EXECUTIVE FUNCTIONS AND SUBTYPES OF CHILDHOOD AGGRESSION IN YOUNG CHILDREN

by

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Abstract

In the present study, linkages between early aggression and Executive Functions (EFs), the cognitive control processes associated with goal-directed behaviour and novel problem solving, were evaluated. Of interest was how specific EFs were related to early dimensional subtypes of aggression, specifically disaggregated into its forms (physical, relational) and functions (proactive, reactive). Kindergarten children (N = 255) were individually rated by teachers in terms of their tendencies to engage in four different subtypes of aggression -- proactive and reactive physical aggression, and proactive and reactive relational aggression. Children rated as high versus low in each of the four subtypes of aggression were compared for differences in “Cool EFs,” such as executive attention, inhibition, working memory, flexibility, planning, and the conjoint use of several EFs, and one “Hot EF” or more affectively-based cognitive control.

Results of a series of 2 (high, low aggression) by 2 (male, female) analyses of variance, conducted for each of the four subtypes of aggression, indicated significant differences in Executive Functioning as a function of both levels of aggression and sex (main effects), and multiple interactions of aggression and sex. Boys were rated by their teachers as displaying higher levels of proactive and reactive physical aggression, and more attention problems than girls, whereas no significant sex differences were observed in proactive or reactive relational aggression. Differential patterns of EFs were observed across aggression subtypes and for male versus female children. Higher levels of proactive physical aggression were associated with weaknesses in several specific EFs (i.e., more attention problems; poorer visual-spatial working memory; poorer conjoint selective attention, flexibility, and working memory; and poorer delay of gratification), as were higher levels of reactive physical aggression (i.e., more attention problems; poorer inhibition; poorer visual-spatial working memory; less flexibility; and poorer conjoint selective attention, flexibility, and working memory). Boys with reactive physical aggression demonstrated additional impairments, including poorer delay of gratification and marginally poorer planning abilities. Further, girls high in proactive relational aggression demonstrated stronger verbal working memory and planning abilities, and marginally higher visual-spatial working memory abilities, whereas boys high in reactive relational aggression demonstrated poorer crystallized and planning abilities.

Preface

This thesis is submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Faculty of Graduate Studies, School Psychology. It is the original, unpublished, independent work of the author, M. Kozey. I was solely responsible for the oversight of all aspects of the research project, including recruitment of participants, data collection, scoring, analysis, and interpretation of the results. I conducted this study under the supervision and guidance of my supervisory committee, Drs. Laurie Ford and Shelley Hymel (co-supervisors) and Dr. Adele Diamond (committee member). Ethical approval for this research was issued by the Behavioural Research Ethics Board at the University of British Columbia (certificate number: H12-02933; “Executive Functions and Childhood Aggression” [dissertation title] and “Children’s Thinking Skills and Social Behaviours” [BREB-approved project title]).

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ADHD	Attention-Deficit Hyperactivity Disorder
BASC-AP	Behavioral Assessment System for Children, 2nd Edition - Attention Problems subscale
DCCS-A	Dimensional Change Card Sort - Advanced task
DG	Delay of Gratification
F-B3 INC	Flanker task - Block 3 Incongruent Trials total score
FM-Seq	Frog Matrix Memory - Sequential task
FM-Si	Frog Matrix - Simultaneous task
HF	Hearts-Flowers task
HS	Happy-Sad Junior Stroop task
NT	NEPSY Tower subtest
PPRA-PP	Preschool Proactive-Reactive Aggression scale (teacher report) - Proactive Physical Aggression score
PPRA-PR	Preschool Proactive-Reactive Aggression scale (teacher report) - Proactive Relational Aggression score
PPRA-RP	Preschool Proactive-Reactive Aggression scale (teacher report) - Reactive Physical Aggression score
PPRA-RR	Preschool Proactive-Reactive Aggression scale (teacher report) - Reactive Relational Aggression score
PPRA-TR	Preschool Proactive-Reactive Aggression scale (teacher report)
PSBS-P	Preschool Social and Behavior Scale (teacher report) - Physical score
PSBS-R	Preschool Social and Behavior Scale (teacher report) - Relational score
PSBS-TR	Preschool Social and Behavior Scale (teacher report)

SB5-AB Stanford-Binet, Fifth Edition - Abbreviated Battery

SB5-NV Stanford-Binet, Fifth Edition - Non-Verbal Routing subtest

SB5-V Stanford-Binet, Fifth Edition - Verbal Routing subtest

WJ III UD Woodcock-Johnson, Third Edition, Tests of Achievement Normative Update - Understanding Directions

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I would like to express my deepest gratitude to my co-supervisors, Dr. Laurie Ford and Dr. Shelley Hymel, and my third committee member, Dr. Adele Diamond, for their support of this doctoral research, my graduate studies, and my development as a psychologist over the years.

Laurie, throughout my graduate career, you have provided me with many amazing learning and professional opportunities. You have blessed me with some of the best cognitive and preschool assessment training available, thereby molding me into the clinician that I am today. At the same time, you had the thankless job of being deadline coach and organizational monitor, yet you never doubted that I would complete my dissertation. Thank you for being the one willing to both nurture and nudge me when needed.

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I also would like to express my gratitude to Dr. Marilyn Ransby of BC Children's Hospital. In addition to your clinical supervision, you have been a constant mentor and an advocate, and patiently provided me with invaluable advice on career development.

This was a large-scale study supported by numerous other agencies and individuals that I would like to acknowledge and thank for their financial support, materials, and manpower. First, I am grateful to the Social Sciences and Humanities Research Council (SSHRC) for my Canada Graduate Scholarship, and the University of British Columbia and the Faculty of Education for scholarship support throughout my graduate studies. I also want to acknowledge that this study was funded by grants from the Melissa Institute for Violence Prevention and Treatment, the UBC Faculty of Education Office of Graduate Programs and Research, the Edith Lando Charitable Foundation, the SSHRC-funded Canadian Prevention Science Cluster, and indirectly, Peter Senkpiel.

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Many individuals made the practical completion of this study possible. I am extremely grateful to the Vancouver and Coquitlam School Boards, the administrative staff and Kindergarten teachers of participating schools, and the children and their families who were willing to take part in this study. In addition to the raw data, my interactions with the teaching staff and young students in this study gifted me with many fond memories and transformative lessons.

Simon Lisaingo was my Research Coordinator and my executive brain for almost a year, and I am in his debt for work that was both professional and timely beyond his career stage. Angelina Lee was my other primary data collection and data entry assistant and deserves recognition for her patience, flexibility, and accuracy, as well as her her perpetual good mood. Robyn Stewart-McClure, Rachel Caufield, and Anna Bowers were also tireless research assistants. Finally, I also would like to thank my colleagues at BC Children’s Hospital; Dr. Tina Wang and Dr. Tim Johnston were very tolerant and supportive of me during the completion of this study.

Dedication

This study is dedicated to my family, who supported me in every way possible
through both my graduate studies and the crazy adventure of life.

First and foremost, this is dedicated to my inspiring and never-failing parents
Dr. Nick Kozey and Dr. Louisa Kozey --
A dissertation-length tome would not suffice to express my love for
and gratitude to you, or all that you have taught me.

And also
my husband, Dr. Jack Patrick Hayes, Louise Bunn, and Geoff Gomery --
I am looking forward to our After Dissertation lives together.

Chapter 1: Introduction

The Impact of Childhood Aggression

Aggression includes acts with the intention or consequence of hurt, harm, or injury to others (Berkowitz, 1981, 1993; Dodge, 1991; Coie & Dodge, 1997; Dodge, Coie, & Lynam, 2006). From an early age children who maltreat one another engage in various forms of aggression, both physical (including hitting, kicking, pushing, or biting) and relational (including humiliation or social exclusion) that may result in actual or threatened harm to a child and/or to that child's relationships with others (Crick & Grotpeter, 1995; Dodge et al., 2006). Physical and relational aggression can also vary in terms of their functional subtype, characterized as proactive or reactive in purpose (Dodge, 1991; Dodge & Coie, 1987a, 1987b). Proactive aggression, both physical and relational, involves intentional, offensive, or instrumental acts for the purposes of deliberately harming another or achieving a goal through harming another (Dodge, 1991; Dodge & Coie, 1987a, 1987b; Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Pulkkinen, 1969,1983,1987). In contrast, reactive aggression, physical or relational, involves defensive or retaliatory acts that occur in response to threat, provocation, or frustration and hostility associated with blocked goals (Dodge, 1991; Dodge et al., 1987a, 1987b; Vitaro & Brendgen, 2005).

Regardless of its presentation, childhood aggression is a widespread problem that can have tragic consequences for its young victims and perpetrators, as well as their schools, families, and communities. Although victims of physical aggression from childhood peers typically do not suffer permanent physical harm, they can experience short-term physical pain and endure higher rates of peer rejection, loneliness, internalizing disorders, negative feelings about their own worth and competencies, and school adjustment problems (see Coie & Dodge, 1998 for a review). Similarly, children who are frequent victims of relational aggression experience higher rates of peer rejection, loneliness, and internalizing problems, as well as increased difficulties with social anxiety, depression, suicidal ideation, school avoidance, and substance use (e.g., Crick, Nelson, Morales, Cullerton-Sen, Casas, & Hickman, 2001; Hawker & Boulton, 2000).

Childhood aggression is also a major public health concern because it is associated with significant long-term risks for its perpetrators as well as its victims, and thus significant costs to society (Dodge, 2008; Tremblay et al., 2004). Child perpetrators of physical aggression demonstrate higher rates of externalizing problems, reduced pro-social skills, and poorer peer relations (Card, Stucky, Sawalani, & Little, 2008). A small, but significant sample of young children ("early starters") who engage in high levels of early physical aggression tend to be chronic life course persisters with regard to aggression (Moffit, 1993; Patterson, Reid, & Dishion, 1992). This developmental trajectory is associated with higher rates of later school difficulties, involvement in anti-social behaviour, delinquency, and violent crime, increased mental health problems and psychopathology, substance abuse, unemployment, and disrupted relationships (Coie & Dodge, 1998; Kokko & Pulkkinen, 2000; Nagin & Tremblay, 1999; Tremblay, 2000; Tremblay & Nagin, 2005). Similarly, children who engage in reactive physical aggression often have a history of maltreatment (Dodge, 1991). Given that the precursors chronic physical aggression are evident prior to school entry (Seguin, Nagin, Assaad, & Tremblay, 2004), there is a strong need to identify and understand early aggression in young children in order to facilitate prevention and intervention services.

The long-term consequences of relational aggression for its victims, perpetrators and society are less clear. Relational victimization has been associated with significant societal costs, in terms of substantially higher rates of cigarette, marijuana, and alcohol use among victims of relational aggression (Sullivan, Farrell, & Kliewer, 2006). Children who engage in high levels of relational aggression experience higher levels of numerous maladaptive outcomes over the course of childhood, including increased rates of peer rejection, loneliness, and internalizing and externalizing disorders, and lower social status (Crick et al., 1997; Crick, Ostrov, Burr, Cullerton-Sen, Jansen-Yeh, & Ralson, 2006; Ostrov & Crick, 2007; Ostrov & Godleski, 2007). Perpetrators of relational aggression also demonstrate significantly higher rates of disruptive behaviour, and in turn, related anti-social behaviours (Prinstein, Boergers, & Vernberg, 2001). However, some relationally aggressive children also exhibit higher levels of pro-social behaviour (Card et al., 2008), and even increased social status, especially if they also have characteristics and assets that are valued by the peer group (Vaillancourt & Hymel, 2006; Vaillancourt, McDougall, & Hymel, 2003).

Approaches to Understanding Childhood Aggression

Psychological research on the antecedents and causes of childhood aggression has historically emphasized psycho-social factors, particularly inadequate social control or acculturation (Hirschi, 2004) and inappropriate social learning (Bandura, 1969, 1973, 1986). Childhood aggression has been shown to be associated with exposure to and learning from aggression in media (Freedman, 2002; Ostrov, Gentile, & Mullins, 2013; Villani, 2001), peer dynamics in social groups (Boivin, Vitaro, & Poulin, 2005), and patterns of familial interaction and learning associated with coercive, inconsistent, or neglectful parenting (e.g., Patterson, 1982; Patterson, Reid, & Eddy, 2002; Webster-Stratton, 1990). However, the perspective that aggression is predominantly the result of “maladaptive learning” may be an inadequate approach to understanding the etiology of childhood aggression.

More recently, Tremblay (2000, 2003) advocated for an alternative approach, suggesting that aggression may be a natural, innate tendency that we learn to self-regulate, and thus “we do not need to learn how to aggress, [rather] we need to learn how not to aggress” (2011, p. 177-178). Consistent with this perspective, increased and persistent patterns of physical aggression have been associated with numerous within-child characteristics, such as difficult temperament, impulsive personality traits, and cognitive delays (Hoaken, Shaughnessy, & Pihl, 2003; Moffit, 2007), genetics (Brendgen et al., 2008), and, in the case of physical aggression, reduced language abilities (see Ostrov & Godeleski, 2007 for a review). Meta-analytic research by Morgan and Lilifield (2002) demonstrated a robust relationship between general anti-social behaviour and weaknesses in neuro-cognitive abilities important to self-regulation, namely Executive Functions. More recent research indicates that these same weaknesses are associated with physical aggression in boys (Seguin, Boulderice, Harden, Tremblay, & Pihl, 1995; Seguin et al., 2004).

Executive Functions (EFs) is a widely recognized term (Lezak, 1995; Miller & Cohen, 2001) that refers to a collection of psychological processes necessary for purposeful, goal-directed problem-solving activities (Anderson, 1998; Diamond, 2006; Miller & Cohen, 2001; Stuss & Alexander, 2000; Stuss & Benson, 1984; Welsh, 2002). Increasingly, EF and Executive Dysfunction (ED) have been recognized as important to numerous childhood behaviours and outcomes, as a contributing etiological factor, symptom, or functional consequence. Substantial evidence links EF and ED to social-emotional functioning (Carlson, 2005; Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2007), behaviour (Barker, Seguin, White, Bates, Lacourse, et al., 2007; Riggs, Blair, & Greenberg, 2001), mental health (Pennington & Ozonoff, 1996; Powell & Voeller, 2004; Zelazo & Mueller, 2002), and academic achievement (Blair & Razza, 2007; Bull, Espy, & Wiebe, 2008; Espy et al., 2004; Martel et al., 2007; Meltzer, 2007; St. Clair-Thompson & Gathercole, 2006; Waber, Gerber, Turcios, Wagner, & Forbes, 2006). The goal of the present study is to explore the links between specific subtypes of early childhood aggression and a variety of specific Executive Functions.

Definition of Key Terms

The present study distinguishes four different types of aggression in terms of both form (physical or relational) and function (proactive, reactive), following Little, Jones, Henrich, and Hawley (2003), and Ostrov and Crick (2007), as described below.

Proactive physical aggression. Proactive physical aggression is the tendency to deliberately and intentionally harm another person through physical force (Dodge, 1991; Dodge, et al., 2006; Ostrov & Crick, 2007), which may or may not involve the use of an object or one's body (Tremblay & Nagin, 2005), often for instrumental or goal-attainment purposes (Card et al., 2008; Dodge & Crick, 1987, 1996; Little et al., 2003; Vitaro, Brendgen, & Barker, 2006).

Reactive physical aggression. Reactive physical aggression also reflects the tendency to harm another person through physical force (Dodge, 1991; Dodge et al., 2006; Ostrov & Crick, 2007). Unlike proactive physical aggression, however, it is a defensive, retaliatory, or hostile response that occurs in reaction to threat, provocation, or blocked goals (Coie, Dodge, Terry, & Wright, 1991; Vitaro & Brendgen, 2005, 2006).

Proactive relational aggression. Proactive relational aggression is the tendency to deliberately and intentionally harm another person or their relationships with peers (Dodge et al., 2006; Ostrov & Crick, 2007) through direct acts such as denigration, character attacks, rejection, or threats of rejection, or through indirect acts such as exclusion, spreading of rumours, gossiping, or manipulation of friendships (Crick, 1995, 1996a, 1996b; Crick, Grotpeter, & Bigbee, 2002; Crick, Ostrov, & Kawabata, 2007).

Reactive relational aggression. Reactive relational aggression also refers to the tendency to harm another person or their relationships with peers through relational means (Dodge et al., 2006; Ostrov & Crick, 2007). Unlike proactive relational aggression, it is a defensive, retaliatory, or hostile response that occurs in reaction to threat, provocation, or blocked goals.

Executive Functions. As noted above, Executive Functions are higher-order, brain-based cognitive functions necessary for purposeful, goal-directed problem-solving activities (Anderson, 1998; Diamond, 2006; Miller & Cohen, 2001; Stuss & Alexander, 2000; Stuss & Benson, 1984; Welsh, 2002). Most models of EF vary in their specification of the number of EFs distinguished and as to the psychological processes that constitute EFs, and many individual EFs themselves are likely multi-factorial or can be further divided into sub-functions (Eslinger, 1996; Grafman, 1995; Pennington, Bennetto, McAleer, & Roberts, 1996; Rabbit, 1997; Stuss & Alexander, 2000). The specific EFs included in this study are itemized below, and reflect a synthesis of the six most commonly recognized individual EFs in the combined experimental (Diamond, 2002; Fuster, 1997, 2000; Kramer, Boxer, Cahn-Weiner, Johnson, et al., 2008; Mesulam, 2002; Miyake, Friedman, Emerson, Witziki, & Howerter, 2000; Roberts & Pennington, 1996; Zelazo, Craik, & Booth, 2004; Zelazo, Carter, Reznick, & Frye, 1997; Zelazo, Muller, Frye, & Marcovitch, 2003) and applied literatures (Anderson, 2002, 2008; Barkley, 1997, 2007; Dawson & Guare, 2004; Lezak, Howieson, & Loring, 2004).

Executive attention. Executive attention has been conceptualized as an individual EF or as a subordinate function closely related to EFs (Anderson, Jacobs, & Anderson, 2008). Executive attention is characterized as higher order, volitionally-controlled attention (Posner & DiGirolamo, 1998) and is subdivided into selective attention (sometimes referred to as focused or divided attention) and sustained attention (Posner, 1990; Stuss, 1992). Selective attention is the ability to deliberately focus on a prioritized, individual goal, whereas sustained attention is the ability to maintain selective attention for extended periods of time. Executive attention is thought to facilitate self-directed or executive behaviour in that the ability to attend to internal or external stimuli is essential to the ability to use other individual EFs, such as working memory (Roberts & Pennington, 1996).

Inhibition. Inhibition is associated with the concept of impulse control and the ability to think prior to acting (Barkley, 1997, 2010; Friedman & Miyake, 2004; Nigg, 2000). Inhibition may involve the ability to stop a habitual response pattern [prepotent response], a current or ongoing response, or a response that comes after a delay [between the present and future] (Barkley, 1997, 2010; Nigg, 2000), and the targets of inhibition may be attentional, verbal (internal or external speech), visual, or mental behavioural modalities. Inhibition facilitates self-directed behaviour because it allows the individual to overcome the “default mode,” thereby allowing more conscious and flexible, instead of stimulus-bound, responses (Mesulam, 2002).

Working memory. Working memory involves the temporary recall of information for up to approximately 30 seconds, through verbal or visual short-term memory systems and their interface with long-term memory (Baddeley, 1986, 2000; Baddeley & Hitch, 1974; Fuster, 1997, 2000; Petrides, 1994, 1998; Goldman-Rakic, 1987, 1995). In addition to holding or maintaining information “online,” working memory involves the manipulation, reorganization, and consequent re-updating of information in mind (D’Esposito, 2007; Mesulam, 2000; Moscovitch, 1992). Working memory specifically facilitates self-directed or executive behaviour through its “cross-temporal organization of behaviour” (Fuster, 1997, pp. 157-158).

Flexibility. Cognitive flexibility is associated with the concepts of set shifting and mental switching (Miyake et al., 2000). Flexibility is the ability to switch mental set or strategies and to adapt responses to changing situations. It may involve shifting between multiple non-conflicting or conflicting rules and simultaneously reflecting upon more than one aspect of a thought at one time (Chevalier & Blye, 2006; Davidson, Amso, Anderson, & Diamond, 2006; Diamond, 2002, 2006). Flexibility is the consideration of novel approaches to situations and thus is the anti-thesis of non-executive or automatic and routine behaviour, in that “it cannot be done on automatic” (Davidson et al., p. 2038).

Planning. Executive planning abilities originate from traditional clinical neuropsychology definitions of EFs (Lezak et al., 2004) and the educational notion of meta-cognition (Meltzer, 2007). Planning abilities include “the identification and organization of the steps and elements (i.e., skills, materials) needed to carry out an intention, and are reliant on concept formation (for formulation of alternatives), and reasoning (to decide between choices)” (Turner & Levine, 2004, p. 614; see also Gioa, Isquith, & Guy, 2001; Gioa, Isquith, Guy, & Kenworthy, 2000).

Hot Executive Functions. Recent distinctions have been made between more cognitively-based, or “Cool EFs,” such as those listed above, and more affectively-based, or “Hot EFs” (Zelazo & Muller, 2002). Whereas “Cool EFs” are typically associated with de-contextualized, abstract processing and fluid intelligence, “Hot EFs” are associated with decision-making in real-life situations that are motivationally laden and involve uncertainty in decision-making, and the traditional notions of self-regulation and emotional intelligence (Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Isquith, Crawford, Espy, & Gioia, 2005; Zelazo & Mueller, 2002). To date, however, more precise definitions of “Hot EFs” are unavailable, and “Hot EFs” typically are defined as performance on specific tasks that involve the deferral of emotionally pleasing, short-term gains for longer-term rewards (Carlson, 2005).

Other cognitive abilities: Crystallized abilities. Crystallized abilities (also referred to as Comprehension-Knowledge) are one of the nine primary cognitive abilities identified within the Cattell-Horn-Carroll factor-analytic model of cognitive ability (Schneider & McGrew, 2012). Crystallized abilities are the “breadth and depth of a person’s acquired knowledge” (McGrew & Flanagan, 1998, pp. 14-15) and, in lay terms, include knowledge of and the ability to understand verbal information, such as vocabulary or general factual knowledge, which are learned through spoken language and culture. Collectively, crystallized and fluid reasoning abilities (see below) are the most predictive of general cognitive or intellectual ability (McGrew, 1997, 2005).

Other cognitive abilities: Fluid reasoning. Fluid reasoning abilities also are one of the nine primary cognitive abilities identified within the Cattell-Horn-Carroll factor-analytic model of cognitive ability (Schneider & McGrew, 2012). Fluid reasoning abilities involve “forming and recognizing concepts...problem-solving, and...inductive and deductive reasoning” (McGrew & Flanagan, 1998, p. 14). Fluid reasoning abilities include abstract reasoning and non-verbal problem-solving. In the present study, measures of crystallized abilities and fluid reasoning were used to estimate general cognitive ability and determine whether prospective participants met inclusion criteria.

Childhood Aggression, Executive Functions, and the Current Study

As elaborated in the review of literature to follow, several recent studies have investigated the relationship between Executive Functions and: 1) general childhood aggression (e.g., Raaijmakers et al., 2008; Riccio, Hewitt, & Bake, 2011; Riggs et al., 2001; Snell, 1998; Sun, 2001); 2) childhood physical aggression (Seguin et al., 1999; Seguin et al., 2004; Seguin, Pihl, Harden, Tremblay, & Boulerice, 1995; Snell, 1998), and, to a lesser extent, 3) functional patterns of childhood aggression (e.g., Broder, 2007; Giancola, Moss, Martin, Kirisci, & Tarter, 1996; Jones, 2007). Of those studies focusing on functional patterns of aggression, only two studies have involved preschool and Kindergarten-aged children (Jones, 2007; Raaijmakers et al., 2008). Further, this author identified only one study that indirectly examined relational aggression and a concept loosely related to EFs and to effortful control (Gower & Crick, 2011).

The purpose of the present study was to systematically examine the relationship between aggression and Executive Functions in early childhood. Specifically, the linkages between subtypes of aggression as defined in the current literature on aggression -- proactive physical, reactive physical, proactive relational, reactive relational aggression -- and specific EFs were examined, with the goal of improving our understanding of the neuro-cognitive factors underlying aggression and informing efforts to help children, their schools, families, and communities.

Structure of the Thesis

This document includes five chapters. In **Chapter 1: Introduction**, a brief overview of the topic area, purpose, and organization of this thesis are provided. In **Chapter 2: Review of the Literature and Statement of the Problem**, a synthesis and critical summary of relevant theoretical and empirical literature is provided, including current dimensional understandings of aggression, current clinical and empirical conceptualizations of Executive Functions, and findings relating childhood aggression and Executive Functions. Also, in this chapter, unresolved issues, methodological problems, and gaps in the existing literature are identified. Next, the rationale, purpose, and significance of the current study are outlined, followed by a detailing of the four research questions that guided this research. In **Chapter 3: Methods,** the study sample participants, procedures, and measures are described. **Chapter 4: Results** details the analyses and results of the study, and **Chapter 5: Discussion** provides a summary and interpretation of the findings of the study, including consideration of the limitations of the study, and its implications for future research and practice.

Chapter 2 - Review of the Literature & Statement of the Problem

The literature review below is divided into several parts. The first section reviews current conceptualizations of and measurement approaches to childhood aggression. The second section briefly summarizes both the empirical and clinical perspectives on Executive Functions. The third section reviews the empirical literature linking childhood aggression and Executive Functions, followed by a statement of the problem and the goals, significance, and specific research questions of the current study.

Introduction

Childhood aggression involves acts that either are intended to or have the consequence of hurt, harm, or injury to other persons (Berkowitz, 1981, 1993; Coie & Dodge, 1998; Dollard, Doob, Miller, Mowrer, & Sears, 1939; Parke & Slaby, 1983; Rule, 1974). It is a specific subset of a larger collection of anti-social behaviours, which are characterized by the infliction of harm, property damage, and sometimes illegal activity (Coie & Dodge, 1998). Thus, childhood aggression is associated with the larger social problems of bullying, fighting, childhood psychopathology, delinquency, violence, and crime (Tremblay, 2000; Tremblay & Nagin, 2005) and is of utmost concern to researchers and policy-makers alike.

Current Conceptualizations of Aggression and Its Subtypes

Although childhood aggression is co-morbid with anti-social, disruptive, and conduct-disordered behaviours, as well as delinquency (Bartol & Bartol, 2008), “the aggregation of different types of aggression with forms of anti-social behaviours” and “the aggregation of different types of aggression...is problem[atic] for a developmental science" (Tremblay, 2000, p. 130). Moreover, uni- or bi-dimensional approaches to aggression itself are likely to be inadequate (see Bushman & Anderson, 2001 for a critique), given that an act of aggression can be described along multiple dimensions (Little et al., 2003; Pitkanen, 1969; Tremblay, 2000; Underwood, 2003). Thus, a multi-dimensional or multi-axial approach has been recommended in studying childhood aggression (Underwood, 2003; see Ostrov, Murray-Close, & Hart, 2013 for a review of related empirical findings). However, until recently, a multi-dimensional approach to the study of aggression was not possible due to a lack of measurement instruments (that evaluated both form and function).

Recent theoretical frameworks and measurement systems offered by Little and colleagues (Card, Stucky, Sawalani, & Little, 2008; Little, Henrich, Jones, & Hawley, 2003; see also Hawley, Little, & Rodkin, 2007; Little, Brauner, Jones, Nock, & Hawley, 2003; Little, Henrich, Jones, & Hawley, 2010) and related instruments developed by Little, Henrich, Jones, et al. (2003) and by Ostrov and Crick (2007) synthesize various taxonomic approaches to childhood aggression and are becoming increasingly accepted as an integrated understanding of aggression, its dimensionalities, and its measurement (Fite, Stauffacher, Ostrov, & Colder, 2008; Gendreau & Archer, 2005; Hart & Ostrov, 2008; Poulin & Boivin, 2000). In these theoretical conceptualizations, childhood aggression is disaggregated along the dimensions of form (e.g., the means or the "vehicle of harm") and function (the reason or purpose of the harm), allowing for the simultaneous assessment and comparison of different subtypes of aggression. Any given incident of aggression can incorporate multiple forms (e.g., physical, verbal, social) and more than one function (proactive, reactive) (Bushman & Anderson, 2001). Accordingly, individual children, not aggressive acts, are categorized in terms of their aggressive tendencies on dimensions of both form and function (Hawley, Little, & Rodkin, 2007; Little, Heinrich, Jones, et al., 2010), thus avoiding problems related to the presence or measurability of intentionality by an aggressor or how to categorize an aggressive act that failed to result in the intended harm (see Tremblay, 2011 for a discussion). As a result, children can be compared in terms of their tendencies to engage in proactive physical aggression, reactive physical aggression, proactive relational aggression, and/or reactive relational aggression. In light of this integrated conceptualization and new instruments for measuring aggressive tendencies using a dimensional approach, prior research on the developmental pathways and factors that underlie aggregated forms and functions of aggression must be re-evaluated.

Physical forms of aggression. Little and colleagues (Little et al., 2003, 2010) subtype childhood aggression into physical[1] and relational aggression (Crick & Grotpeter, 1995; Grotpeter & Crick, 1996; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003), and the disaggregation of aggression into two forms is supported empirically (see Card et al., 2008 for a review; Card & Little, 2007b; Poulin & Boivin, 2000). It is recognized, however, that authors use different terms and operationalizations for the various forms of physical aggression, e.g., overt aggression, property damange (see Tremblay & Nagin, 2005 for a review), and for

[1] Little et al (2003) initially labeled aspects of physical aggression as “overt” aggression. However, aspects of physical, verbal, and relational aggression all can be overt (versus covert) in presentation, and most authors in the field subsequently have adopted the term physical aggression. Thus term "physical" aggression is used here.

relationship-based types of aggression, e.g., relational aggression, (Crick et al., 1997), social aggression (Underwood, 2003), or indirect aggression.

