INDIRECT AND PHYSICAL AGGRESSION IN CHILDHOOD AND
ADOLESCENCE AND OUTCOMES IN EMERGING ADULTHOOD

Indirect and Physical Aggression in Childhood and Adolescence
and Outcomes in Emerging Adulthood

By

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A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfillment of the Requirements

for the Degree

Doctorate of Philosophy

McMaster University

DOCTORATE OF PHILOSOPHY (2011)   McMaster University

(Health Research Methodology)   Hamilton, Ontario

TITLE: INDIRECT AND PHYSICAL AGGRESSION IN CHILDHOOD AND
ADOLESCENCE AND OUTCOMES IN EMERGING ADULTHOOD

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NUMBER OF PAGES: xi, 173

ABSTRACT

This dissertation examined several dimensions of the development of physical aggression and indirect aggression in a longitudinal sample of boys and girls. These data are part of the National Longitudinal Study of Children and Youth which evaluated the development of children bi-annually from 1994 to 2010. The data for this thesis come from individuals aged 10 and 11 in Cycle 1 (1994) through to Cycle 5 (2002) when they were 18 and 19. In an attempt to explore trends in the development of aggression, the research is presented as three separate projects that examine the following: (1) measurement of physical and indirect aggression by informant and sex; (2) group-based trajectories of physical and indirect aggression and outcomes of trajectories in emerging adulthood; and (3) association between indirect aggression in adolescence and depression in emerging adulthood when physical aggression is taken into account. This is the first longitudinal study to investigate group-based physical and indirect aggression trajectories in childhood and adolescence and outcomes in emerging adulthood. The contribution of this thesis to the field of epidemiological research on aggression is the importance of considering distinct subgroups within both physical and indirect aggression, and joint trajectory groups of both physical and indirect aggression when exploring developmental trends and outcomes of aggression.

Keywords: Indirect Aggression, Physical Aggression, Adjustment, Trajectories, Development, Longitudinal, Structural Equation Modelling, Measurement Invariance, Group-Based Trajectory Modelling

PREFACE

This thesis consists of studies that were prepared in collaboration with all three members of the thesis committee. Committee members contributed their disciplinary and analytical expertise to the development of the three research questions that defined each Project, reviewing and providing feedback on the study designs, and editing the manuscripts. For Projects 1 and 2, individuals not on the PhD candidates committee provided expertise when the specific theoretical or statistical expertise fell outside that of the committee. For the manuscript in Chapter 3 (Project 1), Dr. Jesse Miller provided both analytical (Structural Equation Modelling) and theoretical (aggression) support to the PhD candidate. The manuscript in Chapter 4 (Project 2), Dr. Tracy Vaillancourt, provided theoretical support for the paper. Dr. Vaillancourt is an expert in aggression and was consulted at the committee's suggestion. The PhD candidate is the primary author of the manuscript in Chapter 5 (Project 3). The author of this dissertation was the primary contributor to all three projects, including developing the objectives and goals, completing the data analysis, and manuscript preparation and revisions. As such, the work contained in this thesis meets the requirements for inclusion in the main text of this thesis.

Projects 1, 2 and 3 are based on secondary data analysis of the National Longitudinal Study Children and Youth (NLSCY), which collected data bi-annually beginning in 1994 (Cycle 1). Project 1 used data from Cycle 3 (1998) and Projects 2 and 3 used data from Cycles 1, 2, 3, and 5 (1994, 1996, 1998, 2002).

For David Stewart Arthur Cleverley. Always in our hearts.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my brother David Stewart Arthur Cleverley for showing me that mental illness comes in all shapes and sizes and that there is a need to shed light on this, through advocacy, clinical practice, sharing stories, and research. Your spirit gave me the push I needed to complete this dissertation – I wish you were here to share it with me. You are no longer Chasing the Ghost. I will never forget you, Superman.

