostile attentional bias model's results; the second possibility – that aggression is related to slower response times during neutral videos – is supported by this finding. Neutral videos were more distracting to more aggressively behaved boys compared to either angry or happy videos, especially among boys with lower levels of effortful control. This unexpected result prompted further investigation into what characteristic(s) of the neutral videos was distracting to more aggressively behaved boys.

As reported in the Methods section, boys rated the intensity of anger and happiness of each video on the Emotion Video Rating Scale. On average, the neutral videos were perceived as

containing more ambiguous cues (rated as somewhat angry and somewhat happy) than either happy or angry videos, which were clearly rated as examples of either happiness or anger. It may be that more aggressively behaved boys were distracted by the ambiguous nature of the neutral videos. Interestingly, a post hoc analysis that examined child aggression in relation to these ratings of videos found that more aggressively behaved boys rated neutral videos as angrier than less aggressively behaved boys,  $r(111) = .23, p = .02$ , consistent with the suggestion that aggressive children perceived hostility within seemingly ambiguous content to a greater extent than other boys. Aggression was not significantly related to any of the other emotion ratings of videos ( $ps > .05$ ). Given that the neutral videos appear to represent hostile stimuli to more aggressively behaved boys, the attention shifting task (neutral – happy) attentional bias can be interpreted as another measure of the hostile attentional bias, and one that is associated with aggression, with moderation of this relation by effortful control.

## **Chapter 4: Discussion**

According to social information processing theory (SIP; Crick & Dodge, 1994), higher levels of the hostile attentional bias should be positively related to higher levels of aggression in children. However, previous studies have produced inconsistent results in support of this relation. The current study attempted to resolve these inconsistencies by addressing some of the methodological and conceptual issues of past studies. Methodologically, this study used hostile stimuli more specific to aggression in measuring the attentional bias and also employed a multi-informant, multi-measure approach to assessing aggression. In addition, this is the first study to include multiple attention allocation tasks to measure the hostile attentional bias, each task involving different attentional processes. This comprehensive measurement allowed a broader evaluation of the hostile attentional bias hypothesis than in past studies. Furthermore, the current study conceptually extended previous research by examining the moderating role of child effortful control on the relation between the hostile attentional bias and child aggression. Although it is reasonable to predict that effortful control should mitigate the effects of the hostile attentional bias on aggression, prior to the current study, this possibility was untested.

In the following sections I describe findings related to the measures of the hostile attentional bias and aggression, and discuss the individual relation between effortful control and aggression. Subsequently, I review and discuss the study's main findings divided into subsections for each measure of the hostile attentional bias. I conclude with a discussion of the strengths and limitations of the current study, clinical implications, and future directions for research.

## **4.1 Hostile Attentional Bias**

### **4.1.1 Associations among measures of the hostile attentional bias**

In this sample of boys, there were no significant associations among the three attention allocation tasks' measures of the hostile attentional bias. These results are not unexpected given that these tasks differ on a number of parameters, and it is likely that different attentional processes are involved in the performance of each task. The temporal order judgment task had shorter stimuli presentation times than the other tasks (less than 150 ms) and boys responded directly to the hostile stimuli (determining which facial expression photo appeared first). Given these characteristics, it is likely that performance on this task primarily involved attentional deployment. Further, it has been argued that attentional deployment patterns assessed through this task reflect the pre-tuning of attention towards behaviourally relevant stimuli (i.e., attentional set for hostile stimuli). In other words, due to the short presentation times during this task, it is likely that automatic processes, such as attentional sets for hostile stimuli, may have influenced performance to a greater extent than in the other two tasks.

In contrast, the attention shifting task had longer stimuli presentation times (25 seconds) and boys responded to probes rather than directly to the hostile or neutral video stimuli. That is, in order to perform this task boys had to disengage their attention from the distracting hostile or neutral video in order to attend to the probe (determine which side of the screen the probe appeared). Given these characteristics it is likely that attentional disengagement was primarily involved in the performance of this task, and that performance of this task likely involved a combination of automatic and voluntary attentional processes (e.g., Cisler et al., 2009). It should be noted that the three hostile attentional bias measures derived from this attention shifting task were significantly correlated, which was expected as they shared response times for one

component of the difference scores used to measure the hostile attentional bias (e.g., angry – happy and angry – neutral).

The dot-probe task shared characteristics of both the temporal order judgment and attention shifting tasks: it had medium-length stimuli presentation times (500 ms) and boys responded to probes rather than the photo stimuli. Unlike the other tasks, the dot-probe task used hostile stimuli as both distractors and facilitators of boys' performance. Sometimes hostile stimuli were distracting boys' attention away from the probe (incongruent trials) and other times hostile stimuli were attracting attention towards the probe (congruent trials). Due to these characteristics, it is probable that the dot-probe task involved a range of attentional processes, including deployment, engagement, and disengagement (Koster, Crombez, Verschuere, & De Houwer, 2004).

Finally, among the three attention allocation tasks, the dot-probe task had the lowest levels of reliability. Thus, it is possible that failure to find significant relation between the dot-probe task's hostile attentional bias and boys' aggression is due to the low reliability of this measure.

In sum, the lack of significant association among the hostile attentional bias measures from the three tasks appears attributable to differences in the way biases in attention allocation are measured across tasks. Few studies have examined the relations between different measures of attention allocation, especially among children; however, consistent with the current study's results, when measures are compared they tend not be correlated (Morales, Taber-Thomas, & Pérez-Edgar, in press).

#### **4.1.2 Mean levels of the hostile attentional bias**

Consistent with previous research (Kimonis et al., 2006; Salum et al., 2013; Schippell et al., 2003), mean levels of the hostile attentional bias were positive values across the attention shifting task measures of the hostile attentional bias. These results suggest that children have difficulty disengaging from hostile stimuli over non-hostile stimuli; it appears to be normative for children to have their attention become stuck on hostile cues to a greater extent than non-hostile cues. Being aware of hostile cues (e.g., fully attending towards an angry person approaching) is adaptive and may protect children from harm by allowing them to gauge the situation and preemptively respond (e.g., prepare to fight or flee), rather than being caught unawares (e.g., LeDoux, 1995). However, in the extremes, this attentional pattern may be problematic.

In contrast, the mean level for the hostile attentional bias for the dot-probe task measure was negative, and the mean level for the temporal order judgment task measure was close to zero. Although it was expected that, on average, boys would demonstrate some preference to attend to hostile stimuli over neutral or positive stimuli across all tasks (Dudeny et al., 2015), these mixed results are consistent with the limited research examining children's attentional biases across multiple attention allocation tasks (Morales, Taber-Thomas et al., in press). Different attention allocation tasks tap into different attentional processes, some of which may be more relevant to a normative tendency to attend to threatening stimuli.

### **4.2 Aggression**

#### **4.2.1 Associations among measures of aggression**

Aggression was measured using a composite of parent- and child-report on multiple measures. As expected, the three parent reports of aggression were significantly positively

correlated. Encouragingly, the child-report of aggression also was significantly positively correlated with each of the three parent-report measures reducing concerns about rater variance. Although these measures shared significant variance, their correlations ranged in strength from moderate to strong indicating they also each measured some unique aspects of aggression. Therefore, it can be argued that the composite variable provided a comprehensive measure of boys' aggression.

#### **4.2.2 Relation between aggression and effortful control**

As predicted, the boys' effortful control ability was significantly negatively related to the composite measure of their aggression. Boys who had more difficulty inhibiting dominant responses also were more aggressively behaved. It is well established that effortful control is protective against the development/maintenance of aggression (Caspi et al., 1995; Eisenberg et al., 2004; van der Voort et al., 2013; Wang et al., 2015). It is encouraging that the current study replicated this finding using a relatively brief parent-report measure of effortful control, suggesting that this questionnaire was a valid measure of effortful control in the current sample.

#### **4.3 The Hostile Attentional Bias and Aggression**

Parallel to previous research (Arsenault & Foster, 2012; Gouze, 1987; Kimonis et al., 2006; Reid et al., 2006; Schippell et al., 2003), at the bivariate level, the evidence in support of the hostile attentional bias hypothesis in this study was mixed and varied depending on how the hostile attentional bias was measured. On the one hand, failing to support the hypothesis, the dot-probe task's hostile attentional bias measure was not significantly related to boys' aggression. This result was contrary to prediction, but it is consistent with past studies' findings using dot-probe tasks to measure this attentional bias (e.g., Kimonis et al., 2006; Salum et al., 2013). Unexpectedly and contrary to previous studies' findings, both the attention shifting task's

measures of the hostile attentional bias were not significantly related to boys' aggression. However, exploratory analysis suggested that a comparison of responses to neutral and happy stimuli in this task was another potential indicator of the hostile attention bias and was related to aggression, and moderated by effortful control.

In clear support of my hypothesis, at the bivariate level, there was a significant positive relation between the temporal order judgment task's hostile attentional bias and boys' aggression. The temporal order judgment task primarily assesses patterns in attentional deployment, and these results suggest that biased attentional deployment (i.e., prioritizing attention to hostile stimuli over neutral stimuli) is linked to aggression; this is a novel result. Furthermore, because the temporal order judgment task assesses patterns of attention allocation before stimuli are consciously perceived (i.e., less opportunities for voluntary attentional processes compared to the other two attention allocation tasks), these results suggest that more aggressively behaved boys' patterns of attentional deployment were directed by an attentional set for hostile stimuli (i.e., these boys' attention is pre-tuned towards hostile stimuli).

Taken together, these relations of aggression to the measures of hostile attentional bias suggest that aggressive behaviour was linked to a hostile attentional bias operative during attentional deployment (i.e., temporal order judgment task results). Although these results provide some initial insight into how the hostile attentional bias might be related to boys' aggression, they must be considered in light of the effortful control moderator analyses, which are reviewed in the following section.

#### **4.4 Effortful Control as Moderator of the Hostile Attentional Bias**

This is the first study to examine the moderating role of effortful control on the relation between the hostile attentional bias and boys' aggression. Based on research within the literature

on child internalizing problems (Lonigan et al., 2004; Susa et al., 2012), it was expected that effortful control would mitigate the strength of the relation between the hostile attentional bias and aggression. To a certain extent this hypothesis was supported in this sample, but as with the bivariate findings, moderation results varied depending on how the hostile attentional bias was measured.

#### **4.4.1 Finding using a dot-probe task as a measure of the hostile attentional bias**

Contrary to expectation, effortful control did not interact with the dot-probe task's hostile attentional bias in prediction of boys' aggression. However, the main effects of the regression model testing this moderation were consistent with the results from the bivariate relations: the dot-probe task measure of hostile attentional bias was not significantly related to aggression, although effortful control was significantly negatively related to aggression. Altogether, these results are consistent with and assist in the interpretation of past studies' null results (Kimonis et al., 2006; Reid et al., 2006; Salum et al., 2013; Schippell et al., 2003).

The current study improved on the methodology of previous research by using stimuli specific to hostile cues (i.e., angry faces), addressing concerns that previous null results from dot probe tasks may have been due to the use of heterogeneous stimuli not specific to aggression. However, even using stimuli specific to hostile cues, rather than the broader category of threatening stimuli used by some of the previous studies (Reid et al., 2006; Schippell et al., 2003), there was no relation between the dot-probe task measure of the hostile attentional bias and aggression in this study. Therefore, the null results of previous studies may not be attributable to the use of aggression-irrelevant stimuli within dot-probe tasks.

Conversely, as most of these studies, including the current study, assessed the hostile attentional bias within community samples, it could be that dot-probe tasks may adequately

assess the hostile attentional bias among children with more severe aggression problems (i.e., clinical samples). However, arguing against this possibility, Salum et al. (2013) failed to find differences in levels of the hostile attentional bias (measured using a dot-probe task with hostile and neutral stimuli) between control ( $n = 804$ ) and behavioral disordered ( $n = 138$ ) groups of children (6-12 years).

Taken together, it appears that the manner in which the dot-probe task measures the hostile attentional bias yields an index that is not related to child aggression, even among children with lower levels of effortful control. It could be that the hostile attentional bias is specific to certain attentional processes, and because dot-probe tasks are designed in a fashion that capture a range of different attentional processes, they obscure the measurement of this bias. Finally, the dot-probe measure was the least reliable measure of the hostile attentional bias of the three attention allocation tasks, and therefore the most limited of the measures in terms of how strongly it could be correlated with boys' aggression. As is discussed later, future research could improve the reliability of this measure by incorporating eye tracking to ensure participants completed each trial as instructed (e.g., foveating on the fixation cross prior to the start of each trial) (Price et al., 2015).

#### **4.4.2 Findings using a temporal order judgment task as measure of the hostile attentional bias**

The temporal order judgment task's measure of hostile attentional bias interacted significantly with child effortful control in predicting boys' aggression. As hypothesized, the positive relation between the hostile attentional bias on this task and aggression became weaker at increasing levels of effortful control. These results are consistent with the idea that effortful control is protective against the hostile attentional bias (e.g., Lonigan et al., 2004). Boys with

greater control and intentionality in their behaviors appear better able to override the effects of perceiving hostile cues in leading to aggressive behavioral reactions compared to boys who are less in control.

Interestingly, although the (temporal order judgment task's) hostile attentional bias and aggression shared a significant bivariate relation, this relation became non-significant when controlling for levels of effortful control (i.e., step one of the regression model). Although this might be partially attributable to the shared method variance between the parent-reported effortful control and aggression measures, it also may be that effortful control is more closely linked with aggressive behaviors. This finding has implications for the clinical utility of studying the hostile attentional bias, which will be discussed in the Future Directions section. Nonetheless, it is important to interpret this finding in the context of the significant interaction between the bias and effortful control – and results from this study suggest that the bias could be an important predictor of aggression among boys with lower levels of effortful control.

Given that the temporal order judgment task primarily involves attentional deployment (West et al., 2009), these results suggest that effortful control mitigates against the effects of a hostile attentional bias within attentional deployment. That is, the ability to control one's behaviors may exert its greatest benefits early in the attentional process, helping children to override the effects of irrelevant hostile cues beginning the moment these cues are perceived (i.e., overriding effects of a hostile stimuli attentional set), and potentially continuing to exert an effect through downstream cognitive processing of hostile stimuli and subsequent responses to these stimuli.