In the current study, the terms **physical aggression** and **relational aggression** are used to refer to the two primary forms of aggression in a manner consistent with the authors of the primary measure used in this study (Preschool Proactive and Reactive Aggression - Teacher Report, Ostrov & Crick, 2007). Like Little and colleagues (2003, 2010), Ostrov and Crick subtype aggression into physical and relational forms. Physical aggression is characterized as "the use of physical force against another person with an object (e.g., stick, rock, bullet) or without (e.g., slap, push, punch, kick or bite)" (Tremblay & Nagin, 2005, p. 83). Despite labeling differences, variants of physical aggression have been shown to empirically load on the same factor (Crick & Grotpeter, 1995; Hart, Nelson, Robinson, Olsen, & McNeilly-Choque, 1998; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003) and thus are frequently amalgamated under the concept of physical aggression (Hartup & Gendreau, 2005; Tremblay et al., 2004).

Relational forms of aggression. Little and colleagues (2003, 2008, 2010) and Ostrov and Crick (2007) concur that the second primary form of aggression is relational, or aggression that occurs in relationship or social contexts. Relational aggression may consist of a single act or a series of related acts extending over a longer period of time. It is characterized by direct acts of aggression such as denigration, character attacks, rejection or threats, or indirect acts, such as exclusion, rumour-spreading, gossiping, or manipulation of friendships for the purpose of harming the target through damage to peer relationships (e.g., threats, exclusions) (Crick, 1995, 1996a; Crick et al., 2002, 2007). Relational aggression, as well as the related concept of social aggression (Underwood, 2003; Underwood, Galen, Paquette, 2001; Xie, 2005), involves social manipulation that results in hurt and harm to an individual's actual or perceived social status, and thereby their individual adjustment (Archer & Coyne, 2005; Card et al., 2008; Vaillancourt, 2005). Finally, relational aggression is associated with lower risk of self-injury relative to physical aggression (Vaillancourt, 2005), but victims of relational aggression may or may not be aware of the ident(ies) of the aggressor(s) or of the act of relational aggression.

Proactive aggression. The disaggregation of childhood aggression into two functional subtypes is also empirically supported (see Kempes, Matthys, de Vries, & van Engeland, 2005; Little et al., 2003; Poulin & Boivin, 2000; Price & Dodge, 1989; Vitaro & Brendgen, 2005 for reviews). Little and colleagues (Hawley, Little, & Rodkin, 2007; Little et al., 2003a; Little et al., 2003b; Little et al., 2010; Card et al., 2008) and Ostrov and Crick (2007) have disaggregated aggression into subtypes based on the function, the intention, or the goal of the aggressive act (Coie & Dodge, 1998; Dodge & Coie, 1987a, 1987b; Dodge et al.,1997; Pulkkinen, 1969, 1983,1987; Vitaro, Brendgen, & Barker, 2006). In the current study, proactive aggression is defined as aggressive acts that are deliberate, intentional, unprovoked, and involve harm to others for offensive or goal-attainment purposes (Card & Little, 2007a; Cornell et al., 1996; Dodge & Crick,1987a, 1996; Little et al., 2003; Vitaro & Brendgen, 2006).

The functional pattern of instrumental/proactive aggression is consistent with social learning perspectives that aggression is motivated by learned contingencies or anticipations of rewards for aggression (Bandura, 1973). It is recognized that the term instrumental aggression also has been used by some authors to refer to relationship-based forms of aggression (see Underwood, 2003 for a review of labeling and definitional issues). In the current study, the term relational aggression is used consistent with Little et al. (2003) and Ostrov and Crick (2007).

Reactive aggression. The second functional subtype of aggression identified by Little et al. (2003b, 2008, 2010) and by Ostrov and Crick (2007) is reactive aggression. Consistent with early views that aggression is motivated by frustration or anger (e.g., Berkowitz, 1962, Dollard, Doob, Miller, Mowrer, & Sears, 1939), reactive aggression is viewed as a defensive, retaliatory, or hostile response to threat, provocation, or blocked goals (Coie et al., 1991). It is typically accompanied by negative emotion such as anger, is characterized as impulsive and hostile and as reflecting a loss of control (Brendgen, Boivin, Dionne, & Perusse, 2006), and is often direct in presentation (Berkowitz, 1993; Buss, 1961; Feshback, 1964).

Developmental Pathways to Aggression and Executive Functions

Traditional psychological research on the antecedents and causes of childhood aggression has conceptualized it as the result of less-than-optimal psycho-social mechanisms, specifically inappropriate social learning (Bandura, 1969, 1973, 1986) and inadequate social control or acculturation (Hirschi, 2004). However, the developmental pathways to aggression (particularly physical aggression) are recognized as heterogeneous, including both differences associated with distinct patterns of maladaptive, learned behaviours and maladaptive within-child (and potentially biological) differences that affect self-control (Godfriedson & Hirschi, 1990). Aggression has been linked to genetic predispositions (Brendgen et al., 2005), difficult temperament (Card et al., 2008; Card & Little, 2007a; Caspi, Henry, McGee, & Moffit, 1995), and impulsive personality traits (Siever & Kuluva, 2011). As well, aggressive and non-aggressive children have been shown to differ in the *content* of their cognitions, with aggressive children, for example, displaying more hostile attributions for others' behaviours (Dodge & Crick, 1990).

Until the late 1990s, however, it was unclear whether the observed differences in the content of cognitions associated with aggression were also related to differences in intellectual or cognitive abilities related to self-control (Seguin et al., 1995). Recent research has indicated that stable physical aggression in male children is associated with neuro-cognitive weaknesses important to self-regulation, such as attention, baseline memory, and, of interest to this study, individual EFs (Seguin, 2004; Seguin et al., 1995, 1999, 2004; Tremblay et al., 1999), as described in the next section. Paschall and Fishbien (2002) have raised the possibility that the relationship between aggression and EFs may be a significant public health issue.

Executive Functions. Executive Function (EF) is a widely recognized term (Lezak, 1995; Miller & Cohen, 2001) that refers to a collection of higher order neuro-cognitive processes necessary for purposeful, goal-directed problem-solving activities (Anderson, 1998; Diamond, 2006; Miller & Cohen, 2001; Stuss & Alexander, 2000; Stuss & Benson, 1984; Welsh, 2002). Most theorists and clinicians agree that EFs collectively determine whether, how, or with what strategy an individual achieves a particular goal, in contrast to non-executive cognitive functions such as crystallized abilities or visual abilities that provide *content-related* knowledge or behaviour necessary for goal attainment (Lezak, Howieson, & Loring, 2004). Craik and Bialystok (2006) similarly divide the outcome of intelligent behaviour into *control* (associated with Executive Functions abilities*)* versus *knowledge* (non-executive intelligence). EFs and Executive Dysfunction (ED) have been increasingly recognized as significant to numerous developmental pathways, including social-emotional functioning (Carlson, 2005; Riggs et al., 2007), behaviour (Barker et al., 2007; Riggs et al., 2001), and mental health (Pennington & Ozonoff, 1996; Powell, & Voeller, 2004; Zelazo & Mueller, 2002).

Both the theoretical and empirical literatures indicate that EFs are multi-dimensional (Morgan & Liliendfeld, 2000). Miyake et al. (2000) advocate that EFs reflect both unity and diversity, and include an overarching, unitary source of Executive Functions akin to "g" or general intelligence, and several specific Executive Functions. The number of specific EF abilities characterized in theoretical models and reported in factor-analytic studies appears to be age-dependent, as EFs become increasingly differentiated with age (Shing, Lindenberger, Diamond, Li, & Davidson, 2010). In children, at least three to four specific EFs are empirically supported -- *executive attention, inhibition, working memory, flexibility* (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Brocki & Bohlin, 2004; Brookshire, Levin, Song, & Zhang, 2004; Davison et al., 2006; Huizinga, Dolan, & van der Molen, 2006; Klenberg, Korkman, & Lahti-Nuuttila, 200l; Lehto, Juujarvi, Kooistra, &

Pulkkinen, 2003; Levin et al., 1991; Manly et al., 2001; Van der Sluis, de Jong, & van der Leij, 2006; Welsh, Pennington, & Roisser, 1991). Another potential specific EF, *planning*, has been proposed as emerging in middle to late childhood, adolescence, and adulthood (Daigneault, Braun, & Whitaker, 1992; De Frias, Dixon, & Strauss, 2006; Fisk & Sharp, 2004; Fournier-Vincente, Larigauderie, & Gaonach, 2008; Heeden & Yoon, 2006; Hull, Martin, Beier, Lane, & Hamilton, 2008; Miyake et al., 2000; Pineda & Merchan, 2003; Robbins et al., 1998), and is typically identified as a fifth specific EF by neuropsychologists (Dawson & Guare, 2004; Lezak et al., 2004; Turner & Levine, 2004). Finally, each of the above specific EFs can be further subdivided into more narrow neuro-cognitive processes. For example, the specific EF of inhibition can be disaggregated into inhibition of pre-potent responding (verbal or motor), inhibition after a delay, or inhibition of an ongoing response.

Whereas traditional models of EF have emphasized the more cognitive aspects of executive control highlighted above, Zelazo and colleagues have advocated for expanding the definition of EFs to include more affective and motivational processes (Happaney, Zelazo, & Stuss, 2004; Hongwanishkul et al., 2005; Zelazo et al., 2004; Zelazo & Mueller, 2002). Specifically, Zelazo and colleagues have posited that EFs may be subdivided into “Cool EFs,” including attention, working memory, and flexibility, versus “Hot EFs,” including inhibition and regulation of emotions. Zelazo et al. conceptualize “Cool” and “Hot EFs” along a continuum, and as more or less activated by situational or contextual factors. “Cool EFs” are characterized as activated in situations involving de-contextualized, abstract processing and are thought to be strongly associated with fluid intelligence, whereas “Hot EFs” are activated in real-life situations that are affectively or motivationally laden and involve uncertainty in decision-making. Although the definition of “Hot EFs” has been somewhat ambiguous, they are typically operationalized as performance on variations of gambling tasks, such as the Iowa Gambling task developed by Bechara (Bechara, 2001; Bechara, Damasio, Damasio, & Anderson, 1994). Further, it has been proposed that “Hot EFs” may be related to more physical forms of aggression in children (Seguin, 2004; Seguin, Arseneault, & Tremblay, 2007; Seguin & Zelazo, 2005) and to reactive functions of aggression (Giancola, 2004), although the latter association has not been formally evaluated to date.

Re-interpretation of the literature on the associations between childhood aggression and Executive Functions across the various subtypes of aggression, as distinguished by Little et al. (2003, 2008) and Ostrov and Crick (2007), is virtually impossible due to lack of disaggregation of forms and functions in prior studies of aggression. Specifically, as described below, prior studies of childhood aggression and EFs have defined aggression either as 1) generic aggression, without specification of form or function, utilizing aggression measures that include multiple forms and functions of aggressive behaviours; 2) specific *forms* of aggression such as physical or verbal, but without specification of function; and 3) specific functions of aggression, either proactive or reactive aggression, without specification of form, although many of the measures used in these studies assessed physical forms of aggression, and secondary direct verbal aggression, but not relational aggression.

General aggression and Executive Functions. Consistent linkages have been demonstrated between higher parent and teacher ratings of general childhood aggression and lower levels of the EF of inhibition, as well as weaknesses in the EFs of working memory and flexibility. Lower levels of parent- and teacher-rated externalizing behaviours (including aggressive acts) on the Child Behavior Checklist (CBCL, Achenbach & Rescorla, 2000) were concurrently associated with more proficient EFs, including stronger inhibition on a Stroop task and increased flexibility on a Trails task (Riggs et al., 2003). In the latter study, stronger EFs also predicted lower levels of externalizing behaviours one and two years later, even in a small community sample of boys and girls who were 6 to 7 years of age (n = 60; Riggs et al.). In a community sample of 464 children followed from grades 2 through 5, Sun (2001) also found that reduced inhibition predicted early aggression as assessed by teachers on the Teacher Observation of the Child Adaptation-Revised ratings (TOCA-R Wertthamer-Larsson, Kellam, & Wheller, 1989), whereas reduced working memory predicted later aggression (e.g., grades 6 and 7), and a composite EF score of attention, inhibition, and working memory was consistently more predictive of general aggression than a single indicator of EF alone. Snell (1998) found that reduced cognitive flexibility / shifting was associated with higher levels of observed classroom aggression in grade 2 but not to parent / teacher ratings of aggression on the TOCA-R. The failure to find significant relations with parent and teacher reports of aggression may be due to the small sample size (n = 46) and resulting reduced power, as well as the use of composite parent and teacher behaviour scores, averaging ratings of aggressive and delinquent behaviour, and aggression, delinquency, and authority acceptance subscales, respectively.

Using a more specific measure of aggression, Raajimakers et al. (2008) found that higher parent-rated general aggression on the CBCL was significantly and negatively related to multiple EFs in boys and girls as young as four years of age. Increased aggression was associated with a composite index of poorer executive inhibition (based on multiple tasks, as well as on individual measures of inhibition). In the only study to date examining sex differences in the aggression-EF relationship, Raajimakers et al. identified male-female differences across several measures of EF, with boys generally performing worse than girls. Interaction effects for aggression and sex were reported for measures of flexibility, with aggressive boys significantly more impaired on a computerized measure of conjoint selective attention, flexibility, and working memory. Results of the Raajimakers et al. study underscore the need to consider sex differences in evaluating the links between aggression and EFs. Given the literature to date, it was expected that higher levels of physical aggression would be associated with weaknesses in EFs, with physically aggressive boys demonstrating greater impairments than girls in the present study.

Results of a study by Riccio et al. (2011) appear to be an exception within the literature, failing to find any relationship between higher levels of parent-rated pre-adolescent and adolescent general aggression and specific EF abilities. These findings may in part be attributable to significant methodological flaws in this study, including 1) the large age range of the sample (9 to 15 years) and likely age-related differences in aggression levels and EF abilities; 2) the sample composition (the majority of participants were children with developmental conditions characterized by aggression and EDs, ADHD (44%), or other disorders (28%)); and 3) the high inter-correlations observed among individual EF measures (and the consequent increase in multi-collinearity in regression analyses).

Physical aggression and Executive Functions. Studies using measures that specifically target physical aggression have consistently demonstrated a relationship between EFs and physical aggression (Séguin et al., 1995; Seguin et al., 1999; Seguin et al., 2004; Seguin & Zelazo, 2005), particularly in boys with stable or chronic patterns of aggression. Impairments in EFs are thought to facilitate aggression primarily through a lack of inhibitory control, but also inflexibility in responding, impaired planning, and self-monitoring, and potentially a lack of self-other awareness (Hawkins & Trobst, 2000). Impaired executive attention has been found to be associated with higher physical aggression in children with clinical disorders such as Attention-Deficit Disorder (Barkley, 1997; Seguin et al., 1999). Impairments in inhibition have consistently been shown to be associated with higher levels of physical aggression (Atkins & Stoff, 1993; Jones 2007). Further research is needed to determine whether particular types of inhibition are related to physical aggression, such as inhibition of pre-potent responding versus inhibition after a delay (Raajimaaker et al., 2008). Persistent working memory impairments have also been demonstrated among physically aggressive children, even after social adversity and general memory abilities were taken into account (Seguin et al., 1995; Seguin et al., 2004; Seguin & Zelazo, 2005).

Other evidence supports the proposed linkages between physical aggression and Executive D*ys*functions in community and non-clinical populations (see Seguin & Zelazo, 2005 for a review). “Hard-wired” differences in (physical) aggression are known to be a function of genetics, neurochemicals (e.g., serotonin, dopamine), psycho-physiological factors, and factors that alter brain function (see Raine, 2002a, 2002b; Scarpa & Raine, 1997). Moreover, declines in physical aggression during the preschool years are concomitant with a period of rapid growth in EFs and cognitive control (see Diamond, 2002; Garon, Bryson, & Smith, 2008; Zelazo et al., 1997; Zelazo & Frye, 1998), primarily characterized by increases in inhibition and flexibility, which continues through to 7 years of age (see Diamond, 2006; Garon et al., 2008; Welsh, 2002). Similarly, declines in physical aggression in middle childhood and late adolescence are also paralleled by relatively steady increases in the growth of EFs, particularly in flexibility and planning (Anderson et al., 2001; Anderson, 2002; Brocki & Bohlin, 2004; Diamond, 2002, 2006; Zelazo et al., 2003). Given these findings, it was hypothesized that in the present study, higher levels of physical aggression would be associated with weaknesses in a wide range of EFs.

Relational aggression and Executive Functions. To date, no empirical studies were identified that have examined linkages between performance on neuropsychological measures of EF and relational aggression. However, in a study examining the relationship of lower baseline blood pressure and heart rate with relational aggression in preschool-aged children, Gower and Crick (2011) found that lower effortful control, a concept loosely related to the EF of inhibition, moderated the relationship between physiological arousal and relational aggression. Higher levels of relational aggression were associated with lower levels of effortful control, but only in children with lower heart rate and baseline blood pressure. However, Gower and Crick did not examine or report any specific linkages between relational aggression and effortful control.

Some suggest that relational aggression may be adaptive (Hawley, Little, & Rodkin, 2007) and socially desirable (Vaillancourt, 2005), owing in part to empirical evidence that relational aggression is negatively related to victimization (Little et al., 2003), and sometimes associated with higher levels of pro-social behaviour (Card et al., 2008) and social status (Vaillancourt et al., 2003; Vaillancourt & Hymel, 2006). Bjorkqvist, Osterman, and Kaukiainen (1992) and Sutton, Smith, and Swettenham (1999) have also shown that relational aggression is characterized by successful, complex social manipulation, which likely requires more, rather than less, social intelligence. In light of these findings, Muller, Zelazo, and Imrisek (2005) proposed that social cognition skills should be positively correlated with EFs, even when controlling for age and intelligence. Considering both form and function of aggression, it is proposed that proactive relational aggression may be associated with at least average, if not relative strengths in neuro-cognitive abilities such as EFs.

Consistent with the view that proactive relational aggression requires strengths in EFs, roughly concurrent developmental increases in middle childhood have been observed in relational aggression and the differentiation of EFs (Ardila & Rosselli, 1994; Case, 1992; Luciana & Nelson, 1998). Increases in relational aggression occur during the 6-10 year period, in conjunction with growth in the verbal and cognitive skills required for social manipulation (Brendgen et al., 2005).

This period is also correlated with increased development of EFs (De Luca et al., 2003; Diamond, 2006). In particular, significant developments occur in working memory, specifically in updating and manipulation of information (Brocki & Bohlin, 2004; De Luca et al., 2003; Gathercole, Pickering, Ambridge, & Wearing, 2004; Luciana & Nelson, 1998), and in the joint use of working memory and other EFs (such as interference control, flexibility, and strategic planning), as well as growth in fluency / processing speed. In light of the limited research in this area, the present study explored the links between relational aggression and a number of different EFs, with the expectation that at least some forms of relational aggression may be associated with stronger EFs.

Proactive aggression and Executive Functions. The two functional subtypes of aggression have documented differences in social cognitive processing (Social Information Processing model; Crick & Dodge, 1994), and thus have been hypothesized to be associated with different patterns of neuro-cognitive abilities. As reviewed below, variations in proactive and reactive aggression have been linked to individual differences in EF abilities, although the hypotheses about proactive aggression and EFs versus reactive aggression and EFs appear to have been formulated independently of one another.

Similar to the theoretical perspectives on relational aggression discussed earlier, it has been proposed that instrumental or proactive aggression is an adaptive behaviour (Hawley et al., 2007), characterized by planning and potentially complex social manipulation, which should require at least average social and cognitive skills, rather than deficits in EFs (Coie et al., 1991; Sutton et al., 1999).

Broder (2004) similarly observed that the planning, execution, and self-monitoring of deliberate aggressive acts require the EFs of inhibition, working memory, and flexibility in response generation and selection. Foti (2005) extended this line of research, suggesting that instrumental / proactive aggression should require *increased* executive abilities, such as stronger strategic planning, sequencing, and coordination of social behaviour, rather than deficiencies.

Consistent with this perspective, the age of onset of true proactive aggression, hypothetically around 7-8 years (Poulin & Boivin, 2005), is concurrent with the age that the full range of EFs are thought to “come online” at around 8 years of age (Ardila & Rosselli, 1994; Case, 1992; Luciana & Nelson, 1998). Increases in proactive aggression in middle childhood are also concomitant with growth in working memory, specifically in updating and manipulation of information (Brocki & Bohlin, 2004; De Luca et al., 2003; Gathercole, Pickering, Ambridge, & Wearing, 2004; Luciana & Nelson, 1998), and the joint use of working memory and other EFs (such as interference control, flexibility, and strategic planning).

While the literature suggests that extreme instrumental or proactive aggression in adults is associated with average or better performance on select measures of EFs (for a review, see Raine 2002a; see also Cornell et al., 1996; Hicks, Markon, Patrick, Krueger, & Newman, 2004; Ishikawa, Raien, Bihrle, Lacasse, & Lencz, 2001), the linkages between proactive aggression and EFs in childhood have not been definitively explored, and findings to date have been somewhat contradictory. Ellis, Weiss, and Lochman (2009) found that higher levels of proactive aggression in boys were predicted by increased planning abilities, but only when higher levels of hostile attributions were present. Jones (2007) attempted to investigate the relationship between EFs and instrumental / proactive aggression, but was unable to do so because of limited variance in items tapping proactive aggression and extremely high inter-correlations between reactive and proactive aggression within the study sample. In contrast, Broder (2004) reported a negative correlation between proactive aggression and teacher-rated EFs (inhibition, working memory, and flexibility) in a community sample of boys in grades 6 to 8. Given the contradictory findings to date, the relationship between proactive aggression and EFs in children remains unclear, and one of the goals of this study was to clarify this connection.

Reactive aggression and Executive Functions. While the adult theoretical and empirical literature has consistently linked extreme reactive or defensive aggression in adults to neuropsychological deficits in EFs (see Raine, 2002a for a review), far less is known about the relationship between childhood reactive aggression and EFs (Giancola & Zeichner, 1994; Lau, Pihl, & Peterson, 1995). Based on the findings that reactive aggression in children is characterized by impulsivity (Dodge & Coie, 1987a; Coie & Dodge, 1998), Giancola (2004) and colleagues (Giancola et al., 1996) proposed that children high in reactive aggression should demonstrate deficits in EFs. Ellis et al. (2009) further hypothesized that reactive aggression may be the product of an interaction between social and cognitive information processing distortions and specific EDs.

The empirical literature on children displaying reactive aggression and EF is limited, but appears to support the EF-deficit perspective of reactive aggression.

Higher levels of teacher-rated reactive aggression have consistently been associated with weaknesses in the EF of inhibition in several community samples, including studies of 5- to 8-year-olds (Jones, 2007), children in grades 6 to 8 (Broder, 2004), and late adolescents (Santor, Ingram, & Kusumakar, 2003). Quamma (1997) reported that children's ability to generate non-aggressive responses to aggressive confrontations was negatively related to working memory. Broder (2004) similarly reported associations between teacher-rated reactive aggression and weaknesses in the specific EFs of working memory and flexibility, as well as overall EF. Given these findings, it was expected that increased reactive aggression, especially reactive physical aggression, would be associated with weaknesses in EFs.

Summary & Problem Statement

Some aspects of childhood aggression, including general aggression, physical aggression, and reactive aggression, have been empirically linked to executive dys/function, although this relationship has been better established for school-aged children and boys than for younger children and girls. As documented in the present review, higher levels of childhood aggression that are primarily physical in form or reactive in function have been most consistently linked to weaknesses in the specific EFs of inhibition and working memory. Higher childhood aggression also has been associated with weaknesses in flexibility, albeit less consistently. The relationship between physical and reactive aggression and the specific EF of planning has not been definitively clarified, and the linkage between childhood aggression and "Hot EFs" has yet to be studied. In contrast, the literature on proactive aggression and EFs is limited and contradictory, and to date, there also is an absence of research into the relationship between relational forms of aggression and EFs.

Five significant problems are identifiable in research to date on childhood aggression and EFs. First, the empirical findings to date require replication and clarification, specifically with more current conceptualizations and measurement of aggression. Prior studies of this relationship typically have either used indirect measurements of aggression (that assess related constructs, such as violence, problem-behaviour, or refusal of authority) or have been conducted with clinical (rather than normative) samples (Seguin & Zelazo, 2005). More importantly, prior research in this area has not systematically investigated whether and how currently recognized subtypes of aggression are differentially linked to EFs (Tremblay, 2000), owing in large part to a lack of adequate instruments that disaggregate aggression into its forms and functions until this past decade (e.g., Little et al., 2003; Ostrov & Crick, 2007).

A second and significant gap in the aggression-EFs literature is the absence of studies of relational aggression and EFs. Consequently, there is a need to extend prior findings on physical and reactive aggression to other forms of aggression. Efforts also are needed to determine both theoretically and empirically whether relational aggression is similarly related to EFs, and whether relational aggression is linked to deficits or strengths in EFs. Similarly, there is a need to replicate prior findings with younger children, due to the paucity of studies with this age group.

Third, most studies to date have investigated the link between childhood aggression and only a limited number of EFs (typically inhibition, working memory, and flexibility; Seguin et al., 2004). Consequently, there is a need to assess the relationship between aggression and a full range of EFs. Along these lines, there is a need to evaluate the relationship between aggression subtypes and more than one type of inhibition, both verbal and visual working memory, planning, and the relatively new concept of “Hot EFs” (Seguin & Zelazo, 2005).

A fourth gap with the research to date is the lack of information on the role of neuro-cognitive differences (such as EFs) in aggression among females. Except for research by Raajimakers et al. (2008), studies to date have either exclusively examined boys (e.g., Seguin et al., 1995, 1999, 2004), or have included both male and female children without testing for possible sex differences (e.g., Riccio et al., 2011).

Finally, a significant portion of the studies on physical and reactive aggression and EFs have failed to control for significant confounds known to affect EFs, such general intellectual functioning or clinical conditions such as Attention-Deficit-Hyperactivity-Disorder (Seguin et al., 2004; Weingartner, 2000). There is a need to study the aggression-EF relationship with children from a non-clinical sample and without clinical cognitive or EF deficits, and control for the effects of reduced intellectual ability and clinical disorders either with exclusionary criteria or statistically.

Study Purpose

Addressing the above limitations of prior research on childhood aggression and EFs, the primary purpose of the present study was to investigate the relationships between documented subtypes of aggression and a wide range of specific EFs, and possible sex differences in these relationships in a non-clinical sample of young children. The specific goals of the study were to contribute to the discipline of psychology and the professional literature by providing:

1. A replication of the limited findings on physical and functional patterns of aggression using a direct, yet non-clinical measure of aggression in a sample of young children, and the first investigation of linkages between disaggregated subtypes of aggression (proactive physical, reactive physical, proactive relational, and reactive relational aggression) and specific EFs.
2. An extension of prior studies of aggression and EF by evaluating the full range of specific EFs, including executive attention, verbal and non-verbal inhibition, visual-spatial and verbal working memory, flexibility, planning, conjoint use of Executive Functions, and “Hot EFs.”
3. The first examination of the linkages between relational aggression, including proactive relational and reactive relational aggression, and EFs.
4. Extensive examination of possible sex differences in the aggression-EF relationships with a larger sample of boys and girls.
5. An examination of the aggression-EF relationships within a non-clinical sample that excludes individuals with confounding conditions, such as a

diagnosis of Attention-Deficit Hyperactivity Disorder or reduced cognitive ability.

Research Questions & Hypotheses

The following research questions were investigated in the present study:

Research Question #1: Do male and female Kindergarten children with High versus Low levels of teacher-rated Proactive Physical Aggression differ in terms of specific Executive Function abilities?

It was hypothesized that children with high levels of proactive physical aggression would perform more poorly on EF measures of attention (e.g., Seguin & Zelazo, 2005), inhibition (e.g., Raajimakers et al., 2008; Riggs et al., 2001; Snell, 2004; Sun, 2001), working memory (e.g., Riggs et al., 2001; Seguin et al., 1995; Seguin et al., 2004; Sun, 2001), and “Hot EFs” (Seguin, & Zelazo, 2005) than children displaying low levels of physical aggression.

Research Question #2: Do male and female Kindergarten children with High versus Low levels of teacher-rated Reactive Physical Aggression differ in terms of specific Executive Function abilities?

It was hypothesized that children with high levels of reactive physical aggression would perform more poorly on EF measures of inhibition (e.g., Broder, 2004; Giancola, 2004; Giancola et al., 1996; Jones, 2007), working memory (e.g., Broder, 2004; Giancola, 2004), and “Hot EFs” (Seguin & Zelazo, 2005) than children displaying low levels of reactive aggression. It was further hypothesized that children with high levels of reactive physical aggression may perform more poorly than children with low levels of reactive aggression on EF measures of flexibility (e.g., Broder, 2004; Giancola, 2004) and planning (e.g. Giancola, 2004; Giancola, 1996), but this investigation was largely exploratory.

Research Question #3: Do male and female Kindergarten children with High versus Low levels of teacher-rated Proactive Relational Aggression differ in terms of specific Executive Function abilities?

Based on the limited and somewhat contradictory empirical findings to date (e.g., Broder, 2004; Ellis et al., 2009) and limited theoretical literature (e.g., Bjorkqvist et al., 2003; Foti, 2005; Hawley, 2007; Hawley et al., 2007; Sutton et al., 1999), it was hypothesized that children displaying high levels of proactive relational aggression would perform as well as or better than children with low levels of proactive relational aggression on measures of EFs.

Research Question #4: Do male and female Kindergarten children with High versus Low levels of teacher-rated Reactive Relational Aggression differ in terms of specific Executive Function abilities?

Based on the limited literature available to date (e.g., Broder, 2004; Giancola et al., 1996; Jones, 2007), it was hypothesized that children with high levels of reactive relational aggression would perform more poorly than children displaying low levels of reactive relational aggression on measures of EFs.

Chapter 3: Methodology

The methodology chapter is divided into three parts. In the first section, the participant sample and its characteristics are described. Recruitment and data collection procedures are reviewed in the second section, and in the final section, an overview of the measures administered, including the demographics, aggression, and the cognitive and Executive Function measures, is provided.