I am eternally grateful to a number of mentors and faculty members over the years. First off, I would like to thank my supervisor and mentor Dr. Peter Szatmari. Your enthusiam for research and clinical practice inspired me greatly. Thank you for encouraging me to take risks and providing me with the guidance to do so. To my committee members, Dr. Ellen Lipman and Dr. Michael Boyle, thank you for taking the time to provide me with the guidance and support that I needed during this process. To my comprehensive exams supervisor, Dr. Kathy Bennett, our Thelma and Louise road trip to Seattle for SRDC 2009 was unforgettable. I look forward to future collaborations. I would also like to make note of my appreciation for Dr. Tracy Vaillancourt for providing me with the inspiration to broaden my interest in conduct disorder to study indirect and physical aggression. Prof. Dyanne Semogas thank you for initially pushing me to pursue graduate school and providing me with the positive energy and the mentoring to do so. I will be always thankful for your support and guidance early in my nursing and teaching career. Eric Duku thank you for always answering my longwinded and rambling emails,

providing me with the support needed to take on analysis my instinct was to run from, and for always listening and reassuring me.

To my best friend and fiance, Tim Fricker, thank you for your constant love, support, and encouragement. I look forward to what our future together brings.To my parents, Don and Lori Cleverley, who truly instilled in me an appreciation for knowledge and a spirit of intellectual curiosity. You were both there for me in very stressful times and I would not have made it through without you. To my sisters, Megan and Anna, and brother-in-law Dave, I did it. I wouldn't have been able to get through it without you all. I am lucky that my siblings are my best friends. To my neice Carys and nephew Ryder, visiting you both during my PhD instantly took away my stress and worries. Carys you are wise beyond your years and have remained brave and joyful despite experiencing so much loss; you are an inspritation to your Aunt. To my Fricker and Atkins in-law families, all of your support these past few years have been instrumental in my ability to complete this thesis – I am eternally grateful for all of your love.

To my colleagues Dr. Jesse Miller, Dr. Khrista Boylan, Dr. Ryan Van Lieshout, Dr. Jennifer Boyko, Dr. Catherine Kreatsoulas, Dr. Amy Montour, and Dr. Joanna Jacob, there are no words to express my appreciation for your support during my PhD. I look forward to watching where your careers will take you and collaborating with you all along the way. Seana Jackson thank you for the numerous tea dates at my moving office (Starbucks). Thank you to the numerous friends: Cara, Terry, Danielle, Carrie, Claire, Joyce, Phyllis, Geoff and Tawnya, and Meaghan who supported and encouraged me

throughout the dissertation process. To my friend Katie Dupius, thank you for taking the time to carefuly go through my entire thesis with me; you're an editing genius.

Past, current, and future nursing students and patients – it is through you that I seek to be a better researcher, educator, nurse, listener and mentor.

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CHAPTER ONE

BACKGROUND AND GENERAL INTRODUCTION

In the past two decades, knowledge about the developmental trajectories of aggressive and anti-social behaviour has grown rapidly, due largely to data collected from longitudinal studies, improved analytical techniques and concern for the impact of aggressive individuals on society. However, some of this research has serious limitations, and several areas remain unexplored. This review will outline the current state of the literature on aggression research, highlighting limitations and opportunities for future research.

Before reviewing the literature, it is useful to note the differences in terminology used to describe anti-social behaviour. In general, although referring to somewhat different phenomena, many facets of anti-social behaviour (e.g. conduct disorder, aggression and delinquency) tend to coexist and are inter-correlated (Farrington, 2004), but different terminologies tend to be employed by various fields of study (Farrington, 2004). For instance, developmental psychology will use the term 'aggression,' whereas psychiatry tends to employ 'conduct disorder,' and sociology uses 'delinquency.' This dissertation will focus on research related to developmental trajectories of aggression, and in this review, the term 'aggression' will be used and is intended to refer to 'a behaviour that is aimed at harming or injuring another person or persons' (Dodge, Coie, & Lynam, 2006; Parke & Slaby, 1983).