Consistent with the bivariate associations, effortful control was negatively related to aggression in the regression analysis that included the temporal order judgment task attentional

bias measure. What is interesting is that this relation was significant regardless of levels of the hostile attentional bias, suggesting that effortful control may be a stronger protective factor than the (temporal order judgment task's) hostile attentional bias is a risk factor for boys' aggression. The strength of this relation is probably partly attributable to shared method variance. Nonetheless, other factors also likely contributed to the strength of this relation. In particular, the effortful control measure used in the current study assessed a wide range of regulatory skills (i.e., attentional, inhibitory, and activation control), and the strength of this relation suggests that deficits involving many different regulatory skills are linked to aggression. Longitudinal studies, including more fine-grained measures of effortful control, are needed to clarify these relations (e.g., Wang et al., 2015).

#### **4.4.3 Findings using the angry – happy attention shifting task as a measure of the hostile attentional bias**

For this analysis, the hostile attentional bias was measured by the difference in boys' response times to identify a probe while watching distracting videos of actors expressing anger and their response times to identify a probe while watching distracting videos of the same actors expressing happiness. Consistent with the bivariate results, in the regression model testing effortful control and the angry – happy hostile attentional bias as predictors of child aggression, effortful control was a significant predictor of aggression and the angry – happy hostile attentional bias was not related. Nor, contrary to prediction, did effortful control moderate the relation between the angry – happy hostile attentional bias and aggression. That is, even at lower levels of effortful control the relation between this measure of the hostile attentional bias and aggression was non-significant.

It was unexpected that there was not a significant relation between the angry – happy hostile attentional bias and aggression, particularly because this way of measuring the bias (using positively-valenced stimuli as the control condition) most closely replicates the hostile attentional bias measures of previous studies using the attention shifting task (Arsenault & Foster, 2012; Gouze, 1987). In contrast to the current study’s results, both of these previous studies reported a positive association between the hostile attentional bias (angry vs. happy response times) and aggression (Arsenault & Foster, 2012; Gouze, 1987). Methodological differences between the current study and previous research could explain these divergent results.

In particular, the content of the distracting stimuli differed between previous studies and the current study in terms of how participants were engaged as viewers. For both of the previous studies, children were passive observers of aggressive interactions (e.g., children watched cartoons or puppet shows involving characters aggressing against each other). In the current study, participating boys were more actively engaged viewers because they watched videos of same-aged male actors expressing anger and happiness directly towards them. These videos were created to provide a viewing experience of being engaged in a conversation with a peer; actors looked directly at the camera and spoke<sup>4</sup> as if they were having a conversation with viewer. Taking these stimuli differences across studies into account, it may be that more aggressively-behaved children are more drawn towards aggressive content, such as watching one cartoon character fight another, compared to less aggressively-behaved children (as reported by

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<sup>4</sup> Videos were muted to avoid potential confounds from auditory stimuli. However, actors appeared to be speaking at the viewer.

Arsenault & Foster, 2012 and Gouze, 1987). But, most children – regardless of aggression levels – may focus their attention towards hostile content that more directly involves them, such as watching a same-aged peer express anger towards them (as in the current study). This would suggest a possible ceiling effect in my results, with all children being drawn to the clearly angry videos in a way that obscured any potential differences related to level of aggression.

#### **4.4.4 Findings using the angry – neutral attention shifting task as a measure of the hostile attentional bias**

For this analysis, the hostile attentional bias was measured by the difference in boys' response times to identify a probe while watching distracting videos of actors with angry expressions and their response times to identify a probe while watching distracting videos of the same actors with neutral expressions. In the regression model, there was a marginally significant interaction between the attention shifting task's angry – neutral hostile attentional bias and effortful control in the prediction of child aggression. Surprisingly, at lower levels of effortful control the relation between the hostile attentional bias and aggression was negative, not positive as predicted. That is, at lower levels of effortful control boys who had higher levels of aggression had more difficulty disengaging their attention from *neutral videos* and less difficulty disengaging attention from angry videos, when it had been predicted that they would have more difficulty disengaging attention from angry compared to neutral videos. The unexpected nature of these results prompted further examination of the data.

These results suggested two possibilities: 1) less difficulty disengaging attention from angry videos is related to aggression (as measured by faster response times to identify the probe while distracting angry videos were presented), or 2) greater difficulty disengaging attention from neutral videos is related to aggression (as measured by slower response times to identify the

probe while distracting neutral videos were presented). In conjunction with the planned analyses using the angry – happy measure of the hostile attentional bias, follow-up analyses using a neutral – happy attentional bias measure were used to further investigate these possibilities. On the one hand, if the first possibility was true, higher levels of aggression also should be negatively related to the angry – happy hostile attentional bias, because aggression would be related to having less difficulty disengaging attention from distracting angry videos (i.e., faster response times). On the other hand, if the second possibility was true, higher levels of aggression should be positively related to the neutral – happy attentional bias measure because aggression would be related to having more difficulty disengaging attention from distracting neutral videos (i.e., slower response times).

Regarding the first possibility, if aggression was related to faster response times while watching angry videos (relative to other types of distracting videos), one would expect a similar negative relation to emerge between aggression and the attention shifting task angry – happy hostile attention bias (especially at lower levels of effortful control). However, this possibility was not supported as the relation between the angry – happy hostile attentional bias and aggression was not significant either at the bivariate level or within the regression model.

Exploratory analyses using neutral – happy attentional bias are discussed in the next section and address the alternate possibility that aggression is related to slower response times during neutral distracting videos. It is noted that the angry and happy videos were rated as clear examples of these emotions, and, as is discussed below, it may be that aggression is linked to the processing of the neutral or more emotionally ambiguous stimuli (Crick & Dodge, 1994).

#### **4.4.5 Findings using the neutral – happy attention shifting task as a measure of the hostile attentional bias**

Based on the nonsignificant results found using angry stimuli, of the two regressions testing attention shift task measures of attentional bias, it was speculated that boys' aggression was related to slower response times during neutral videos. Exploratory analyses were conducted to test this possibility using the difference between response times during happy trials subtracted from response times during neutral trials as a measure of a neutral attentional bias. First, at the bivariate level, this neutral - happy attentional bias was significantly positively related to boys' aggression. This result supports the possibility that longer response times during neutral trials were associated with aggression. In other words, more aggressively behaved boys appear to have difficulty disengaging their attention from neutral videos to a greater extent than less aggressively behaved boys. As noted, the neutral videos were rated as containing low levels of both anger and happiness by boys (i.e., on average, rated as appearing *a little* angry and *a little* happy), and it may be that the emotionally ambiguous content of these videos was what captured more aggressively behaved boys' attention. This explanation is elaborated upon later in this section.

Second, to parallel the analyses of other hostile attentional bias measures, a regression model was created to test the moderating role of effortful control upon the relation between this neutral versus happy attentional bias and aggression. Of course, given the exploratory nature of this question, there was no a priori prediction for how effortful control might moderate this relation. Interestingly, and in contrast to the other models, the neutral – happy attentional bias remained a significant predictor of aggression even after effortful control and the interaction term were entered into the model. Further, the interaction between the neutral – happy attentional

bias and aggression also was significant. Probing of the interaction revealed that the strength of the relation between this attentional bias and aggression was weaker at higher levels of effortful control. Taken together, it appears that boys who were more distracted by the neutral videos also were more aggressive – and similar to the predicted results for other attentional bias measures, this relation was weaker among boys who were better at controlling or regulating their behaviors, suggesting that effortful control may protect against some of the effects of this attentional bias. However, the fact that the attentional bias was a significant predictor in the model even accounting for effortful control and the interaction, suggests that, regardless of how well boys were able to control their behaviors, those who had more difficulty disengaging their attention from neutral videos (compared to happy videos) were more aggressive than those who had less difficulty disengaging their attention from these videos.

Overall, these results demonstrate an unexpected, but strong positive relation between this attentional bias and aggression. In conjunction with the other attention shifting task analyses, these results suggest that boys with higher levels of aggression had more difficulty disengaging their attention from videos portraying peers with neutral facial expressions, compared to either videos of clearly happy or angry faces of peers. It also is notable that on post-task ratings of the videos, aggressive boys rated these neutral videos as hostile than nonaggressive boys. It may be that the ambiguous nature of the neutral videos distracted boys with higher levels of aggression to a greater extent than the clearer expressions of happiness in the happy videos, or of anger in the angry videos.

The idea that aggression is linked to the cognitive processing of ambiguous stimuli has been argued within the SIP model (Crick & Dodge, 1994). As discussed in the Introduction, this model proposes six cognitive steps involved in the processing of social information, and argues

that biases in the processing of social information within these steps contributes to aggression. Although this study focused on the first step of this model (attending to social information), there is good evidence from tests of the second step of the model (describing the interpretation of social information), showing that hostile biases in how children interpret others' behaviours are particularly apparent when the intentions behind others' behaviours are ambiguous and the consequences of their behaviours are negative (e.g., you are standing in a line-up and are bumped by someone, did this person bump you on purpose or by accident?). And it is these hostile interpretations of ambiguous peer events that have been linked to aggression (de Castro et al., 2002). Furthermore, converging with other research within step 2 of the SIP model, recent studies reported a positive relation between aggression and interpreting neutral or ambiguous facial expressions as hostile (Penton-Voak et al., 2013; Schönenberg & Jusyte, 2014). The results of the current study parallel these step 2 findings within step 1: preferentially attending to emotionally ambiguous stimuli over clearly happy stimuli was positively related to aggression. In addition, I note that although the interaction was only marginally significant, preferentially attending to emotionally ambiguous stimuli over clearly angry stimuli also was positively related to aggression – but only among boys with lower levels of effortful control.

In summary, among boys with higher levels of aggression, the neutral videos were perceived as less emotionally ambiguous, and instead as examples of anger and in contrast to happy videos, the aggressive boys with low effortful control had difficulty disengaging from these potentially threatening or hostile stimuli. In contrast most boys perceived the angry videos as containing a moderate intensity of anger, and these ratings did not differ by how aggressively behaved the boys were. All these results converge on the same idea: more aggressively behaved

boys, especially those with low effortful control perceive hostility in ambiguous situations or stimuli and respond with aggression.

#### **4.5 Summary**

In summary, the current study offered preliminary evidence that attentional biases may contribute to boys' aggression. Consistent with expectation, the results indicated that preferentially attending to clearly hostile stimuli (i.e., angry faces) was related to aggression, at least when attentional deployment is involved. Unexpectedly, the results also indicated that difficulty disengaging attention from more emotionally ambiguous stimuli (i.e., neutral videos), and not clearly hostile stimuli (i.e., angry videos), was related to aggression. Both these results were strongest among boys with lower levels of effortful control.

#### **4.6 Contributions of the Current Study to the Social Information Processing Model**

These results build upon previous research on the SIP model by providing additional insight into how attentional biases might fit within the larger model. In this model, six interconnected cognitive processing steps contribute to aggressive behaviours. These steps also interact with a central database containing children's latent mental structures, including (but not limited to) memory stores and social schemas. In broad terms, the central database provides children with a template for how to approach social situations. This template is dynamic (e.g., a negative peer experience may strengthen a child's expectation for future negative interactions with that peer; a positive experience may weaken this expectation) and reciprocally connected to each of the SIP model's cognitive processing steps. The results from the current study offer some evidence for how attentional processing (at step 1 of this model) might interact with the central database.

The SIP model argues that more aggressively behaved children have a hostile schema within their central database (i.e., an expectation that they will encounter hostility within social situations), and there is reasonable evidence that hostile schemas contribute to biased cognitive processing at several SIP steps (e.g., Burks, Laird, Dodge, Pettit, & Bates, 1999; Ostrov & Godleski, 2010; Yeager, Miu, Powers, & Dweck, 2013) and that these hostile schemas are related to higher levels of aggression (Lochman & Dodge, 1998). Although the current study did not directly measure boys' social schemas, the pattern of results obtained from the temporal order judgment task and the attention shifting task provide some insight into how the hostile schema and hostile attentional bias may operate together. In particular, the results provide indirect evidence that a hostile schema may underlie the hostile attentional bias.

The temporal order judgment task assesses automatic patterns of attentional deployment, and it has been argued that these patterns reflect the pre-tuning of attention towards behaviourally relevant stimuli (Corbetta & Shulman, 2002; West et al., 2009). One could imagine that a hostile schema might contribute to a child's pre-tuning of attention towards hostile stimuli. This is the first study to measure individual differences using the temporal order judgment task, and it is difficult to determine how these differences might map onto hostile schema without a measure of such schema. However, past studies using the temporal order judgment task have found evidence consistent with the idea that schemas contribute to the attention allocation patterns assessed through this task (West et al., 2009; West, Anderson, Bedwell, & Pratt, 2010). For instance, in one study Truong, Handy, and Todd (2016) found that self-relevant objects were perceived faster than other objects (presumably because the self-relevant objects fit within a self-schema and other objects do not).

In contrast to the temporal order judgement task results, in this study during the attention shifting task, which involved longer attentional processing times, emotionally ambiguous stimuli (i.e., neutral videos) were allocated more attention compared to the clearly hostile or clearly happy stimuli (especially at lower levels of effortful control). Emotionally ambiguous stimuli do not cleanly fit within hostile schema, and more aggressively behaved boys may have allocated more attention to these stimuli in an effort to determine whether they fit with their schema. Similar results have been reported by studies using eye tracking of negative scenes (e.g., soccer ball kicked into window) with either ambiguous or intentional hostile cues (e.g., protagonist has neutral expression versus angry expression) embedded within the scenes (Horsley, de Castro, & Van der Schoot, 2010; Wilkowski, Robinson, Gordon, & Troop-Gordon, 2007). In these studies, individuals with higher levels of externalizing symptoms, such as aggression, attended longer to ambiguous cues than clearly hostile cues.

Taken together, it appears that more aggressively behaved children may attend to situations with the expectation that these situations will contain hostile cues. This assertion is indirectly supported by the current study's results from the temporal order judgment task and attention shifting task: (1) at the level of automatic attentional processing, hostile cues were more quickly perceived than other cues, and (2) at longer processing durations, ambiguous cues – that did not fit clearly within the hostile schema – were allocated more attention than cues that were clearly hostile (i.e., angry videos) or clearly not hostile (i.e., happy videos).

The results of this study inform the SIP also inform how regulatory processes may fit within the model. Although not well articulated in the original SIP model, revisions of this model have argued that regulatory processes fit within the central database and interact with each of the cognitive processing steps (Lemerise & Arsenio, 2000). From this perspective, the current

study's results demonstrating the moderating role of effortful control fit well with the SIP model. Boys who are more able to regulate/control their behaviours seem better able to override maladaptive cognitive processing patterns, such as the hostile attentional bias, than boys with more difficulty regulating their behaviours. Within the context of the SIP model, one could imagine that effortful control may exert both proximal and distal effects on mitigating the hostile attentional bias. As argued in the Introduction, this may occur within step 1 of the model (e.g., redirecting attention away from hostile cues) or within other steps that may be triggered by a hostile attentional bias (e.g., overriding an urge to respond aggressively because attended to hostile cues; steps 4 to 6)<sup>5</sup>. Nonetheless, these possibilities are speculative and require future study, with comprehensive measures of effortful control and multiple SIP steps, to precisely understand how effortful control might mitigate the relation between the hostile attentional bias' and aggression.