Participants

The final sample included 255 students (149 males, 106 females) enrolled in full-day Kindergarten in urban areas of the British Columbia Lower Mainland, with a mean age of 5.7 years (SD = 0.35 years, range 5 years, 0 months to 6 years, 4 months). None of the parents of the final participants reported that their child had a medical diagnosis of ADHD. The socio-economic status of the sample was estimated using parental self-reports of their educational attainment. Parental levels of educational attainment in the present study were slightly higher than Canadian national levels, in that fewer parents reported less than a high school education than is typically found in the general Canadian population (see Table 3.1).[2] The sample was linguistically diverse, with 39 languages reported as spoken either by the child participants or as the languages in the home (see Table 3.2). The majority of the child participants came from a combined English and non-English language background (71.4%), with a minority of the sample being monolingual English-speaking children from monolingual English-speaking families (28.6%).

[2] Human Resources and Skills Development Canada (2012) statistics indicate 19.1% of Canadians over 15 years of age have less than a high school diploma, while 22.2% of persons in Canada over 15 years in Canada have obtained a bachelor's degree.

Table 3.1

Demographic Characteristics of Child Participants (n = 255)

Characteristic	n	Percentage[1]
Sex		
Boys	149	58.40%
Girls	106	41.60%
Age		
5:0 to 5:2	3	1.20%
5:3 to 5:5	48	18.82%
5:6 to 5:8	61	23.92%
5:9 to 5:11	76	29.80%
6:0 to 6:2	57	22.35%
6:3 to 6:4	10	2.92%
Paternal Education		
Not applicable†	21	8.20%
Less than high school diploma	15	5.90%
High School diploma/equivalent	19	7.50%
Some college/trades/	53	20.80%
Apprenticeship/trades certification	11	4.30%
Bachelor's degree	60	23.50%
More than bachelor's degree	59	23.10%
Not reported	17	6.70%
Maternal Education		
Not applicable†	3	1.20%
Less than high school diploma	22	8.60%
High school diploma/equivalent	22	8.60%
Some college/trades/	55	21.60%
Apprenticeship/trades certification	14	5.50%
Bachelor's degree	66	26.90%
More than bachelor's degree	55	21.60%
Not reported	19	7.20%

[1] Percentages were rounded and thus do not always add to 100.

† Guardian providing consent reported that educational level (for the mother or father) was not applicable because the parent was deceased or missing or their educational status was unknown.

Table 3.2

Language Characteristics of Child Participants: Percentages (n = 255)

Language Group	Child First Language	Child Main Language	Family Main Language	Family Other Language
English	54.50%	77.30%	55.30%	36.10%
Slavic	2.70%	2.40%	3.10%	1.20%
Other European	4.3%	1.60%	3.50%	9.40%
Chinese/Sino-Tibetan	12.9%	6.30%	12.20%	7.80%
Other Northeast Asian	3.5%	2.00%	2.40%	2.40%
Other Southeast Asian	7.80%	2.70%	8.60%	5.10%
Indo	7.80%	4.30%	8.60%	3.50%
Arabic	6.3%	3.50%	6.30%	1.60%

Procedures

Approval and recruitment. Ethics approval was received from the University of British Columbia Behavioural Research Ethics Board and permission to conduct research was received from the school district research review committees. Schools and participants were recruited from a variety of neighbourhoods and socioeconomic backgrounds, including more vulnerable neighborhoods.[3] Principals and teachers from two school districts were invited through letters and flyers to have their Kindergarten classrooms participate in the study. Twenty-two Kindergarten teachers at ten schools in two school districts provided written consent (Appendix A). Classroom teachers distributed study information and consent forms to the parents of their Kindergarten students (Appendix B). A verbal presentation was given by the Co-Principal Investigator to the students in each participating classroom at a level developmentally appropriate for young children (Appendix C). Teachers each

[3] Schools were identified as more or less vulnerable based on neighbourhood maps compiled by researchers from the Human Early Learning Partnership.

received a gift certificate ($25.00 value) for their assistance. All children returning a consent form, regardless of whether or not they received permission to participate in the study, were entered into a classroom draw for a small toy (approximately $5.00 in value). After completing testing activities, participants selected an educational toy valued at approximately $5.00. Parents of participating children were offered a brief written summary of their child's performance on the cognitive and Executive Function measures completed for the study.

Three hundred and sixty-two forms were distributed to solicit prospective participants; 313 (86.46%) were returned, and parents of 291 (80.39%) provided consent for their children to participate. A total of 269 participants met the inclusion criteria (same age cohort as fellow Kindergarten students; no past or current medical diagnosis of Attention-Deficit Hyperactivity Disorder; English language skills needed to complete testing; estimated cognitive abilities within two standard deviations of average) and participated in the study. Seven participants (2.67%) were later excluded because of an inability to complete the introductory testing activities, and data from seven others (2.67%) were excluded from the final data analyses list-wise because of missing data on computer-based tasks (see Appendix D for summary).

Direct child assessment. Child participants were evaluated individually at their school during school hours, either by the primary researcher or by trained research assistants under the supervision of the primary researcher and a certified school psychologist. Verbal assent was obtained from child participants at the beginning of the first individual assessment session using a semi-structured procedure (Appendix

D). For most participants, direct assessment data was collected over two individual testing sessions, each approximately 25-35 minutes in length. Although the mean time interval between sessions was 5.4 days (SD = 4.06 days; range 1-14 days), the mode time interval was 1 day.

Tasks (as described below) were administered with standardized procedures and in a set administration order: Session 1 - tasks administered from a test manual; Session 2 - computer-based tasks.[4] A set administration order was utilized (versus counter-balancing) because of exclusion criteria screening, rapport and behaviour management issues, and logistical reasons. In order to screen for low cognitive ability (and avoid unnecessary or inappropriate extended evaluation of children not eligible for the study), the Stanford-Binet 5 Abbreviated IQ battery had to be given as the first task. Because some children become dysregulated or upset during the Delay of Gratification task, this measure was placed as the last task in a testing session. Due to logistical issues (e.g., availability of equipment, transportation of equipment, variable access of rooms at the schools suitable for manually-administered versus computer-administered tasks), all of the manual tasks had to be administered together, and all of the computer-based tasks needed to be administered together. As a set administration order was needed for the manually administered tasks, a set administration order also was used for the computer-based tasks. Short breaks and small incentives were provided as needed during sessions.

[4] Session 1 (manual tasks) and session 2 (computerized tasks) were reversed for 10 cases (4% of the total sample). This occurred largely due to limited room availability for testing activities during the last weeks of the school year and an inability to assess these participants. No observable or significant scores differences were found between participants tested sessions 1 and then 2 versus sessions 2 and then 1.

Teacher ratings. Teachers completed a two-page behaviour rating survey for each participating student (see Appendix E). Written and verbal instructions for completing the survey were provided. As remuneration for their time, teachers received $10.00 per completed survey. The most common and mean time interval between teacher ratings and the first direct participant assessment session was 8 days (SD = 4.0 days; range 0 to 21 days).

Measures

Demographic information. Child and family background information related to inclusion and exclusion criteria (age, English language ability, medical diagnosis of Attention-Deficit Hyperactivity Disorder), and parental education was collected on the parent consent form (see Appendix B). Child and family language background information was obtained on a brief language survey (see Appendix F).

Aggression measures. *The Preschool Proactive & Reactive Aggression-Teacher Report* (PPRA-TR; Ostrov & Crick, 2007) was used to estimate the tendency of each child to engage in four different subtypes or patterns of aggression, namely, Proactive Physical Aggression, Reactive Physical Aggression, Proactive Relational Aggression, and Reactive Relational Aggression. The PPRA-TR is a downward adaptation of the Self-Report of Forms and Functions of Aggression questionnaire developed by Little et al. (2003; SR-FFA), which is an expansion of the well-established Proactive and Reactive Aggression–Teacher Report Scale (Dodge & Coie, 1987b).

On the PPRA-TR, teachers rated each child participant on 14 items, using a 5-point Likert scale that ranged from 1 (never or almost never true) to 5 (always or almost always true). Teacher ratings on the PPRA-TR were used to compute four subscale scores: 1) Proactive Physical Aggression (3 items, e.g., “This child often starts physical fights to get what s/he wants”); 2) Reactive Physical Aggression 3 items, e.g., “If other children anger this child, s/he will often hit, kick or punch them”); 3) Proactive Relational Aggression (3 items, e.g., “To get what this child wants, s/he often tells others that s/he won’t be their friend anymore”); 4) Reactive Relational Aggression (3 items, e.g., “If other children hurt this child, s/he often keeps them from being in their group of friends”). The PPRA-TR also includes two Pro-Social items (e.g., “This child will often include others after they have cooperated with her/him”). The four subscale scores were created by summing the individual items associated with each subscale; a higher score was reflective of an increased tendency to engage that particular subtype of aggression.

The psychometric data to date for the PPRA-TR, although limited, suggests that it is a reliable and valid measure (Ostrov & Crick, 2007; Hart & Ostrov, 2013). Previously reported Cronbach alpha values indicate adequate internal consistency with a sample of late preschool children (PPRA-PP, $\alpha = .88$; PPRA-RP, $\alpha = .92$; PPRA-PR, $\alpha = .88$; PPRA-RR, $\alpha = .82$; Ostrov & Crick, 2007; PPRA-PP, $\alpha = .84$; PPRA-RP, $\alpha = .90$; PPRA-PR, $\alpha = .84$; PPRA-RR, $\alpha = .85$, Hart & Ostrov, 2013). The validity of teacher PPRA ratings of physical aggression has been based on moderate association with formal researcher observations of physical aggression (PPRA-PP, $r = .40$, and PPRA-RP, $r = .43$, $p < .001$), although associations between teacher PPRA and observer ratings have not been significant other than for teacher ratings of female proactive relational aggression ($r = .36$, $p < .05$; Ostrov & Crick, 2007). In the present sample, the internal consistency values for the PPRA physical and PPRA relational subscales were good to adequate (PPRA-PP, α = .93; PPRA-RP, α = .97; PPRA-PR, α = .89; PPRA-RR, α = .90). All of the internal consistency ratings for the PPRA were almost equivalent across boys and girls.

The Preschool Social Behavior Scale-Teacher Report (PSBS-TR; Crick, Casas, & Mosher, 1997) was administered as a validity measure, given the relatively limited use of the PPRA-TR to date. The PSBS-TR has been considered to be one of the primary measures of physical and relational forms of aggression in early childhood (see Crick, Ostrov, Appleyard, Jansen, & Casas, 2005) and is an adaptation of the Children's Social Behavior Scale–Teacher Form (Crick, 1996a). On the PSBS-TR, teachers were asked to rate each child on 16 items, using a 5-point Likert scale that ranged from 1 (never or almost never true of this child) to 5 (always or almost always true of this child). Teacher ratings on the PSBS-TR were used to compute three subscales: 1) Physical Aggression (PSBS-P; 6 items, e.g., "Kicks or hits others"); 2) Relational Aggression (PSBS-R; 6 items, e.g., "Tries to get others to dislike a peer"); and 3) Pro-Social Behaviour (3 items, e.g., "Is kind to peers"; not used in current analyses).

The PSBS-TR is widely recognized as a psychometrically sound and valid measure of aggression (Bonica, Arnold, Fisher, Zeljo, & Yershova, 2003; Crick et al., 2006; Ostrov & Bishop, 2008; Ostrov & Keating, 2004). The internal consistency of the physical and relational aggression subscales has routinely been reported as adequate or better (e.g., > .80). The validity of teacher PSBS ratings of physical aggression has been based on moderate associations with formal researcher observations of physical aggression (PSBS-P, *r* = .30, and PSBS-R, *r* = .38, *p* < .001; Ostrov & Bishop, 2008; Ostrov & Keating, 2004). In the present sample, the internal consistency values for the PSBS physical and relational aggression subscales were good (PSBS-P, α = .93; PSBS-R, α = .95) and equivalent across boys and girls.[5]

Cognitive measures. The non-executive function cognitive measures administered in this study, the abbreviations used, and their related constructs are summarized in Table 3.3.

The *Stanford-Binet, Fifth Edition–Abbreviated Battery* (SB5-AB; Roid, 2003) was used to estimate overall cognitive abilities, both for descriptive purposes and as exclusionary criteria. As one index provided from the SB5 battery, the SB5-AB is one of the most commonly used screening measures of cognitive abilities. The SB5-AB reflects performance on the two SB5 subtests most strongly associated with general intelligence (Roid, 2003). The Verbal Routing task (SB5-VR or the Vocabulary subtest) measures crystallized abilities through evaluation of word knowledge (e.g., "define the following word…"; Flanagan, Ortiz, & Alfonso, 2013). The Non-Verbal Routing task (SB5-NVR or the Matrices subtest) measures fluid reasoning abilities, and primarily inductive reasoning (e.g., "which puzzle piece or picture completes the pattern?"; Flanagan et al., 2013), both subtests are summarized in scaled scores (*M* = 10, *SD* = 3).

Of the available measures of cognitive ability in young children (Alfonso & Flanagan, 2007, 2009; Ford, Kozey, & Negreiros, 2012), the SB5 has some of the

[5] The PSBS items were presented to the teachers in the order that they were listed in the original published description the scale (Crick et al., 1997, p. 581). Specifically, the relational aggression items were listed first, followed by the physical aggression items, and then the prosocial items.

strongest psychometric properties available, with extensive data on its validity presented in Roid (2003, 2005) and Alfonso and Flanagan (2007, 2009). The internal consistency for the SB5-AB subtests are generally considered to be adequate at the 4 and 5 year age level (SB5-VR, α = .84 - .85, SB5-NVR, α = .91), as is the test-retest stability (SB5-VR, 2-5 years, r = .91; 6–20 years, r = .88; SB5-NVR, 2-5 years and 6–20 years, r = .76). The abbreviated cognitive ability indices obtained in the present sample (SB5-V M = 8.73, SD = 2.39; SB5-NV M = 11.59, SD = 3.00) roughly approximated test norms (M = 10, SD = 3). For the current study, the full sample SB5-V and SB5-NV internal consistency values were adequate (α = .80, α =.79, respectively).[6]

The *Attention Problems* subscale of the *Behavioral Assessment System for Children, 2nd Edition, Teacher Rating Scales-Preschool* (BASC-2-AP; Reynolds & Kamphaus, 2004) was used to estimate attention problems and to estimate indirectly executive attention abilities. The BASC-2 is a well-established measure of child mal/adaptive behaviours; the BASC-2-AP subscale is a measure of a child's level of success and challenges with paying attention and managing distraction. Regardless of age, all child participants in the present study were rated on the six items of the BASC-2 TR Preschool form (for ages 2 to 5 years) because of the non-equivalence of items on the Child (ages 6 to 12 years) form. Specifically, teachers were asked to rate each child on six items (e.g., "This child does not pay attention"), using a 4-point, Likert scale ranging from 0 (the behaviour never occurs) to 3 (the

[6] The latter values were lower than the values associated with the standardization sample (5-year SB5-NV α = .91, 5-year SB5-V α = .84), likely because a small number of children completed an unusually high number of items well beyond the end point for the majority of the sample, thus distorting the inter-item correlations and IC calculation, and possibly because of the linguistic diversity of the sample.

behaviour almost always occurs). Raw score totals (based on the sum of responses across all six Attention Problems subscale items) for the BASC-2 AP scores were converted to T-scores (M = 50, SD = 10), using age-based norms, with the exception of raw scores for children ages 6 years, 0 months to 6 years, 4 months to 6 years, 3 months (which were converted with the 5: 9 - 5:11 norms). Psychometric properties of the AP score were adequate to good at the 5-year level (internal consistency with the standardization sample was high, α = .93, while the adjusted test-retest stability was .82). Internal consistency for the current sample also was high (α =.96).

The *Happy-Sad* version of the *Day-Night Stroop* task *(*HS; Lagattuta, Safyan, & Monsour, 2011; see also Gerstadt, Hong, & Diamond, 1994, and Montgomery & Koeltzow, 2010 for a review) was used to estimate the EF of inhibition, specifically verbal inhibition of pre-potent responding. Participants were presented with picture cards and instructed to say "happy" when they were presented with a card printed with a picture of "frowny face" and to say "sad" when they were presented with a card printed with a "smiley face." A pair of demonstration cards was used to teach the task; the child was verbally required to re-state the rules; then up to three practice trials were administered. Most participants required only one practice trial, and all participants learned the task within three practice trials. Initial item-level responses from the 16 trials, rather than self-corrections, were scored as 0 (incorrect) or 1 (correct), and summed to create a total accuracy score (0 to 16), with higher scores reflecting stronger inhibition.[7]

[7] For the directly administered Executive Function measures, psychometric properties such as internal consistency and test-retest reliability are not reviewed here, given their limited utility with

The *Hearts-Flowers* task (HF; Diamond, Barnett, Thomas, & Munro, 2007; Davidson et al., 2006) Condition 2 score (HF-B2) was used to estimate the EF of inhibition, specifically inhibition of a pre-potent motor response, and to a lesser degree, working memory and flexibility/shifting. The Hearts-Flowers task is a computerized task programmed in Presentation© software. It is related to tasks pioneered by Shaffer (1965) and subsequent variants associated with the Simon effect and is a hybrid of Simon and spatial Stroop tasks (Simon, 1990; see also Lu & Proctor, 1995). Participants were seated approximately 20–30 cm from the mid-line of a touch screen computer monitor, with their hands resting on a handle-bar device immediately in front of the screen, which assists with participants' hands being within reach of the touch screen and limits missed items due to hands being away from the touch-screen. A horizontal rectangle with a central fixation point was shown on the computer monitor, and a red heart or flower appeared on either the left or the right side of the rectangle. Participants used their index fingers to press either the left or right side response box on the touch screen. In the first or congruent block, "Hearts," participants were required to remember and follow one rule ("press on the same side as the heart" for 11 trials). This condition largely measures working memory, rather than short-term memory, in that subjects translate "same side" and "opposite side" into "right hand" or "left hand"; thus, it requires holding a rule in mind and manipulating it (Diamond et al., 2007). In the

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these measures. With measures of EFs, there is often an inverse relationship between reliability and ecological validity, as task novelty is a critical requirement for the valid assessment of executive functions (Diamond, 2006; Lezak et al., 2004; Stuss, 1984, 2000, 2002; Walsh, 1978; Welsh, 2002). Similarly, test-retest reliability, or the consistency of performance across time, is virtually impossible with measures of EFs by definition, as once an individual has been exposed to a task, it subsequently ceases to be a novel task for that individual. Thus, psychometrically unreliable measures with fewer items are often better measures of EF (Blair, Zelazo, & Greenberg, 2004; Lezak et a.l, 2004; Manchester et al., 1997).

second or incongruent block, “Flowers,” participants were required to remember and follow a new rule (“press on the side opposite the flower” for 11 trials), which requires inhibition of the pre-potent tendency to respond in a stimulus-congruent manner. This block of trials measures inhibition in addition to working memory (Diamond, 2013). Each block was preceded by instructions and practice items. Stimulus presentation time was 1500 ms, with a maximum allowable response time of 4000 ms. Total raw scores from the second block were used to create the HF-B2 accuracy score (0–11). Consistent with prior scoring procedures, the first item of each condition was excluded from the total score for each condition. Items with reaction times of less than 250 ms (indicative of responding too fast to have been in response to the stimulus) were scored as errors. Higher total Hearts-Flowers Block 2 scores reflect stronger inhibition of pre-potent responding, and to a lesser degree, working memory and flexibility/shifting.

The *Frog Matrices-Sequential* task (FM-Seq, Morales, Calvo, & Bialystok, 2013) was used to estimate the EF of visual-spatial working memory. This task is a computerized version of a forward memory span task programmed in E-Prime software ©. Participants were seated approximately 20–30 cm from the mid-line of a touch screen computer monitor, with their hands resting on a handle-bar device immediately in front of the screen. They were instructed to remember and replicate the order of “a frog hopping across some frog ponds,” or appearing in the cells of a 3 by 3 matrix on a touch screen monitor. Ten trials ranging from two to six frogs were displayed for 2000 ms, with two trials per number of frogs (e.g., two trials when three frogs were displayed). The end of a display was signaled by a blank matrix shown for 2000 ms, and then a bell sounded to cue participant responses. For each item, points were awarded for each correctly identified target “frog” location (e.g., one point for accurate identification of whether the frog had been present in a given location on that trial) and for each correctly sequenced target location (e.g., was the first frog or location identified actually the first place that the frog appeared in the stimulus sequence on that trial); thus a three-frog item would be scored out of six possible points. Total scores ranged from 0 to 80 points (based on the sum of scores across all 10 trials), with higher scores reflecting stronger visual-spatial working memory.

The *Frog Matrices-Simultaneous* task (FM-Si; Morales et al., 2013) total score was used to estimate the EF of visual-spatial working memory. This task is a computerized version of the neuropsychological working memory task, Corsi Blocks (Milner, 1971; Milner, Corsi, & Leonard, 1991; see also Berch, Krikorian, & Huha, 1998), programmed in E-Prime software ©. Participants were instructed to remember and replicate the “simultaneous locations of multiple frogs resting in frog ponds,” by touching identified squares in a 3 X 3 matrix on the touch screen monitor. Ten trials of stimulus “frog sets” (with two to six frogs per set) were displayed for 2000 ms, and the end of an item display was signaled by a blank matrix shown for 2000 msand then a bell sounded to cue participant responses. Points were awarded for each correctly identified target within an item (e.g., a three-frog item would be worth three points), and total accuracy scores ranged from 0 to 40 points (based on the sum of scores across all 10 trials), with higher scores reflecting stronger visual-spatial working memory.

The *Woodcock-Johnson Third Edition Tests of Achievement Normative Update–Understanding Directions* (WJ III UD; Woodcock, McGrew, & Mather, 2001) standard score was used to estimate the EF of verbal working memory. This test also measures the Cattell-Horn-Carroll narrow ability of Listening Ability (Flanagan et al., 2013). Participants were exposed to a picture for 10 seconds, and listened to instructions from an audio track through headphones. They then were asked to point to one or a set of items in the picture, often in a specified order (e.g., "point to the elephant, then the giraffe, but first the monkey"), followed by a beep to signal the participant to respond. Children initially answered a starting "block" of 20 items and, depending upon their (lack of) success with these items, discontinued, or completed more easier or more difficult items. The WJ III Normative Update software (Woodcock, McGrew, & Mather, 2005) was used to calculate a raw score, based upon the number of items completed and the number of items answered correctly. Raw scores were then converted into standardized scores (*M* = 100, *SD* = 15), based upon age norms, with higher scores reflecting stronger verbal working memory and listening abilities.

The *Dimensional Change Cart Sort-Advanced* (DCCS-A; Frye, Zelazo, & Palfai, 1995; Zelazo, Frye, & Rapus, 1996; Zelazo, 2006; Hongwanishkul et al., 2005) Condition 3 accuracy score was used to estimate the EF of cognitive flexibility, and secondarily working memory and inhibition. In the first or "Pre-Switch" condition, participants were instructed to manually sort six picture cards of blue trucks and red stars by color (e.g., blue or red) into two sorting bins labeled with red trucks and blue stars ("Blue ones go here; red ones go here"). In Condition 2, "Post-Switch," participants were instructed to sort six more picture cards by shape (e.g., truck or star) into the same sorting bins ("Trucks go here, and stars go here."); for this condition, the blue truck and red star cards now would be sorted into the red truck and blue star bins, respectively (in contrast to condition 1, where they would have been sorted into the blue star and red truck bins, respectively). For each condition, participants were told the colour of the card and either reminded of or asked to re-state the sorting rule (e.g., "This is a blue one. Where does it go?" or "Where do the trucks go? Where do the stars go?"), limiting the demand on prior conceptual knowledge or working memory. All children passed the first and second conditions.

In the third condition, "Mixed Sorting," participants were instructed to sort the stimulus cards according to the presence of an additional visual cue printed on the cards (e.g., a small rainbow or a small collection of shapes), and the condition rule was re-stated by the examiner prior to each item (e.g., "Remember: rainbow clue – colour game, shape clue – shape game"). Individual final responses, including self-corrections, were scored as 0 (incorrect) or 1 (correct), with self-corrections scored as correct. The Condition 3 total accuracy score was computed as the sum of the item-level responses and ranged from 0 to 12, based on 12 trials, with higher scores reflecting stronger cognitive flexibility.

The *NEPSY Tower* subtest (NT; Korkman, Kirk, & Kemp, 1998) scaled score was used to estimate the EF of planning and problem-solving, and secondarily, inhibition and visual working memory. This task is a more developmentally appropriate version of the neuropsychological Tower of London task (Shallice, 1982), in which participants move three coloured wooden balls across three wooden pegs of different heights mounted on a board to match the stimulus picture pattern, while following a series of rules (e.g., move only one ball at a time, all balls must remain on a peg). Individual responses were scored as 0 (incorrect number of moves executed, either due to excess moves or rule violations, or failure to match the stimulus picture pattern) or 1 (correct number of moves with no rule violations executed); consistent with NEPSY administration procedures, item administration was discontinued after 4 consecutively incorrect items. Raw scores were converted to scaled scores (*M* = 10, *SD* = 3) using age-based norms from the NEPSY standardization sample. Higher scores reflected stronger planning abilities.

The *Flanker* task with reversed Flanker trials (FF; Munro, Chau, Gazarian, & Diamond, 2005; see also Diamond et al., 2007) Block 3 Incongruent score (FF-B3-INC) was used to measure the conjoint usage of multiple EFs: selective attention, working memory, and flexibility. As noted by Diamond et al. (2007), the Hearts-Flowers task requires “inhibition of a behavioural tendency…while the Flanker (task) requires inhibition of an attentional tendency” (supplemental online material, p.7). This version of the Flanker task is an expansion of the Flanker with reverse-Flanker tasks that is suitable for ages 5 to 90 years (Eriksen & Eriksen, 1974).

Participants were seated approximately 20–30 cm from the mid-line of a touch screen computer monitor, with their hands resting on a handle-bar device immediately in front of the screen. Participants were shown a row of five fish on most trials, with the centre fish often facing or pointing in a different direction from the four other “flanking” or distractor fish. Occasionally, there only would be a centre fish or only the four other flanking fish. Participants used their index fingers to press either a left or right side response box to indicate the direction that the target fish were facing. In Block 1, the Flanker task was presented; participants were required to remember and follow the rule “press where the middle fish is facing, ignore where the outside fish are facing” for 16 trials. For Block 1, all of the stimulus fish were blue. In Block 2, the “Reverse Flanker” task was presented; participants were required to switch to a new rule, and remember and follow the rule to “press where the outside fish are facing, ignore the middle fish” for 16 trials. In Block 2, all of the stimulus fish were pink. In Block 3, or the final “mixed block,” participants were required to remember and follow both rules that they had previously learned, flexibly switching between them for 44 trials, depending upon whether the fish were blue (when they were to “press where the middle fish is facing”) or pink (when they were to “press where the outside fish are facing”).

Consistent with prior administration and scoring procedures (Diamond et al., 2007), the congruent and incongruent conditions were preceded by instructions and practice items, while the mixed block was preceded by instructions alone. Stimulus presentation time was 200 ms, with a maximum allowable response time of 4000 ms. Individual items were scored as 0 (incorrect) or 1 (correct). For this study, the 16 incongruent item scores from Block 3 were summed to create the total Flanker Block 3 - INC score. Consistent with prior scoring procedures, the first item of each block was excluded from the total scores. Trials with reaction times of less than 250 ms (indicative of responding too fast to have been in response to the stimulus) also were scored as errors. Higher scores reflected stronger conjoint use of selective attention, working memory, and flexibility.

A *Delay of Gratification* task (DG; Mischel et al., 1989; see also Metcalfe & Mischel, 1999) was used to estimate “Hot Executive Function,” or the Executive Functions that are more motivational or emotional in nature (Hongwanishkul et al., 2005). Consistent with the traditional Mischel paradigm, the child participant was seated at a table with a bell placed at their mid-line on the table, approximately six inches from the edge, and then asked to identify their preferred treat from a choice of oreo cookies, marshmallows, or pretzel sticks. The examiner placed two treats on a napkin on one side of the bell, and only one treat on a napkin on the other side of the bell. Using the script traditionally used by Mischel et al., the children were instructed that the examiner needed to leave the room, and that they had a choice: “If you wait until I’m done, then you can have these (*examiner points to two treats*). If you don’t want to wait, then you can ring the bell *(examiner rings the bell*), and I’ll come back any time you want. But if you ring the bell, you can’t have these (*examiner points to two treats*). If you ring the bell, you can have this one (*examiner points to one treat*).”

Examiners verified participant understanding of the rules, and then left the participant sitting at the table, and discretely observed participant behaviours during the delay period. Given that approximately 70% of 5-year-old children are able to wait at least seven minutes (see Carlson, 2005 for a review), the delay period in the current study was extended to 15 minutes. For 91% of the participants in the present study, the examiner left the room and observed through a peep-hole in a screened door or wall window. For the remaining participants (9%), limited testing room options at the schools necessitated that examiners observe the child through a peep-hole in a large cardboard screen, at least 10 feet away from the child.[8] Delay of Gratification scores were calculated as total time waited until eating any portion of the treat(s), ringing the bell to summon the examiner, or the time limit; higher scores reflected stronger ability to delay or defer gratification, and were used as a proxy for "Hot EF." For this task, data were available for only 220 (86.27%) of the 255 participants.[9]

Strict scoring, verification, and data-entry procedures were used. Entry of item level data and scoring for the aggression and attention rating scales were completed by one research assistant and checked by a second research assistant, with discrepancies reviewed by the primary researcher. All manual scoring (SB5, HS, DCCS-A, NT, WJ III UD, DG) was completed by one research assistant and verified by a second research assistant, with any discrepancies reviewed by the primary researcher. Due to the subjectivity and use of clinical expertise in its scoring, all item-level scoring for the SB5-VR was reviewed by the primary researcher. Item-level scoring for computer-based tasks was completed as part of the individual task software, with total task scores computed in Excel 2010 and SPSS 21.0

[8] There was no significant difference in time waited between children who were observed by the examiners through a door/wall window versus those who were observed through a cardboard peep-hole.