Aggressive Behaviour

The long-standing devotion to theoretical and clinical aggression research is due to the serious negative short- and long-term outcomes associated with it and its frequent co-morbidity with other psychiatric problems (Campbell, Spieker, Burchinal, Poe, & The NICHD Early Child Care Research Network, 2006; Campbell et al., 2010; Card, Stucky, Sawalani, & Little, 2008; Coie & Dodge, 1998). Recently, researchers (Gendreau & Archer, 2005; Tremblay, 2000; Tremblay & Cote, 2005; Tremblay, 2010) have posited that in order to better understand the developmental origins, trajectories, prevention and treatment of aggression, researchers and clinicians need to disaggregate aggressive behaviours based on type and/or expression (for example, physical aggression (PA) and indirect aggression (IA)). Although subtyping aggressive behaviour is a fairly new research focus, the notion that definitions of aggression are too broad is not (Bandura, 1973; Cairns, Cairns, Neckerman, Ferguson, & Gariépy, 1989b).

Research on the distinctiveness of PA and IA as aggressive subtypes has been supported by both factor-analytic studies of aggression and the moderate correlations found between the two aggression subtypes (Bjorkqvist, Osterman, & Kaukiainen, 1992; Card et al., 2008; Crick & Grotpeter, 1995; Crick, Casas, & Mosher, 1997; Kaukiainen et al., 1999; Underwood, Beron, & Rosen, 2009; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003). PA refers to a set of overt behaviours that are aimed at harming or injuring another person, like hitting or attacking someone and getting into fights (Dodge et al., 2006; Lagerspetz, Bjorkqvist, & Peltonen, 1988). IA describes a set of covert behaviours that are socially manipulative, like rumour spreading, talking behind

someone's back and encouraging others to dislike someone else (Bjorkqvist, 1994; Crick & Grotpeter, 1995; Lagerspetz et al., 1988; Macgowan, Nash, & Fraser, 2002). In the literature, IA is also referred to as 'social aggression' (e.g. (Galen & Underwood, 1997) and 'relational aggression' (e.g. (Crick & Grotpeter, 1995); however, researchers contend that all three terms refer to the same phenomenon (Archer & Coyne, 2005; Bjorkqvist, 2001). For the purposes of this dissertation, and to reduce confusion between these related constructs, the term 'indirect aggression' will be used.

Developmental Course of Physical Aggression

The last 40 years of research have helped to define the developmental trajectories, precursors and outcomes of PA (Herrenkohl, Catalano, Hemphill, & Toumbourou, 2009; Tremblay, 2000). This research has demonstrated that the prevalence of physical aggression varies across developmental periods. PA emerges early in life and is quite common during the toddler years (Côté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; NICHD Early Child Care Research Network, 2004; Tremblay, 2000; Tremblay, 2004). It has been shown to gradually decrease during preschool and elementary school years (Broidy et al., 2003; Côté, Vaillancourt, Barker, Nagin, & Tremblay, 2007; Côté et al., 2006; Nagin & Tremblay, 1999; Shaw, Gilliom, Ingoldsby, & Nagin, 2003), except for a small group who remain physically aggressive through adolescence and into young adulthood (Bongers, Koot, Van Der Ende, & Verhulst, 2004; Brame, Nagin, & Tremblay, 2001; Broidy et al., 2003; Côté et al., 2007; Côté et al., 2006; Maughan, Pickles, Rowe, Costello, & Angold, 2000; Nagin & Tremblay, 1999; Tremblay, 2010; Underwood et al.,

2009). Sex differences in the development of PA have found that almost twice the number of boys than girls display this behaviour during preschool and childhood and that boys are more likely to employ harsher forms of aggression (e.g. hitting) (Archer & Côté, 2005; A. Campbell, 1999; Hay, Castle, & Davies, 2000; Salmivalli & Kaukiainen, 2004), but these male-female differences begin to disappear in late adolescence (Archer, 2004; Bongers et al., 2004).