Finally, as will be discussed in Future Directions, it is important to contextualize these relations within a longitudinal perspective. In particular, it is likely that effortful control protects against the development of the hostile attentional bias early in life and that, because of this protective process, it would be unusual for a school-aged child to have high levels of effortful control and high levels of the hostile attentional bias (Lonigan et al., 2004). That is, effortful

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<sup>5</sup> The SIP model does not clearly specify how attentional processes are linked to the other cognitive processing steps. Based on the literature (including the current study), it remains unclear how the hostile attentional bias might be related to other SIP steps. It is possible the bias is directly linked to other SIP steps, or indirectly linked through the central database, or unrelated to other SIP steps (e.g., Horsley et al., 2010). Future study is needed to test these possibilities.

control may exert the strongest protective effect against hostile attentional bias related aggression by interfering with the development of this bias in early childhood (Morales, Pérez - Edgar, & Buss, 2016), rather than intervening on “in-the-moment” hostile attentional bias related processes.

#### **4.7 Strengths and Limitations**

This study has several notable strengths. This study used a multi-method multi-measure approach to address the research questions, including using parent- and child-report measures, in a relatively large, culturally-diverse sample of boys. This is one of only a few studies focused on the hostile attentional bias in relation to aggression, and to my knowledge, is the first study to examine the relation using multiple measures of the hostile attentional bias. Notably, biases in attentional deployment were assessed using the temporal order judgment task, which had not been used in previous research. By including several measures of this bias it was possible to investigate how it is related to aggression across a range of attentional processes.

The current study also measured the hostile attentional bias by using aggression-relevant stimuli in all the attention allocation tasks (i.e., videos and photos of boys expressing anger). By using aggression-relevant stimuli, the current study’s measures of the hostile attentional bias were likely more sensitive to detecting patterns of attention allocation that may contribute to aggressive behaviors compared to studies that employed many different kinds of threatening stimuli (including aggression-irrelevant stimuli, such as “hospital” or “fail”) to assess attentional biases (Kimonis et al., 2006; Reid et al., 2006; Schippell et al., 2003).

From a theoretical perspective, this study extended previous research by directly testing step 1 of the SIP model (i.e., attending to hostile stimuli is related to aggression), which has been understudied relative to the other SIP steps in the child aggression literature (de Castro et al.,

2002). As a new addition to this research area, the current study built upon the SIP step 1 model by investigating how boys' ability to control or regulate their behaviors (i.e., effortful control) might alter how much preferentially attending to hostile stimuli translates into aggressive behaviors.

Notwithstanding these strengths, the current study had several limitations. First, as one would expect in a community sample, average levels of boys' aggression were relatively low. Although nearly all boys demonstrated some level of aggressive behaviour (indicated by either parent- or child-reports), for most boys these behaviors occurred at a low frequency. As a result, the composite aggression variable had a positively skewed distribution. Appropriate statistical techniques (i.e., bootstrapping) were used to protect against the effects of this non-normality on the study's results (DiCiccio & Efron, 1996). Nonetheless, a sample with a wider variability of aggressive behaviors would increase the generalizability of these results. Data about boys' aggression also was limited to parent- and child-report; a more comprehensive measure of aggression could include observation, teacher-, and peer-reports.

Second, the current study's results are most generalizable to boys with levels of aggression within a normative range; it is unknown whether a similar pattern of results would emerge within samples of boys with extremely high or clinical levels of aggression. From a dimensional perspective, the same biases in SIP should contribute to aggressive behaviours across the continuum of aggression severity. Supporting this perspective, in a meta-analysis of 41 studies, de Castro and colleagues (2002) reported a positive relation between the hostile attribution bias and aggression within both non-referred and referred samples of boys. However, it remains an empirical question whether the hostile attentional bias would be similarly related to aggression within non-referred and referred samples. It also is notable that the sample had a

relatively high SES on average, and that the study's results may be less generalizable to boys from lower SES backgrounds.

Third, it is likely that the current study's results are not generalizable to girls as previous research suggests that different proximal factors contribute to aggressive behaviour in boys and girls. For instance, there are stronger links between the hostile attribution bias and aggression within all male samples compared to mixed gender samples (de Castro et al., 2002). Boys and girls also engage in different types of aggressive behaviors. School-aged boys typically demonstrate both overt/physical and relational forms of aggression (Card et al., 2008). In contrast, girls who behave aggressively primarily rely on relational aggression, and rarely are observed being overtly/physically aggressive (Card et al., 2008; Crick & Grotpeter, 1995). Given that the current study used a general aggression measure, it is unclear how the hostile attentional bias would be related to the purely relational forms of aggression seen in girls.

Fourth, aggression is a heterogeneous construct and, as mentioned above, encompasses many different types of behaviours. The current study was aimed at detecting any relation between the hostile attentional bias and aggression, and used general measures of aggression to capture the most variability. However, it is likely that different associations would emerge with different types of aggressive behaviours; the social information processing argues that the hostile attentional bias should be more strongly related to reactive versus proactive aggression (Dodge & Coie, 1987; Dodge et al., 1997). By definition, reactive aggression involves responses to perceived threat, and is retaliatory. In contrast, proactive aggression is goal-directed, and involves using aggression instrumentally to achieve a desired outcome. Therefore, given that the hostile attentional bias involves the perception of threat, it should be more strongly linked to reactive, as opposed to proactive, aggression. Unfortunately, it was not possible to examine these

relations within the sample due to low item endorsement on the two measures that distinguished between reactive and proactive aggression (i.e., parent- and child-report on the Peer Conflict Scale). Inclusion of teacher- or peer-reports of proactive and reactive aggression also may have improved the measurement of these constructs.

Fourth, the reliability of the attention allocation tasks as measures of the hostile attentional bias ranged from poor (dot-probe task) to adequate (neutral – happy, attention shifting task). Therefore, it is difficult to determine whether null results, especially from the dot-probe task analyses, were due to the poor reliability of the task as a measure of the hostile attentional bias or because there is no relation between the bias (as measured using the dot-probe task) and aggression. Similarly, although the results from the temporal order judgment and attention shifting tasks' analyses were significant, these should be considered in light of the poor reliability of these tasks' measure of the hostile attentional bias. However, because these measures demonstrated validity (i.e., expected relations with other constructs, such as effortful control or aggression), it could be that questionnaire-adapted ways of assessing reliability (i.e., split-half reliability, internal consistency) did not adequately capture the true reliability of these measures. For instance, attention waxes and wanes, and local patterns of attention (e.g., within trials of same block) likely differ from global patterns of attention across an entire task (Naim et al., 2015). This is an ongoing issue within research of attentional biases, and it remains an open question as how to best assess reliability of these measures and how to interpret the results of these measures when they do not demonstrate adequate 'questionnaire-based' reliability (Price et al., 2015).

Finally, the three attention allocation tasks used angry facial expressions in peers as hostile stimuli and neutral expressions as control stimuli, with the exception of the attention

shifting task, which used both neutral and happy facial expressions as control stimuli. Results from the exploratory analyses involving the attention shifting task indicated that among boys with low effortful control, responses to neutral expressions (in relation to happy expressions, or angry expressions) were predictive of aggression. That is, the attention shifting task data demonstrated that an attentional bias towards emotionally ambiguous stimuli (rather than an attentional bias towards clearly hostile stimuli) was positively related to boys' aggression. However, these analyses could not be conducted using data from the other two tasks because they did not include happy expressions in their stimuli sets (i.e., a bias reflecting boys' responses to neutral versus happy stimuli could not be calculated).

What is clear from the attention shifting task results is that neutral stimuli do not provide the best control measure of attentional processes (i.e., a baseline measure of boys attentional deployment, engagement, and difficulty disengaging from stimuli). Rather it appears that preferentially attending towards neutral/emotionally ambiguous stimuli is linked to aggressive behavior, and using these stimuli as control measures may obscure results. It is possible that using positively valenced stimuli would have provided a better baseline measure of attentional processes across all three attention allocation tasks, as these may be less susceptible to activating children's aggression-related attentional biases compared to clearly hostile or neutral/emotionally ambiguous stimuli. Indeed, Tottenham and colleagues (2009), the creators of the NimStim empirically validated set of adult emotion expressions, recommend using photos of calm expressions, rather than neutral expressions, as control stimuli (similar to neutral expression but containing slight positive valence) because neutral expressions can be perceived as containing some negative valence (e.g., Thomas et al., 2001).

In the current study, neutral facial expressions were used as control measures of attention for the temporal order judgment and dot-probe tasks, and it is unknown how child aggression would be related to attentional bias measures using positive stimuli as controls in these tasks. For instance, in the temporal order judgment task, it could be that, in addition to preferentially deploying attention to hostile stimuli, more aggressively behaved boys also preferentially deploy attention to emotionally ambiguous stimuli relative to their baseline levels of attentional deployment (measured using positively valenced stimuli as control stimuli). That is, emotionally ambiguous stimuli may be judged by these boys as fitting within a hostile stimuli attentional set and thus may have partially benefited from prioritization effects, although positive stimuli would not fit and not benefit from these effects. Similarly, using the dot-probe task, it is unclear how aggression would be related to attentional bias measures including neutral and happy expressions within trials. Although past studies using the dot-probe task have used either neutral or positive stimuli as controls, no study has included them together (Kimonis et al., 2006; Reid et al., 2006; Salum et al., 2013; Schippell et al., 2003). Unfortunately, the current study cannot resolve these issues, and they remain open to speculation.

#### **4.8 Clinical Implications**

The relation between attentional biases and internalizing symptoms across the life span is well studied (Bar-Haim et al., 2007), however externalizing symptoms have been largely neglected within the attentional bias literature. This study serves as a preliminary step in building an understanding of how the hostile attentional bias might contribute to child aggression. Prior to the current study, the evidence in support of this relation was inconsistent and weak. The current study's results clarify, and to some extent strengthen this evidence by investigating the relations between the hostile attentional bias and aggression across a range of attentional processes and by

examining effortful control as a possible moderator. Attentional deployment and disengagement emerged as important processes to target in future study of the hostile attentional bias, and clarify that the effect of this bias on aggression is strongest among boys with lower levels of effortful control, a population that should be targeted in future research. Although there is evidence that the hostile attentional bias can be reduced through attentional retraining (Young, 2011), the results of the current study are not strong enough to recommend targeting the hostile attentional bias in the prevention or treatment of aggression. If anything, the current study's results suggest that effortful control, which was strongly associated with aggression across analyses, may be a better intervention target in treating child aggression. This confirms the effects of many intervention programs for aggressive behaviors that already target children's self-regulatory processes, including improving children's effortful control abilities (e.g., Diamond, 2016; Lochman & Wells, 2004; Schonert-Reichl et al., 2015). Nonetheless, because this study used a cross-sectional design, I cannot rule out the possibility that high levels of aggression contributed to lower levels of effortful control; therefore, these results do not provide direct evidence in support of targeting effortful control in aggression intervention programs.

#### **4.9 Future Directions**

As previously discussed, due to the use of a community sample of boys, the current study's results are limited in their generalizability. To extend these findings, it would be useful for future research to investigate the links between the hostile attentional bias and aggression using samples of children with greater severity of aggressive problems, such as clinical samples or among children at higher risk for developing these problems (e.g., lower socioeconomic status, higher neighborhood violence; Guerra, Huesmann, & Spindler, 2003). It also would be useful to extend this research to younger and older samples of children to better understand how

this bias might change over the course of development and to include girls to examine gender differences.

Further, future research could build upon the current study's results by expanding the measures of attentional biases. First, future research should assess attentional biases using combinations of hostile, neutral, and positive stimuli to clarify how different forms of the hostile attentional biases are related to aggression. As previously discussed, the ways children attend to neutral stimuli may not provide the best control measure of attentional processes because they are emotionally ambiguous. Based on SIP theory, it could be argued that the ways children process emotionally ambiguous stimuli is linked to aggressive behavior (much like more aggressively behaved children attribute hostility to the ambiguous actions of others) (Crick & Dodge, 1994). However, this explanation is speculative and future research is needed to test whether more aggressively behaved children preferentially attend to more emotionally ambiguous cues relative to clear emotional cues. Further, future research should use clearly positively valenced stimuli to assess children's baseline attentional processing. It may be most productive to contrast children's performance among clearly hostile, clearly positive, and ambiguous stimuli across a range of attention allocation tasks to maximize our understanding of what constitutes an aggression-related attentional bias.

Second, incorporating other methodologies such as eye tracking into the temporal order judgment task or attention shifting task might provide more specificity in terms of clarifying the attentional processes that are primarily involved in these tasks (e.g., where are children looking while the videos play in the attention shifting task? Are they slower to shift their gaze from angry videos compared to happy videos?).

In addition to addressing the methodological concerns discussed in previous sections, in future research it would be interesting to see how the hostile attentional bias and effortful control interact over time, and how each is related to the developmental trajectory of aggression. Effortful control emerges during preschool years (2-3 year olds) and could exert a stronger protective effect against the development of a hostile attentional bias earlier in life when patterns of attention allocation are less well established (e.g., Rothbart et al., 2003). For instance, preschoolers who are better able to control where they direct their attention could learn how to shift their attention towards and away from emotionally arousing stimuli (such as hostile cues) as appropriate to the situation; effortful control could help these children shape their attention allocation patterns to be intentional and driven by top-down/conscious cognitive processes rather than reactive to the situation (i.e., bottom-up/automatic cognitive processes) (Lonigan et al., 2004). Taken a step further, one could imagine a meditational model in which the negative relation between preschoolers' effortful control and school-aged children's aggression is partially explained through the hostile attentional bias. Longitudinal research involving young children at risk for developing aggressive behaviors is needed to investigate this possibility. This research should include environmental-level variables, including parenting, as these are likely to influence the development of effortful control and aggression (Chang, Shaw, Dishion, Gardner, & Wilson, 2015; Reuben et al., 2015; Taylor, Eisenberg, Spinrad, & Widaman, 2013). Further, it would be interesting to examine how effortful control and the hostile attentional bias might interact over time as protective and risk factors for the development and maintenance of aggression. Are children with low levels of effortful control and a hostile attentional bias most at risk for developing aggression? To what extent do higher levels of effortful control protect against

developing aggression if a child has a hostile attentional bias? Does this vary across development?