[9] Of the 35 participants for whom the DG was unavailable, 19 did not have parental permission to participate in the task (e.g., due to food allergies, dietary concerns, or religious practices), 4 participants could not verify that they understood the directions, 4 participants refused to continue the task shortly after commencing it (and refused the treat), 2 participants required a bathroom break mid-task, 2 participants required that the task be discontinued due to safety reasons (e.g., child was in danger of harming themselves through unsupervised play on furniture), 1 participant had the talk spoiled by a school alarm, and data from 3 participants had to be dropped due to examiner error (failure to record correct time, unable to verify when marshmallow eaten, violation of procedure).

Table 3.3

Cognitive and Executive Function (EF) Measures Administered

Measure	Abbreviation	Constructs Measured	
		General	Specific
Stanford-Binet Fifth Edition: Verbal Routing	SB5-VR	Cognitive	Crystallized Abilities
Stanford-Binet Fifth Edition: Verbal Routing	SB5-NVR	Cognitive	Fluid Reasoning Abilities
Behavioral Assessment System for Children, 2nd Edition – Attention Problems	BASC-AP	Attention	Attention Problems (teacher-rated)
Happy-Sad Stroop	HS	EF	Verbal Inhibition
Hearts-Flowers Block 2	HF-B2	EF	Inhibition pre-potent responding, Working Memory
Frog Matrix - Sequential	FM-Seq	EF	Visual-Spatial Working Memory
Frog Matrix - Simultaneous	FM-Si	EF	Visual-Spatial Working Memory
Woodcock-Johnson Third Edition Tests of Achievement Normative Update – Understanding Directions	WJ III - UD	EF	Verbal Working Memory
Dimensional Change Card Sort - Advanced	DCCS-A	EF	Flexibility
NEPSY Tower	NT	EF	Planning, Working Memory, Inhibition
Flanker - Block 3 Incongruent	FF-B3 INC	EF	Selective Attention, Working Memory, Flexibility
Delay of Gratification	DG	Hot EF	Impulse Control, Delay of Gratification

Chapter 4: Results

Overview of the Analyses

Data analyses were conducted in several stages using SPSS 21.0 (IBM Corporation, 2012). Preliminary analyses included outlier identification and inspection of univariate variable distributions. Descriptive analyses included inspection of variable means, variability, and sex differences, and inter-correlations among the aggression variables, and between cognitive and EF variables. Given male-female differences observed on the aggression measures (as described below), subsequent analyses were conducted with sex as a factor. The four primary research questions were initially investigated using correlation analyses to examine the first-order relations between each specific functional subtype of aggression and the ten cognitive and Executive Function variables.

The initial planned analyses for the four research questions involved modeling the relationship between childhood aggression subtypes, cognitive abilities, and specific EFs through a series of multivariate regression models. The goal was to assess which of the specific EFs (and combination of EFs) best predicted each subtype of aggression, after controlling for baseline differences in cognitive abilities (SB5-VR, SB5-NVR), attention abilities (BASC-AP), and memory abilities (FM-Seq or FM-Si). However, multivariate regression analyses were precluded by the quasi-bi-modal distributions of the PPRA (and PSBS) aggression subscales and the accompanying limited variance observed in the scores.

An attempt was made to conduct a series of logistic regression analyses with the same model, using dichotomous high and low aggression groups as the dependent variable. This approach had limited efficacy because of the high level of inter-correlations observed between teacher ratings of aggression and teacher ratings of attention problems, as well as the moderate to high levels of inter-correlation (and multi-collinearity) between the cognitive measures and the EF measures. Further logistic regression analyses were attempted, using a simultaneous entry of all of the cognitive and EF variables (without covariates). The latter approach also was precluded by the moderate inter-correlation and consequent high multi-collinearity between the cognitive and individual EF variables, particularly between fluid reasoning abilities and the individual EFs, and between memory abilities and the other individual EFs.

Significant baseline sex differences in aggression also warranted examination of sex as a covariate in any regression model, and if possible, as an interaction term. Full examination of sex differences and potential interactions between aggression level and sex within a regression approach would have necessitated entry of sex as a covariate, the twelve cognitive / EF scores as independent variables, and 12 additional interaction terms, for a total of 26 variables. Even though the size of the current sample was relatively large in comparison to most other studies in the literature (N = 255), it would have been inadequate to model this relationship (e.g., given the need for a minimum of 10-20 cases per variable and the expectation of small effect sizes due to the younger age of the current sample).

Given these challenges, the final analyses involved a series of two factorial analyses of variance, with two levels of aggression (high, low) and sex (boys, girls) and measures of cognitive and Executive Function as dependent variables.[10]

Data Screening

Outlier Identification was approached with caution, given the interest in participants with extreme aggression or extreme Executive Function scores. Screening for potential outliers was conducted using a combination of methods: Tukey's Outlier Labeling approach based on quartiles (Tukey, 1977; see also Hoaglin & Iglewiwicz, 1987; Hoaglin, Iglewicz, & Tukey, 1986); a means-based approach when variable distributions approximated normal to identify values greater than three standard deviations from the mean (Kline, 1988); and visual inspection of variable distributions to identify substantial gaps between the contiguous tail of a distribution and a data point.[11] Across 255 cases and 19 variables (4845 data points), 11 data points (0.22%) from six variables were identified as outliers. The latter raw scores were winsorized to one unit beyond the next proximate score within allowable bounds in order to minimize undue influence of extreme scores on subsequent statistical analyses, yet preserve the rank of scores (Tabachnick & Fidell, 2005).

Univariate variable characteristics were reviewed statistically using the Shapiro-Wilk test (Shapiro & Wilk, 1964) for the skewness and kurtosis values, and graphically using histograms, boxplots, and Normal and Detrended Q-Q plots. All

[10] Within the narrow age range of the sample (just over one year), data screening indicated no major differences associated with age. Thus to preserve power, age was not entered as a covariate.
[11] Screening for outliers was conducted separately for males versus females on variables where there were significant sex differences (e.g., the aggression variables).

three physical aggression variables (PPRA-PP, PPRA-RP, PSBS-P) were non-normal in their distribution for both boys and girls (Shapiro-Wilk test, $p < .000$). Based on graphical inspection, all three physical aggression variables demonstrated a point-mass or quasi-dichotomous pattern of scores for both sexes, rather than a true positive skew (Appendix G, H). All three relational aggression variables were also non-normal in distribution for both boys and girls (Shapiro Wilk test, $p < .000$). The PPRA-PR and PPRA-RR distribution patterns consistently were suggestive of positive skew and sometimes bi-modal distributions (see Appendix I). In contrast, the PSBS-R demonstrated a point-mass or quasi-dichotomous pattern of scores for both sexes (Appendix J).

Of the 12 dependent variables, six (SB5-V, SB5-NV, FM-Seq, WJ III UD, NT, and FF-B3-INC) approximated normal distribution patterns (skew and kurtosis < 1.0, visual inspection of histogram). Because of inadequate task difficulty and thus insufficient psychometric ceilings, the HS and FM-Si scores exhibited significant negative skew (e.g., skew > 2 *SE* skew, graphical inspection); these variables were reflected and log-transformed to allow for further statistical analyses.[12] The HF-B2 scores were also negatively skewed (-2.18), although reflection and log-transformation had negligible effects on the distribution pattern of these scores or results from their analyses with the dependent variables, and thus the HF-B2 variable was analyzed in its original form. Finally, the BASC-AP, DCCS-A, and DG

[12] Reflection and log-transformation are the combination of procedures used to log-transform a positively skewed variable. They are achieved by subtracting the raw score of each case from the highest value of the variable scale plus one, followed by a log-transformation. As a consequence, the correlation between the reflected variable and other variables will be inverse to the natural relationship between the reflected variable and other variables. However, these effects do not substantially alter the natural magnitude of the relationship between the two variables.

variables exhibited multi-modal distributions: the BASC-AP score pattern for males was quasi-tri-modal, the BASC-AP score pattern for females was suggestive of a point-mass distribution with some positive skew (see Appendix J), and the DCCS-A and DG distributions were moderately and extremely bi-modal, respectively. Transformations did not improve any of the distribution properties of these variables, and thus they were analyzed in their original forms.

Descriptive Analyses

The PPRA and PSBS mean scores, variability and sex differences are presented in Table 4.1. Across all three physical aggression subscales, Mann-Whitney U-test results indicated that boys were rated by their teachers as having significantly higher levels of physical aggression than girls (PPRA-PP, PPRA-RP, and PSBS-P, $p < 0.001$). Mann-Whitney U-test results indicated no significant sex differences on any of the relational aggression measures (PPRA-PR, PPRA-RR, and PSBS-R, $p > 0.001$).

Table 4.1

Means, Standard Deviations and Sex Differences for the Preschool Proactive and Reactive Aggression-Teacher Report and Preschool Social Behavior Scale - Teacher Report[13]

Aggression rating	Range	Full sample (n = 255)	Boys (n = 149)	Girls (n = 106)	Sex Differences Mann Whitney *U* (df)
PPRA-Proactive Physical	3 - 15	4.19 (2.41)	4.65 (2.81)	3.55 (1.49)	6068.50 (.00)***
PPRA-Reactive Physical	3 - 15	5.43 (3.38)	6.19 (3.66)	4.36 (2.62)	5511.00 (.00)***
PSBS-Physical	6 - 28	8.84 (4.35)	9.77 (4.88)	7.53 (3.06)	5422.00 (.00)***
PPRA-Proactive Relational	3 - 15	6.73 (3.32)	6.54 (3.26)	6.98 (3.41)	7340.00 (.33)
PPRA-Reactive Relational	3 - 15	7.26 (3.34)	7.21 (3.29)	7.33 (3.42)	7764.00 (.82)
PSBS-Relational	6 - 30	12.54 (6.36)	12.52 (6.42)	12.57 (6.32)	7841.50 (.92)

*p < 0.05 level (2-tailed), **p < 0.01 level (2-tailed), and ***p < 0.001 level (2-tailed)

[13] Parametric t-tests produced the same pattern of results. The Mann-Whitney test was used to be consistent with the rank-based correlation analyses that were conducted with the PPRA.

The cognitive and Executive Function mean scores, variability, and sex differences are presented in Table 4.2. No significant sex differences were observed across the cognitive and Executive Function variables, with two exceptions. Boys were rated by teachers as having significantly higher rates of attention problems than girls (BASC-AP, U = 6615.00, p = .03), and demonstrated significantly lower verbal inhibition abilities than girls on the HS task (U = 6766.00, p = .05). No other significant sex differences were observed.

Table 4.2

Cognitive and Executive Function Mean Scores, Standard Deviations, and Sex Differences

Task	Full sample (n = 255)	Boys (n = 149)	Girls (n = 106)	Sex differences *U* (df)
Stanford-Binet 5 Verbal Routing	8.73 (2.40)	8.59 (2.57)	8.93 (2.13)	7055.00 (253)
Stanford-Binet 5 Non-Verbal Routing	11.59 (2.99)	11.36 (2.81)	11.92 (3.23)	6864.50 (253)
BASC-2 Attention Problems	48.88 (10.80)	50.34 (11.24)	46.82 (9.84)	6615.00 (253)*
Happy-Sad	12.11 (2.72)	11.86 (2.74)	12.47 (2.68)	6766.00 (253)*
Hearts-Flowers Block 2	9.44 (2.02)	9.39 (2.02)	9.52 (2.01)	7539.50 (253)
Frog Matrix - Sequential	53.18 (8.85)	53.60 (9.33)	52.58 (8.12)	7315.00 (253)
Frog Matrix - Simultaneous	37.02 (2.53)	37.17 (2.60)	36.81 (2.42)	7022.00 (253)
WJ III Understanding Directions	106.90 (14.40)	106.68 (14.68)	107.22 (14.07)	7778.50 (253)
Dimensional Change Card Sort-Advanced	7.90 (2.62)	8.07 (2.61)	7.67 (2.63)	7206.50 (253)
NEPSY Tower	9.22 (2.91)	9.27 (3.07)	9.15 (2.68)	7576.50 (253)
Flanker - Block 3 Incongruent	9.80 (2.86)	9.89 (2.85)	9.67 (2.90)	7566.50 (253)
Delay of Gratification	502.43 (397.55)	523.16 (401.09)	470.12 (392.10)	5474.00 (253)

*Significant at the $p < 0.05$ level (2-tailed tests), ** $p < 0.01$ level (2-tailed tests), and *** $p < 0.001$ level (2-tailed tests).

Note. Number of Participants for Delay of Gratification task n = 220.

Correlation Analyses

Aggression inter-correlations. Full sample and sex-specific correlations among the aggression subscales are presented in Table 4.3 and Table 4.4, respectively. The two general forms of aggression (PSBS-P, PSBS-R) were strongly correlated (*rho* = .66, $p < .001$), with a marginally significant trend toward the two forms of aggression being more correlated for boys than girls (*rho* = .66 versus .51, *Fischer Z* = 1.84, $p < .07$). Similarly, physical aggression (PSBS-P) was more strongly correlated with the functional subtypes of relational aggression (PPRA-PR, PPRA-RR) for boys than girls (*Fischer Z* = 1.66, $p < .09$; *Fischer Z* = 2.34, $p < .02$).

All three ratings of physical aggression (PPRA-PP, PPRA-RP, and PSBS-P) were strongly and positively correlated for the full sample (*rho* = .81 - .87, $p < .001$) and for both sexes. However, the PSBS-Total Physical Aggression score was more strongly correlated with the PPRA-Proactive and -Reactive physical aggression scores for boys than girls (*Fischer Z* = 2.6, $p < .01$; *Fischer Z* = 3.86, $p < .001$).

All three relational aggression ratings (PPRA-PR, PPRA-RR, and PSBS-R) were very strongly positively correlated for the full sample (*rho* = .87 - .92) and for both sexes. Both proactive and reactive subtypes of relational aggression (PPRA-PR, PPRA-RR) were highly correlated, although significantly more so for girls than boys (*rho* = .94 versus .90 respectively, *Fischer Z* = -2.16, $p < .03$).

At a functional level, both forms of proactive aggression (PPRA-PP and PPRA-PR) and both forms of reactive aggression (PPRA-RP and PPRA-RR) were strongly correlated for both boys and girls. However, both types of proactive aggression were significantly more strongly correlated for boys than girls (*Fischer Z* = 1.97, $p < .05$). The two subtypes of reactive aggression demonstrated a non-significant trend toward being more strongly correlated for boys than girls (*Fischer Z* = 1.51, $p < .13$).

Table 4.3

Spearman Correlations for the Preschool Proactive and Reactive Aggression - Teacher Report, and the Preschool Social Behavior Scale - Teacher Report - Full Sample (n = 255)

	1	2	3	4	5
1. PPRA-Proactive Physical	-				
2. PPRA-Reactive Physical	.81***	-			
3. PSBS-Physical	.81***†	.86***†	-		
4. PPRA-Proactive Relational	.52***†	.55***	.54***	-	
5. PPRA-Reactive Relational	.49***	.57***	.54***†	.92***†	-
6. PSBS-Relational	.52***	.57***	.57**	.87***	.88***

*Significant at the $p < 0.05$ level (1-tailed), ** $p < 0.01$ level (1-tailed), and *** $p < 0.001$ level (1-tailed tests).

† Significant Fischer Z correlation coefficient difference (2-tailed test) between the sexes at the $p < .05$ level.

Table 4.4

Spearman Correlations for the Preschool Proactive and Reactive Aggression - Teacher Report, and the Preschool Social Behavior Scale - Teacher Report - By Sex

	1	2	3	4	5	6
1. PPRA-Proactive Physical	-	.74***	.71***	.45***	.41***	.44***
2. PPRA-Reactive Physical	.82**	-	.74***	.58***	.54***	.56***
3. PSBS-Physical	.84**	.90***	-	.52***	.46***	.51***
4. PPRA-Proactive Relational	.63***	.62***	.66***	-	.94***	.88***
5. PPRA-Reactive Relational	.58***	.66***	.66***	.90***	-	.90***
6. PSBS-Relational	.59***	.61***	.66***	.86***	.86**	-

*Significant at the $p < 0.05$ level (1-tailed), ** $p < 0.01$ level (1-tailed), and *** $p < 0.001$ level (1-tailed tests).

Note. Inter-correlations for boys (n = 149) are displayed below the diagonal, and inter-correlations for girls (n = 106) are displayed above the diagonal.

The very strong correlations observed between the PSBS and the PPRA generally were expected, and support the validity of the PPRA. Given that the two measures are heavily redundant and the PPRA provides information beyond the PSBS on functional patterns of aggression, no further analyses were conducted with the PSBS.

Cognitive and Executive Function inter-correlations. After accounting for variable reverse-scaling (e.g., BASC-AP) and the reflection-log transformation effects (e.g., rlogHF and rlogFM-Si), directionality of the inter-correlations among the cognitive and EF variables was positive, as expected, and consistent with prior literature demonstrating that cognitive abilities and EF are strongly related and less differentiated from one another at younger ages. Inter-correlations between the two estimates of cognitive ability and EF scores were slightly lower than the EF inter-correlations. Except for the strong inter-correlation between the two tasks that tapped crystallized abilities (Flanagan et al., 2013; SB5-VR and WJ III UD, $r(255) = .68$, $p < .001$), the inter-correlations between the SB5-VR and EF scores were positive, but ranged from minimal ($r(255) = .10$) to moderate ($r(255) = .36$). Most of the inter-correlations among the SB5-NVR and EF scores were weakly positive (e.g., most $r(255) = .21 - .28$, $p < .01$), which contrasted with the expectation that EFs would be more strongly correlated with non-verbal estimates of cognitive ability than verbal estimates of cognitive ability. It was unclear whether this pattern of small differences (between the SB5-VR versus SB5-NVR correlations with the EF scores) represented a real difference, or whether it was a function of the linguistic diversity of our sample or the truncated range of cognitive abilities in our sample due to our inclusion criteria of cognitive abilities within two standard deviations of average, or another reason. Nonetheless, the overall pattern of positive correlations between both estimates of cognitive ability and the measures of EF highlights the challenge of attempting to use cognitive abilities as covariates in explaining EFs, particularly at younger ages when cognitive abilities and EFs may be less differentiated.

Inter-correlations among the EF scores were unique for boys versus girls, and were different for “Cool” versus “Hot EFs” (as indicated by the Delay of Gratification task). HF-B2 scores were more strongly correlated with the SB5-VR and the SB5-NVR scores among boys than among girls (*Fischer Z* = 1.96, $p < .05$; *Fischer Z* = 2.12, $p < .03$), and a marginal trend of stronger correlation with the BASC-AP was also observed (*Fischer Z* = -1.82, $p = .07$). Inter-correlations among the “Cool EF” tasks were minimal to strong in strength ($r(255) = .12$ - .48, $p < .05$), indicating that stronger EFs of one sort typically were associated with strengths in other specific EFs. In contrast, inter-correlations between the Delay of Gratification task and other EF tasks were null to significant, yet weak ($r(255)$ = n.s. - .22, $p < .05$), suggesting that the “Cool EF” tasks versus the Delay of Gratification task were tapping independent constructs. For boys, there were generally significant, but weak positive relationships between the Delay of Gratification and the BASC-AP, rlogHS, HF-B2, FF-B3, and the WJ III UD ($r(255) = .15$ - .26, $p < .05$). In contrast, for girls there was no significant relationship observed between the Delay of Gratification and other EF scores ($p > 0.05$).

The above findings of sex differences in EF inter-correlations indicated that separate analyses for boys versus girls were warranted. The modest level of inter-correlation among the “Cool EF” measures was not strongly suggestive of redundancy (other than between the two measures of visual-spatial working memory) and thus was interpreted as support for retaining all measures in the primary analyses. However, the modest inter-correlations observed among the “Cool EFs” measures did not appear to be low enough to warrant use of any of the specific EFs (e.g., attention problems or visual-spatial working memory) as covariates. Finally, the unique pattern of inter-correlations between the “Cool EFs” versus the Delay of Gratification task was interpreted as evidence that these constructs should not be collectively merged into a global EF score.

Table 4.5

Spearman Correlations between Cognitive and Executive Function Scores - Full Sample (n = 255)

Predictor	1	2	3	4	5	6	7	8	9	10	11
1. Stanford-Binet 5 Verbal Routing	-										
2. Stanford-Binet 5 Non-Verbal Routing	.14*	-									
3. BASC-2 Attention Problems	-.13*	-.10	-								
4. rlogHappy-Sad	-.11*	-.26***	.20**	-							
5. Hearts-Flowers-Block 2	.10†	.15**†	-.14*††	-.32***	-						
6. Frog Matrix - Sequential	.10	.23***	-.26***	-.22***	.26***	-					
7. rlogFrog Matrix - Simultaneous	-.10	-.21***	.14***	.25***	-.20**	-.48***	-				
8. WJ III Understand-ing Directions	.68***	.28***	-.13*	-.23***	.19**	.28***	-.22***	-			
9. Dimensional Change Card Sort - Advanced	.36***	.22***	-.12*	-.12*	.06	.19**	-.17**	.41***	-		
10. NEPSY Tower	.28***	.25***	-.16**	-.20**	.13*	.29***	-.36***	.27***	.30***	-	
11. Flanker - Block 3 Incongruent	.20**	.24***	-.20**	-.21***	.16**	.26***	-.27***	.30***	.24***††	.15**†	-
12. Delay of Gratification	.12*	.22***†	-.20**	-.17**	.04†	.08	-.05	.21***	.08	.03†	.21**

*Significant at the *p* < 0.05 level (1-tailed), ** *p* < 0.01 level (1-tailed), and *** *p* < 0.001 level (1-tailed tests).
Note. DG *n* = 220
Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were generally expected to be negative. The rlogHS, and rlogFM-Si variables were reflected, and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

Table 4.6

Spearman Correlations between Cognitive and Executive Function Scores - Boys (n = 149)

	1	2	3	4	5	6	7	8	9	10	11
1. Stanford-Binet 5 Verbal Routing	-										
2. Stanford-Binet 5 Non-Verbal Routing	.16*	-									
3. BASC-2 Attention Problems	-.18*	-.14*	-								
4. rlogHappy-Sad	-.16*	-.21**	.21**	-							
5. Hearts-Flowers - Block 2	.20**	.21**	-.22**	-.31***	-						
6. Frog Matrix - Sequential	.16*	.30***	-.28***	-.17*	.29***	-					
7. rlogFrog Matrix - Simultaneous	-.19**	-.21**	.21**	.22**	-.21**	-.51***	-				
8. WJ III Understand-ing Directions	.68***	.30***	-.18*	-.28***	.25**	.30***	-.22**	-			
9. Dimensional Change Card Sort - Advanced	.41***	.19***	-.19*	-.17*	.09	.21**	-.23**	.39***	-		
10. NEPSY Tower	.32***	.25**	-.22**	-.16*	.10	.26**	-.30***	.28***	.32***	-	
11. Flanker - Block 3 Incongruent	.26**	.26**	-.23**	-.23**	.18*	.24**	-.30***	.36***	.33***	.25**	-
12. Delay of Gratification	.16*	.33***	-.22**	-.20**	.15*	.12	-.08	.26***	.07	.12	.25**

*Significant at the $p < 0.05$ level (1-tailed), ** $p < 0.01$ level (1-tailed), and *** $p < 0.001$ level (1 tailed tests).

Note. DG $n = 132$

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were generally expected to be negative. The rlogHS, and rlogFM-Si variables were reflected, and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

Table 4.7

Spearman Correlations between Cognitive and Executive Function Scores - Girls (n = 106)

	1	2	3	4	5	6	7	8	9	10	11
1. Stanford-Binet 5 Verbal Routing	-										
2. Stanford-Binet 5 Non-Verbal Routing	.10	-									
3. BASC-2 Attention Problems	.03	-.07	-								
4. rlogHappy-Sad	-.02	-.29**	.13	-							
5. Hearts-Flowers-Block 2	-.05	.06	.01	-.32***	-						
6. Frog Matrix - Sequential	.04	.17*	-.28**	-.31***	.21*	-					
7. rlogFrog Matrix - Simultaneous	.00	-.28**	.11	.33***	-.16*	-.42***	-				
8. WJ III Understanding Directions	.69***	.28**	-.00	-.17*	.10	.23**	-.22*	-			
9. Dimensional Change Card Sort - Advanced	.31**	.28**	-.06	-.06	.04	.17*	-.06	.45**	-		
10. NEPSY Tower	.22*	.26**	-.07	-.29**	.19*	.34***	-.39***	.25**	.26**	-	
11. Flanker - Block 3 Incongruent	.12	.24**	-.24**	-.20*	.12	.27**	-.21*	.21*	.10	-.01	-
12. Delay of Gratification	.07	.08	-.17	-.10	-.14	-.01	.01	.14	.07	-.14	.13

*Significant at the $p < 0.05$ level (1-tailed), ** $p < 0.01$ level (1-tailed), and *** $p < 0.001$ level (1-tailed tests).

Note. DG $n = 86$.

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were generally expected to be negative. The rlogHS, and rlogFM-Si variables were reflected, and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

Group Comparison and ANOVA Analyses

Based on the four aggression subscales of the PPRA-TR, participants were assigned to either a low or high aggression group for each subtype of aggression (PPRA-PP, PPRA-RP, PPRA-PR, and PPRA-RR). Group assignment was based on whether the raw score of a participant was below / equal to a raw score associated with the 75th percentile, versus a raw score greater than the 75th percentile.[14] Given the sex differences observed on the PPRA-PP and the PPRA-RP, separate sex-based cutoffs were used to designate boys versus girls as low or high in proactive and reactive physical aggression. Boys with aggression raw scores greater than 5 and 9 on the PPRA-PP and PPRA-RP, respectively, were identified as high in the two subtypes of physical aggression. Girls with raw scores greater than 4 and 5 on the PPRA-PP and PPRA-RP, respectively, were identified as high in the two subtypes of physical aggression. Consistent with the lack of sex differences for the PPRA-PR and the PPRA-RR, the 75th percentile score was the same for boys and girls on the PPRA-PR and the PPRA-RR subscales, and thus the same raw score cutoff was used to designate boys and girls as low or high proactive and reactive relational aggressors. Children with scores greater than 9 and 10 on the PPRA-PR and the PPRA-RR, respectively, were identified as high in the relational subtypes of aggression.

[14] The use of alternative cutoffs for group designation was explored. A preferred cutoff of > 86th percentile or at least 1 SD above the mean (commonly found in clinical measures) was not used due to the combination of the atypical distribution patterns of the PPRA variables, and the substantial reduction in power associated with the limited number of participants that would be categorized into the High Aggression based on this cutoff. The pattern of results using this cutoff was similar but lacked adequate statistical power to identify most effects found with a > 75th percentile cutoff.

Research Question #1. Do children with High versus Low levels of teacher-rated Proactive Physical Aggression differ in terms of specific Executive Function abilities?

Mean cognitive and Executive Function z-scores for children low and high in proactive physical aggression are presented in Table 4.8, with correlations between the raw proactive physical aggression scores and the cognitive and Executive Function variables presented in Table 4.9. Proactive physical aggression as measured by the PPRA-PP (Ostrov & Crick, 2007) was not significantly correlated with the verbal (crystallized) or non-verbal (fluid reasoning) measures of cognitive abilities (SB5-VR, SB5-NVR, $p > .05$). For the full sample, higher proactive physical aggression was moderately related to higher levels of teacher-rated attention problems (BASC-AP, *rho* = .31, $p < .001$) and negatively related to one of the two measures of visual-spatial working memory (FM-Seq, *rho* = .13, $p < .05$). For boys but not girls, proactive physical aggression was negatively correlated to verbal inhibition (rlogHS, *rho* = .17, $p < .05$), to the conjoint use of selective attention, working memory, and shifting (FF-B3INC, *rho* = -.15, $p < .05$), and to delay of gratification (*rho* = -.29, $p < .001$). It is unclear whether this difference represents a true sex difference, or whether the lack of correlation for girls between proactive physical aggression and the Flanker and DG scores was due to the lower number of girls who were rated by teachers as high in proactive physical aggression. As well, the negative correlation observed between proactive physical aggression and the ability to delay gratification was significantly stronger for boys than girls (Fisher's z = -1.62, $p = .05$). Thus, children rated by their teacher as displaying more proactive physical aggression also showed more attention problems and lower visual-spatial memory and tended to show less flexibility. Higher proactive physical aggression in boys was associated with poorer verbal inhibition, simultaneous use of multiple EFs, and less ability to delay gratification.