Recent research using semi-parametric-group-based-trajectory-modelling methods (SPGBMM; see (Nagin, 2005)) has highlighted the apparent heterogeneity in the development of physically aggressive behaviours over childhood and adolescence. When modelled using parent or teacher ratings in children and adolescents, three or four patterns are typically found. Most longitudinal studies have identified a large group of children that either never use PA (53-64%) or rarely use PA across childhood and adolescence (28-76.9%), a smaller group that follows a moderate-declining trajectory of physical aggression (15.5-53%), and an even smaller group with a high, stable trajectory of physical aggression (6.4-19%) (See Table 1)(e.g., (Barker, Tremblay, Nagin, Vitaro, & Lacourse, 2006; Bongers et al., 2004; Brame et al., 2001; Broidy et al., 2003; Campbell et al., 2006; S. B. Campbell et al., 2010; Cote, Vaillancourt, LeBlance, Nagin, & Tremblay, 2006; Côté et al., 2007; Maughan et al., 2000; Nagin & Tremblay, 1999; Nagin & Odgers, 2010; Underwood et al., 2009). Differences in the range of group sizes is likely due to differences in methodology employed in the studies (e.g. sampling, measurement and modelling), informant (e.g. teacher, parent) and whether sex-specific rates are reported.

Developmental Course of Indirect Aggression

Less is known about the development of indirect aggression (IA) (Bjorkqvist, 1994; Lagerspetz et al., 1988). Early research on IA was conducted using cross-sectional designs (Bjorkqvist et al., 1992; Bjorkqvist, Lagerspetz, & Kaukiainen, 1992), and it was not until more recently that longitudinal studies were conducted. Cross-sectional studies have reported that older children use IA more than younger children (Bjorkqvist et al., 1992; Bjorkqvist et al., 1992; Cairns, Cairns, Neckerman, Ferguson, & Gariépy, 1989b; Osterman et al., 1998) and longitudinal studies of the stability of IA have shown that, on average, its use increases with age in childhood and into adolescence (Cairns, Cairns, Neckerman, Ferguson, & Gariépy, 1989b; Côté et al., 2007; Underwood et al., 2009; Vaillancourt, Miller, Fagbemi, Côté, & Tremblay, 2007). With a view of understanding whether groups or clusters of children change similarly over time (Nagin, 2005), group-based trajectory studies have been employed. These studies suggest that IA starts in early childhood and that most (55-68% of children) continue to use low levels of indirect aggression while others, depending on the final age studied, exhibit high-increasing levels (32-35%) in later childhood and high-declining levels in early adolescence (45%) (See Table 1)(Côté et al., 2007; Underwood et al., 2009; Vaillancourt et al., 2007).

There have been inconsistencies in reports of sex differences in the development of IA, with some studies finding more girls than boys exhibiting high IA behaviours (Bjorkqvist et al., 1992; Crick & Grotpeter, 1995; Crick et al., 1997; Lagerspetz et al., 1988; Osterman et al., 1998; Salmivalli, Kaukiainen, & Lagerspetz, 2000) while others report no sex differences (Coyne, Archer, & Eslea, 2006; Galen & Underwood, 1997;

Osterman et al., 1998). Variations in the size and direction of sex differences may be partly due to differences in age, method of measurement, informant and sample included in the studies (Archer & Côté, 2005; Archer & Coyne, 2005). Recent group-based trajectory approaches to analyzing clusters of IA groups have found that children of both sexes use low levels of IA, however more girls are in the high or increasing indirectly aggressive groups compared to boys (Côté et al., 2007; Salmivalli & Kaukiainen, 2004; Vaillancourt et al., 2007).

Physical and Indirect Aggression: Empirical Findings

Support for the distinctiveness of PA and IA as subtypes of aggression has come from both correlation analysis and confirmatory factor-analytic (CFA) studies. For example, several studies of children have reported moderately strong correlations for physical and indirect aggression for both boys and girls (Crick et al., 1997; Côté et al., 2007; Kaukiainen et al., 1999; Underwood et al., 2009; Vaillancourt et al., 2007). Crick and colleagues (1997) found high correlations for both preschool boys ($r = .76$) and girls ($r = .73$) based on teacher-reported aggression. Using longitudinal data, Côté and colleagues (2007) reported that the strength of the correlation between PA and IA increased with age (age 4, $r = .27$; age 6, $r = .34$, and at age 8, $r = .42$). Until recently (Miller, Vaillancourt, & Boyle, 2009; Vaillancourt et al., 2003) most CFA studies supporting the distinctiveness of PA and IA have been cross-sectional (Bjorkqvist et al., 1992; Crick & Grotpeter, 1995; Crick et al., 1997; Kaukiainen et al., 1999) and as such, several methodological

limitations need to be addressed. These include studying wider age ranges and evaluating the invariance of the 2-factor model by sex and informant.