It also would be interesting to see how aggressive behavior contributes to the developmental trajectory of the hostile attentional bias, as it is likely the relation between the hostile attentional bias and aggression is bidirectional. One potential mediator of this relation could be exposure to violence. For instance, more aggressively behaved children may experience more violent or threatening environments than less aggressively behaved children (Guerra et al., 2003) and chronic exposure to violent environments may contribute to the development of a hostile attentional bias (in this case, the hostile attentional bias could be an adaptive response to as hostile cues are accurate predictors of threat and being attuned to them gives the child an advantage). Additionally, there is evidence that cognitive processing within other SIP steps may be contextually specific (e.g., children generate physically aggressive responses when confronted with a physical peer provocation; Dirks, Treat, & Weersing, 2007). Longitudinal research, especially incorporating environmental-level and contextual variables (e.g., neighbourhood violence, antecedent peer behaviours), is needed to fully understand the transactional relations among these variables.

Finally, it is likely that affective states influence both aggression and SIP cognitive processes (Lemerise & Arsenio, 2000), including the hostile attentional bias. For example, anger might increase the hostile attentional bias, whereas happiness might reduce it (see Harper, Lemerise, & Caverly, 2010 for an example of affect manipulation on other SIP steps). Incorporating measures of affective states and/or manipulating these states would be an informative next step for understanding how the hostile attentional bias and aggression are linked (e.g., Liang, Zhang, & Bao, 2015).

Boys' with higher levels of aggression experience significant difficulties across several domains, including family, social, and academic functioning (e.g., Broidy et al., 2003; Fergusson & Horwood, 1998; Lahey et al., 1999). The SIP model provides an evidence-based explanation for how different cognitive processes contribute to the development/maintenance of aggression. And this model has informed many empirically supported treatment approaches for child aggression (e.g., Dodge et al., 2013; Lochman & Wells, 2004). Nonetheless, step 1 of this model has been relatively understudied and prior to this study it was unclear whether from preferentially attending to hostile cues was related to aggression. The results of the current study offer preliminary support for this hypothesis: more aggressively behaved boys are looking for trouble.

## References

- Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for ASEBA school-age forms and profiles*. Burlington: University of Vermont, Research Center for Children, Youth, & Families.
- Arsenault, D. J., & Foster, S. L. (2012). Attentional processes in children's overt and relational aggression. *Merrill-Palmer Quarterly*, *58*, 409-436. doi: 10.1353/mpq.2012.0015
- Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*, 1-24. doi: 10.1037/0033-2909.133.1.1
- Broidy, L. M., Nagin, D. S., Tremblay, R. E., Bates, J. E., Brame, B., Dodge, K. A., ... Vitaro, F. (2003). Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: A six-site, cross-national study. *Developmental Psychology*, *39*, 222-245. doi: 10.1037/0012-1649.39.2.222
- Burks, V. S., Laird, R. D., Dodge, K. A., Pettit, G. S., & Bates, J. E. (1999). Knowledge structures, social information processing, and children's aggressive behavior. *Social Development*, *8*, 220-236. doi: 10.1111/1467-9507.00092
- Card, N. A., & Little, T. D. (2006). Proactive and reactive aggression in childhood and adolescence: A meta-analysis of differential relations with psychosocial adjustment. *International Journal of Behavioral Development*, *30*, 466-480. doi: 10.1177/0165025406071904
- Card, N. A., Stucky, B. D., Sawalani, G. M., & Little, T. D. (2008). Direct and indirect aggression during childhood and adolescence: A meta-analytic review of gender differences, intercorrelations, and relations to maladjustment. *Child Development*, *79*, 1185-1229. doi: 10.1111/j.1467-8624.2008.01184.x

- Caspi, A., Henry, B., McGee, R. O., Moffitt, T. E., & Silva, P. A. (1995). Temperamental origins of child and adolescent behavior problems: From age three to fifteen. *Child Development*, *66*, 55-68. doi: 10.2307/1131190
- Chang, H., Shaw, D. S., Dishion, T. J., Gardner, F., & Wilson, M. N. (2015). Proactive parenting and children's effortful control: Mediating role of language and indirect intervention effects. *Social Development*, *24*, 206-223. doi: 10.1111/sode.12069
- Cisler, J. M., Bacon, A. K., & Williams, N. L. (2009). Phenomenological characteristics of attentional biases towards threat: A critical review. *Cognitive Therapy and Research*, *33*, 221-234. doi: 10.1007/s10608-007-9161-y
- Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical Psychology Review*, *30*, 203-216. doi: 10.1016/j.cpr.2009.11.003
- Cleverley, K., Szatmari, P., Vaillancourt, T., Boyle, M., & Lipman, E. (2012). Developmental trajectories of physical and indirect aggression from late childhood to adolescence: Sex differences and outcomes in emerging adulthood. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*, 1037-1051. doi: 10.1016/j.jaac.2012.07.010
- Connor, D. F., Chartier, K. G., Preen, E. C., & Kaplan, R. F. (2010). Impulsive aggression in attention-deficit-hyperactivity disorder: Symptom severity, co-morbidity, and attention-deficit/hyperactivity disorder subtype. *Journal of Child and Adolescent Psychopharmacology*, *20*, 119-126. doi: 10.1089/cap.2009.0076
- Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature reviews neuroscience*, *3*, 201-215. doi: 10.1038/nrn755

- Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, *115*, 74-101. doi: 10.1037/0033-2909.115.1.74
- Crick, N. R., & Dodge, K. A. (1996). Social information-processing mechanisms on reactive and proactive aggression. *Child Development*, *67*, 993-1002. doi: 10.2307/1131875
- Crick, N. R., & Grotpeter, J. K. (1995). Relational aggression, gender, and social-psychological adjustment. *Child Development*, *66*, 710-722. doi: 10.2307/1131945
- de Castro, B. O., Slot, N. W., Bosch, J. D., Koops, W., & Veerman, J. W. (2003). Negative feelings exacerbate hostile attributions of intent in highly aggressive boys. *Journal of Clinical Child and Adolescent Psychology*, *32*, 56-65. doi: 10.1207/s15374424jccp3201\_06
- de Castro, B. O., Veerman, J. W., Koops, W., Bosch, J. D., & Manshouwer, H. J. (2002). Hostile attribution of intent and aggressive behavior: A meta-analysis. *Child Development*, *73*, 916-934. doi: 0009-3920/2002/7303-0017
- Diamond, A. (2016). Why improving and assessing executive functions early in life is critical. In J. A. Griffin, P. McCardle, L. S. Freund, J. A. Griffin, P. McCardle & L. S. Freund (Eds.), *Executive function in preschool-age children: Integrating measurement, neurodevelopment, and translational research*. (pp. 11-43). Washington, DC, US: American Psychological Association.
- DiCiccio, T. J., & Efron, B. (1996). Bootstrap confidence intervals. *Statistical Science*, *11*, 189-228. doi: 10.1214/ss/1032280214

- Dirks, M. A., Treat, T. A., & Weersing, V. R. (2007). The situation specificity of youth responses to peer provocation. *Journal of Clinical Child and Adolescent Psychology, 36*, 621-628. doi: 10.1080/15374410701662758
- Dodge, K. A. (1991). The structure and function of reactive and proactive aggression. In D. J. Pepler & K. H. Rubin (Eds.), *The development and treatment of childhood aggression*. (pp. 201-218). Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.
- Dodge, K. A., & Coie, J. D. (1987). Social-information-processing factors in reactive and proactive aggression in children's peer groups. *Journal of Personality and Social Psychology, 53*, 1146-1158. doi: 10.1037/0022-3514.53.6.1146
- Dodge, K. A., Godwin, J., & The Conduct Problems Prevention Research Group. (2013). Social-information-processing patterns mediate the impact of preventive intervention on adolescent antisocial behavior. *Psychological Science, 24*, 456-465. doi: 10.1177/0956797612457394
- Dodge, K. A., Lochman, J. E., Harnish, J. D., Bates, J. E., & Pettit, G. S. (1997). Reactive and proactive aggression in school children and psychiatrically impaired chronically assaultive youth. *Journal of Abnormal Psychology, 106*, 37-51. doi: 10.1037/0021-843x.106.1.37
- Dudeney, J., Sharpe, L., & Hunt, C. (2015). Attentional bias towards threatening stimuli in children with anxiety: A meta-analysis. *Clinical Psychology Review, 40*, 66-75. doi: 10.1016/j.cpr.2015.05.007
- Egger, H. L., Pine, D. S., Nelson, E., Leibenluft, E., Ernst, M., Towbin, K. E., & Angold, A. (2011). The NIMH Child Emotional Faces Picture Set (NIMH-ChEFS): A new set of

- children's facial emotion stimuli. *International Journal of Methods in Psychiatric Research*, 20, 145-156. doi: 10.1002/mpr.343
- Eisenberg, N., & Spinrad, T. L. (2004). Emotion-related regulation: Sharpening the definition. *Child Development*, 75, 334-339. doi: 10.1111/j.1467-8624.2004.00674.x
- Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annual Review of Clinical Psychology*, 6, 495-525. doi: 10.1146/annurev.clinpsy.121208.131208
- Eisenberg, N., Spinrad, T. L., Fabes, R. A., Reiser, M., Cumberland, A., Shepard, S. A., ... Thompson, M. (2004). The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development*, 75, 25-46. doi: 10.1111/j.1467-8624.2004.00652.x
- Ellis, L. K. (2002). *Individual differences and adolescent psychological development*. Unpublished doctoral dissertation University of Oregon. Retrieved from <http://www.bowdoin.edu/~sputnam/rothbart-temperament-questionnaires/pdf/ellis-dissertation-2002.pdf> on September 6, 2016.
- Ellis, M. L., Weiss, B., & Lochman, J. E. (2009). Executive functions in children: Associations with aggressive behavior and appraisal processing. *Journal of Abnormal Child Psychology*, 37, 945-956. doi: 10.1007/s10802-009-9321-5
- Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, 7, 336-353. doi: 10.1037/1528-3542.7.2.336

- Fergusson, D. M., & Horwood, L. J. (1998). Early conduct problems and later life opportunities. *Journal of Child Psychology and Psychiatry*, *39*, 1097-1108. doi: 10.1111/1469-7610.00414
- Fontaine, R. G. (2006). Evaluative behavioral judgments and instrumental antisocial behaviors in children and adolescents. *Clinical Psychology Review*, *26*, 956-967. doi: 10.1016/j.cpr.2006.07.003
- Fontaine, R. G., Yang, C., Dodge, K. A., Pettit, G. S., & Bates, J. E. (2009). Development of response evaluation and decision (RED) and antisocial behavior in childhood and adolescence. *Developmental Psychology*, *45*, 447-459. doi: 10.1037/a0014142
- Fox, J. (2008). *Applied regression analysis and generalized linear models* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Frick, P. J., & Morris, A. S. (2004). Temperament and developmental pathways to conduct problems. *Journal of Clinical Child and Adolescent Psychology*, *33*, 54- 68. doi: 10.1207/S15374424JCCP3301\_6
- Gibb, B. E., McGeary, J. E., & Beevers, C. G. (in press). Attentional biases to emotional stimuli: Key components of the RDoC constructs of sustained threat and loss. *American Journal of Medical Genetics*. doi: 10.1002/ajmg.b.32383
- Gouze, K. R. (1987). Attention and social problem solving as correlates of aggression in preschool males. *Journal of Abnormal Child Psychology*, *15*, 181-197. doi: 10.1007/bf00916348
- Gresham, F. M., & Elliot, S. N. (2008). *Social Skills Improvement System - Rating Scales*. Minneapolis, MN: Pearson Assessments.

- Guerra, N. G., Huesmann, L. R., & Spindler, A. (2003). Community violence exposure, social cognition, and aggression among urban elementary school children. *Child Development, 74*, 1561-1576. doi: 10.1111/1467-8624.00623
- Harper, B. D., Lemerise, E. A., & Caverly, S. L. (2010). The effect of induced mood on children's social information processing: Goal clarification and response decision. *Journal of Abnormal Child Psychology, 38*, 575-586. doi: 10.1007/s10802-009-9356-7
- Hakamata, Y., Lissek, S., Bar-Haim, Y., Britton, J. C., Fox, N. A., ... Pine, D. S. (2010). Attention bias modification treatment: A meta-analysis towards the establishment of novel treatment for anxiety. *Biological Psychiatry, 68*, 982-990. doi: 10.1016/j.biopsych.2010.07.021
- Horsley, T. A., de Castro, B. O., & Van der Schoot, M. (2010). In the eye of the beholder: Eye-tracking assessment of social information processing in aggressive behavior. *Journal of Abnormal Child Psychology, 38*, 587-599. doi: 10.1007/s10802-009-9361-x
- Kimonis, E. R., Frick, P. J., Fazekas, H., & Loney, B. R. (2006). Psychopathy, aggression, and the processing of emotional stimuli in non-referred girls and boys. *Behavioral Sciences & the Law, 24*, 21-37. doi: 10.1002/bsl.668
- Kimonis, E. R., Frick, P. J., Munoz, L. C., & Aucoin, K. J. (2008). Callous-unemotional traits and the emotional processing of distress cues in detained boys: Testing the moderating role of aggression, exposure to community violence, and histories of abuse. *Development and Psychopathology, 20*, 569-589. doi: 10.1017/s095457940800028x
- Koster, E. H. W., Crombez, G., Verschuere, B., & De Houwer, J. (2004). Selective attention to threat in the dot probe paradigm: Differentiating vigilance and difficulty to disengage. *Behaviour Research and Therapy, 42*, 1183-1192. doi: 10.1016/j.brat.2003.08.001