Table 4.8

Z-Score Means and Standard Deviations for Cognitive and Executive Function Variables for Proactive Physical Aggression

Measure	Low Aggression			High Aggression		
	Both Sexes n = 201	Girls n = 88	Boys n = 113	Both Sexes n = 54	Girls n = 18	Boys n = 36
SB5 Verbal Routing	0.04 (1.02)	0.12 (0.85)	-0.02 (1.13)	-0.14 (0.92)	-0.07 (1.07)	-0.18 (0.84)
SB5 Non-V Routing	0.05 (1.04)	0.14 (1.10)	-0.03 (0.99)	-0.18 (0.82)	-0.05 (1.01)	-0.24 (0.72)
BASC-2 AP	-0.16 (0.96)	-0.36 (0.82)	-0.01 (1.03)	0.61 (0.92)	0.64 (0.90)	0.59 (0.95)
Happy-Sad	0.06 (0.99)	0.14 (1.00)	0.00 (0.98)	-0.24 (1.03)	0.08 (0.93)	-0.40 (1.05)
Hearts-Flowers Block 2	0.02 (1.02)	0.05 (1.03)	0.01 (1.01)	-0.09 (0.92)	0.00 (0.82)	-0.14 (0.97)
Frog Matrix - Sequential	0.07 (0.99)	0.02 (0.91)	0.11 (1.05)	-0.26 (1.01)	-0.50 (0.83)	-0.13 (1.07)
Frog Matrix - Simultaneous	0.02 (0.99)	-0.04 (0.99)	0.07 (1.00)	-0.08 (1.03)	-0.27 (0.74)	0.01 (1.14)
WJ III Und Directions	0.03 (0.99)	0.02 (1.00)	0.04 (0.99)	-0.11 (1.03)	0.02 (0.88)	-0.18 (1.10)
DCCS - Advanced	0.04 (1.00)	-0.06 (1.02)	0.12 (0.98)	-0.15 (0.99)	-0.22 (0.92)	-0.11 (1.03)
NEPSY Tower	0.04 (0.99)	-0.02 (0.94)	0.09 (1.03)	-0.15 (1.04)	-0.04 (0.87)	-0.21 (1.12)
Flanker - B3 INC	0.07 (1.01)	-0.01 (1.03)	0.13 (1.00)	-0.25 (0.91)	-0.24 (0.93)	-0.26 (0.91)
Delay of Gratification	0.10 (0.99)	-0.04 (0.99)	0.21 (0.98)	-0.35 (0.98)	-0.27 (1.00)	-0.39 (0.98)

Note: SB5 = Stanford-Binet Fifth Edition; BASC-AP = BASC-2 Attention Problems Subscale; WJ III Und Directions = Woodcock-Johnson Third Edition Normative Update Tests of Achievement, Understanding Directions; DCCS-Advanced = Dimensional Change Card Sort - Advanced; Flanker - B3 INC = Block 3 Incongruent Trial

Table 4.9

Spearman Correlations between Proactive Physical Aggression and the Cognitive and Executive Function Scores

Variable	Ability	Full sample (n = 255)	Boys (n = 149)	Girls (n = 106)
Stanford-Binet 5 Verbal Routing	crystallized abilities	-.05	.03	-.04
Stanford-Binet 5 Non-Verbal Routing	fluid reasoning abilities	-.07	-.08	-.03
BASC- Attention Problems	attention problems	.31**	.26***	.39***
rlog Happy-Sad Junior Stroop	verbal inhibition	.13*	.17*	.05
Hearts-Flowers Block 2	inhibition pre-potent response	-.03	-.09	-.10
Frog Matrix - Sequential	visual spatial working memory	-.13*	-.10*	-.22*
rlog Frog Matrix - Simultaneous	visual spatial working memory	-.02††	-.01	-.13
WJ III - Understanding Directions	verbal working memory	-.04	-.08	-.00
Dimensional Change Card Sort-Advanced	flexibility	-.09	-.09	-.07
NEPSY Tower	planning	-.07	-.11	-.01
Flanker - Block 3 Incongruent	selective attention, working memory, flexibility	-.12*	-.15*	-.09
Delay of Gratification	delay of gratification	-.21**†	-.29***	-.09

*$p < 0.05$ level (1-tailed), **$p < 0.01$ level (1-tailed), ***$p < 0.001$ level (1-tailed)

† Significant sex differences in correlation $p < 0.05$ level (1-tailed)

†† Marginally significant sex differences in correlation $p < 0.05$ level (1-tailed)

Note. DG Task: Low Aggression n = 170, High Aggression n = 50

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

Fifty-four of the 255 participants (21%; 36 boys, 18 girls) were identified as high in proactive physical aggression. Group data and results of the factorial Analysis of Variance are presented in Table 4.10. Consistent with correlational results for the full sample, significant main effects were observed for proactive physical aggression group status in terms of teacher-rated attention problems (BASC-AP, F (200, 54) = 27.91, p < .001), and one of the two measures of visual-spatial working memory (FM-Seq, F(200, 54) = 5.72, p < .05). Children with higher levels of proactive aggression had more attention problems and poorer visual-spatial working memory abilities.

Main effects were also observed for the proactive physical aggression group in terms of conjoint selective attention, inhibition, and flexibility (FFB3-INC, F(200, 54) = 3.75, p < .05), and delay of gratification (DG, F(200, 54) = 5.95, p < .05). The high proactive physical aggression group scored more poorly on these tasks than the low proactive physical aggression group. These main effects also are consistent with significant full sample correlations between proactive physical aggression and performance on the Flanker and Delay of Gratification tasks. However, as these correlations appear to be driven by stronger correlations for boys (accompanied by non-significant correlations for girls), it is unclear whether these main effects represent a true difference for both boys and girls high in proactive physical aggression or may be a statistical artifact.

Similarly, there was a near-significant trend for the proactive physical aggression group on the measure of verbal inhibition (rlogHS, F(200, 54) = 2.66, p = .10), with the high aggression group tending to demonstrate poorer inhibitory control than the low aggression group. A main effect for sex was also observed for this variable (rlogHS, $F(200, 54) = 4.03$, $p = .05$), with boys performing more poorly than girls ($M = 11.86$, $SD = 2.74$, versus $M = 12.47$, $SD = 2.68$). No other main effects for sex or significant interactions were noted.

Table 4.10

Proactive Physical Aggression and Differences in Cognitive and Executive Functions (ANOVA)

Variable	Low aggression (n = 200)	High aggression (n = 54)	ANOVA			
			Effect	F	*p* value	Partial Eta^2
Stanford-Binet 5 Verbal Routing (crystallized abilities)	8.83 (2.44)	8.39 (2.20)	main effect agg main effect sex agg *sex	1.17 0.57 0.01	.28 .45 .92	.01 .00 .00
Stanford-Binet 5 Non-Verbal Routing (fluid reasoning abilities)	11.73 (3.11)	11.06 (2.45)	main effect agg main effect sex agg *sex	1.61 1.27 0.01	.20 .27 .92	.01 .01 .00
BASC- Attention Problems	47.12 (10.35)	55.44 (9.98)	main effect agg main effect sex agg *sex	27.81 .99 1.74	.00*** .32 .19	.10 .00 .01
rlog Happy-Sad Junior Stroop (verbal inhibition)	.60 (.27)	.68 (.24)	main effect agg main effect sex agg *sex	2.66 4.03 .81	.10 .05 .37	.01 .02 .00
Hearts-Flowers Block 2 (inhibition pre-potent response)	9.49 (2.51)	9.26 (1.89)	main effect agg main effect sex agg *sex	.35 .29 .10	.56 .59 .75	.00 .00 .00
Frog Matrix - Sequential (visual-spatial working memory)	53.79 (8.75)	50.91 (8.91)	main effect agg main effect sex agg *sex	5.72 2.01 .81	.02* .16 .37	.02 .01 .00
reflected/logged - Frog Matrix - Simultaneous (visual-spatial working memory)	.49 (.31)	.53 (.29)	main effect agg main effect sex agg *sex	1.42 3.27 .83	.24 .07 .36	.01 .01 .00

Table 4.10 Continued

Proactive Physical Aggression and Differences in Cognitive and Executive Functions (ANOVA)

Variable	Low aggression (n = 200)	High aggression (n = 54)	ANOVA			
			Effect	F	*p* value	Partial Eta^2
WJ III - Understanding Directions (verbal working memory)	107.34 (14.28)	105.26 (14.76)	main effect agg main effect sex agg *sex	.47 .33 .44	.49 .57 .51	.00 .00 .00
Dimensional Change Card Sort - Advanced (flexibility)	8.00 (2.63)	7.52 (2.59)	main effect agg main effect sex agg *sex	1.43 .80 .05	.23 .37 .82	.01 .00 .00
NEPSY Tower (planning)	9.34 (2.88)	8.78 (3.02)	main effect agg main effect sex agg *sex	.95 .04 .76	.33 .85 .38	.00 .00 .00
Flanker - Block 3 Incongruent (selective attention, flexibility, working memory)	10.00 (2.90)	9.07(2.61)	main effect agg main effect sex agg *sex	3.75 .12 .22	.05* .73 .64	.02 .00 .00
Delay of Gratification (delay of gratification)	543.79 (391.60)	361.78 (389.03)	main effect agg main effect sex agg *sex	5.95 .15 1.17	.02* .70 .28	.03 .00 .01

*p < 0.05 level (1-tailed), **p < 0.01 level (1-tailed), ***p < 0.001 level (1-tailed)

Note. DG Task: Low Aggression n = 170, High Aggression n = 50

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

Research Question #2. Do children with High versus Low levels of teacher-rated Reactive Physical Aggression differ in terms of specific Executive Function abilities?

Mean cognitive and Executive Function z-scores for children low and high in reactive physical aggression are presented in Table 4.11, with correlations between the reactive physical aggression scores and the cognitive and Executive Function variables presented in Table 4.12. Higher levels of reactive physical aggression were associated with lower crystallized or verbally-based estimates of cognitive abilities for boys (SB5-V, *rho* = -.14, *p* < .05), but not girls (n.s.), and were not related to fluid reasoning or non-verbal estimates of cognitive abilities for either sex (SB-NV, *p* > .05). Higher levels of reactive physical aggression were moderately associated with more attention problems (BASC-AP, *rho* = .30), although this was stronger for girls (*rho* = .43) than boys (*rho* = .23; *Fischer Z* = 1.75, *p* = .04). Higher levels of reactive physical aggression also had a weaker correlation with poorer verbal inhibition (rlogHS, *rho* = .11), lower inhibition of pre-potent responding (HF-B2, *rho* = -.11), and poorer visual-spatial working memory (FM-Seq, *rho* = -.20; rlogFM-Si, *rho* = .13).

For boys, but not girls, higher reactive physical aggression was significantly and negatively related (*p* < .05) to poorer verbal working memory (WJ III UD, *rho* = -.17), reduced flexibility (DCCS-A, *rho* = -.27), lower conjoint use of selective attention, working memory, and flexibility (FFB3-INC, *rho* = -.19), and less ability to delay gratification (DG, *rho* = -.26). Thus, boys rated as high in reactive physical aggression had additional weaknesses in verbal working memory, flexibility, simultaneous use of multiple EFs together, and the ability to delay gratification.

Table 4.11

Z-Score Means and Standard Deviations for Cognitive and Executive Function Variables for Reactive Physical Aggression

Measure	Low Aggression			High Aggression		
	Both Sexes n = 201	Girls n = 80	Boys n = 121	Both Sexes n = 54	Girls n = 26	Boys n = 28
SB5 Verbal Routing	0.05 (1.01)	0.10 (0.87)	0.02 (1.10)	-0.20 (0.95)	0.03 (0.97)	-0.41 (0.89)
SB5 Non-V Routing	0.03 (1.04)	-0.42 (1.13)	-0.03 (0.98)	-0.10 (0.84)	0.11 (0.94)	-0.30 (0.70)
BASC-2 AP	-0.16 (0.97)	-0.42 (0.79)	0.01 (1.04)	0.59 (0.88)	0.52 (0.90)	0.66 (0.87)
Happy-Sad	0.04 (1.00)	0.13 (1.03)	-0.01 (0.99)	-0.16 (0.98)	0.13 (0.84)	-0.44 (1.03)
Hearts-Flowers Block 2	0.06 (1.00)	0.10 (1.05)	0.04 (0.97)	-0.24 (0.98)	-0.14 (0.80)	-0.33 (1.13)
Frog Matrix - Sequential	0.11 (0.98)	0.05 (0.87)	0.15 (1.05)	-0.41 (0.98)	-0.42 (0.99)	-0.39 (0.99)
Frog Matrix - Simultaneous	0.06 (0.99)	-0.01 (1.01)	0.10 (0.98)	-0.22 (1.00)	-0.31 (0.72)	-0.14 (1.22)
WJ III Und Directions	0.05 (1.01)	0.03 (1.03)	0.07 (0.99)	-0.20 (0.96)	0.00 (0.82)	-0.39 (1.06)
DCCS - Advanced	0.09 (1.00)	-0.04 (1.03)	0.18 (0.98)	-0.34 (0.91)	-0.23 (0.91)	-0.45 (0.92)
NEPSY Tower	0.05 (1.01)	-0.03 (0.95)	0.11 (1.05)	-0.20 (0.93)	0.00 (0.84)	-0.38 (0.99)
Flanker - B3 INC	0.08 (1.03)	0.01 (1.04)	0.13 (1.02)	-0.31 (0.84)	-0.23 (0.91)	-0.39 (0.77)
Delay of Gratification	0.06 (0.99)	-0.11 (0.98)	0.17 (0.99)	-0.23 (1.01)	0.01 (1.03)	-0.43 (0.97)

Note: SB5 = Stanford-Binet Fifth Edition; BASC-AP = BASC-2 Attention Problems Subscale; WJ III Und Directions = Woodcock-Johnson Third Edition Normative Update Tests of Achievement, Understanding Directions; DCCS-Advanced = Dimensional Change Card Sort - Advanced; Flanker - B3 INC = Block 3 Incongruent Trials.

Table 4.12

Spearman Correlations between Reactive Physical Aggression and the Cognitive and Executive Function Scores

Variable	Ability	Full sample (n = 255)	Boys (n = 149)	Girls (n = 106)
Stanford-Binet 5 Verbal Routing	crystallized abilities	-.08	-.14*	.01
Stanford-Binet 5 Non-Verbal Routing	fluid reasoning abilities	-.02	-.09	.05
BASC- Attention Problems	teacher-rated attention problems	.30*** †	.23***	.43***
rlog Happy-Sad Junior Stroop	verbal inhibition	.11*	.11	.05
Hearts-Flowers Block 2	inhibition pre-potent response	-.19**	-.16*	-.22*
Frog Matrix - Sequential	visual spatial working memory	-.20**	-.20**	-.19*
rlog Frog Matrix - Simultaneous	visual spatial working memory	.13*	.07	.19*
WJ III - Understanding Directions	verbal working memory	-.10	-.17*	-.02
Dimensional Change Card Sort-Advanced	flexibility	-.19** ††	-.27**	-.08
NEPSY Tower	planning	-.10	-.18*	.02
Flanker - Block 3 Incongruent	selective attention, flexibility, working memory	-.15**	-.19**	-.09
Delay of Gratification	delay of gratification	-.14*†	-.26**	-.03

**p* < 0.05 level (1-tailed), ***p* < 0.01 level (1-tailed), ****p* < 0.001 level (1-tailed)

Note. DG Task: Low Aggression n = 172, High Aggression n = 42

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

Fifty-four of the 255 participants (21%; 28 boys, 26 girls) were identified as high in reactive physical aggression. Group data and the results of the factorial ANOVA are presented in Table 4.13. There were several main effects observed for the reactive physical aggression group for many of the EF measures. Consistent with correlation results, children high in reactive physical aggression had higher scores for teacher-rated attention problems (BASC-AP, F (200, 54) = 30.38, p < .001), and performed more poorly on measures of inhibition pre-potent responding (HF-B2, F (200, 54) = 3.93, p < .05), both measures of visual-spatial working memory (FM-Seq, F(200, 54) = 11.12, p < .001; rlogFM-Si, F(200, 54) = 4.44, p < .05), measures of flexibility (DCCS-A, F(200, 54) = 7.32, p < .05), and conjoint use of selective attention, working memory, and flexibility (FFB3-INC, F(200, 54) = 6.21, p < 0.05). Consistent with significant full sample correlations between reactive physical aggression and verbal inhibition, there was a marginally significant main effect for the reactive physical aggression group for the measure of verbal inhibition (rlogHS, F(200, 54) = 3.29, p = .07). There also was a marginally significant main effect for verbal inhibition (rlogHS, F(200, 54) = 3.29, p =.07), indicating that higher levels of reactive physical aggression tended to be associated with weaknesses in inhibition that involve spoken language.

Main effects for sex were obtained for measures of attention problems (BASC-AP, F(200, 54) = 3.99, p = .05), consistent with significant results from the Mann-Whitney test for sex differences and Fischer's Z tests for sex differences in correlations between the BASC-2 Attention problems subscale and the Happy-Sad task. Also consistent with significant results from the Mann-Whitney test for sex differences, there was a main effect for sex on verbal inhibition (rlogHS, $F(200, 54) = 5.54$, $p < .02$). Specifically, boys had higher levels of teacher-rated attention problems and scored more poorly on the Happy-Sad Junior Stroop task than girls.

A significant interaction and a marginally significant interaction were observed between reactive physical aggression and sex, although these interactions did not qualify any of the above significant main effects for reactive aggression group status or sex. Consistent with significant results from Fisher's Z test of sex differences in the correlation between reactive physical aggression and Delay of Gratification / NEPSY Tower scores, there was a significant aggression subtype interaction with Delay of Gratification scores and sex (DG, $F(200, 54) = 5.03$, $p < .05$; Figure 4.1). Post-hoc, one-way ANOVAs indicated that girls who were low versus high in reactive physical aggression did not differ in their ability to delay gratification (DG, $F(1, 85) = .276$, n.s.), and boys and girls who were low in reactive physical aggression (DG, $F(1, 170) = 3.32$, n.s.) and in reactive physical aggression (DG, $F(1, 46) = 2.40$, n.s.) did not differ significantly. However, boys with higher levels of reactive physical aggression had significantly weaker Delay of Gratification abilities than boys with lower levels of reactive physical aggression (DG, $F(1, 132) = 7.82$, $p <0.01$).

Also consistent with significant results from Fisher's Z test of sex differences in the correlation between reactive physical aggression and NEPSY Tower scores, there was a marginally significant interaction between reactive physical aggression and sex for planning abilities (NT, $F(200, 54) = 5.03$, $p < .08$). Boys with higher levels of reactive physical aggression tended to have weaker planning abilities.

Table 4.13

Reactive Physical Aggression and Executive Function Differences (ANOVA)

Variable	Low aggression (n = 200)	High aggression (n = 54)	ANOVA			
			Effect	F	*p* value	Partial Eta^2
Stanford-Binet 5 Verbal Routing (crystallized abilities)	8.86 (2.42)	8.26 (2.27)	main effect agg main effect sex agg *sex	2.69 2.89 1.40	.10 .09 .24	.01 .01 .01
Stanford-Binet 5 Non-Verbal Routing (fluid reasoning abilities)	11.67 (3.11)	11.28 (2.51)	main effect agg main effect sex agg *sex	0.80 3.19 0.84	.37 **.08** .36	.00 .01 .00
BASC- Attention Problems	47.15 (10.49)	55.30 (9.51)	main effect agg main effect sex agg *sex	30.38 3.99 1.03	.00*** .05* .31	.11 .02 .00
rlog Happy-Sad Junior Stroop (verbal inhibition)	.60 (.27)	.67 (.23)	main effect agg main effect sex agg *sex	3.29 5.54 1.05	**.07** .02* .31	.01 .02 .00
Hearts-Flowers Block 2 (inhibition pre-potent response)	9.57 (2.01)	8.96 (1.97)	main effect agg main effect sex agg *sex	3.93 0.59 .18	**.04** .44 .68	.02 .00 .00
Frog Matrix - Sequential (visual-spatial working memory)	54.14 (8.66)	49.59 (8.67)	main effect agg main effect sex agg *sex	11.12 0.20 .04	.00** .65 .84	.04 .00 .00
reflected/logged Frog Matrix - Simultaneous (visual-spatial working memory)	.48 (.31)	.58 (.27)	main effect agg main effect sex agg *sex	4.44 2.46 0.61	.04* .12 .44	.02 .01 .00

Table 4.11 Continued

Reactive Physical Aggression and Executive Function Differences (ANOVA)

Variable	Low aggression (n = 200)	High aggression (n = 54)	ANOVA			
			Effect	F	*p* value	Partial Eta^2
WJ III - Understanding Directions (verbal working memory)	107.69 (14.46)	103.98 (13.81)	main effect agg main effect sex agg *sex	2.58 1.28 1.97	.11 .26 .16	.01 .01 .01
Dimensional Change Card Sort - Advanced (flexibility)	8.14 (2.63)	7.00 (2.39)	main effect agg main effect sex agg *sex	7.32 .00 2.24	.01** .99 .14	.03 .00 .01
NEPSY Tower (planning)	9.37 (2.95)	8.65 (2.71)	main effect agg main effect sex agg *sex	2.21 .64 2.97	.14 .44 .08*	.01 .00 .01
Flanker - Block 3 Incongruent (selective attention, flexibility, working memory)	10.04 (2.94)	8.91 (2.40)	main effect agg main effect sex agg *sex	6.21 0.03 .86	**.01**** .87 .35	.03 .00 .00
Delay of Gratification (delay of gratification)	527.67 (393.91)	411.96 (401.47)	main effect agg main effect sex agg *sex	2.11 .25 5.03	.15 .62 .03*	.01 .00 .02

**p* < 0.05 level (1-tailed), ***p* < 0.01 level (1-tailed), ****p* < 0.001 level (1-tailed)

Note. DG Task: Low Aggression n = 172, High Aggression n = 42
Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

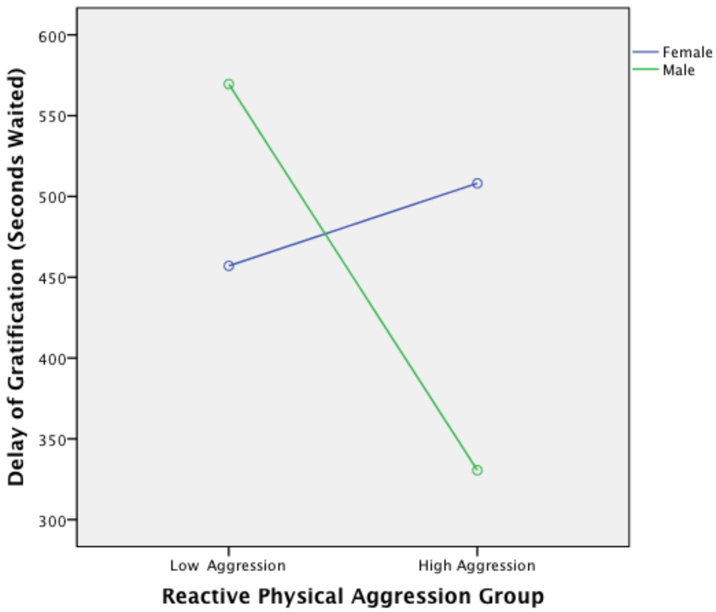

Figure 4.1 Mean number of seconds waited on Delay of Gratification task as a function of reactive physical aggression group and sex of participant

Research Question #3. Do children with High versus Low levels of teacher-rated Proactive Relational Aggression differ in terms of specific Executive Function abilities?

Mean cognitive and Executive Function z-scores for children low and high in proactive relational aggression are presented in Table 4.14, with correlations between proactive relational aggression scores and the cognitive and Executive Function variables presented in Table 4.15. Proactive relational aggression was associated with increased teacher-rated attention problems for both sexes (BASC-AP, *rho* = .25, $p < .001$, males; BASC-AP, *rho* = -.15, $p < .001$, females).

The remaining significant or marginally significant relationships between proactive relational aggression and the EF variables were sex-specific, with unique directional patterns in the correlations. For boys, higher teacher-rated proactive relational aggression was associated with lower flexibility (DCCS-A, *rho* = -.15, $p < .05$), and poorer conjoint use of selective attention, working memory, and flexibility (FF-B3-INC, *rho* = -.14, $p < .05$). Thus, boys with higher levels of teacher-rated proactive relational aggression also showed more attention problems, reduced flexibility, and poorer simultaneous use of multiple EFs

For girls, proactive relational aggression was associated with stronger cognitive and EF abilities. Girls' proactive relational aggression was positively correlated with crystallized abilities or verbally-based estimates of cognitive abilities (SB5-VR, *rho* = .17, $p < .05$), verbal working memory abilities (WJ III UD, *rho* = .23, $p < .001$), and planning abilities (NT, *rho* = .22, $p < .05$). The correlation between proactive relational aggression and visual-spatial working memory abilities was marginally significant for girls (rlogFM-SI, -.13, $p = .09$). Thus, girls rated by their teachers as higher in proactive relational aggression showed more teacher-rated attention problems, but stronger verbal estimates of cognitive abilities, verbal working memory, and planning abilities, and tended to show stronger visual-spatial working memory abilities.

Table 4.14

Z-Score Means and Standard Deviations for Cognitive and Executive Function Variables for Proactive Relational Aggression

Measure	Low Aggression			High Aggression		
	Both Sexes n = 204	Girls n = 80	Boys n = 124	Both Sexes n = 51	Girls n = 26	Boys n = 25
SB5 Verbal Routing	-0.01 (1.01)	0.02 (0.84)	0.29 (1.11)	0.03 (0.97)	-0.02 (1.03)	-0.24 (0.85)
SB5 Non-V Routing	0.02 (1.03)	0.11 (1.11)	0.10 (0.98)	-0.07 (0.86)	-0.05 (1.01)	-0.24 (0.66)
BASC-2 AP	-0.13 (0.97)	-0.37 (0.84)	0.36 (1.02)	0.53 (0.96)	0.02 (0.91)	0.70 (0.98)
Happy-Sad	-0.02 (1.04)	0.13 (1.02)	0.13 (1.04)	0.10 (0.83)	-0.12 (0.88)	0.06 (0.79)
Hearts-Flowers Block 2	0.02 (1.01)	0.06 (1.04)	-0.03 (1.00)	-0.06 (0.96)	-0.01 (0.88)	-0.10 (1.06)
Frog Matrix - Sequential	0.05 (1.03)	-0.01 (0.95)	-0.23 (1.09)	-0.19 (0.83)	0.09 (0.83)	-0.16 (0.85)
Frog Matrix - Simultaneous	-0.01 (1.04)	-0.15 (0.96)	0.13 (1.08)	0.05 (0.84)	0.08 (0.92)	-0.02 (0.76)
WJ III Und Directions	-0.03 (1.04)	-0.10 (1.02)	0.39 (1.06)	0.10 (0.80)	0.02 (0.75)	-0.20 (0.74)
DCCS - Advanced	0.04 (1.01)	-0.09 (1.01)	-0.08 (1.01)	-0.14 (0.96)	0.12 (1.01)	-0.21 (0.91)
NEPSY Tower	-0.01 (1.02)	-0.14 (0.93)	0.32 (1.07)	0.06 (0.93)	0.06 (0.82	-0.21 (0.96)
Flanker - B3 INC	0.05 (1.03)	-0.02 (1.06)	-0.12 (1.01)	-0.19 (0.85)	0.09 (0.87)	-0.27 (0.85)
Delay of Gratification	0.01 (1.01)	-0.08 (0.99)	-0.08 (1.02)	-0.04 (0.97)	0.06 (0.99)	0.00 (0.97)

Note: SB5 = Stanford-Binet Fifth Edition; BASC-AP = BASC-2 Attention Problems Subscale; WJ III Und Directions = Woodcock-Johnson Third Edition Normative Update Tests of Achievement, Understanding Directions; DCCS-Advanced = Dimensional Change Card Sort - Advanced; Flanker - B3 INC = Block 3 Incongruent Trials.

Table 4.15

Spearman Correlations between Proactive Relational Aggression and the Cognitive and Executive Function Variables

Variable	Ability	Full sample (n = 255)	Boys (n = 149)	Girls (n=106)
Stanford-Binet 5 Verbal Routing	crystallized abilities	-.03	-.07	.17*
Stanford-Binet 5 Non-Verbal Routing	fluid reasoning abilities	-.01	-.05	.02
BASC- Attention Problems	teacher-rated attention problems	.26***	.25***	.35***
rlog Happy-Sad Junior Stroop	verbal inhibition	-.02	-.05	.05
Hearts-Flowers Block 2	inhibition pre-potent response	-.06	-.03	-.10
Frog Matrix - Sequential	visual spatial working memory	-.12	-.12†	-.10
rlog Frog Matrix - Simultaneous	visual spatial working memory	.00	.11†	-.13*†
WJ III - Understanding Directions	verbal working memory	.04	-.11†	.23**
Dimensional Change Card Sort - Advanced	flexibility	-.07	-.15*	-.04
NEPSY Tower	planning	-.03	-.11†	.22*
Flanker - Block 3 Incongruent	selective attention, flexibility, working memory	-.10†	-.14*	-.04
Delay of Gratification	delay of gratification	-.03	.01	-.04

*p < 0.05 level **p < 0.01 level ***p < 0.001 level (1-tailed)

† Marginally significant trends *p* < 0.10.

Note. DG Task: Low Aggression n = 171, High Aggression n = 49

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables

Fifty-one of the 255 participants (20%; 25 boys, 26 girls) were identified as high in proactive relational aggression. Group data and results of the factorial ANOVA are presented in Table 4.16. Consistent with correlation results obtained for the full sample, there only was one significant main effect for the proactive relational aggression group. Children high in proactive relational aggression had higher ratings of attention problems than children low in proactive relational aggression (BASC-AP, $F(203, 51) = 22.27$, $p < .001$). No other significant main effects for the proactive relational aggression group were noted.

Consistent with previously reported Mann-Whitney U sex differences, there was a main effect for sex in terms of teacher-rated attention problems. Namely, boys had higher attention problem scores than girls (BASC-AP, $F(203, 51) = 5.92$, $p < .05$).

There also were significant interactions between the proactive relational aggression group and sex, although these results did not qualify any of the above main effects for the proactive relational aggression group or sex. Consistent with significant female-specific correlations between proactive relational aggression and verbal working memory and planning scores, there were significant aggression group by sex interactions for verbal working memory (WJ III UD, $F(203, 51) = 5.21$, $p < .05$; Figure 4.2) and planning (NT, $F(203, 51) = 5.50$, $p < .05$; Figure 4.3). Post-hoc one-way ANOVA results indicate that boys with low versus high levels of proactive relational aggression did not differ in terms of verbal working memory abilities (WJ III UD, $F(1, 147) = 1.01$, n.s.), nor did girls and boys with low levels of proactive relational aggression (WJ III UD, $F(1, 202) = .64$, n.s.). However, girls high in proactive relational aggression had significantly stronger verbal working memory abilities than girls low in proactive relational aggression (WJ III UD, $F(1, 104) = 5.12$, $p < 0.05$) and than boys with high levels of proactive relational aggression (WJ III UD, $F(1, 49) = 8.10$, $p < 0.01$).

In terms of planning abilities, boys with low versus high levels of proactive relational aggression did not differ (NT, $F(1, 147) = 1.43$, n.s.), nor did girls versus boys with low levels of proactive relational aggression (NT, $F(1, 202) = 1.86$, n.s.). However, girls high in proactive relational aggression had significantly stronger planning abilities than girls low in proactive relational aggression (NT, $F(1, 104) = 5.01$, $p > 0.05$) and boys with high levels of proactive relational aggression (NT, $F(1, 49) = 4.55$, $p > 0.05$).

A marginally significant interaction also was noted for one measure of visual-spatial working memory (FM-Si, $F(203, 51) = 3.68$, $p = .06$). Girls with higher levels of proactive relational aggression tended to demonstrate stronger visual-spatial working memory abilities than girls low in proactive relational aggression.