Physical and Indirect Aggression: Theoretical Perspectives

One influential theory on the joint development of physical and indirect aggression is from the work of Bjorkqvist and colleagues, who propose that the best model of aggression is one that incorporates type (e.g. physical, indirect) and developmental phase (Bjorkqvist et al., 1992; Bjorkqvist et al., 1992; Bjorkqvist, 1994; Lagerspetz et al., 1988). According to Bjorkqvist and colleagues (Bjorkqvist et al., 1992; Bjorkqvist et al., 1992; Bjorkqvist, 1994; Lagerspetz et al., 1988), physical aggression in early childhood is common, but as children mature and develop more advanced language and social-cognitive skills, the type of aggression changes to a more indirect form. This is an example of heterotypic continuity, where the nature of aggression changes in early adolescence (Bjorkqvist et al., 1992; Bjorkqvist et al., 1992; Bjorkqvist, 1994; Lagerspetz et al., 1988). Recent studies have found support for Bjorkqvist and colleagues' developmental hypothesis, noting that physical aggression is relatively common in preschool years but decreases throughout elementary school (Broidy et al., 2003; Cote et al., 2006; Tremblay, 2004). Indirect aggression, on the other hand, increases from early to middle childhood and into adolescence (Cairns, Cairns, Neckerman, Ferguson, & Gariépy, 1989a; Côté et al., 2007; Vaillancourt et al., 2007).

Evidence supporting this developmental theory of aggression has been criticized because (i) of the small number of longitudinal studies and (ii) the failure to study PA and

IA together, limiting our knowledge about their common variance and its effect on changes in both types of aggression over time (Côté et al., 2007; Miller et al., 2009; Underwood et al., 2009; Vaillancourt et al., 2003). These limitations led Heilbron and Prinstein (2008) to conclude that more research is required to support the developmental model posited by Bjorkqvist and colleagues (Heilbron & Prinstein, 2008).

Longitudinal studies that employ both person-centred and variable-centred analytical methods (Laursen & Hoff, 2006) are likely to provide a more comprehensive picture of the joint development of PA and IA. Commonly-used analytical methods such as regression, factor analysis and structural equation modelling take a variable-centred approach to analysis (Laursen & Hoff, 2006; Muthen & Muthen, 2000). This approach assumes that patterns of trajectory growth are experienced similarly by the entire sample and that the predictors operate on the outcomes in the same way (Laursen & Hoff, 2006). The goal of variable-centred analysis is to model the trajectories of a response variable and to identify variables that are associated with between-subject differences in the trajectories of response. As a complementary analytical approach, person-centred analysis is based on the assumption that different groups of individuals carry different patterns (or clusters) of change and long-term outcomes (Muthen & Muthen, 2000). The goals of these analyses are to identify or verify meaningful clusters or groups of individuals who share similar trajectories of responses (Laursen & Hoff, 2006). Analytical methods such as cluster analysis and group-based trajectory modelling are examples of person-centred analysis. Both analytical approaches are important to understanding patterns of development. Understanding the joint development of PA and IA will require both

approaches: (i) person-centred methods to determine whether certain groups of individuals are likely to be following high trajectories of IA, PA and joint IA/PA and link these groups to outcomes, and (ii) variable-centred methods to understand the effect of the co-variation of PA and IA on an outcome and determine whether the measurement models confirm a 2-factor model of aggression.

Longitudinal Development of Indirect and Physical Aggression

Researchers are now beginning to explore the joint development of PA and IA longitudinally. To date, only four published studies have explored the concurrent longitudinal development of these two forms of aggression. Using a variable-centred approach, two studies examined the stability and structural invariance between PA and IA using confirmatory factor analysis (Miller et al., 2009; Vaillancourt et al., 2003). Two other studies have examined the joint trajectories of PA and IA (Côté et al., 2007; Underwood et al., 2009) using a person-centred approach.