- Lahey, B. B., Goodman, S. H., Waldman, I. D., Bird, H., Canino, G., Jensen, P., ... Applegate, B. (1999). Relation of age of onset to the type and severity of child and adolescent conduct problems. *Journal of Abnormal Child Psychology*, *27*, 247-260. doi: 10.1023/a:1022661224769
- LeDoux, J. E. (1995). Emotion: Clues from the brain. *Annual Review of Psychology*, *46*, 209-235. doi: 10.1146/annurev.ps.46.020195.001233
- Lemerise, E. A., & Arsenio, W. F. (2000). An integrated model of emotion processes and cognition in social information processing. *Child Development*, *71*, 107-118. doi: 10.1111/1467-8624.00124
- Liang, W., Zhang, J., & Bao, Y. (2015). Gender-specific effects of emotional modulation on visual temporal order thresholds. *Cognitive Processing*, *16*, 143-148. doi: 10.1007/s10339-015-0709-6
- Lochman, J. E. & Dodge, K. A. (1998). Distorted perceptions in dyadic interactions of aggressive and nonaggressive boys: Effects of prior expectations, context, and boys' age. *Development and Psychopathology*, *10*, 495-512. doi:10.1017/S0954579498001710
- Lochman, J. E. & Wells, K. C. (2004). The Coping Power Program for preadolescent aggressive boys and their parents: Outcome effects at the 1-year follow-up. *Journal of Consulting and Clinical Psychology*, *72*, 571-578. doi: 10.1037/0022-006X.72.4.571
- Lonigan, C. J., Vasey, M. W., Phillips, B. M., & Hazen, R. A. (2004). Temperament, anxiety, and the processing of threat-relevant stimuli. *Journal of Clinical Child and Adolescent Psychology*, *33*, 8-20. doi: 10.1207/S15374424JCCP3301\_2
- MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*, 15-20. doi: 10.1037/0021-843x.95.1.15

- Marsee, M. A., Barry, C. T., Childs, K. K., Frick, P. J., Kimonis, E. R., Munoz, L. C., ... Lau, K. S. L. (2011). Assessing the forms and functions of aggression using self-report: Factor structure and invariance of the Peer Conflict Scale in youths. *Psychological Assessment, 23*, 792-804. doi: 10.1037/a0023369
- Marsee, M. A., & Frick, P. J. (2007). Exploring the cognitive and emotional correlates to proactive and reactive aggression in a sample of detained girls. *Journal of Abnormal Child Psychology, 35*, 969-981. doi: 10.1007/s10802-007-9147-y
- Marsee, M. A., Weems, C. F., & Taylor, L. K. (2008). Exploring the association between aggression and anxiety in youth: A look at aggressive subtypes, gender, and social cognition. *Journal of Child and Family Studies, 17*, 154-168. doi: 10.1007/s10826-007-9154-1
- Morales, S., Pérez-Edgar, K., & Buss, K. (2016). Longitudinal relations among exuberance, externalizing behaviors, and attentional bias to reward: The mediating role of effortful control. *Developmental Science, 19*, 853-862. doi: 10.1111/desc.12320
- Morales, S., Taber-Thomas, B. C., & Pérez-Edgar, K. (in press). Patterns of attention to threat across tasks in behaviorally inhibited children at risk for anxiety. *Developmental Science*. doi: 10.1111/desc.12391. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/desc.12391/full> on September 6, 2016.
- Munoz, L. C., Frick, P. J., Kimonis, E. R., & Aucoin, K. J. (2008). Types of aggression, responsiveness to provocation, and callous-unemotional traits in detained adolescents. *Journal of Abnormal Child Psychology, 36*, 15-28. doi: 10.1007/s10802-007-9137-0

- Naim, R., Abend, R., Wald, I., Eldar, S., Levi, O., ... Bar-Haim, Y. (2015). Threat-related attention bias variability and posttraumatic stress. *The American Journal of Psychiatry*, *172*, 1242-1250. doi: 10.1176/appi.ajp.2015.14121579
- Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*, *47*, 395-422. doi: 10.1111/j.1469-7610.2006.01612.x
- Oldehinkel, A. J., Hartman, C. A., De Winter, A. F., Veenstra, R., & Ormel, J. (2004). Temperament profiles associated with internalizing and externalizing problems in preadolescence. *Development and Psychopathology*, *16*, 421-440. doi: 10.1017/S0954579404044591
- Ostrov, J. M., & Godleski, S. A. (2010). Toward an integrated gender-linked model of aggression subtypes in early and middle childhood. *Psychological Review*, *117*, 233-242. doi: 10.1037/a0018070
- Penton-Voak, I. S., Thomas, J., Gage, S. H., McMurrin, M., McDonald, S., & Munafò, M. R. (2013). Increasing recognition of happiness in ambiguous facial expressions reduces anger and aggressive behavior. *Psychological Science*, *24*, 688-697. doi: 10.1177/0956797612459657
- Pérez-Edgar, K., Reeb-Sutherland, B. C., McDermott, J. M., White, L. K., Henderson, H. A., Degnan, K. A., ... Fox, N. (2011). Attention biases to threat link behavioral inhibition to social withdrawal over time in very young children. *Journal of Abnormal Child Psychology*, *39*, 885-895. doi: 10.1007/s10802-011-9495-5
- Posner, M. I. (1980). Orienting of attention. *The Quarterly Journal of Experimental Psychology*, *32*, 3-25. doi: 10.1080/00335558008248231

- Price, R. B., Kuckertz, J. M., Siegle, G. J., Ladouceur, C. D., Silk, J. S., Ryan, N. D., ... Amir, N. (2015). Empirical recommendations for improving the stability of the dot-probe task in clinical research. *Psychological Assessment, 27*, 365-376. doi: 10.1037/pas0000036
- Putnam, P., Ellis, L. K., & Rothbart, M. K. (2001). The structure of temperament from infancy through adolescence. In A. Elias & A. Angleitner (Eds.), *Advances in research on temperament* (pp. 65-182). Germany: Pabst Science.
- Reid, S. C., Salmon, K., & Lovibond, P. F. (2006). Cognitive biases in childhood anxiety, depression, and aggression: Are they pervasive or specific? *Cognitive Therapy and Research, 30*, 531-549. doi: 10.1007/s10608-006-9077-y
- Reuben, J. D., Shaw, D. S., Neiderhiser, J. M., Natsuaki, M. N., Reiss, D., & Leve, L. D. (in press). Warm parenting and effortful control in toddlerhood: Independent and interactive predictors of school-age externalizing behavior. *Journal of Abnormal Child Psychology*. doi: 10.1007/s10802-015-0096-6
- Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. Damon, R. Lerner & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 99-166). New York: Wiley.
- Rothbart, M. K., Ellis, L. K., Rueda, M. R., & Posner, M. I. (2003). Developing mechanisms of temperamental effortful control. *Journal of Personality, 71*, 1113-1143. doi: 10.1111/1467-6494.7106009
- Rothbart, M. K., Sheese, B. E., & Posner, M. I. (2007). Executive attention and effortful control: Linking temperament, brain networks, and genes. *Child Development Perspectives, 1*, 2-7. doi: 10.1111/j.1750-8606.2007.00002.x

- Saarni, C., Campos, J. J., Camras, L. A., & Witherington, D. (2006). Emotional development: Action, communication, and understanding. In N. Eisenberg, W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Vol. 3, Social, emotional, and personality development (6th ed.)*. (pp. 226-299). Hoboken, NJ US: John Wiley & Sons Inc.
- Salum, G. A., Mogg, K., Bradley, B. P., Gadelha, A., Pan, P., Tamanaha, A. C., ... Pine, D. S. (2013). Threat bias in attention orienting: Evidence of specificity in a large community-based study. *Psychological Medicine, 43*, 733-745. doi: 10.1017/s0033291712001651
- Samson, J. E., Ojanen, T., & Hollo, A. (2012). Social goals and youth aggression: Meta-analysis of prosocial and antisocial goals. *Social Development, 21*, 645-666. doi: 10.1111/j.1467-9507.2012.00658.x
- Schippell, P. L., Vasey, M. W., Cravens-Brown, L. M., & Bretveld, R. A. (2003). Suppressed attention to rejection, ridicule, and failure cues: A unique correlate of reactive but not proactive aggression in youth. *Journal of Clinical Child and Adolescent Psychology, 32*, 40-55. doi: 10.1207/15374420360533059
- Schönenberg, M., & Jusyte, A. (2014). Investigation of the hostile attribution bias toward ambiguous facial cues in antisocial violent offenders. *European Archives of Psychiatry and Clinical Neuroscience, 264*, 61-69. doi: 10.1007/s00406-013-0440-1
- Schonert-Reichl, K. A., Oberle, E., Lawlor, M. S., Abbott, D., Thomson, K., Oberlander, T. F., & Diamond, A. (2015). Enhancing cognitive and social-emotional development through a simple-to-administer mindfulness-based school program for elementary school children: A randomized controlled trial. *Developmental Psychology, 51*, 52-66. doi: 10.1037/a0038454

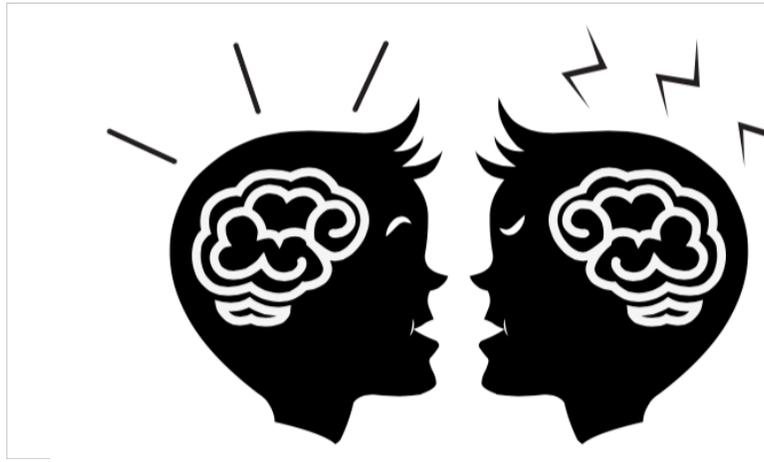
- Shore, D. I., Spence, C., & Klein, R. M. (2001). Visual prior entry. *Psychological Science, 12*, 205-212. doi: 10.1111/1467-9280.00337
- Susa, G., Benga, O., Pitică, I., & Miclea, M. (2014). Child temperamental reactivity and self-regulation effects on attentional biases. *Frontiers in Psychology, 5*, 1-11. doi: 10.3389/fpsyg.2014.00922
- Susa, G., Pitică, I., Benga, O., & Miclea, M. (2012). The self regulatory effect of attentional control in modulating the relationship between attentional biases toward threat and anxiety symptoms in children. *Cognition and Emotion, 26*, 1069-1083. doi: 10.1080/02699931.2011.638910
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson.
- Taylor, Z. E., Eisenberg, N., Spinrad, T. L., & Widaman, K. F. (2013). Longitudinal relations of intrusive parenting and effortful control to ego-resiliency during early childhood. *Child Development, 84*, 1145-1151. doi: 10.1111/cdev.12054
- Thomas, K. M., Drevets, W. C., Whalen, P. J., Eccard, C. H., Dahl, R. E., Ryan, N. D., ... Casey, B. J. (2001). Amygdala response to facial expressions in children and adults. *Biological Psychiatry, 49*, 309-316. doi: 10.1016/S0006-3223(00)01066-0
- Tottenham, N., Tanaka, J. W., Leon, A. C., McCarry, T., Nurse, M., Hare, T. A., ... Nelson, C. (2009). The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research, 168*, 242-249. doi: 10.1016/j.psychres.2008.05.006
- Tremblay, R. E. (2000). The development of aggressive behaviour during childhood: What have we learned in the past century? *International Journal of Behavioral Development, 24*, 129-141. doi: 10.1080/016502500383232

- Tremblay, R. E., Masse, L. C., Vitaro, F., & Dobkin, P. L. (1995). The impact of friends' deviant behavior on early onset of delinquency: Longitudinal data from 6 to 13 years of age. *Development and Psychopathology, 7*, 649-667. doi: 10.1017/s0954579400006763
- Truong, G., Handy, T. C., & Todd, R. M. (April, 2016). *Self-relevance as a source of attentional bias*. In R. M. Todd (Chair) & G. Truong (Co-Chair), *Affective motivational salience and attentional sets*. Symposium conducted at the meeting of the Cognitive Neuroscience Society, New York, NY.
- van der Voort, A., Linting, M., Juffer, F., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2013). Delinquent and aggressive behaviors in early-adopted adolescents: Longitudinal predictions from child temperament and maternal sensitivity. *Children and Youth Services Review, 35*, 439-446. doi: 10.1016/j.chilyouth.2012.12.008
- Vasey, M. W., El-Hag, N., & Daleiden, E. L. (1996). Anxiety and the processing of emotionally threatening stimuli: Distinctive patterns of selective attention among high- and low-test-anxious children. *Child Development, 67*, 1173-1185. doi: 10.2307/1131886
- Wang, F. L., Chassin, L., Eisenberg, N., & Spinrad, T. L. (2015). Effortful control predicts adolescent antisocial-aggressive behaviors and depressive symptoms: Co-occurrence and moderation by impulsivity. *Child Development, 86*, 1812-1829. doi: 10.1111/cdev.12406
- West, G. L., Anderson, A. A. K., & Pratt, J. (2009). Motivationally significant stimuli show visual prior entry: Evidence for attentional capture. *Journal of Experimental Psychology: Human Perception and Performance, 35*, 1032-1042. doi: 10.1037/a0014493
- West, G. L., Anderson, A. K., Bedwell, J. S., & Pratt, J. (2010). Red diffuse light suppresses the accelerated perception of fear. *Psychological Science, 21*, 992-999. doi: 10.1177/0956797610371966

- Wilkowski, B. M., Robinson, M. D., Gordon, R. D., & Troop-Gordon, W. (2007). Tracking the evil eye: Trait anger and selective attention within ambiguously hostile scenes. *Journal of Research in Personality, 41*, 650-666. doi: 10.1016/j.jrp.2006.07.003
- Yeager, D. S., Miu, A. S., Powers, J., & Dweck, C. S. (2013). Implicit theories of personality and attributions of hostile intent: A meta-analysis, an experiment, and a longitudinal intervention. *Child Development, 84*, 1651-1667. doi: 10.1111/cdev.12062
- Yoon, J., Hughes, J., Gaur, A., & Thompson, B. (1999). Social cognition in aggressive children: A metaanalytic review. *Cognitive and Behavioral Practice, 6*, 320-331. doi: 10.1016/s1077-7229(99)80051-0
- Young, L. E. (2011). *Shifting our attention to encoding: Intervening at the forgotten stage of social information-processing among reactively aggressive youth*. 72, ProQuest Information & Learning, US. Retrieved from [http://acumen.lib.ua.edu/legacy/u0015\\_0000001\\_0000469.mods.xml](http://acumen.lib.ua.edu/legacy/u0015_0000001_0000469.mods.xml) on September 6, 2016.

## Appendices

### Appendix A Recruitment Flyer



#### **Attention ALL boys 9-12 years old**

We are conducting a research based experiment on social behaviour focusing on aggression.