Table 4.16

Proactive Relational Aggression and Cognitive and Executive Function Differences (ANOVA)

Variable	Low aggression (n = 203)	High aggression (n = 51)	ANOVA			
			Effect	F	*p value*	Partial Eta^2
Stanford-Binet 5 Verbal Routing (crystallized abilities)	8.72 (2.42)	8.80 (2.32)	main effect agg	.03	.86	.00
			main effect sex	3.28	.07	.01
			agg *sex	2.40	.12	.01
Stanford-Binet 5 Non-Verbal Routing (fluid reasoning abilities)	11.64 (3.09)	11.39 (2.58)	main effect agg	.42	.52	.00
			main effect sex	2.46	.12	.01
			agg *sex	.32	.57	.00
BASC- Attention Problems (teacher-rated attention problems)	47.45 (10.48)	54.59 (10.23)	main effect agg	22.27	.00***	.08
			main effect sex	5.92	.02*	.02
			agg *sex	.04	.85	.00
rlog Happy-Sad Junior Stroop (verbal inhibition)	.62 (.27)	.61 (.23)	main effect agg	.00	.99	.00
			main effect sex	1.87	.17	.01
			agg *sex	.18	.67	.00
Hearts-Flowers Block 2 (inhibition pre-potent response)	9.48 (2.04)	9.31 (1.93)	main effect agg	.31	.58	.00
			main effect sex	.20	.65	.00
			agg *sex	.00	.99	.00
Frog Matrix - Sequential (visual-spatial working memory)	53.60 (9.15)	51.47 (7.33)	main effect agg	2.12	.15	.01
			main effect sex	.31	.58	.00
			agg *sex	.01	.93	.00
rlog Frog Matrix - Simultaneous (visual-spatial working memory)	.50 (.32)	.52 (.27)	main effect agg	.01	.93	.00
			main effect sex	.01	.93	.00
			agg *sex	3.68	.06	.01

Table 4.16 Continued

Proactive Relational Aggression and Cognitive and Executive Function Differences (ANOVA)

Variable	Low aggression (n = 203)	High aggression (n = 51)	ANOVA Effect	F	*p* value	Partial Eta^2
WJ III - Understanding Directions (verbal working memory)	106.54 (15.02)	108.35 (11.45)	main effect agg	.73	.40	.00
			main effect sex	2.29	.13	.01
			agg *sex	5.21	.02	.02
Dimensional Change Card Sort - Advanced (flexibility)	8.00 (2.64)	7.53 (2.50)	main effect agg	.99	.32	.00
			main effect sex	.07	.79	.00
			agg *sex	1.14	.29	.01
NEPSY Tower (planning)	9.18 (2.96)	9.39 (2.69)	main effect agg	.33	.56	.00
			main effect sex	1.15	.29	.01
			agg *sex	5.50	.02*	.02
Flanker - Block 3 Incongruent (selective attention, flexibility, working memory)	9.93 (2.95)	9.25 (2.44)	main effect agg	2.09	.15	.01
			main effect sex	.01	.92	.00
			agg *sex	.69	.42	.00
Delay of Gratification (delay of gratification)	507.70 (487.53)	401.98 (385.35)	main effect agg	.03	.86	.00
			main effect sex	.47	.50	.00
			agg *sex	.05	.83	.00

*p < 0.05 level , **p < 0.01 level, ***p < 0.001 level

Note. DG Task: Low Aggression n = 171, High Aggression n = 49

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were generally expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

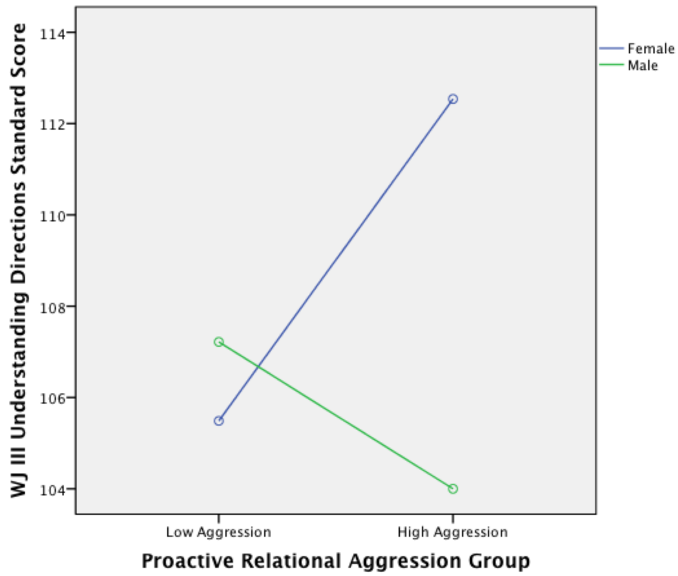

Figure 4.2 Woodcock-Johnson III Understanding Directions standard score as a function of aggression group and sex of participant

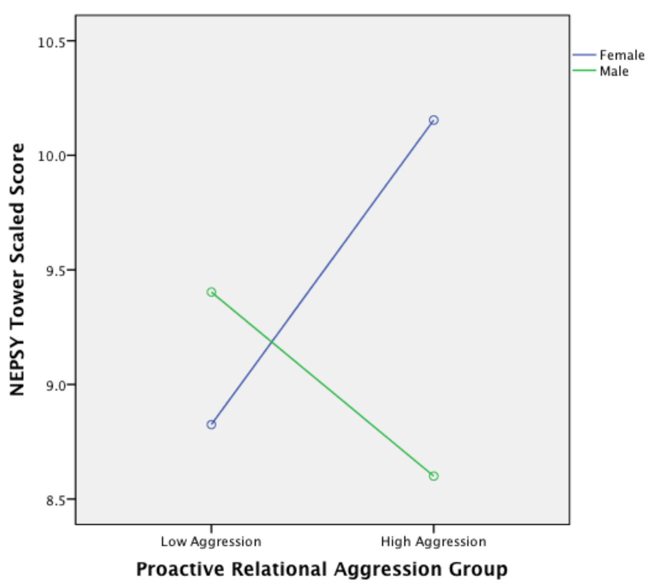

Figure 4.3 NEPSY Tower scaled score as a function of proactive relational aggression group and sex of participant

Research Question #4. Do children with High versus Low levels of teacher-rated Reactive Relational Aggression differ in terms of specific Executive Function abilities?

Mean cognitive and Executive Function z-scores for children low and high in reactive relational aggression are presented in Table 4.17. Correlations between the raw reactive relational aggression scores and the cognitive and Executive Function variables are presented in Table 4.18. For both boys and girls, higher levels of reactive relational aggression were significantly and positively correlated with teacher-rated attention problems (BASC-AP, *rho* = .26, $p < .001$). However, the remaining correlations between reactive relational aggression and the cognitive and EF variables were sex-specific.

For boys, reactive relational aggression was significantly and negatively associated with crystallized abilities or verbally-based estimates of cognitive abilities (SB5-VR, *rho* = -.14, $p < .05$), with one measure of visual-spatial working memory (FM-Seq, *rho* = -.15, $p < .05$), with planning (NT, *rho* = .20, $p < .05$), and with conjoint use of selective attention, working memory, and flexibility (FF-B3-INC, *rho* = -.16, $p < .05$), although these correlations were relatively weak. In contrast, for girls, reactive relational aggression was not significantly correlated with any measure of cognitive ability or EF ($p > .05$). Thus, children of both sexes with higher levels of reactive relational aggression also showed more attention problems. In addition, boys with higher levels of reactive relational aggression showed mild weaknesses in multiple cognitive and EFs, including crystallized abilities, visual-spatial working memory, planning, and simultaneous use of EFs. Girls with higher levels of reactive relational aggression did not show any strengths or weaknesses in the cognitive and EF measures evaluated.

Table 4.17

Z-Score Means and Standard Deviations for Cognitive and Executive Function Variables for Reactive Relational Aggression

Measure	Low Aggression			High Aggression		
	Both Sexes n = 206	Girls n = 84	Boys n = 122	Both Sexes n = 49	Girls n = 22	Boys n = 27
SB5 Verbal Routing	0.03 (1.01)	0.04 (0.86)	0.26 (1.11)	-0.11 (0.94)	0.02 (1.00)	-0.41 (0.79)
SB5 Non-V Routing	0.03 (1.04)	0.12 (1.10)	0.06 (0.99)	-0.11 (0.83)	-0.04 (1.01)	-0.26 (0.62)
BASC-2 AP	-0.13 (.096)	-0.33 (0.86)	0.34 (1.01)	0.55 (0.97)	0.00 (0.92)	0.73 (0.99)
Happy-Sad	0.03 (1.01)	0.19 (0.98)	-0.09 (1.02)	-0.12 (0.96)	-0.08 (1.00)	-0.15 (0.95)
Hearts-Flowers Block 2	0.00 (1.05)	0.07 (1.02)	-0.08 (1.07)	0.01 (0.76)	-0.05 (0.93)	0.09 (0.59)
Frog Matrix - Sequential	0.06 (1.01)	-0.02 (0.91)	-0.26 (1.07)	-0.25 (0.93)	0.11 (0.95)	-0.25 (0.93)
Frog Matrix - Simultaneous	-0.01 (1.02)	-0.13 (0.96)	0.10 (1.05)	0.02 (0.92)	0.08 (0.92)	-0.04 (0.92)
WJ III Und Directions	0.01 (1.01)	-0.02 (0.98)	0.19 (1.03)	-0.05 (0.97)	0.04 (0.97)	-0.25 (0.95)
DCCS - Advanced	0.04 (0.99)	-0.07 (0.98)	-0.15 (0.99)	-0.15 (1.04)	0.11 (1.09)	-0.15 (1.02)
NEPSY Tower	0.04 (0.99)	-0.07 (0.92)	0.14 (1.03)	-0.18 (1.02)	0.12 (0.91)	-0.44 (1.07)
Flanker - B3 INC	0.05 (1.02)	-0.04 (1.04)	-0.07 (1.02)	-0.19 (0.87)	0.10 (0.94)	-0.29 (0.82)
Delay of Gratification	0.01 (1.00)	-0.06 (0.98)	-0.14 (1.02)	-0.05 (1.00)	0.06 (1.01)	0.03 (1.00)

Note: SB5 = Stanford-Binet Fifth Edition; BASC-AP = BASC-2 Attention Problems Subscale; WJ III Und Directions = Woodcock-Johnson Third Edition Normative Update Tests of Achievement, Understanding Directions; DCCS-Advanced = Dimensional Change Card Sort - Advanced; Flanker - B3 INC = Block 3 Incongruent Trials.

Table 4.18

Spearman Correlations between Reactive Relational Aggression and Cognitive and Executive Function Scores

Variable	Ability Measured	Full sample (n = 255)	Boys (n = 149)	Girls (n =106)
Stanford-Binet 5 Verbal Routing	crystallized abilities	-.04	-.14*	.11
Stanford-Binet 5 Non-Verbal Routing	fluid reasoning abilities	-.04	-.09	.00
BASC- Attention Problems	teacher-rated attention problems	.26***	.27***	.29***
rlog Happy-Sad Junior Stroop	verbal inhibition	-.08	-.04	.13†
Hearts-Flowers Block 2	inhibition pre-potent response	-.06	-.03	-.11
Frog Matrix - Sequential	visual spatial working memory	-.12*	-.15*	-.08
rlog Frog Matrix - Simultaneous	visual spatial working memory	-.01	-.09	-.10
WJ III - Understanding Directions	verbal working memory	-.01	-.10	.10
Dimensional Change Card Sort - Advanced	flexibility	-.08	-.11	-.03
NEPSY Tower	planning	-.08	-.20*	.09
Flanker - Block 3 Incongruent	selective attention, flexibility, working memory	-.10*	-.16*	-.02
Delay of Gratification	delay of gratification	-.04	-.01	-.07

*p < 0.05 level (1-tailed) **p < 0.01 level (1-tailed) ***p < 0.001 level (1-tailed)

† Marginally significant trends *p* < 0.10.

Note. DG Task: Low Aggression n = 173, High Aggression n = 47

Forty-nine of the 255 participants (19.22%; 27 boys, 22 girls) were identified as high in reactive relational aggression. Group data and results of the factorial ANOVA are presented in Table 4.19. Only one significant main effect for the reactive relational aggression group was observed. Children who were high in reactive relational aggression were also higher in teacher-rated attention problems relative to children in the low reactive relational aggression group (BASC-AP, $F(203, 51) = 20.77$, $p < .001$). There was a marginally significant main effect for the reactive relational aggression group with visual-spatial working memory (FM-Seq, $F(204, 49) = 3.58$, $p = .06$), where children high in reactive relational aggression tended to display lower visual working memory abilities. Although there was no main effect for sex on this variable, correlation results and scatter-plots suggest that this trend was likely statistically driven by patterns of male data (e.g., higher levels of reactive aggression in boys being associated with lower scores on the Frog Matrix - Sequential task).

Two main effects for sex were observed. Girls had significantly higher verbally-based estimates of cognitive ability than boys (SB5-VR, $F(204, 49) = 4.79$, $p < .05$). Consistent with significant Mann-Whitney results for sex differences on the BASC-2 Attention problems subscale, boys had higher ratings of attention problems than girls (BASC-AP, $F(204, 49) = 20.77$, $p < .001$).

Significant interaction effects were observed between the reactive relational aggression group and sex. Consistent with correlational results (that the relationship between crystallized abilities and reactive relational aggression was negative for boys, but positive for girls), findings of a main effect of sex for crystallized abilities were qualified by a significant interaction (SB5-VR, $F(204, 49) = 4.31$, $p < .04$; Figure 4.4). Post-hoc one-way ANOVA results indicated that girls and boys with low levels of aggression had similar levels of crystallized abilities (SB5-VR, $F(1, 204) = 0.02$, n.s.), and girls with low and high levels of reactive relational aggression did not differ from each other in terms of crystallized abilities (SB5-VR, $F(1, 104) = 1.14$, $p = .29$). However, boys with high levels of reactive relational aggression had weaker crystallized abilities than girls with high levels of reactive relational aggression (SB5-VR, $F(1, 47) = 7.07$, $p < .01$), and these abilities tended to be weaker in comparison to boys with low levels of reactive relational aggression (SB5-VR, $F(1, 147) = 3.70$, $p = .06$).

One other significant interaction was noted. Consistent with a significant negative correlation for boys only (between reactive relational aggression and NEPSY Tower scores), there was a significant interaction between the reactive relational aggression group and sex for planning (NT, $F(204, 49) = 5.96$, $p < .02$; Figure 4.8). On post-hoc one-way ANOVA comparisons of the planning scores, girls with low and high levels of reactive relational aggression did not differ significantly in planning ability (NT, $F(1, 104) = .91$, n.s.), nor did girls versus boys with low levels of reactive relational aggression (NT, $F(1, 204) = .1.77$, n.s.). In contrast, boys with high levels of reactive relational aggression had poorer planning scores than boys with low levels of reactive relational aggression (NT, $F(1, 47) = 4.18$, $p < .05$) scored more poorly than girls with high levels of reactive relational aggression (NT, $F(1, 147) = 6.55$, $p < .01$).

Table 4.19

Reactive Relational Aggression and Cognitive and Executive Function Differences (ANOVA)

Variable	Low aggression (n = 205)	High aggression (n = 49)	ANOVA Effect	F	*p* value	Partial Eta^2
Stanford-Binet 5 Verbal Routing (crystallized abilities)	8.80 (2.43)	8.47 (2.26)	main effect agg	0.42	.52	.00
			main effect sex	4.79	.03*	.02
			agg *sex	4.31	.04*	.02
Stanford-Binet 5 Non-Verbal Routing (fluid reasoning abilities)	11.67 (3.10)	11.24 (2.47)	main effect agg	0.77	.38	.00
			main effect sex	2.25	.14	.01
			agg *sex	0.25	.61	.00
BASC- Attention Problems	47.46 (10.41)	54.86 (10.46)	main effect agg	20.77	.00***	.08
			main effect sex	5.67	.02*	.02
			agg *sex	0.04	.83	.00
rlog Happy- Sad Junior Stroop (verbal inhibition)	.61 (.27)	.66 (.24)	main effect agg	1.86	.17	.01
			main effect sex	1.72	.19	.01
			agg *sex	0.27	.60	.00
Hearts-Flowers Block 2 (inhibition pre-potent response)	9.44 (2.12)	9.47 (1.53)	main effect agg	0.00	.98	.00
			main effect sex	0.03	.87	.00
			agg *sex	0.87	.35	.00
Frog Matrix - Sequential (visual-spatial working memory)	53.71 (8.92)	50.94 (8.23)	main effect agg	3.58	.06	.02
			main effect sex	0.20	.65	.00
			agg *sex	0.13	.72	.00
rlog Frog Matrix - Simultaneous (visual-spatial working memory)	.50 (.32)	.52 (.27)	main effect agg	0.03	.88	.00
			main effect sex	0.10	.75	.00
			agg *sex	2.04	.16	.01

Table 4.19 Continued

Reactive Relational Aggression and Cognitive and Executive Function Differences (ANOVA)

Variable	Low aggression (n = 205)	High aggression (n = 49)	ANOVA			
			Effect	F	*p* value	Partial Eta^2
WJ III - Understanding Directions (verbal working memory)	107.08 (14.49)	106.16 (14.00)	main effect agg	0.05	.83	.00
			main effect sex	1.44	.23	.01
			agg *sex	2.47	.12	.01
Dimensional Change Card Sort - Advanced (flexibility)	8.00 (2.59)	7.51 (2.72)	main effect agg	1.10	.29	.00
			main effect sex	0.35	.56	.00
			agg *sex	0.30	.59	.00
NEPSY Tower (planning)	9.34 (2.88)	8.69 (3.01)	main effect agg	1.24	.27	.01
			main effect sex	1.61	.21	.01
			agg *sex	5.96	.02*	.02
Flanker - Block 3 Incongruent (selective attention, flexibility, working memory)	9.93 (2.93)	9.25 (2.50)	main effect agg	1.82	.18	.01
			main effect sex	0.06	.81	.00
			agg *sex	1.28	.26	.01
Delay of Gratification (delay of gratification)	507.77 (398.54)	482.77 (397.52)	main effect agg	0.12	.74	.00
			main effect sex	0.74	.39	.00
			agg *sex	0.02	.89	.00

*p < 0.05 level, **p < 0.01 level, ***p < 0.001 level

Note. DG Task: Low Aggression n = 173, High Aggression n = 47

Note. The BASC-AP scale measures attention problems, rather than attention abilities, and thus its correlation values with other measures of EF were expected to be negative. The rlogHS and rlogFM-Si variables were reflected and then log-transformed. The correlation rho values between these variables and other variables thus are expected to be inverse to the correlation relationship between their untransformed values and other variables.

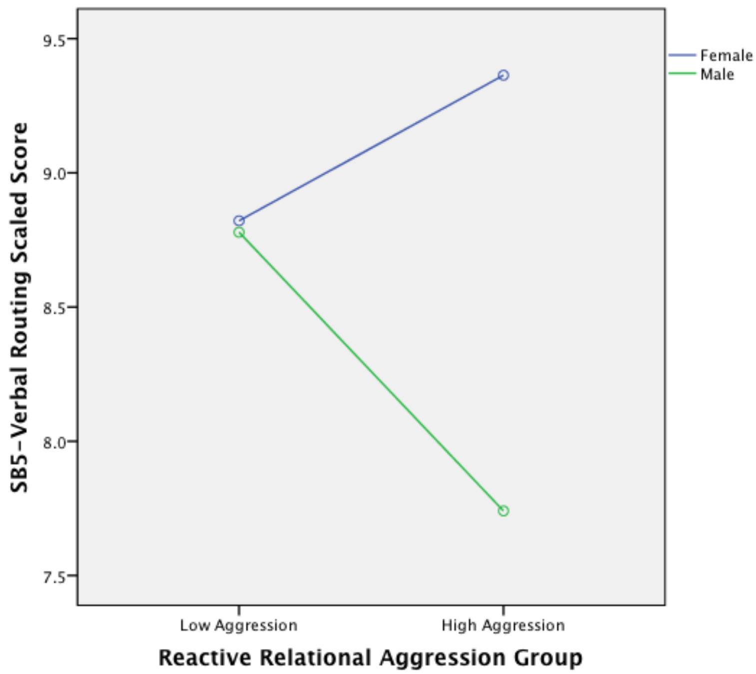

Figure 4.4 Stanford-Binet Fifth Edition - Verbal Routing subtest scaled score as a function of reactive relational aggression group and sex of participant

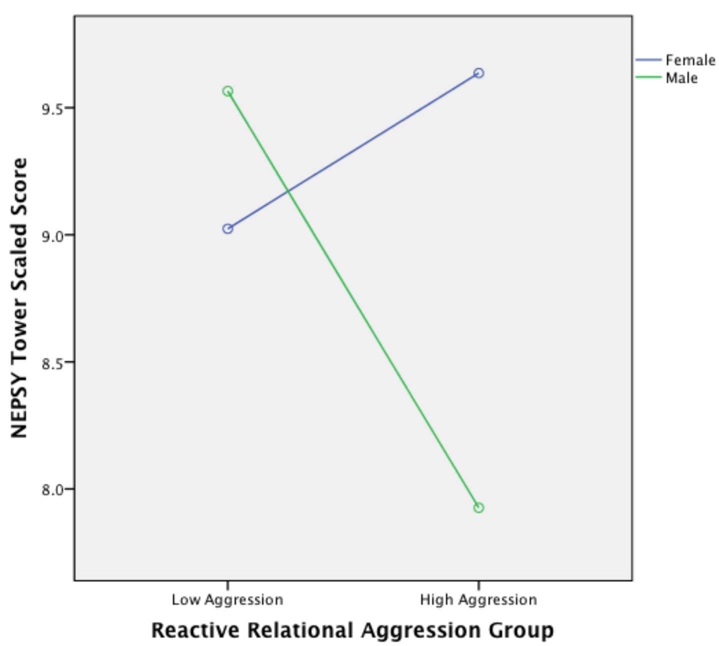

Figure 4.5 NEPSY Tower subtest scaled score as a function of reactive relational aggression group and sex of participants

Table 4.20

Summary of ANOVA Results for Four Aggression Subtypes

Variable	Ability	Aggression Subtype			
		Proactive Physical	Reactive Physical	Proactive Relational	Reactive Relational
Stanford-Binet 5 Verbal Routing	crystallized	-	-	-	$High_{BOYS} < Low_{BOYS}$ & $High_{GIRLS}$
Stanford-Binet 5 Non-Verbal Routing	fluid reasoning	-	-	-	-
BASC-Attention Problems	teacher-rated attention problems	High > Low	High > Low Boys > Girls	High > Low Boys > Girls	High > Low Boys > Girls
Happy-Sad Junior Stroop	verbal inhibition	Boys < Girls	Boys < Girls	-	-
Hearts-Flowers Block 2	inhibition pre-potent response	-	High < Low	-	-
Frog Matrix - Sequential	visual spatial working memory	High < Low	High < Low	-	-
Frog Matrix - Simultaneous	visual spatial working memory	-	High < Low	-	-
WJ III - Understanding Directions	verbal working memory	-	-	$Low_{GIRLS} < High_{GIRLS}$	-
Dimensional Change Card Sort - Advanced	flexibility	-	High < Low	-	-
NEPSY Tower	planning	-	-	$Low_{GIRLS} < High_{GIRLS}$	$High_{BOYS} < Low_{BOYS}$ & $High_{GIRLS}$
Flanker - Block 3 Incongruent	selective attention, flexibility, working memory	High < Low	High < Low	-	-
Delay of Gratification	delay of gratification	High < Low	$High_{BOYS} < Low_{BOYS}$	-	-

Chapter 5: Discussion

Overview

The primary goal of this study was to evaluate whether young children who engage in specific subtypes of aggression differed in terms of specific "Cool Executive Functions" and "Hot Executive Functions," in a community sample of Kindergarten children that excluded children with a diagnosis of ADHD and reduced cognitive ability. The results for each research question are discussed, followed by an integrated discussion of the overall findings. A summary of the major findings is presented, along with a discussion of the limitations of the study and implications for the practice of school psychology and future research.

Key Findings for Specific Research Questions

Research question #1. Results of the present study were the first to document that proactive physical aggression in young children was significantly associated with weaknesses on objective measurements of EF. As hypothesized, early proactive physical aggression was found to be associated with weaknesses in specific "Cool" and "Hot" EFs (as measured by a Delay of Gratification task) for both boys and girls. Also, for both boys and girls, greater proactive physical aggression was associated with more teacher-rated attention problems, poorer visual-spatial working memory, poorer simultaneous use of attentional inhibition, working memory, and flexibility on a complex switching task, and less ability to delay gratification. In contrast to prior literature that consistently supports a linkage between aggression and reduced inhibition (Raajimakers et al., 2008; Riggs et al., 2001; Snell, 2004; Sun, 2001), the current study only identified a non-significant trend between proactive physical aggression and verbal inhibition. However, this non-significant trend must be interpreted with caution, given that this measure of verbal inhibition (Day-Night task) had an inadequate ceiling for the age of our sample. Accordingly, further replication is needed, possibly with multiple measures of different subtypes of inhibition, in order to clarify whether there is continuity in the proactive physical aggression-inhibtion relationship, or whether proactive physical aggression is uniquely related to only some subtypes of inhibition.

The findings also are consistent with research by Broder (2004) for non-form specific proactive aggression as related to parent ratings of the EFs of inhibition, working memory, and shifting/ flexibility, as well as findings from research literature on general and physical aggression, irrespective of functional pattern, that link greater aggression to impaired attention (e.g., Seguin & Zelazo, 2005), inhibition (e.g., Raajimakers et al., 2008; Riggs et al., 2001; Snell, 2004; Sun, 2001), and working memory (e.g., Riggs et al., 2001; Seguin et al., 1995; Seguin et al., 2004; Sun, 2001). The parallels between the findings and the larger literature, which is predominantly based on studies with older children, suggest some developmental continuity for this relationship, where proactive physical aggression is consistently characterized across childhood by weaknesses in EFs. Further inquiry with longitudinal studies is needed to clarify the causal pathways of proactive physical aggression and the role of Executive Functions in the development of proactive physical aggression.

Research question #2. As hypothesized, early reactive physical aggression was consistently associated with weaknesses in specific “Cool” and “Hot” EFs (as measured by a Delay of Gratification task) in the present study. Compared to the other four subtypes of aggression, reactive physical aggression was associated with the greatest number of cognitive and EF weaknesses, with significant or marginally significant weaknesses observed on the majority of the 12 measures administered and across the full spectrum of EFs. These findings also parallel recent results from Hart and Ostrov (2013) indicating that reactive physical aggression is associated with the highest level of psycho-social impairments among the four subtypes of aggression. Children who were viewed by their teachers as engaging in higher levels of reactive physical aggression had higher levels of teacher-rated attention problems and poorer EF abilities with regard to inhibition of pre-potent responding, visual-spatial working memory, flexibility, and simultaneous use of multiple EFs. Boys high in reactive physical aggression demonstrated additional impairments in "Hot EFs" (as measured by the Delay of Gratification task) and marginally poorer planning than boys with low levels of reactive physical aggression. Again, longitudinal research is needed to determine whether there is continuity in these EF-reactive aggression linkages across the age range and whether the magnitude of these relationships increases with age.

As with the results for proactive physical aggression, findings regarding EF and reactive physical aggression were consistent with the limited findings to date indicating that reactive aggression is associated with global weaknesses in EF (Giancola et al., 1996) and especially the EF of inhibition (Broder, 2004; Jones, 2007). In addition, the present findings were roughly consistent with those from prior studies regarding general and function non-specific physical aggression, both demonstrating weaknesses in inhibition (Raajimakers et al., 2008), and the less frequent finding of weaknesses in working memory (Seguin et al., 1995; Seguin et al., 2004; Sun, 2001).

An exploratory investigation of the relationship between reactive physical aggression and the specific EF of flexibility indicates that this is an additional area of weakness for children who engage in reactive physical aggression. For both male and female children in the present study, reactive physical aggression was linked to robust weaknesses in simple flexibility, akin to findings by Broder (2004) regarding parent ratings of flexibility in reactively aggressive children and by Riggs et al. (2001) and Snell (1998) on a Trail-Making task with generally aggressive children. However, the findings in the current study are in contrast with the findings by Sun (2001) of no differences on the Wisconsin Card Sort Test in a large-scale study. The reason for this contradiction is unclear, but may be related to task non-equivalence across the studies.

Kindergarteners in the present study who displayed greater physical reactive aggression were also impaired in the more complex use of flexibility, as reflected in performance on the Flanker task that requires concurrent use of attentional inhibition, working memory, and flexibility. Raaijimakers et al. (2008) also found that general aggression was associated with impairments on a similar complex task, the Shape School Inhibition and Switching task, but only in aggressive males. The latter may be attributable to differences in the measurement of aggression across studies; teacher reports of reactive physical aggression on the PPRA-TR subscale were used in the present study whereas parent reports on the more general CBCL aggression subscale were used in the Raaijimakers et al. study. Variations in sample size and composition may also have contributed to the different results obtained. With 109 females overall and 26 girls identified as high in reactive physical aggression, the present study may have had greater power to detect differences in flexibility than Raajimakers et al., whose sample only included 58 females overall and 23 highly aggressive girls. The older, reactively aggressive girls in the current study may have represented more “chronic persisters” in physical aggression, versus the four-year-old and potentially “more normative” female aggressors included in the Raajimakers et al. study.

Preliminary evidence was also found for more generalized EF deficits in boys who engaged in reactive physical aggression, consistent with the general pattern of findings by Raajimakers et al. (2008). First, the findings in the present study indicated a trend of reactive physical aggression being marginally associated with impairments in the EF of planning for males, as measured by performance on the NEPSY Tower subtest. This finding of possible impairments in the EF of planning is consistent with differences observed on a maze-based measure of planning in studies of EF and general aggression and reactive aggression (Snell, 1998; Giancola et al., 1996), but not the null findings reported by Seguin et al. (1995) with strategic problem-solving tasks in a sample of physically aggressive boys. However, it is unclear whether the trend observed in the present study represented an actual weakness in planning or perhaps reflected poor inhibition instead (as lost points on the NEPSY Tower can also be due to rule violations due to disinhibited responding). Finally, the present findings that reactive physical aggression was associated with impairments in “Hot EF,” as measured by the Delay of Gratification task, support prior theoretical and empirical perspectives that reactive physical aggression is characterized by impulsivity and emotion dysregulation.