Vaillancourt and colleagues (2003) used confirmatory factor analysis to study the structural invariance of physical and indirect aggression across three different measurement occasions in the National Longitudinal Study of Children and Youth (NLSCY) on a sample of 3089 children aged 6 to 11 years. They found that a two-factor model of aggression was invariant across time, sex and cohorts. They reported no cross-lagged effects between PA and IA, meaning that children did not switch between types of aggression during the study period (e.g.., PA symptoms at Time 1 to IA symptoms at Time 2). This study failed to support Bjorkqvist's developmental theory of aggression,

but it should be considered that the ages of the children sampled may have been too young to detect a change in type of aggression, the developmental period studied may not have been long enough, or that they utilized maternal reports only (Vaillancourt et al., 2003). Miller, Vaillancourt and Boyle (2009) sought to replicate and extend their earlier findings, this time using teacher reports and a slightly older age group (6 to 13 years). They also confirmed a two-factor model of PA and IA that was stable over time but not sex. Results showed that cross-lagged effects (the impact of IA on PA and vice versa) varied by sex, where PA at Time 1 predicted IA in girls at Time 2 and IA in both girls and boys at Time 3. Furthermore, IA at Time 1 predicted decreased PA at Time 2 for boys and Time 3 for boys and girls. This analysis found heterotypic continuity of aggression and supports Bjorkqvist's theory of development.

Both studies (Miller et al., 2009; Vaillancourt et al., 2003) used a variable-centred approach to determine the measurement structures of PA and IA and the predictive links between aggression types. The main purpose of these two variable-centred studies was not to describe how children change in terms of forms of aggression over time, but rather to understand the stability of PA and IA and establish an invariant measurement structure of both types of aggression. A complimentary analytical method, person-centred analyses, focuses on the change in PA and IA trajectories over time. Recently, two studies have focused on describing the developmental trajectories of PA and IA using a person-centred analytical approach, specifically semi-parametric-group-based-trajectory-modelling-methods (SPGBMM) (Côté et al., 2007; Underwood et al., 2009).

Côté and colleagues (2007) used the database (NLSCY), items, and subsequent two-factor structure developed by Vaillancourt and colleagues (2003) to examine the joint development of trajectories of physical and indirect aggression in 1183 children aged 2 to 8 years using maternal reports. Using SPGBMM, the authors found that most children followed low or declining trajectories of PA and low trajectories of indirect aggression. When joint trajectories were developed, the group memberships indicated that most children (62.1%) exhibited declining levels of both PA and IA. However, there was a large group (14.2%) that simultaneously followed a trajectory of moderately declining PA and rising IA, providing some support for Bjorkvist et al's developmental hypothesis (1994). In the Côté study, there was no difference in the proportion of boys and girls in the high IA/ high PA trajectory group or the low IA/ low PA trajectory group; however, girls were significantly more likely to be in the high IA/ declining PA group, again supporting Bjorkqvist's hypothesis.

Underwood and colleagues (2009) followed a sample annually from 9 to13 years (n=281), from one school district in the United States, to determine the trajectories of PA and IA. Using teacher reports, they found that mean overall levels of PA and IA decreased over time. Specifically, using SPGBMM they reported two distinct trajectory groups within IA (stable-low; high-declining) and three distinct trajectory groups within PA (stable-low; high-declining; high-stable). The authors then extended their analysis to look at joint trajectories over this age group and reported that in the six joint trajectory groups, PA and IA developed similarly over time where increases in PA were

accompanied by increases in IA and vice versa. These findings do not support Bjorkqvist and colleagues' (1994) developmental theory of aggression.