- ➔ **Perks for participating?**  
You will receive a \$20 honorarium and earn up to \$5 during one of the computer tasks.
- ➔ **How long will it take?**  
about 2 - 2.5 hours to complete.
- ➔ **What will you need to do:**  
schedule a home visit OR visit our lab.  
Noon, evening, and weekend appointments are available.

---

If you're interested contact **Natalie Miller, MA**



## Appendix B Family Information Questionnaire

### Part I: General Family and Child Information

1. a ) What is your son's date of birth? \_\_\_\_\_ (dd/mm/yyyy)

b) How old is your son? \_\_\_\_\_

2. What grade is your son in? \_\_\_\_\_

3. Was your son adopted?

Yes. Age at adoption: \_\_\_\_\_

No, my child is not adopted.

4. Do you have any other children?

Yes. Please write their age(s) and gender(s) below.

_____	_____
_____	_____
_____	_____
_____	_____

No, I do not have any other children.

5. Has your son been diagnosed with any disorders, behavior problems, or learning, developmental, or neurological problems?

Yes. Please describe: \_\_\_\_\_

No. (*please skip to question 7*)

6. Is your son currently taking any medication for these problems?

Yes. Please describe: \_\_\_\_\_

No.

7. How often does your son play video games in one week?

My child does not play video games (*please skip to question 9*)

0 to 5 hours

5 to 10 hours

10 to 15 hours

15 to 20 hours

20 to 25 hours

25 to 30 hours

More than 30 hours

8. What type of game does your son play the most? [*Choose one*]

- Action (e.g., shooting, close combat, fighting)
- Adventure (e.g., Myst)
- Role-playing (e.g., Final Fantasy, Elder Scrolls)
- Simulation (e.g., SimCity, The Sims, racing or flying simulation games)
- Strategy (e.g., Civilization, Warcraft, Age of Empires, Minecraft)
- Sports (e.g., NHL, NFL, NBA)
- 

9. How would you describe your son's ethnicity?

---

Part II: Parent Information

10. What is your relationship to [*child's name*]?

- Biological mother
- Biological father
- Step-mother
- Step-father
- Adoptive mother
- Adoptive father
- Other, please explain: \_\_\_\_\_

11. How old are you? \_\_\_\_\_ (years)

12. How would you describe your ethnicity?

---

13. On a scale of 1 to 10, where 1 is not at all, and 10 is completely, how much do you identify yourself as Canadian? (circle one)

1 ----- 2 ----- 3 ----- 4 ----- 5 ----- 6 ----- 7 ----- 8 ----- 9 ----- 10  
 Not at all Completely

14. What is your level of education?

- Less than grade 7
- Junior high school
- Partial high school (grade 10 or 11)
- High school graduate
- Partial college/university (min. 1 year) or special training
- Standard college or university graduate (i.e.: B.A., B.Ed.)
- Graduate or professional training (i.e.: M.A., PhD)

15. Are you currently employed?

Yes. Please briefly describe your occupation:

No, I am not currently employed.

---

16. Please check your **household income** category for this past year:

- Less than \$5000
- \$5000 - \$19 999
- \$20 000 - \$34 999
- \$35 000 - \$49 999
- \$50 000 - \$74 999
- \$75 000 - \$99 999
- \$100 000 - \$149 999
- \$150 000 - \$199 999
- \$200 000 and higher

17. What is your marital status?

- Married or common law. How many years? \_\_\_\_\_
- Divorced or separated
- Widowed
- Single

Part III: Other Parent Information

If applicable, please answer the following questions about your partner:

18. What is your partner's relationship to [*child's name*]?

- Biological mother
- Biological father
- Step-mother
- Step-father
- Adoptive mother
- Adoptive father
- Other, please explain: \_\_\_\_\_

19. How old is your partner? \_\_\_\_\_ (years)

20. How would you describe your partner's ethnicity?

\_\_\_\_\_

21. On a scale of 1 to 10, where 1 is not at all, and 10 is completely, how much does your partner identify him/herself as Canadian? (circle one)

1 ----- 2 ----- 3 ----- 4 ----- 5 ----- 6 ----- 7 ----- 8 ----- 9 ----- 10  
Not at all Completely

22. What is your partner's level of education?

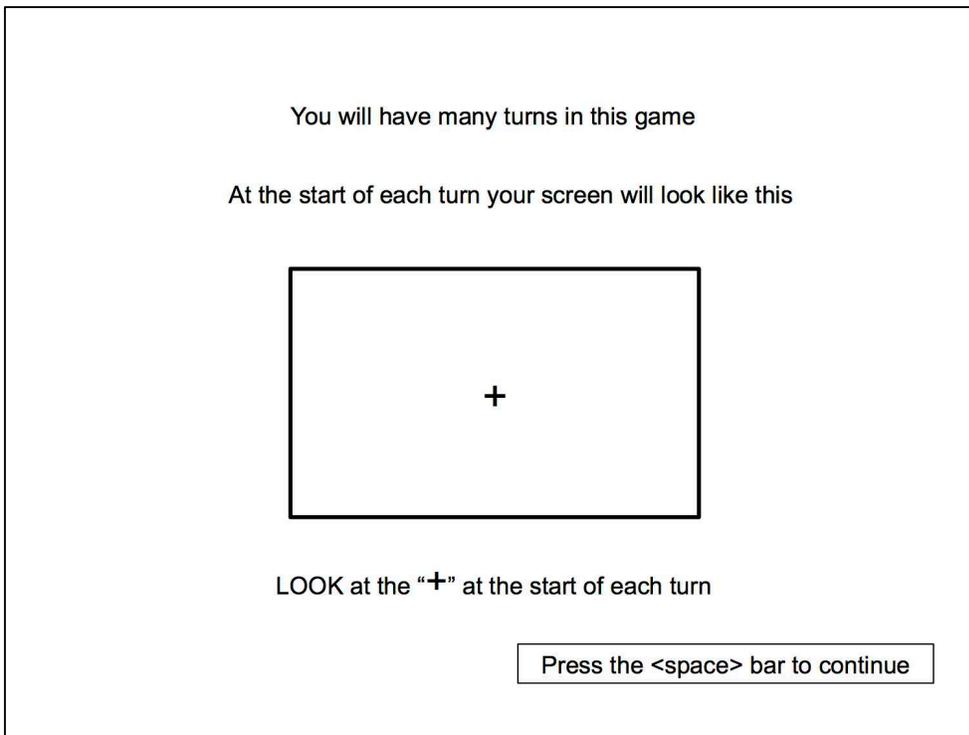
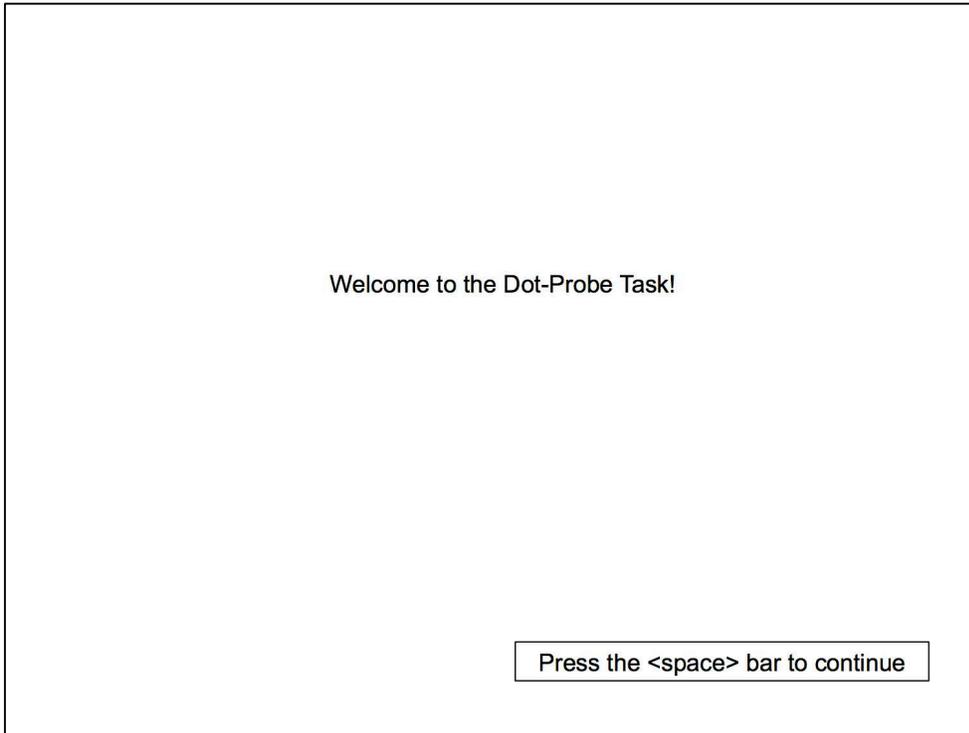
- Less than grade 7
- Junior high school
- Partial high school (grade 10 or 11)
- High school graduate
- Partial college/university (min. 1 year) or special training
- Standard college or university graduate (i.e.: B.A., B.Ed.)
- Graduate or professional training (i.e.: M.A., PhD)

23. Is your partner currently employed?

Yes. Please briefly describe your partner's occupation:

No, he/she is not currently employed. \_\_\_\_\_

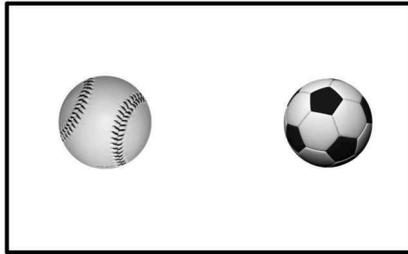
## Appendix C Instruction Screens for the Dot-Probe Task



“+” will disappear

Two pictures will appear on the LEFT and RIGHT sides of the screen

For each turn, your screen will look something like this, with a different picture on either side

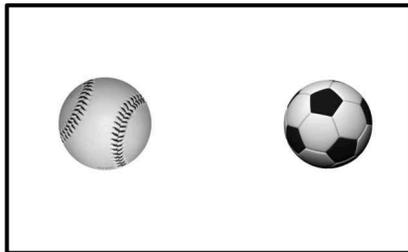


Press the <space> bar to continue

Look at both pictures

Do NOT focus on the centre

You will need to move your eyes back and forth to focus on each of the pictures while they are on the screen



Press the <space> bar to continue

The pictures will disappear after a short amount of time

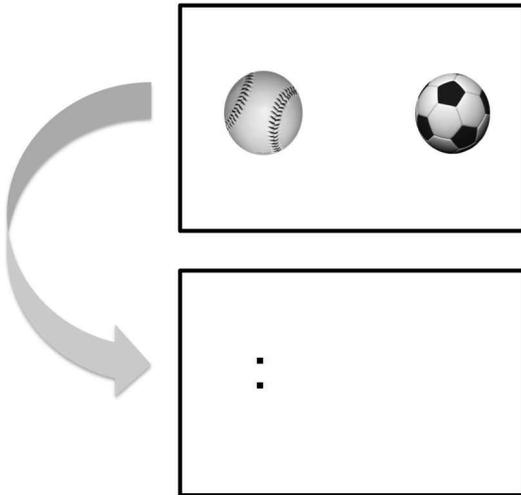
One of the pictures will be replaced by a symbol, which will appear in the same part of the screen as the picture was

The symbols will either be:

▪                    or                    ▪ ▪

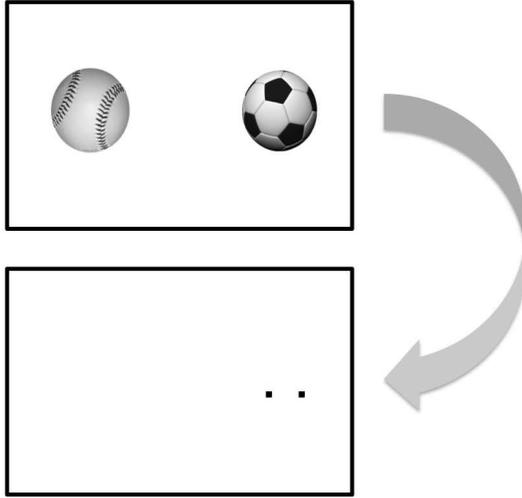
Press the <space> bar to continue

Sometimes ▪ will appear after the pictures disappear



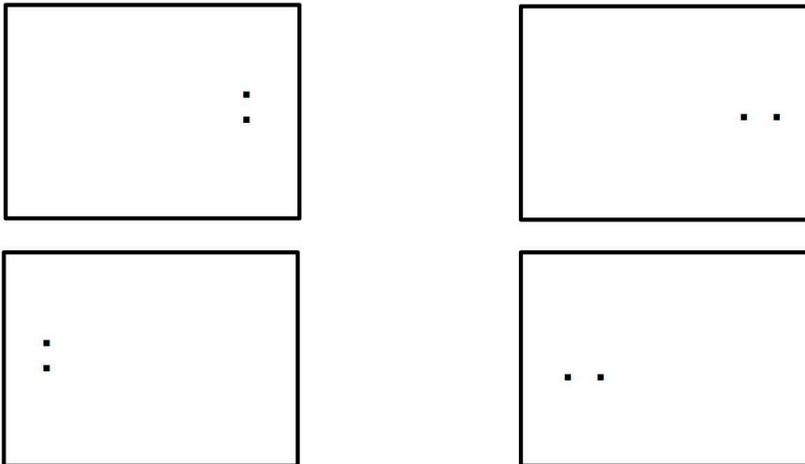
Press the <space> bar to continue

Other times . . will replace the pictures



Press the <space> bar to continue

. and . . may appear on EITHER side of the screen



Press the <space> bar to continue

It is your job to tell us if  $\overset{\cdot}{\square}$  or  $\square \cdot$   
appeared

Press **BLUE**  
button

when  $\square \cdot$   
appears

Press **RED** button

when  $\overset{\cdot}{\square}$  appears

Press the <space> bar to continue

To help you understand this exercise better, you will have  
some practice turns first before the real turns

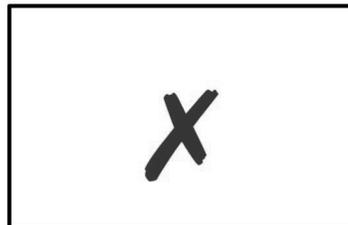
Press the <space> bar to continue

During practice, when you press the correct button you will see this



Press the <space> bar to continue

If press the wrong answer on the keyboard during the practice turns, you will see this on your screen