Research question #3. Results of the present study regarding proactive relational aggression were only partially consistent with hypotheses based on the theoretical literature (e.g., Bjorkqvist et al., 2003; Foti, 2005; Hawley, 2007; Hawley et al., 2007; Sutton et al., 1999) that children with high levels of proactive relational aggression would perform better than children with low levels of proactive relational aggression on measures of EF. Contrary to expectations, higher proactive relational aggression was associated with greater, not fewer, attention problems. Although there were no sex differences in baseline levels of relational aggression and most EF measures, the relationship between proactive relational aggression and EFs appeared to be sex-specific, with sex moderating the relationship between proactive relational aggression and EF. Girls high in proactive relational aggression demonstrated strengths in verbal working memory and planning relative to girls or boys with low levels of proactive relational aggression, and marginally stronger visual-spatial working memory abilities than other children. For boys, no substantial pattern of linkages was observed between proactive relational aggression and direct measures of EFs. Finally, proactive relational aggression was not associated with differences in “Hot EFs” or the ability to delay gratification for boys or girls in the present sample, consistent with recent findings by Ostrov et al. (2013) that proactive relational aggression in young children was linked to stronger emotion regulation skills.

Findings from the current study for proactive relational aggression contrasted with expectations and with findings by Broder (2004) that general proactive aggression in boys was associated with poorer teacher ratings of inhibition, working memory, and flexibility. This discrepancy may be due to differences in the construct of aggression measured in the current research versus that assessed by Broder (2004). While the research question and the PPRA-TR PR subscale focused on relational forms of proactive aggression, the measure used in Broder (Proactive–Reactive Aggression, Coie & Dodge, 1987) primarily evaluated the construct of proactive and reactive physical aggression.

Research question #4. Based on the minimal empirical literature on reactive aggression (form not specified, e.g., Broder, 2004; Giancola et al., 1996; Jones, 2007), it was hypothesized that children with higher levels of reactive relational aggression would perform more poorly than children with low levels of reactive relational aggression on measures of EFs. Contrary to expectations, higher levels of reactive relational aggression were associated with very few weaknesses in EFs. As with the other three subtypes of aggression, reactive relational aggression was associated with higher levels of teacher-rated attention problems. The reactive relational aggression-EF relationship also appeared to be sex-specific, as boys, but not girls, high in reactive relational aggression demonstrated limited cognitive and EF weaknesses. Boys with high reactive relational aggression had poorer crystallized and planning abilities than boys with low levels of reactive relational aggression or girls with high levels of reactive relational aggression.

Overall Findings on Subtypes of Aggression and Executive Functions

Findings from the present study contribute to our understanding of early aggression by exploring the links between specific subtypes of aggression and their relationship to Executive Functions, with five major conclusions. First, even in very young children, higher levels of all subtypes of aggression (proactive and reactive, physical and relational) were associated with differences in individual and global Executive Functioning. Although the direction of causality remains a question for future research, the findings of the present study underscore the importance of Executive Function in understanding aggressive behaviour in children. Although a number of previous studies used either clinical samples (Giancola et al., 1996; Riccio et al., 2011) or studied at-risk children / children referred for mental health difficulties (Rajimaakers et al., 2008; Seguin et al., 1995, 2005; Snell, 1998), the present results, along with those of Broder (2004), Ellis et al. (2009), Riggs et al., (2001), and Sun (2001), demonstrate that the aggression–EF relationship is present in “normative” or sub-clinical aggression in the general population. This suggests that weaknesses in EFs are features of developmentally normative, rather than just extreme versions of aggression.

A second major conclusion is that both form and function of aggression matter in understanding the linkages between aggression and specific EFs, as the pattern of differences was unique to each of the four subtypes of aggression. The *form* of aggression (physical versus relational) appears to be more strongly involved in determining the directionality of the relationship between aggression and EFs. Indeed, physical aggression was consistently related to weaknesses in EF, whereas relational aggression reflected a more complex set of relationships with EF, some reflecting EF weaknesses, others reflecting EF strengths, and still others demonstrating no relationship. The *function* of aggression appears to be more strongly involved in determining the magnitude of weaknesses when present. Indeed, both reactive physical and reactive relational aggression were related to a wider range of weaknesses in EFs than were proactive physical and proactive relational aggression.

The pattern of unique EF differences across subtypes of aggression was challenging to interpret, particularly in the context of the high correlation and comorbidity between physical and relational aggression, and between proactive and reactive aggression. Most children who engage in one functional subtype of a given form of aggression also engage in the other functional subtype of that form (Vitaro & Brendgen, 2005). In the present sample, such comorbidity was especially evident in the high correlations observed between both reactive and proactive aggression for both physical and relational forms of aggression (*rho* = .81 and .92 respectively), partially in keeping with results from Little et al. (2003). Given this and the age of the participants in the sample (when both aggression and EFs are developmentally challenging to assess), our numerous significant findings of aggression subtype-specific differences in EFs was somewhat remarkable. Unfortunately, our sample size and the high comorbidity of the various subtypes of aggression (which was likely associated with the younger age of our sample) did not permit multivariate analysis of our data with the other functional subtype as a covariate (as per Ellis et al., 2009). An attempt was made to disaggregate the current data further into children who engaged in low levels of aggression (71.4% physical; 76.1% relational), versus children high in proactive aggression only (4.7% physical; 4.7% relational), children high in both proactive and reactive aggression (16.5% physical; 15.3% relational), and children high in reactive aggression only (4.7% physical; 3.9% relational), but the low numbers in the high proactive-only and reactive-only groups were inadequate for group comparisons at this level with the sexes combined, nor within sex. It is possible that the present findings actually reflect patterns of weaknesses associated with high levels of comorbid proactive and reactive physical aggression (or high levels of comorbid proactive and reactive relational aggression), rather than EF patterns specific to just proactive or reactive aggression. If this is the case, the comorbidity of proactive and reactive aggression (for either form) in this sample may be masking or conflating EF differences that are specific to either proactive or reactive aggression (for either form). Further large sample or meta-analytic studies are needed to clarify these findings.

A third major conclusion was that, depending upon the subtype of aggression considered, the sex of the aggressor appears to influence the aggression subtype–EF relationship. Although there were few sex differences in either subtype of relational aggression or most baseline EF abilities, subsequent analyses indicated significant sex interactions between three of the four subtypes of aggression (reactive physical, proactive and reactive relational) and four specific EFs. Sex thus appears to influence both the directionality of the relationship between aggression subtype and EFs (e.g., negative for physical aggression and reactive relational aggression versus positive for proactive relational aggression in girls) and magnitude (e.g., the number of EF deficits in reactive physical aggression versus other subtypes). In the present sample, being a male aggressor (of any form or function of aggression, except proactive relational aggression) was associated with increased likelihood of EF weaknesses, whereas only physically aggressive females had EF impairments. The current findings of sex-specific differences across the aggression subtypes also appears to lend empirical support to the Gender-Linked Model of Aggression proposed by Ostrov and Godleski (2010), which suggests that sex may predict the developmental pattern of aggression and associated maladaptive outcomes. Alternatively, relational aggression may present or look different in girls versus boys. Ideally, future studies on aggression subtypes should investigate whether sex or other constructs that may vary as a function of sex actually moderate the aggression subtype-EF relationship, such as language abilities, anger, emotion regulation, or empathy, and whether any differences exist in how the two sexes enact relational aggression.

A fourth major conclusion was that "Hot EFs," or more emotionally-based aspects of self-control, as measured by a Delay of Gratification task, appear to matter for the form, but not the function of aggression. Specifically, the ability to delay gratification appears to matter for physical forms of aggression (children with higher levels being less able to delay gratification), but less so for relational forms of aggression (proactive or reactive relationally aggressive children showing no differences in ability to delay gratification). Moreover, the relationship between subtypes of physical aggression and the ability to delay gratification varied, in some cases, by sex, as boys high in proactive physical aggression (but not girls) were impaired on this task. Further research is needed to determine whether and how more emotionally-based forms of control play a role in physical aggression, and whether and why they do not appear to play a role in more relational forms of aggression.

The generalizability of present findings regarding “Hot EFs” as a weakness in some subtypes of childhood aggression is unknown, as only one indicator of “Hot EF,” the Delay of Gratification task (Mischel et al., 1989), was administered. As noted earlier, the concept of “Hot EFs” typically has been defined as performance on tasks recognized as measures of “Hot EFs,” such as our Delay of Gratification task, or the Iowa Gambling task (Bechara, 2002). In the present study, “Hot EFs” were not evaluated with a larger number of tasks because of the limited number of “Hot EFs” suitable for the late preschool and early-elementary age range (Carlson, 2005; Hongwanishkul et al., 2005). While it would have been desirable to administer more than one measure of “Hot EFs,” this is not typically possible for studies conducted in natural or community-based settings such as the present study, given the lack of a laboratory setting or filming facilities in the testing rooms at schools required to code and score other “Hot EF” tasks, such as the Disappointing Gift task (Saarni, 1984). Moreover, findings of sex differences in the current study may partially be accounted for by baseline sex differences in the ability to delay gratification, given that girls typically performed marginally better on this task than boys (Silverman, 2003). Finally, there is some debate as to whether the Delay of Gratification task actually measures “Hot EFs,” or additional factors, such as social trust of the reward provider (Michaelson, de la Vega, Chatham, & Munakata, 2013) or environmental predictability (Kidd, Palmeri, & Ashlin, 2013). In some cases, failure on this task may reflect rational decision-making rather than impaired self-control (McGuire & Kable, 2013). In order to move this line of inquiry forward, development of additional measures of "Hot EFs" that are psychometrically sound and valid measures across the age ranges is required.

Finally, the effect sizes of the present findings were small, indicating that differences in EFs explain only a limited portion of the variability in aggression subtypes. However, this does not necessarily diminish the importance of EFs for aggression, as the smaller effects in the present study can partially be accounted for by methodological challenges (e.g., inadequate psychometric ceilings on several of our tasks and reduced sensitivity to detect small differences in EF abilities), the developmental nature of aggression and EFs (i.e., that EFs are less differentiated at younger ages; Shing et al., 2010), and the fact that there is a period of rapid growth and maturation in EFs between four and seven years of age (Diamond, 2006; Garon et al., 2008; Welsh, 2002). As discussed, detection of small differences in EF abilities in the late preschool / early elementary periods is challenging. The age of the present sample also was younger than that of most other studies on aggression and EF, and at earlier ages, aggression is typically more normative (Tremblay & Nagin, 2005). In contrast, studies involving older samples may include children with more stable, chronic/persistent patterns of aggression, and thus participants of these studies may be children with more extreme levels of aggression and EF deficits.

Strengths, Limitations, & Implications for Future Research

The current study met most of its initial goals, and thus has provided several novel and informative contributions to the existing literature. By using the Preschool Proactive and Reactive Aggression scale by Ostrov and Crick (2007), this was the first study to investigate the childhood aggression and EF relationship using more current conceptualizations of aggression measured with research-based, rather than clinical measures of aggression. The present study was also the first to examine linkages between relational aggression and EFs. In contrast to most of the other studies in the literature, the fairly stringent exclusion criteria of this study also allowed for the examination of more normative childhood aggression, or aggression that does not result from confounding comorbid conditions, such as reduced cognitive ability or ADHD. Another strength of this study was its relatively large sample size and the inclusion of a high number of aggressive girls, allowing direct sex comparisons with generally adequate power. Finally, the number and range of cognitive and EF constructs included and measured in this study was significantly higher than in most other studies in this area to date, permitting analyses of the full range of EF constructs, often with multiple measures of individual EFs.

At the same time, no study is without its limitations, and many of the challenges commonly found in studies of early childhood aggression and EFs were observed in the current study, particularly related to measurement. First, the non-normative nature of aggression and associated non-normal distribution curve for our PPRA variables limited the types of statistical analyses that could be conducted, such as multivariate techniques. Similarly, the relatively small size of the aggression groups (approximately 20% of the overall sample, 16.78 - 24.16 % of boys, 16.98 - 24.52% of girls) may have contributed to the small effect sizes of our findings, and potentially the null findings for physically aggressive girls. Related, the statistical power was variable across the many EF variables and the four research questions (e.g., .52 - .82), and thus may have limited our ability to identify significant differences in some cases. Some of the null findings for the post-hoc, pair-wise comparisons with the higher aggression groups may reflect a lack of power due to small n for the higher aggression groups, rather than a lack of sex differences. It is also possible that the sex-specific cutoffs used in this study (for assigning male versus female children to the low and high physical aggression groups) may have influenced the pattern of findings. Crick (1997) demonstrated that girls who engage in non-normative forms of aggression (e.g., physical aggression) have significantly higher maladjustment than girls who engage in sex-normative forms of aggression (e.g., relational aggression). The present results underscore the importance of considering sex interactions in aggression-EF relationships, and the need to study boys and girls separately, and with larger samples that allow formal comparison of sex differences with and without sex-specific methods of identifying children as highly physically aggressive.

The current study also relied exclusively upon teacher ratings to measure aggression, and thus there is the possibility that the accuracy of these ratings might have varied somewhat as a function of teacher bias (e.g., teachers' own beliefs about what constitutes aggressive versus non-aggressive behaviour, or their beliefs regarding individual children). We elected not to measure aggression with other informants such as parents (due to the reduced opportunity to observe their children in the school social context) or self reporting (due to the age of the sample and the lack of such measures for the Kindergarten age range), or with other measures such as peer sociometric ratings (because they are less well received by schools and parents), or observations (due to the time and cost). Recent research suggests that observational approaches may be a more valid measurement of aggression in young children (Murray & Ostrov, 2009; Ostrov & Crick, 2007; Ostrov & Keating, 2004; Ostrov, Ries, Stauffacher, Godleski, & Mullins, 2008). Consequently, future studies ideally should employ multi-modal measurements of aggression, as well as multi-modal measurements of EFs, such as the research conducted by Riccio, Hewitt, and Blake (2011).

Another limitation relates to the attempt to measure both physical and relational aggression at the age level of the current study participants. As physical aggression normatively continues to decline into the early elementary years (Tremblay & Nagin, 2005), this study ideally should be replicated with older children when both functional subtypes of physical aggression have become more stable (e.g., chronically extreme physical aggressors are more easily differentiated from other children passing through the normative developmental stages of aggression). Similarly, the measurement of relational aggression at five years of age is a relatively new phenomenon. Ideally, this study would be replicated with older participants, when both functional subtypes of relational aggression are past the age of onset, more mature, more frequent to sample, and better understood empirically.

An additional challenge was the evaluation of EF in young children, which was acutely difficult in the current sample of five- and young six-year-olds. As noted earlier, the late preschool / early elementary period is a time of significant growth in and maturation of EF, and thus the number of available EF measures that sensitively detect small differences in EF ability is limited (Carlson, 2005). Consistent with this, several of the EF measures in the present study may have been too easy and lacked adequate psychometric ceilings for the age of the participants (the Happy-Sad Junior Stroop task, the Hearts-Flowers Block 2 task, the Frog Matrix-Simultaneous task, and possibly the Frog Matrix-Sequential and the Delay of Gratification tasks). Thus, the limited ability to differentiate between lower and higher levels of EF may have reduced the likelihood of detecting EF differences, and / or may have reduced the effect sizes obtained. Given the fairly robust linkages between inhibition and physical aggression, it is possible that alternative measures of EF may have produced different results; in particular, an alternative and more sensitive measure of verbal inhibition likely would have detected a stronger pattern of differences between the high and low aggression groups. Similarly, the reduced variability in the range of many of the EF score distributions, the pattern of inter-correlations observed among the EF measures in this study, and the relatively greater unitary nature of EFs in younger children also placed further limitations on the types of statistical analyses that could be conducted. Accordingly, further replication of these results are needed, and ideally would be conducted at ages where EFs are more fully developed and differentiated (e.g., past 7-9 years of age), with small differences in EF development being more easily measured.

With regard to the measurement of specific EFs, it is dubious whether the indirect measure of attention actually functioned as a measure of attention. Similarly, the BASC-2 AP scores for participants older than six years of age were based on estimates, rather than actual norms due to the non-equivalence of BASC-2 items for five- versus six-year-olds. The other measures of cognitive ability or specific EFs were directly administered, clinical or experimental measures of EF *ability*, whereas the measure of attention in this study was a teacher rating of attention *problems*. Based on teacher comments to the researchers, it appears that this scale was viewed as a measure of problem behaviour, such as oppositional behaviour or deference to authority, and not a measure of attention. This perception also may have been influenced by the consistent presentation order of the BASC-2 items after the PSBS and the PPRA (given that the PSBS and the PPRA items are largely negative in tone) on the teacher survey. Although they are time-consuming to administer, it is recommended that future studies use a validated direct observation measure of attention rather than parent or teacher ratings, or at minimum some combination of direct (observation) and indirect (ratings) measures of attention.

The measurement of and findings related to the role of visual-spatial working memory deficits in aggression subtypes in the present study requires further clarification. The measures used to evaluate visual-spatial working memory, namely the Frog Matrix Simultaneous and Sequential, are developmentally-appropriate measures of more complex visual working memory or "executive visual memory" for four- to six-year-olds. However, it is unclear whether they actually measured visual working memory or visual span (or both), in addition to visual spatial abilities, as these tasks share similarities with well-established measures of visual working memory (e.g., Self-Ordered Pointing tasks) and more rudimentary measures that are characterized by Flanagan et al. (2013) as short-term visual memory. Developmental trajectory data suggests that differentiation between visual memory span and visual working memory only begins to emerge in the late preschool years, and thus it is unclear whether alternative measures would have produced different results in the age range of the present study. Future studies with older participants ideally will either control for or examine the covariance relationship between baseline memory abilities and EFs/aggression (see Seguin & Zelazo, 2005 for a review).

Several other qualifications should be noted. First, the present sample was characterized by a very high level of linguistic diversity. Given prior findings that suggest accelerated EF development in some cultural groups (Lewis, Koyasu, Oh, Ogawa, Short, & Huang, 2009; Sabbagh, Xu, Carlson, Moses, & Lee, 2006) and in bilingual individuals (Bialystok, 1999; Carlson & Meltzoff, 2013; Riggs, Shin, Unger, Spruji-Metz, & Pentz, 2013), the ethnic and linguistic composition of the current sample may have impacted study results. The linguistic diversity of our sample could be partially responsible for the lack of robust differences between the proactive or reactive physical aggression groups in verbal or crystallized abilities (such as on the SB5 Verbal Routing task) or verbal working memory (such as on the WJ III Understanding Directions task), which has been a consistent finding at least for physical aggression in boys (see Tremblay et al., 2005). Second, there were some minor variations in study procedures because the assessments were conducted in schools, namely, variability in the testing environments of the Delay of Gratification task, and the reversal of the manual and computer-based testing for a small number of children at the end of the study due to room availability at the end of the school year. Although children with ADHD and low cognitive abilities were excluded from the present sample, a full range of possible covariates was not examined, nor were extended multivariate analyses able to be conducted with important correlates, such as extended language abilities (e.g., Ostrov & Godleski, 2007), hyperactivity (Nagin & Tremblay, 1999; Seguin et al., 2004) or oppositional behaviour.

Finally, the primary purpose of this study was to establish whether current classifications or subtypes of early aggression were associated with differences in Executive Functions. Having established that these differences exist in young children, further replication is needed with older children, as well as samples of younger and older children with limited linguistic and ethnic diversity. Moreover, more theoretical and empirical modeling is needed to specify the mechanisms through which EFs contribute to aggression, which specific EFs (or combinations of EFs) are most important to the different subtypes of aggression, and whether the effects of EF differences on aggression are direct, or if they mediate / moderate or are mediated / moderated by other variables, such as social cognition, emotion regulation, empathy, or moral reasoning (Brower & Price, 2001; Riccio et al., 2011).

Implications for the Practice of School Psychology

The findings from the present study have a significant number of implications for the practice of School Psychology and the services that School Psychologists provide to students. Current results emphasize the need for School Psychologists to be informed by contemporary research and the developmental literature on aggression, specifically that aggressive behaviour at school is not just the result of maladaptive social learning at home. Our findings emphasize that many aggressive students also may be children with neuro-cognitive weaknesses. While these young perpetrators of aggression may inflict harm upon their peers, they too are vulnerable and at-risk for other morbidities associated with delayed development of or chronic impairments in EF, including maladjustment related to academics, mental health, and vocational success. Conversely, School Psychologists may need to monitor young students identified with Executive Dysfunction for possible increased risk for subtypes of aggression, due to the confirmed relationship between weaknesses in EF and some subtypes of aggression.

Results also indicate that many students first arrive at school and begin Kindergarten exhibiting relatively high levels of aggression, and often concomitantly poorly developed cognitive and behavioural self-regulation abilities. The prevalence of the latter underscores the need to conduct early social-emotional and behavioural screening, and in particular, screening of basic social skills related to EFs, such as theory of mind and perspective-taking, and also of basic behavioural self-regulation skills, such as behavioural inhibition and flexibility, or the ability to delay gratification. At the same time, screening programs need to be accompanied by school-based intervention programs that both discourage aggression and promote more pro-social behaviour (Ostrov & Godleski, 2007) and promote the healthy development of

Executive Function abilities (Diamond, 2012; Diamond & Lee, 2011; Munro et al., 2005).

In a review of the literature on the efficacy of interventions for Executive Functions, Diamond and Lee (2011) found that improvements in the core EFS of inhibition, working memory, and flexibility can be produced with activities such as computer-based memory training activities, aerobic exercise, music instruction, martial-arts training, and mindfulness training. Bodrova and Leong (2006) have reported increases in self-regulation in association with regular organized dramatic play. Diamond and colleagues (2005, 2011, 2013) have identified one formal educational curriculum as empirically supported for improving early EF development, *Tools of the Minds* (Bodrova & Leong, 2007). Early *Montessori* instruction (Montessori, 1949) also has been associated with at least short-term gains in early EF development. Diamond and Lee emphasize that EFs development can be fostered in general classrooms by general education teachers through the use of "instructional add-ons." Instructional add-ons include ways of engaging children in academic curricula that facilitate EF, but are embedded throughout the daily school schedules (rather than being taught in isolation) and continually are adjusted to increase the demands on EF abilities (Diamond, Barnett, Thomas, & Munro, 2007; Munro et al., 2005). Finally, Diamond (2013) highlights the need to combat the adverse effects upon brain development, the functioning of the pre-frontal cortex, and thus EFs, related to stress, depression, social isolation, poor sleep, and physical de-conditioning. Thus, school programs that seek to promote EF abilities may have life-long positive outcomes for children and their communities, and potentially reduce peer aggression and the substantial impact of childhood aggression upon both perpetrators and victims.

Given the findings that proactive relational aggression in girls is associated with strengths in EF, caution is warranted in School Psychologist selection of school-based prevention and intervention programs for relational aggression. School staff may need to consider whether interventions for physical and relational aggression may need to be distinct. Current population-based education programs for relational aggression and bullying (which emphasize education about the causes and processes of bullying) may in fact be counter-indicated at least for girls, in that the education and promotion of knowledge about the mechanisms of relational aggression in proactively relational girls may be iatrogenic (Dishion, McCord, & Poulin, 1999). It is noteworthy that one program, “You Can’t Say You Can’t Play” (Harrist & Bradley, 2003), which emphasizes psycho-education on social exclusion and inclusion as well as the emotional experience of feeling excluded, resulted in significant *increases* in social dissatisfaction and no changes in teacher ratings of classroom behaviour. The limited number of studies to date (Ostrov et al., 2009) on interventions for relational aggression and victimization appear to highlight the importance of promoting prosocial competence (Leff 2007), social-emotional skills such as empathy, anger management, behavioural self-regulation, or problem-solving (Van Schoiack-Edstrom et al., 2002), social competence (Leadbeater, Hoglund, & Woods, 2003), and behavioural training methods for relational inclusion and friendship-making skills, and social skills (Ostrov et al., 2009). Accordingly, future school-based interventions will need to take into account that there are differential patterns of neuro-cognitive functions and other risk factors that contribute to different patterns of aggression, and that interventions may need to be either specifically tailored to the different subtypes of aggression or include elements that address multiple subtypes of aggression.

Conclusions

The current study provides additional support for arguments that childhood aggression is associated with differences in Executive Functions and that these differences are present even at a very young age and in more normative or non-clinical aggression. Prior findings characterizing childhood physical aggression with a wide range of weaknesses in EFs were supported. However, current analyses underscore the need to disaggregate the forms and functions of aggression, showing that reactive physical aggression and physically aggressive boys may be associated with more Executive Dysfunction than proactive physical aggression or physically aggressive girls, suggesting an EF-deficit model may not be valid for all subtypes of aggression or for both sexes. Despite high comorbidity, the subtypes of proactive and reactive relational aggression appear to have unique patterns of differences in EFs that are moderated by sex. Notably, proactive relational aggression in girls seems to be associated with strengths in EFs, indicating that the EF-deficit model may not be valid for all subtypes of aggression. As strategies for measuring disaggregated subtypes of aggression and for detecting smaller differences in EF development improve, we may be better able to understand the neuro-cognitive underpinnings of early aggression and support children with these challenges.

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Appendix A

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Educational & Counseling Psychology & Special Education
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Thinking Skills & Children's Social Behavior
A UBC Research STUDY

Information for Principals and Teachers

Principal Investigator:	Laurie Ford, Ph.D.	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
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What is the study about?

We invite you to be part of a research study investigating how early thinking skills (what neuroscientists call "executive functions") are related to positive and negative social behaviors in Kindergarten children. The research is part of Ms. Kozey's doctoral dissertation, entitled "Executive Functioning and Subtypes of Childhood Aggression." Recent studies in neuroscience have linked children's physical aggression with certain thinking skills or executive functions, which are brain-based, cognitive processes believed to underlie self-regulation. It is not yet known whether these thinking skills also underlie prosocial behavior and the more commonly experienced social and relational forms of aggression (e.g., saying means things, exclusion, etc.).

We believe that greater understanding of whether and how thinking/problem-solving skills impact children's social behavior will help us better identify students at risk for all types of aggression, and will inform school-based prevention programs. In British Columbia schools, the majority of our students are involved in physical, and more often, social aggression and bullying, either as victims, perpetrators, or witnesses. Prevention and intervention programs, including school-wide anti-bullying campaigns, have had some, albeit limited success in curbing such aggression. By understanding the early thinking processes that contribute to both positive and negative behaviors, we hope to improve programs for preventing and addressing aggression.

Our research team is experienced with young children (e.g., school psychology graduate students, preschool or elementary teachers). They will work with your students at an appropriate pace, provide verbal encouragement and tangible incentives, and will offer breaks or stop the activities as needed.

What is involved?

The research study includes two parts. In Part One, Kindergarten teachers will send home consent letters to parents of their students. Teachers will receive a $25 gift certificate for sending home the letters. Teachers then will be paid $10 per survey to complete a survey about each participating child's behaviors. The survey will take approximately 5 minutes per student. In Part Two, students will be asked to complete a series of individually-administered thinking and problem-solving tasks at school (about 50 - 60 minutes), at times agreed upon by the teacher, student, and researchers.

What will school administrators be asked to do?

The school principal (or designate) will be asked to support the UBC team conducting the research at their school, and arrange a time for researchers to present the study to the school staff. They also will provide an appropriate location for the individual student assessment sessions in Part Two of the study.

What will Teachers be asked to Do?

- **Part One: Teacher Survey** (approximately 5 minutes of teacher time per survey).
    1. Coordinate with researchers the distribution and collection of completed consent forms
    2. Complete teacher surveys on student positive and negative behaviors.

- **Part Two: Thinking Skills/Cognitive Problem-Solving Tasks**
    1. Within 2 - 3 weeks of completing the teacher surveys, teachers will coordinate with and allow the researchers access to students who are participating, in order to complete the Part 2 tasks.
    2. Each participating child will complete roughly 50 - 60 minutes of Thinking Skills/Problem-Solving tasks, typically across two, 25 - 30 minute sessions, or as per the child's needs.

What will students be asked to Do?

- **Part One: Teacher Survey**
    - Return parent consent forms, and verbally say whether or not they would like to take part.

- **Part Two: Thinking Skills/Cognitive Problem-Solving Tasks** (approximately 50-60 minutes)
    - Participating children will be asked to complete tasks involving thinking and problem-solving skills (Executive Functions), likely will happen over two, 25-30 minute sessions, including:
        - Defining words and solving printed puzzles (learning abilities tasks)
        - Playing computer touch-screen games that involve pictures of fish, hearts and flowers, and feeding a hungry donkey
        - Playing Simon Says
        - Remembering lists of words, and the path of a hopping frog on the computer
        - Sorting picture cards into stacks
        - Stacking discs onto a peg in order
        - Having one food treat immediately or waiting to receive two food treats (we will ask for parent permission for the student to eat 1 or

2 oreos, marshmallows, or pretzel sticks)

- The purpose of the word definitions and printed puzzles tasks is to help us learn a bit more about the overall learning abilities of each student. If you would like to know more about these tasks, including the names of tests and subtests, please contact the investigators by phone or email, listed above.

Confidentiality & feedback for Schools, Teachers, & Parents

All teacher responses on the social behaviour surveys will be private, and will not be viewed by anyone other than the researchers. Similarly, individual student results for the Part 2 tasks are confidential, except that a brief summary will be provided to their parents (if requested on the parent consent form).

- **Feedback to Individual Schools & Teachers:**
  - Each school administrator will be provided with written feedback, detailing the overall findings of the study as well as information on the prevalence and pattern of student social behaviors, including pro-social and aggressive behavior across all participating classrooms at their schools.
  - If desired, a member of the research team will present results to the staff once the study is completed.
  - Findings may help schools to better understand patterns of physical and social/relational aggression and pro-social behaviors at their institutions.
- **Workshops:**
  - Participating school staff will be eligible to take part in workshops and trainings at UBC on the prevention of and interventions for social aggression, for little or no cost.
- **Feedback to Parents:**
  - Parents also can request the overall feedback provided to the schools.
  - If requested at the time of consent, parents will receive a brief, general summary of their child's results on the Thinking Skills/Problem-Solving tasks.