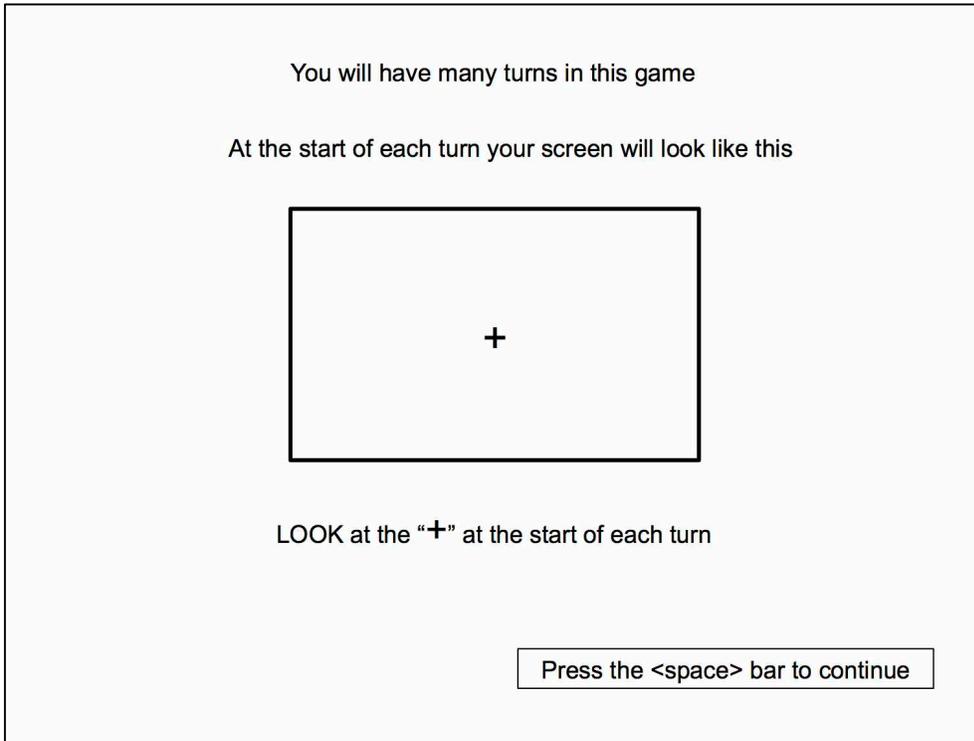
Press the <space> bar to continue

Try to work as quickly as you can, while still  
answering correctly on each turn

Now you are ready to start the practice turns

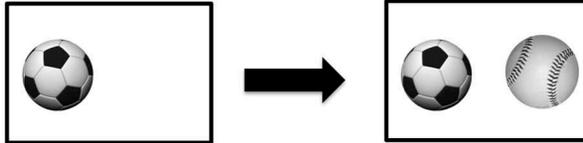
Press the <space> bar to start

## Appendix D Instruction Screens for the Temporal Order Judgment Task



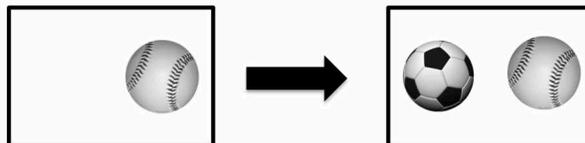
In this game the computer will show you two pictures on either side of the screen

Sometimes the picture on the LEFT side of the screen will appear first



Press the <space> bar to continue

Other times the picture on the RIGHT side of the screen will appear first



Press the <space> bar to continue

Your job is to decide which picture appeared first on the screen

If you think the picture on the **Left** came first, press the  
**Blue** button on the **Left** side of the keyboard

If you think the picture on the **Right** came first, press the  
**Red** button on the **Right** side of the keyboard

Press the <space> bar to continue

Sometimes it will be hard to tell which picture came first  
because they appear very quickly

If you are unsure, just take your best guess and move onto the next turn

To help you understand this game better, you will have  
some practice turns first before the real turns

Press the <space> bar to continue

For the first few practice turns the pictures will appear in slow motion

You will receive feedback during the slow motion turns

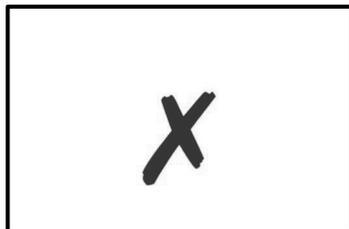
Press the <space> bar to continue

During the slow motion practice, when you press the correct button you will see this



Press the <space> bar to continue

If press the wrong answer on the keyboard during the practice turns, you will see this on your screen



Press the <space> bar to continue

Try to work as quickly as you can, while still answering correctly on each turn

Now you are ready to start the practice turns

Remember:

Press the **Blue** button when the picture on the **Left** appears first

Press the **Red** button when the picture on the **Right** appears first

Press the <space> bar to start

## Appendix E Statistical Calculations for the Point of Perceived Simultaneity (PSS)

The PSS is calculated from the following equation:

$$\text{Log}(p / 1 - p) = \text{intercept} + \text{slope} * \text{SOA}$$

$p$  is the probability of responding “neutral first”

PSS occurs when there is equal probability for responding “neutral first” or “angry first”, in other words,  $p = 50\%$

$$\text{Log}(0.5 / 1 - 0.5) = 0 = \text{intercept} + \text{slope} * \text{SOA}$$

Solving for SOA:

$$- \text{intercept} / \text{slope} = \text{SOA when } p = 50\% = \text{PSS}$$

In this equation, the intercept represents the log-odds of responding “neutral first” when  $\text{SOA} = 0$ . If there is no attentional bias, the intercept and PSS will be equivalent. A positive intercept means that when  $\text{SOA} = 0$  “neutral first” responses are favoured (i.e.,  $p > 50\%$ ). A negative intercept means that when  $\text{SOA} = 0$  “angry first” responses are favoured (i.e.,  $p < 50\%$ ). In sum, the intercept indicates whether or not there is an attentional bias and provides the probability of responding “neutral first” when  $\text{SOA} = 0$  (i.e.,  $p$  is y-axis coordinate of the PSS).

The slope denotes the magnitude of an attentional bias, and describes the relation between the SOA and the probability of responding “neutral first.” A positive relation indicates that as SOA increases, the probability of responding “neutral first” also increases. As previously mentioned, SOAs were coded as negative when angry faces were presented first and positive when neutral faces were presented first. Therefore, if participants completed the task correctly, the probability they responded “neutral first” should be positively related to SOAs. All participants had positive slope values, meaning that in cases when it was clear that a neutral face

was presented first (e.g., SOA of 112 ms) or that an angry face was presented first (e.g., SOA of -112 ms) they responded accurately.

## Appendix F Instruction Screens for the Attention Shifting Task

Welcome to the Video Task!

Press the <space> bar to continue

In this game you will watch videos

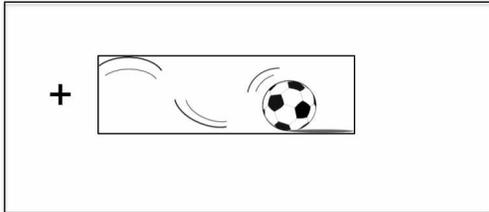
The videos will play in the centre of the screen

While you are watching the videos, **+** will appear on either  
the **Right** or **Left** side of the screen

Your job is to tell the computer which side **+** appears

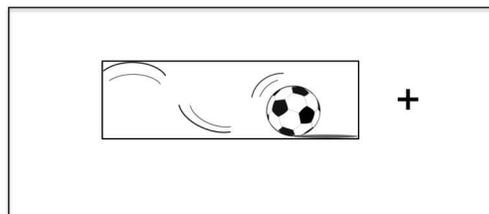
Press the <space> bar to continue

When **+** appears on the **Left** side of the screen, press the **Blue** button



Press the <space> bar to continue

When **+** appears on the **Right** side of the screen, press the **Red** button



Press the <space> bar to continue

Try to work as quickly as you can, while still answering correctly

Before you start the actual task you will have some practice turns

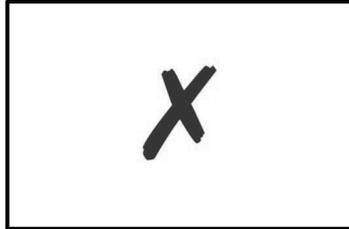
Press the <space> bar to continue

During practice, when you press the correct button you will see this



Press the <space> bar to continue

If press the wrong answer on the keyboard during the practice turns, you will see this on your screen



Press the <space> bar to continue

Try to work as quickly as you can, while still answering correctly on each turn

Now you are ready to start the practice turns

Remember:

Press the **Blue** button when + appears on the **Left**

Press the **Red** button when + appears on the **Right**

Press the <space> bar to start

## **Appendix G Eligibility Screening Questions**

*[Response to email from parent expressing interest in the study]*

Dear \_\_\_\_\_,

Thanks for your interest in the Social Skills Study!

I just have a few questions to determine eligibility for the study:

- (1) Are you legal guardian of your son?
- (2) Have you lived with him for the past year?
- (3) Has he ever been diagnosed with a psychological disorder or condition (i.e., intellectual disability, autism)? Please note that children with autism spectrum disorder or pervasive developmental disorders are not eligible for this study.
- (4) Does he have any difficulties with vision? (i.e., wears glasses)
- (5) Does your son speak English fluently?
- (6) How old is your son? This study is for boys aged 9 to 12 years.

Please answer these questions and then I can let you know if your son is eligible. From there we can set up either a home or lab visit, whichever is your preference. In terms of time, I'm happy to accommodate your schedule, with a weekday afternoon, evening, or weekend appointment.

Thanks!

## Appendix H Parent Consent Form



### THE UNIVERSITY OF BRITISH COLUMBIA

Department of Psychology  
University of British Columbia  
Vancouver, BC, V6T 1Z4  
Dr. Johnston's Lab

## Parent Consent Form

### Social Skills Study

Principal Investigator: Dr. Charlotte Johnston, Ph.D., R.Psych.

Co-Investigator: Natalie Miller, M.A.  
Department of Psychology

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, please ask. Take the time to read this carefully.

#### **Purpose:**

This study looks at how different ways of attending to different types of social cues are related to boys' social behaviour, including aggressive behaviour towards others.

You and your child have been asked to participate in this study because he is 9 to 12 years old.

#### **Study Procedures:**

This study will take place at either your home or Dr. Johnston's lab at UBC depending on your preference. For the study, you and your child will complete questionnaires and your child also will complete five computer tasks.

The questionnaires you will complete include:

- A questionnaire asking for general information about your family (e.g., child's age, number of children, your occupation, education, income, and ethnicity)
- Three questionnaire about your child's social and emotional functioning abilities
- A questionnaire about your child's aggressive behaviour
- A questionnaire about parenting

The questionnaires your child will complete include:

- Two questionnaires about his social and emotional functioning abilities  
With your child's permission, we will record his responses to some open-ended questions on one of these questionnaires
- A questionnaire asking him to rate intensity of emotions in pictures and short videos of other boys
- A questionnaire about his aggressive behaviour

The computer tasks your child will complete include:

- A task requiring him to monitor a light while simultaneously watching video footage of boys acting in either an aggressive or neutral manner with one another
- A task requiring him to determine which of two pictures (photos of boys with angry or neutral facial expressions) was presented first
- A task requiring him to determine the location of a probe on the computer screen after two pictures are presented (photos of boys with angry or neutral facial expressions)
- A search task in which he will be asked to find a target among a set of distractors (target and distractors will be drawings of angry or neutral faces)
- A competitive task in which your child will compete with a fictitious peer opponent for points that he can exchange for money (i.e., 10 cents per point). During this task, he will have the ability to subtract points from his opponent and points also will be subtracted from him. He will be told the points are being subtracted by the peer opponent, but in fact they will be subtracted at random times by the computer. At the end of the study, he will be debriefed and told that the peer was fictitious and that the computer was playing against him.

### **Potential Risks:**

Your responses to questionnaire items are voluntary and you may skip questions you do not feel comfortable answering. Similarly, your child may skip questions he does not feel comfortable answering. We encourage both of you, however, to complete as many questions as possible.

### **Potential Benefits:**

You will not receive any direct benefit from participating in the study, but your answers will help us understand how children's attention is related to their social behaviour.

### **Confidentiality:**

Your responses and your child's responses will be kept strictly confidential. Your questionnaires, your child's questionnaires, recordings of your child's responses to one of the questionnaires, and your child's performance on the five computer tasks will be identified only by code number. Questionnaires will be kept in a locked file cabinet and recordings and computer task information will be stored on an encrypted and password-

protected computer. Your contact information, including your name and address, will be kept in a locked filing cabinet in Dr. Johnston's Lab and will be destroyed after your participation in the study is complete. Data from the questionnaires and computer tasks will be kept on a computer hard disk, will be identified only by code number and will be encrypted and password-protected so that only Natalie Miller, Dr. Johnston, and authorized research assistants will have access to it. Following the completion of the study, the data will be transferred to an encrypted USB and stored in a locked filing cabinet. The results of this study will be used to write a scientific report but individual participants will not be identified. Raw data (responses to questionnaires and data from computer tasks) will be destroyed seven years after the data has been published.

Should the researcher suspect or have information disclosed to them about possible child abuse or neglect, they are required by law to report that information to the proper child authorities.

### **Compensation**

Your child will receive \$20 for his participation in this research, up to \$5 for his performance on the competitive computer task. We also will provide you with a list of resources related to children's social skills should you wish.

### **Contact for Information about the Study:**

Please feel free to contact Dr. Charlotte Johnston's lab if you have any questions about the research at #####.

### **Contact for Concerns about the Rights of Research Subjects:**

If you have any concerns about your treatment or rights as a research subject, please contact the Research Subject Information Line in the Office of Research Services at the University of British Columbia at #####.

**Consent:**

Your and your child's participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Signing this form indicates that you have read, understood, and consented to participate in the following research. A copy of this consent form will be provided for you to keep.

I acknowledge that I have read this agreement. \_\_\_\_\_(initial)

I consent to allow my child to participate in the project. \_\_\_\_\_ (initial)

Parent signature \_\_\_\_\_

Parent name \_\_\_\_\_

Date \_\_\_\_\_

**Appendix I Child Assent Form**

**THE UNIVERSITY OF BRITISH COLUMBIA**



Department of Psychology  
University of British Columbia  
Vancouver, BC, V6T 1Z4  
Dr. Johnston's Lab

**Child Assent Form**

**Social Skills Study**

Principal Investigator: Natalie Miller, M.A.  
Research Supervisor: Dr. Charlotte Johnston, Ph.D., R.Psych.  
Department of Psychology

We want to tell you about a research study we are doing. A research study is a way to learn more about something. We are studying the ways that boys look at different things around them and how that is related to how they act.