***** PLEASE RETURN COMPLETED PAGE TO RESEARCHERS *****

TEACHER CONSENT FORM

Thinking Skills & Children's Social Behavior

Investigators: Laurie Ford, Shelley Hymel, and Michelle Kozey, University of British Columbia

Consent: I have read and understand the information about the study, "Thinking Skills and Children's Social Behavior." I understand that my participation in the study is voluntary, and I may stop at any time.

Please check one:

☐ **NO, I myself do not wish to and/or I do not wish to have my students participate in this study.**

☐ **YES, I consent to participate in this study, and to allow my students to participate in this study, including (please <u>check all that you agree to</u>):**

- ☐ Part One: Filling out social behavior surveys for participating students, with an honorarium of $10 per ***completed*** survey.
- ☐ Part Two: Within 2 weeks of completing the teacher surveys, schedule with researchers the individual student assessment sessions and allow students to participate in these sessions.

____
Teacher Name (Please Print)

____
Teacher Classroom / School

____
Teacher Signature

____
(date)

Who Do I Contact With Questions?

Please contact Michelle Kozey, at (XXX) XXX-XXXX or XXX@XXX

Appendix B

(FORMATTING ALTERED FOR DISSERTATION BINDING)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Educational & Counseling Psychology & Special Education
Faculty of Education 2125 Main Mall Vancouver, B. C. Canada V6T 1Z4

THINKING SKILLS & CHILDREN'S SOCIAL BEHAVIOR

A UBC RESEARCH STUDY

INFORMATION FOR PARENTS AND CONSENT
NOVEMBER 2012

Principal Investigator:	Laurie Ford, Ph.D.	(Phone: ((XXX) XXX-XXXX; Email: XXX@XXX
Co-Investigators:	Shelley Hymel, Ph.D.	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
	Michelle Kozey, Ph.D.Candidate	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
	University of British Columbia, Faculty of Education	
	Department of Educational and Counseling Psychology & Special Education	
	XXX Main Mall, Vancouver, BC, XXX XXX	

Dear Parent(s),

We are writing to ask your permission for your Kindergarten child to take part in a UBC research study.

WHAT IS THE STUDY ABOUT?

In this project, we want to find out how children's thinking-skills/problem-solving strategies and social behavior are related. The study has two parts described below. The results will be a part of Ms. Kozey's dissertation research, titled "Executive Functioning and Childhood Aggression".

WHO IS BEING ASKED TO TAKE PART?

All children in Kindergarten at your child's school will be invited to take part. However, only children who have written parent/guardian permission can take part in the study. Children must be between 5 and 6 years old during the study period, and speak English. Taking part is voluntary. Your child can stop at any time if they wish. All children who return consent forms (both those who take part and those who do not) will be entered in a draw for a prize. There will be one prize per classroom.

WHAT IS INVOLVED?

First, we verbally will ask your child if they want to take part, and if they understand what they will be asked to do. Then there are two parts to the study: 1) the Teacher Survey, and 2) the Child Thinking Skills Tasks.

- **Part One: Teacher Survey**

If you both agree, your child's teacher will complete a brief survey about child social behaviours. It has questions about **Positive Social Behaviours,** like *“The child says supportive things to peers”,* **Negative Social Behaviours** like *“The child gets others to gang up on a peer."*

Before Part Two, we will ask your child whether they want to do the Thinking Skills/Problem-Solving (Executive Functions) tasks. We will do the study at school in a location agreed upon by your child's teacher and principal. All members of our team are approved to work in schools. We will not rush your child. We will be positive, give them stickers as they work, give breaks, and stop the activities when needed. We will try to make the tasks game-like and fun for your child.

- **Part Two: Thinking Skills/Cognitive Problem-Solving Tasks**
- These tasks will be done at school at a time and place agreed upon by your child and their teacher. The tasks usually will be done in two 25-30 minute sessions, and will include:
  - Defining words and solving printed puzzles (learning abilities tasks)
  - Playing computer touch-screen games involving pictures of fish, hearts and flowers
  - Playing Simon Says
  - Remembering lists of words, and the path of a hopping frog on the computer
  - Sorting picture cards into stacks
  - Stacking discs onto a peg in order
  - Having one food treat immediately or waiting to receive two food treats

The purpose of the word definitions and solving printed puzzles tasks is to help us learn a bit more about the overall learning abilities of your child. If you would like to know more about these tasks, including the names of tests and subtests we are using, please contact the investigators by phone or email, listed above. We will provide you with a brief summary of your child's results if you request it on the consent form.

Children who do part or all of the Thinking Skills/Problem-Solving tasks will receive a small token as a thank-you (a choice of a book or toy). On the consent form, we ask you a set of 5 optional questions, about your child's language, early child-care and learning history, number of brothers/sisters, and family.

How Will Your Privacy Be Respected?

- All information about your child and your family on the consent form will be private.
- All answers on the teacher surveys are private and will only seen by the researchers.
- Your child's Thinking Tasks results are private and will not be given back to their school. We will mail you a brief summary about how your child did on the Thinking Skills tasks if you request it on the consent form.
- All information will be stored with a code, and not your child's name, in a locked file cabinet location at UBC.
- Each school will receive a summary of overall results for the social behaviour surveys, but individual results will not be given to schools. No child, teacher, or school names will be reported in our final report.

What are the Benefits & Risks if your Child takes part?

We hope that results from this study will help improve the school experiences of children. We believe that the risks in this study are minimal, and not unlike what children experience in their day-to-day life. Most children find the Thinking Skills tasks fun and game-like, although they might become frustrated sometimes. Should your child become frustrated, the tasks will be stopped. Your child may stop taking part at any time. If they want to stop, that is okay. If your child does not take part, then your child will take part in normal classroom activities. Taking part or not does not affect any services that your child receives.

Who do You contact if You have questions?

If you have any questions about this study, please call or email Ms. Kozey, as listed at the top of this letter. If you have any questions about your child's treatment or rights as a research participant, please contact the Director of Research Services at the University of British Columbia at (XXX) XXX-XXXX.

How do i give my consent?

We hope your child takes part in this study, but it is your choice. If you give consent for your child to take part in our project, please:

1. Complete the consent form on the next page. You may keep this letter for your records.
2. Have your child return the consent form to their teacher ***by Friday of this week***.
3. ***If you do not want your child to take part, please return the form so we know that you got our letter***

'Thank-You

Laurie Ford Shelley Hymel Michelle Kozey

PARENT/GUARDIAN CONSENT FORM

PLEASE RETURN PAGE TO SCHOOL

THINKING SKILLS & CHILDREN'S SOCIAL BEHAVIOR PROJECT

Investigators: Laurie Ford, Shelley Hymel, and Michelle Kozey, University of British Columbia

1. Consent: I have read and understand the information about the project, "Thinking Skills and Children's Social Behavior." I understand that their taking part in the project is voluntary. My child may stop at any time.

2. Please check one:

☐ **NO,** I do not consent to my son/daughter's taking part in this study.

☐ **YES,** I consent to my son/daughter's taking part, including (***check all that you agree to***):

- ☐ Part One: their teacher may fill out a social behavior survey
- ☐ Part Two: your child may do the individual thinking skills/problem-solving tasks

IF YES THEN CHECK ONE:

- ☐ Your child **may eat** a choice of 1 or 2 oreos cookies, marshmallows, or pretzel sticks
- ☐ Your child **may not be allowed to eat** oreos cookies, marshmallows, or pretzel sticks

3. If you consent *for your son/daughter to take part in this project, let us know if you would like:*

☐ YOUR CHILD'S RESULTS SUMMARY - a summary your child's results for the Thinking Tasks.

☐ STUDY REPORT SUMMARY - a copy of the full study report when it is done.

If you want either summary, please give us your mailing address (please ***print clearly***):

Your Name: ____________________________

Mailing Address: ____________________

City: ______________________ Postal Code: ___________________

4. Please fill out the following and sign below:

___________________________ ___________________________

Your Son/Daughter's Name - PRINT **Your Son/Daughter's School**

___________________________ ___________________________

Parent/Guardian Name - PRINT **Parent/Guardian Signature (date)**

5. ***If you consent for your child to take part, please let us know the following <u>only if you are willing:</u>***

Your Child's Birthday	_______ (Day) - ____________ (Month) - ___________ (Year) (Used to schedule Thinking Skills Session)
Your Child's Languages	☐ **Yes -** My child speaks English. ☐ **No -** My child does not speak English.
Before Kindergarten	☐ **Yes** - My child was in a child care or early learning center on a regular basis (such as daycare or preschool) before they started kindergarten. ☐ **No** - My child was not in a child care/early learning center bef starting Kindergarten.
Before / In Kindergarten	☐ **Yes** - My child has been formally diagnosed <u>by a medical doctor or a psychologist</u> with Attention-Deficit-Hyperactivity-Disorder (ADHD) or Attention-Deficit-Disorder (ADD). ☐ **No** - My child has not been formally diagnosed with ADHD or ADD.
Other Children Living in Your Home	☐ My child is the <u>only child</u> living in my/our home. ☐ Other children live at home with my child (such as full, half, or step-siblings).
Family Background (of Family <u>Living with</u> Child)	**Caregiver 1** (circle mother father other): ☐ Less than Grade 12 ☐ High School Diploma or Equivalent ☐ Some College/Trades/University ☐ Apprenticeship/Trades Certificate ☐ Bachelors Degree ☐ More than Bachelors
	Caregiver 2 (circle mother father other): ☐ Less than Grade 12 ☐ High School Diploma or Equivalent ☐ Some College/Trades/University ☐ Apprenticeship/Trades Certificate ☐ Bachelors Degree ☐ More than Bachelors

Appendix C

(FORMATTING ALTERED FOR DISSERTATION BINDING)

THEUNIVERSITY OF BRITISH COLUMBIA

Department of Educational & Counseling Psychology & Special Education
Faculty of Education2125 Main Mall
Vancouver, B. C. Canada V6T 1Z4

THINKING SKILLS & CHILDREN'S SOCIAL BEHAVIOR
A UBC RESEARCH STUDY

INFORMATION FOR STUDENTS

Principal Investigator:	Laurie Ford, Ph.D.	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
Co-Investigators:	Shelley Hymel, Ph.D.	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
	Michelle Kozey, Ph.D.Candidate	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
	University of British Columbia, Faculty of Education	
	Department of Educational and Counseling Psychology & Special Education	
	XXXX Main Mall, Vancouver, BC, XXX XXX	

(Given the age of the children, to be read to the classroom in a developmentally appropriate and conversational way before distributing the parent consent forms. This will be reviewed again individually with each student prior to beginning Part Two: Thinking Skills Activities.)

"We are researchers from the University of British Columbia. We study kids at school. We are asking if you would like to be in a study, called “Thinking Skills and Children's Social Behavior”

WHAT IS A STUDY? WHAT'S THIS ABOUT?

We're doing a research study. This means we are trying to find something out like detectives. We are finding out about the ways kids act with other kids, like being nice and not-so-nice. We also are trying to find out if thinking skills are important to how kids act.

WHO ARE WE ASKING FOR HELP? DO YOU HAVE TO DO THIS?

We are asking kids like you, in Kindergarten, if you want to take part in the study, and to be our helpers. You have to be at least 5 years old. You also have to speak and understand English.

Whether or not you do the study is up to your mom and dad, and up to you. If your mom and dad decide that it's ok for you to do the study, then they have to sign the study permission form. You have to give the signed form back to your teacher.

We hope that you will want to do the activities with us, but no one has to do anything that they don't want to do. If you don't want to be in the study, it's ok.

ARE YOUR ANSWERS PRIVATE?

It's ok for you to tell others about what you do in the study. You can tell others what you think about the study.

However, what you tell us, and how you did on some Thinking Skills activities, is private. We only tell you and your parents how you did, but we don't tell anyone else.

When we talk to other people about the study, we never tell them your name, if you did the study, or how anyone did on the activities.

What Happens If You Do the Study?

- **PART ONE: Teacher Survey**

Your teacher will answer some questions about how the kids in your class act toward each other, including you. The teacher answers are private. We don't tell anyone the teachers' answers.

- **PART TWO: Student Thinking Skills/Problem-Solving Tasks**

We will ask you to do some thinking and problem-solving skills activities. It's your choice if you want to do them. We will do the activities with you here at your school. We will work with you a couple of times.

These activities will include: telling me what a word means, solving puzzles, playing some computer games, word and picture memory games, Simon Says, & trace some mazes. When we do the activities, we can take breaks or have a snack if you get tired. If you don't feel like doing the activities or want to stop, it's ok.

Why Might You want to Do The Study?

It would be great if you can help and take part in this research study. We want to better understand how kids act toward and feel about other kids. You can help your teachers and principal make your school a better place.

For your class, everybody who returns the parent form will have their names entered into a draw for a prize. Even if you and your parents don't want to do the study, please bring the form back. Everybody, even the people who say no, get to enter the draw for a prize.

Most kids find the thinking skills tasks to be fun. If you decide to do the study, after we are done, we will let you pick a small treat from a prize bucket, like a book or small toy. This is to say thank-you for your help.

Who Can I Talk to About the Study?

If you have questions, you can ask me, Ms. Kozey, your teacher, or your parents, who have my phone number and email.

INDIVIDUAL STUDENT ASSENT FORM
Thinking Skills & Children's Social Behavior

(formatting altered for dissertation binding)

Investigators: Laurie Ford, Shelley Hymel, and Michelle Kozey, University of British Columbia
(to be done with each student after parental consent has been received, but prior to Part A/B)

RESEARCH ASSISTANT:

1.A. In developmentally appropriate language, verbally explain and review each of the following aspects of informed assent with the potential participant.
1.B. Check off each item after it has been explained to the student.
1. C. Answer any questions that the potential participant may have.

☐ Who you are (researcher with UBC)
☐ What is a study and purpose of this study (to understand how kids act toward each other, and whether thinking skills are important to how kids act)
☐ Parental Consent (that their parents have said that it is ok, but it's ok for them to say no)
☐ Child Assent (that it is their choice, and nothing bad will happen if they say no)
☐ Study Child Requirements (communicate both teacher questionnaire and student tasks)
☐ Study Risks and Benefits (boredom/frustration, choice of prize at the end)
☐ Privacy / Confidentiality (all answers to be secret, don't use any names of children)
☐ Voluntary Participation (they can take breaks or stop at any time)

RESEARCH ASSISTANT:

2.A. Ask the below questions to evaluate if assent is truly informed and voluntary.
2.B. If the student provides an appropriate response (that indicates understanding of the related aspect of informed assent), tick the related box.
2.C. If the student does not provide a response that is appropriate, re-explain the related concept and then re-ask the question. If an appropriate response cannot be obtained for each question, assent is not informed. Make relevant notes, and confer with study coordinator before commencing any further study activities.

☐ Do you understand what a study is?
☐ Who gets to decide whether kids take part in the study?
☐ Does anything happen to the kids who say no to the study?
☐ For kids in the study, what are they asked to do?
☐ For kids in the study, what are some good and bad things that might happen when they do the study?
☐ What does it mean that your answers are "private"?
☐ If you take part, can you change your mind or stop at any time?

RESEARCH ASSISTANT & STUDENT

3. Ask student to make a checkmark in one of the two boxes. Tell them that we will ask them again later, whether they want to be in the study (in case they change their mind).

☐ **NO,** I do not want to be in the study

☐ **YES** - I want to be in the study.

☐ **YES** - my teacher can do the checklist

☐ **YES** - I want to do the Thinking Skills activities

Child's Name: _________________ Child's Mark for Name: ______________________

Date:_____________________________

Appendix D – Summary of Missing Data

Summary of Missing Data (10 data points across 4 variables)

Summary By Variable (n = 262)			
Dependent Variable	Missing Data		
	Number	Percent	Cases (Reason)
SB6 Verbal	0	0	
SB5 Non-Verbal	0	0	
BASC-2 Attention Problems	0	0	
Frog Memory Span	3	1.15%	ID008 (examiner error) ID617 (program crash) ID758 (program crash)
Happy-Sad	0	0	
DCCS-A	0	0	
Frog WM	1	0.38%	ID008 (examiner error)
WJ III Und Dir	0	0	
NEPSY Tower	0	0	
Hearts-Flowers	3		ID008 (examiner error) ID517 (program did not save data) ID767 (program did not save data)
Flanker Fish	3		ID517 (program did not save data) ID730 (program did not save data) ID761 (program did not save data)

Summary by Case			
Number of Missing Data Points Per Case	Number of Cases	Percent of Sample	Cases
0	255	97.33%	-
1	5	1.90%	ID617 ID730 IID758 D761 ID767
2	1	0.38%	ID517
3	1	0.38%	ID008

Appendix E

Thinking Skills and Children's Social Behavior: TEACHER SURVEY[15]

(FORMATTING ALTERED FOR DISSERTATION BINDING)

Investigators: Laurie Ford, Shelley Hymel, and Michelle Kozey, University of British Columbia

We would like to ask you about some ways that students act around other students. Please rate the student's behaviour to the best of your knowledge, and complete all items. Your answers are completely **confidential** and **private**, and **will not** be shared with the student or parents. Please be honest with your answers. If you have questions or need help, please contact Michelle Kozey at XXX-XXX-XXXX or XXX@XXX.

PART A	Never True	Rarely True	Some-times True	Often True	Almost Always True
Tells a peer that he or she won't play with that peer or be that peer's friend, unless he or she does what this child asks	1	2	3	4	5
Tells others not to play with or be a peer's friend	1	2	3	4	5
When mad at a peer, this child keeps that peer from being in the play group	1	2	3	4	5
Tells a peer that they won't be invited to their birthday party unless he or she does what the child wants	1	2	3	4	5
Tries to get others to dislike a peer	1	2	3	4	5
Verbally threatens to keep a peer out of the play group if the peer doesn't do what the child asks	1	2	3	4	5
Kicks or hits others	1	2	3	4	5
Verbally threatens to hit or beat up other children	1	2	3	4	5
Ruins other peer's things when he or she is upset	1	2	3	4	5
Pushes or shoves other children	1	2	3	4	5
Hurts other children by pinching them	1	2	3	4	5
Verbally threatens to physically harm a peer in order to get what they want	1	2	3	4	5

[15] Adapted with permission from Crick, Casas, & Mosher (1997); Hawley (2002); Ostrov & Crick (2007).

Is good at sharing and taking turns	1	2	3	4	5
Is helpful to peers	1	2	3	4	5
Is kind to peers	1	2	3	4	5
Says or does nice things for other kids	1	2	3	4	5

PART B	**Almost Never**	**Not Often**	**Somet imes**	**Often**	**Always/ Almost Always**
S/he usually gets the best roles in class activities	1	2	3	4	5
S/he gets what s/he wants in class	1	2	3	4	5
S/he usually gets attention from others	1	2	3	4	5
S/he usually gets what s/he wants, even if others don't	1	2	3	4	5
S/he usually gets attention from teachers	1	2	3	4	5
S/he make sure s/he gets what s/he wants	1	2	3	4	5

PART C	**Never/ Almost Never True**	**Not Often**	**Some-times**	**Often**	**Always/ Almost Always**
When this child is hurt by someone, s/he will often physically fight back.	1	2	3	4	5
If other children hurt this child, s/he often keeps them from being in their group of friends.	1	2	3	4	5
If other children make this child mad, s/he will often physically hurt them.	1	2	3	4	5
This child will often share with others, to get what s/he wants.	1	2	3	4	5
This child often keeps others from being in her/his group of friends to get what s/he wants.	1	2	3	4	5
This child often starts physical fights to get what s/he wants.	1	2	3	4	5
This child often threatens others physically to get what they want.	1	2	3	4	5
This child will often include others, after they have cooperated with her/him.	1	2	3	4	5
If other children anger this child, s/he will often hit, kick or punch them.	1	2	3	4	5
When s/he is angry at others, this child	1	2	3	4	5

will often tell them that s/he won't be their friend anymore.					
When s/he is upset with others, this child will often ignore or stop talking to them.	1	2	3	4	5
To get what this child wants, s/he often tells others that s/he won't be their friend anymore.	1	2	3	4	5
This child often hits, kicks, or punches to get what s/he wants.	1	2	3	4	5
To get what this child wants, s/he often will ignore or stop talking to others.	1	2	3	4	5
PART D - see attached sheet. Complete ONLY highlighted items.					

Thank you!

Appendix F – Parent Language Follow-up

Thinking Skills & Children's Social Behavior **A UBC Research Study** Information for Parents and Consent April 2012		
Principal Investigator:	Laurie Ford, Ph.D.	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
Co-Investigators:	Shelley Hymel, Ph.D.	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
	Michelle Kozey, Ph.D.Candidate	(Phone: (XXX) XXX-XXXX; Email: XXX@XXX
	University of British Columbia, Faculty of Education Department of Educational and Counseling Psychology & Special Education XXXX Main Mall, Vancouver, BC, XXX XXX	

Dear Parent(s),

You recently gave permission for your child ____ to take part in our research study "Thinking Skills and Children's Social Behavior." We have finished our study activities with your child. We will send you the summary of your child's results soon.

We would like to be better understand your child's results. We are asking all participating families to please tell us:

1. What was your child's **first** language? ____________________
2. What is the **main** language your child speaks? ____________________
3. What is the **main** language your family speaks **at home**? ________________
4. What **other** languages does your family speak **at home?** ______________

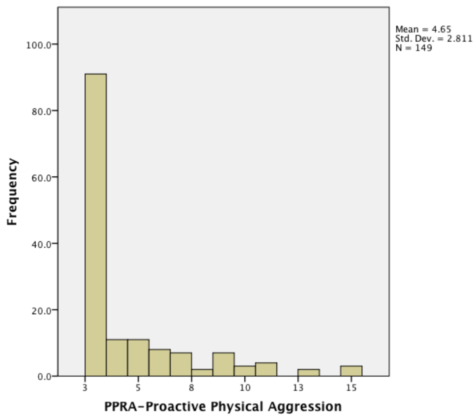
Please return to Your Child's Teacher at the School

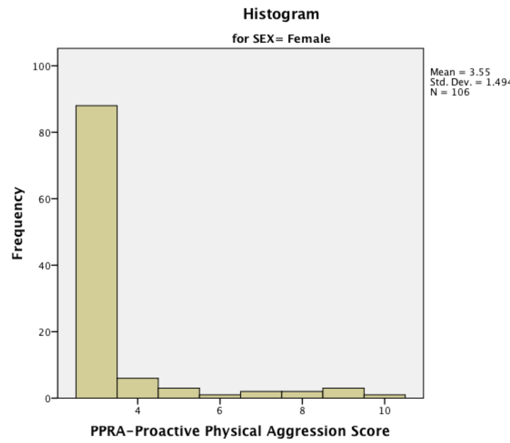
Thank-You

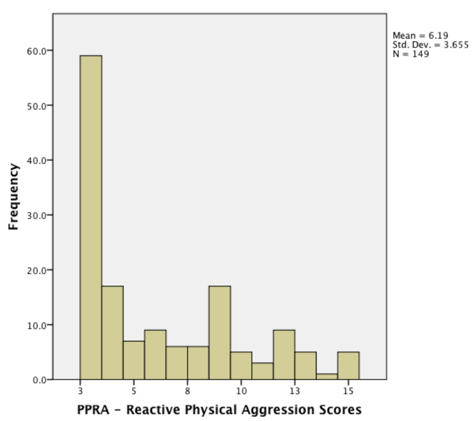
Laurie Ford　　Shelley Hymel　　Michelle Kozey

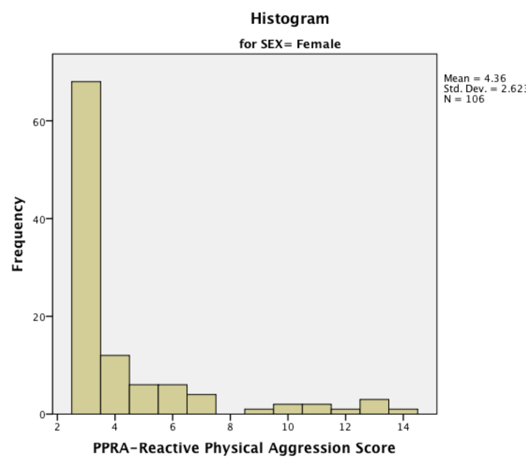
Appendix G

Histograms of Preschool Proactive Reactive Aggression Measures (Physical)



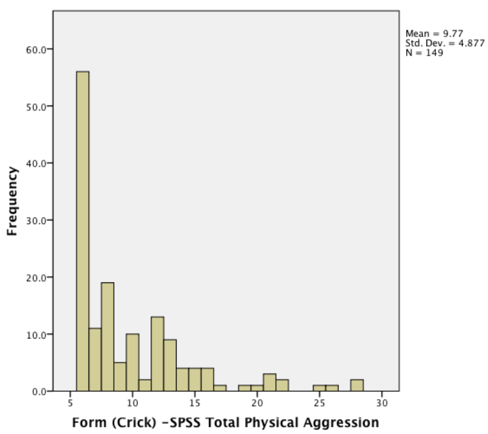


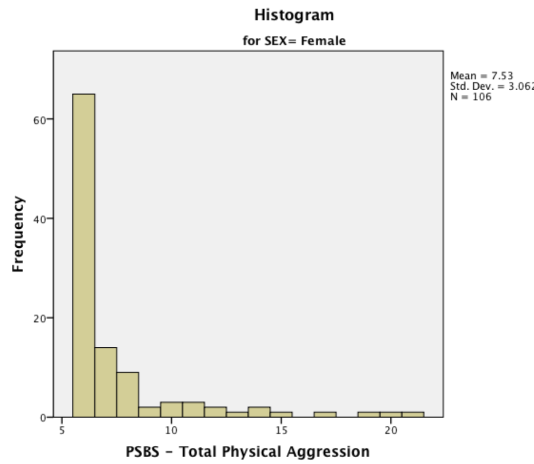




Appendix H

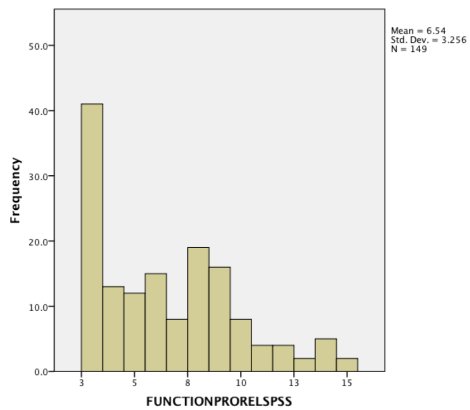
Histograms of Preschool Social Behaviour Scale - Physical

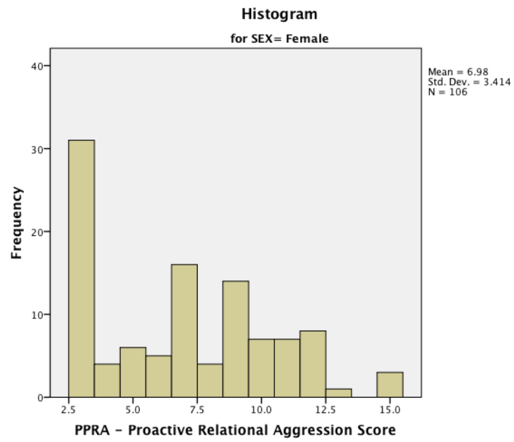


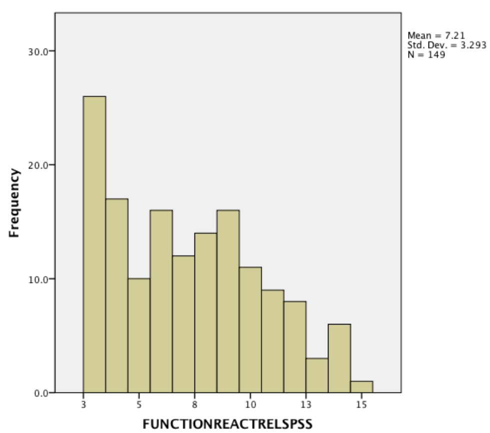


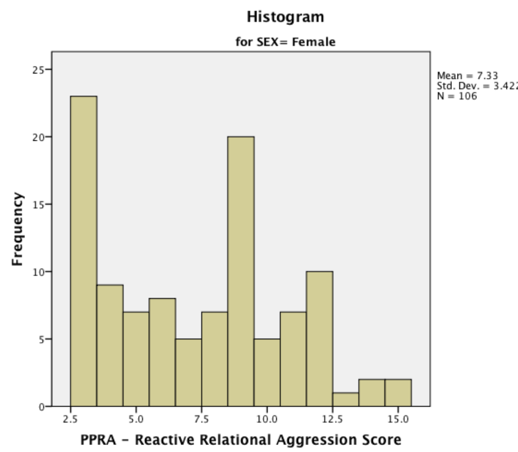
Appendix I -

Histograms of Preschool Proactive Reactive Aggression Measures (Relational)



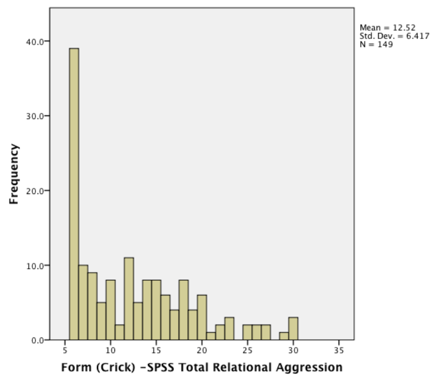


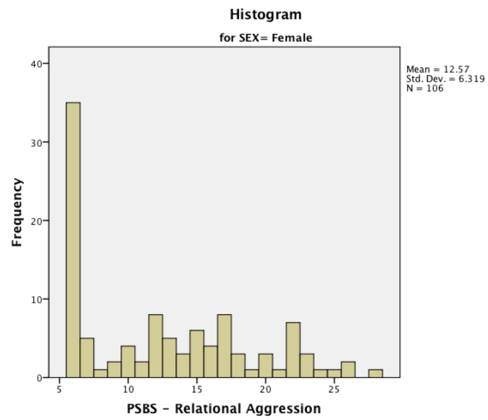




Appendix J -

Histograms of PSBS-Relational Aggression for Males and Females





Appendix K -

Histograms of BASC-AP Scores for Males and Females