If you agree to join this study, you will be asked to do three types of things. First, you will do a few things on the computer. This will involve looking at different types of things, like faces with different expressions, and making decisions about them, like which one appeared first, or watching for a cue while there is a movie playing. You will do four different things like this. Second, you will play a game that will involve earning points on the computer against another boy. During this game points also will be taken away from you by the boy you play against. Third, you will answer some questions about how you usually act. All these things will take 2 to 2.5 hours.

If you have any questions, or want to take a break from the study, you can ask the research assistant. Also, you can stop taking part in the study at any point if you do not want to continue. If you have any questions you can also call Dr. Charlotte Johnston at #####.

You will receive \$20 for taking part in this study regardless of how much you complete, and up to \$5 for playing the game with points.

Child Signature \_\_\_\_\_

Date \_\_\_\_\_

## Appendix J Procedure Manual

### Preparing participant file

Each file contains, in the following order:

- 2 consent forms
- 2 assent forms
- 1 study summary sheet
- 8 parent questionnaires
- 1 volunteer registry form
- 5 child questionnaires

### **Consent and Assent Forms**

- Have parent and child sign one of the copies, and give the other copy (consent and assent) to parent for their records

### **Study Summary Sheet**

- Fill in Participant ID, date of participation, and start and end times
- Complete the Attention Task Order section prior to running the study (i.e., 1, 2, 3, and 4)
- Below this section write the order in which the PCS and MASC will be administered
- During the study you will complete the other sections including:
  - Child's distance from computer screen (cm)
  - Child's affect at the onset of their participation (ratings for anger, sadness, anxiety)
  - Child's comprehension of task instructions and questionnaires
  - Parent's completion of questionnaires
  - Child's awareness of deception during the Point Subtraction Aggression Paradigm
  - Any other pertinent information (e.g., if room was noisy, if parent's English comprehension was questionable)

### **Parent Questionnaires (8)**

Family Information Questionnaire (FIQ)	Alabama Parenting Questionnaire (APQ)	Early Adolescent Temperament Questionnaire (EATQ)	Child Behavior Checklist (CBCL)
Social Skills Improvement System (SSIS)	Inventory for Callous-Unemotional Traits (ICU)	Matson Evaluation of Social Skills with Youngsters (MESSY)	Peer Conflict Scale (PCS)

- Parents complete FIQ first always (write "complete this FIRST" on front page of FIQ)
- Remaining 7 questionnaires should be sorted in randomized order to be completed (sorted 1-7)

- Use the Parent Questionnaire word document, which has randomized orders, to assign an order to each participant
- Write the number of completion order on each questionnaire (e.g., if CBCL is to be completed 3<sup>rd</sup> write “3” in the corner of the first page)
- Parents only complete the third and fourth pages of the CBCL, use a marker to draw a diagonal line through the first and second pages
- Use a marker to wipe out any spaces for identifying information on the SSIS, PCS, and ICU

### **Volunteer Registry Form**

- If family has not previously signed up for the registry, included this form in the package and give to parents with the parent questionnaires

### **Child Questionnaires (5)**

Peer Conflict Scale (PCS)	Multidimensional Anxiety Scale for Children (MASC)	Emotion Ratings Faces	What Do You Think? (WDYT)	Emotion Ratings Videos
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- Children complete the PCS and MASC first (the order in which they complete these will be counterbalanced)
- Emotion Ratings Faces, WDYT, and Emotion Ratings Videos are completed later in participation and are always in the same order (Faces, WDYT, Videos)

### Running a participant

#### **Arrival**

- If visit takes place in participant’s home, request to work at a table (kitchen or dining room tables work best)
- If visit in lab, use clinic rooms 1615 and either 1623 or 1625
  - Set up 1615 for child – move table away from the mirror and against on the walls with a chair. The child will complete computer tasks and questionnaires here.
  - After obtain consent and assent take parent to other clinic room (1623 or 1625)

#### **Obtaining consent and assent**

- Allow parents to review the parent consent form while you explain the study to the child
- Highlights to tell child:
  - “We will be spending the next two hours together, maybe a bit longer”
  - “You will be doing a lot of things on my computer, as well as some questionnaires”
  - “When you do the questionnaires you will be asked lots of different questions about yourself and you will fill in the answers on rating scales”
  - “You will receive \$20 for your participation, and you have a chance to earn up to another \$5 during on the computer tasks”
  - “Your participation in voluntary, which means that you are in charge of how much of the study you complete – so if you feel uncomfortable at any time and do not wish to continue the study let me know, we will stop the study and you will still receive \$20”

- “The study is not scary or anything, in fact, it is probably more on the boring side of things – the main thing I want you to know is that you are in charge of your participation”
- Once you have explained the study to the child, give them a chance to review assent form
- After parent has signed consent, give them a clipboard with all 8 parent questionnaires (and the volunteer registry form if appropriate)
  - If at participant home, mention to parent that you would prefer they do not work at the same table as child is working with you as we have found it is distracting to child, but they are welcome to stay in same room/near by if they wish (usually they are fine with this, and go to a separate area)

### **Preparing for child participation**

- Limit distractions and optimize conditions
  - If any curious siblings are hanging around, gently request that they allow their sister some space to complete the study/concentrate
  - Have child sit in a comfortable/preferred seat at table
  - Ensure that they can see the screen okay (i.e., close blinds/curtains if there is glare)
- Set up computer in front of child
  - Place keyboard protector on keyboard
- Measure how far the child is sitting from the screen using measuring tape
  - Have the child place their right and left index fingers on the red and blue buttons respectively, as if they were completing an attention task
  - Measure from edge of screen to their shoulder
  - Child should be 45 to 55 cm from the screen, ideally 50 cm, help adjust them until you are in this range
  - Request they stay approximately this distance from the screen while they work
  - Record this number (cm) on the Study Summary Sheet

### **Child participation**

#### **First Attention Task**

- Select appropriate labels and place them on the keyboard protector if completing the Dot Probe Task or Visual Search task first
  - Dot Probe Task Labels
    - : → above the red key
    - .. → above the blue key
  - Visual Search Task Labels
    - Same → above red key
    - Different → above blue key
- Have child place right and left index fingers on the red and blue buttons
- Start first assigned task in Inquisit (enter participant ID number when prompted)
- Read instructions aloud while child clicks through them on the screen
- Once instructions are completed, allow the child to work through the practice trials on their own. Monitor their hands on keyboard (i.e., make sure they are using their right and left index fingers to answer at all times). Sitting at 90 degrees to them (i.e., at corner of table) helps to monitor without being intrusive.

- Often child will ask questions about how many turns there are. You can answer with number of sections (i.e., bunch of trials separated by a break).
  - Visual Search – 8
  - Temporal Order Judgment Task (What was first) – 5
  - Dot Probe Task – 3
  - Attention Shifting Task – continuous for 12 minutes
- Allow child to complete the task, and encourage them if they complain about length (e.g., “you’re more than half-way”).

### **Second Attention Task**

- Follow similar procedures as first task, attach labels if needed, read instructions, monitor their fingers on keyboard, and encourage if needed.
- You can tell them that they will receive a break with a questionnaire after this task, especially if motivation low.

### **First Questionnaire**

- Look at Summary Sheet to determine which questionnaire child should complete (i.e., either PCS or MASC).
- If PCS:
  - This questionnaire asks you to rate *how well* each sentence describes you using this scale (point to scale on questionnaire and on booklet)
  - Sometimes children comment that this questionnaire is all negative/bad – you can say that different questionnaires measure different things and this one looks at getting along with others (do **not** agree that items are bad or negative)
- If MASC:
  - This questionnaire asks you to rate *how often* things happen to you in each sentence using this scale (point to scale on questionnaire and on booklet)
- If child is younger or seems to have comprehension difficulties, read the items to the child and have them point to answers on the booklet (pointing protects their privacy in case anyone else is present in the room). If no one is present (e.g., you are in the lab), the child can call out the numbers.
- If child cannot decide between two answers, encourage them to pick the answer that is slightly more true for them.
- If child completed questionnaire on their own, review responses and get them to answer any missed questions (unless skipped on purpose) or resolve any questions that they chose two responses.

### **Third Attention Task**

- Look at the Summary Sheet to determine the third task, attach labels if needed, read instructions, and monitor child’s fingers on keyboard. Encourage if needed.

### **Second Questionnaire**

- Look at Summary Sheet to determine which questionnaire (i.e., PCS or MASC).
- Follow instructions above.

#### **Fourth Attention Task**

- Look at the Summary Sheet to determine the third task, attach labels if needed, read instructions, and monitor child's fingers on keyboard. Encourage if needed.

#### **Emotion Face Ratings**

- Get the Emotion Face booklet, the picture of the Emotion Face rating scale (loose sheet of paper inside the booklet), and the Emotion Face rating scale (questionnaire).
- Instructions:
  - "I'm going to show you a bunch of different faces, and for each face I want you to answer three different things. The first thing I'll ask you is how angry each face looks, then I'll ask you how happy each face looks, and finally, I'll ask how speedy or how fast your heart beats when you look at the face. For speedy, it is more of a feeling about your heart, so you don't have to take your actual pulse. If you don't notice any change in your heart, then you would rate "not at all," (point to not at all), if you notice your heart rate increases at all, rate the increase on this scale (point to 2-5 on the scale)."
- Flip booklet to the first face, and ask child:
  - "How angry does she look?"
  - "How happy does she look?"
  - "How speedy is your heart when you look at her?"
- Repeat the same sequence for the second and third face. After this, if child seems to have hang of it, you can shorten instructions to "angry?", "happy?", and "speedy?".

#### **Point Subtraction Aggression Paradigm ("The Points Game")**

- Prepare the keyboard with the labels:
  - Earn → above green key
  - Protect → above blue key
  - Take → above red key
- Begin task, read instructions to child, at the end of instructions ask the child how many times they have to press earn to earn a point, how many times they have to press take to take a point, and how many times they have to press protect to protect. If they are incorrect, correct them and move on.
- Once they have finished instructions, tell them that as soon as they press the space bar they will jump right into the game and can start pressing buttons immediately.
- At the 1 minutes halfway break, limit discussion with child. Do not praise them for their points, or ask any questions about their strategy or point amount. Discourage parents or siblings from discussing with child during the game.
- At the end of the game, ask child how many points she earned. You can praise now for their effort. Try to remember this total because they will be paid depending on their points. You can also look up their points on the PSAP summary Inquisit document.
- Common questions:
  - Sometimes children are skeptical about the existence of their opponent, if they express any doubt (e.g., how are you connecting to other player, how is there another person playing at same time) you can tell them things to support

believability of peer opponent (e.g., connect through my phone's data, we have lots of kids in this study and are able to coordinate appointments this way).

- If child asks how much time is left, say they will have a break halfway through and that the task is several minutes long.
- Child says protect is not working because they just pressed it and then lost points. Say protect lasts varying amounts of time depending on what buttons have been pressed by child and their opponent.
- Child wants to know how many points peer got. Say we don't have access to that information.
- Try to reveal as little information as possible. Limit information given to child to what was already discussed in instructions.

### **What Do You Think?**

- Praise child for their efforts in getting this far, and tell child they only have two things left.
- Ask child if okay if we record what they say during this next questionnaire, as it will save us time because we won't have to write it down. In my experience child always agrees, but if they don't be prepared to write their responses down on the questionnaire.
- Set up recorder on the computer
- Instructions:
  - "I'm going to read you some stories. I want you to pretend the things in the story are actually happening to you, and then answer the questions I ask you."
- Read first vignette. Ask child open-ended question. Prompt if they do not provide a neutral or hostile attribution (e.g., they describe what child did and not why they did it).
  - Prompt: "Why did the kid do that?"
  - If child *really* struggles, you can ask "Was the child trying to be mean?" as a last resort
- Ask child to complete the following 3 closed-ended questions for the first vignette.
  - Read instructions, and show child how to make ratings. If child provides the same rating for 2a and 2b, repeat the instructions to ensure they understand one is for being mean on purpose, and one is for accidental.
- Repeat this process for the remaining vignettes.

### **Emotion Video Ratings**

- Get the picture of the Emotion Rating Scale (loose sheet of paper) and Emotion Rating Scale for Videos.
- Instructions:
  - This task is very similar to the face-rating task, except this time we will be looking at videos.
  - The videos are a bit long, so you don't have to watch the whole thing. What I want you to tell me is the answer to those three questions: how angry, how happy, and how speedy. You can tell me as soon as you know the answers.
- Start first video. Prompt child if they do not respond while video is playing. Record their responses on the Emotion Video Rating Scale.
- Videos are stored in the AST file, titled 'Ratings'

## Conclusion

- Review all parent and child questionnaires for missing items, and have parent/child complete if they accidentally missed these.
- If parent completed Volunteer Registry, ensure all information is provided (e.g., birthdates of children).
- Debrief child about the Points Game.
  - Remember when I told you were playing against another kid? You were actually playing against the computer. Did you think it was another kid?
  - The reason we use the computer is because it would be really hard for us to get another kid to play at the exact same time as you, so we use the computer instead. We tell all the kids in this study the same thing that they are playing against another kid but it is actually the computer.
  - Record whether child was aware of deception or not in the Summary Sheet.
- Provide child with \$20 and whatever they earned during the Points Game (10 cents per point).
  - Have child sign receipt (first and last name)
  - Make receipt for “Social Skills Study (CIHR)”

## Wrapping Up

- Ensure participant ID is written on every questionnaire (all pages of multipage questionnaires)
- Ensure Summary Sheet is complete
  - Deception Awareness
  - All questionnaires comprehension items completed
  - Start and end time completed
- Rename computer tasks as:
  - AST\_###(e.g., participant 303 would be AST\_303)
  - DPT\_###
  - TOJ\_###
  - VS\_###
  - PSAPsummary\_###
  - PSAPraw\_###
  - WDYT\_### (audio file)
- Place all these into a folder named after the participant ID, and put this folder into the Data folder.
- Copy this data onto lab computer.

**Appendix K Descriptive Statistics for Attention Allocation Tasks' Response Times (ms)**

	M	SD	Range	Skew <sup>a</sup>	Kurtosis <sup>b</sup>
Dot-probe: congruent	900.20	217.91	476 to 1527	.64	.15
Dot-probe: incongruent	899.00	212.47	472 to 1622	.73	.71
Temporal order judgment	824.19	263.28	424 to 1579	.98	.96
Attention shifting: angry	540.51	95.19	391 to 884	1.36	2.15
Attention shifting: neutral	540.04	87.77	392 to 807	1.04	1.10
Attention shifting: happy	537.38	88.02	370 to 846	.89	.98

<sup>a</sup> Standard error for skew = .23

<sup>b</sup> Standard error for kurtosis = .45