Although all four of these studies have increased our understanding of the development of PA and IA, knowledge gaps remain. In particular, there are insufficient studies on the longitudinal development of IA across developmental periods, which is important to fully understanding the joint development of PA and IA. Neither of the longitudinal group-based studies of PA and IA used youth as informants. Youth self-report is important for understanding the prevalence of aggressive behaviour, particularly of IA behaviours which can often go unnoticed by teachers and parents. Finally, none of these studies have sought to understand the effect of joint trajectories of PA and/or IA on maladjustment, an important aspect of validating that group-based trajectories are meaningful and useful. This seems to be a logical next step as researchers have individually linked PA and IA cross-sectionally and longitudinally to outcomes and shown that they are important predictors of maladjustment.

Outcomes of Physical Aggression

Although it is well known that childhood aggressive behaviour is one of the best predictors of adolescent and adult criminality (Farrington, 1991; Hawkins et al., 1998; Herrenkohl et al., 2009; Huesmann, Eron, Lefkowitz, & Walder, 1984; Lipsey & Derzon, 1998; Tolan & Gorman-Smith, 1998), it was only recently that researchers have begun to study the outcomes of subgroups of individuals with physical aggression. Several outcomes of different PA trajectories have been explored in detail. In a study of group-

based trajectories of PA in 2-to-9 year olds, Campbell and colleagues (2006) reported that

those in the high-stable and moderate-stable PA trajectories showed poor adjustment,

including externalizing problems, poor social skills and inattention, at age 12. Fite and

colleagues recently (2010) examined 10-year outcomes of proactive and reactive

aggression (sub-constructs of PA) in a group of adolescent males. They found that

reactive aggression was associated with anxiety in adulthood but proactive aggression

was associated with psychopathy and antisocial behaviour (Fite, Raine, Stouthamer-

Loeber, Loeber, & Pardini, 2010). However, both were associated with later substance

use.

Nagin and Tremblay (1999) reported that in a high-risk sample of boys assessed at

age 6, and then annually from ages 10-15, chronic physical aggression trajectories in

childhood were a risk factor for serious delinquency, theft and physical violence at age

17, particularly compared to those children in a low physical aggression trajectory.

Likewise, Campbell and colleagues (2006, 2008) recently reported the results of a

longitudinal study of children aged 24 months to grade 6 using parent-reported (2006)

and teacher-reported (2008) measures of PA and found that in grade 6, children following

high levels of persistent aggression had the poorest adjustment compared to other

trajectory groups in a number of areas including externalizing behaviour, social skills,

school performance, ADHD and ODD symptoms, and quality friendships. Broidy and

colleagues (2003) used Nagin and Tremblay's (1999) findings and results from 4 other

studies to examine the link between groups displaying PA in childhood and later

delinquency. These authors found that for boys there is a clear link between childhood PA

and later non-violent and violent delinquency. However, the link for females is not as clear, as no consistent relationship between childhood PA and adolescent delinquency was observed. The authors pointed out that although this finding may be related to the low reporting of delinquency behaviours in females, it does not negate the need to include females in a study of the development of aggression. This is especially important since PA trajectories in childhood may predict outcomes other than delinquency in females later in life (Broidy et al., 2003).

The studies reviewed here imply that PA trajectories have important implications for later functioning and adjustment. A limitation of the work to-date is the lack of studies that follow groups of physically aggressive children into adolescence with a view of determining whether highly aggressive trajectories predict maladjustment in the transition to an important life stage - emerging adulthood (Arnett, 2000; Arnett, 2004). As well, there is a need to understand the outcomes of developmental group-based trajectories for both boys and girls as most of the research has focused almost exclusively on boys.

Outcomes of Indirect Aggression

There have been few published longitudinal studies on the association between IA and adjustment in childhood, adolescence, and adulthood (see Heilbron and Prinstein, 2008). Research to date has shown that indirect aggression is associated with both positive and negative adjustment in childhood and adolescence, particularly as it relates to peer relationships and popularity.

Among the negative outcomes, indirectly aggressive behaviour is associated with an increased risk of peer rejection and decreased peer acceptance, lower perceived popularity, fewer friends, and an increase in relationally aggressive peer relationships in both cross-sectional (Prinstein & Cillessen, 2003; Werner & Crick, 2004) and longitudinal studies (Cillessen & Borch, 2006; Crick, 1996; Johnson & Foster, 2005; Rose, Swenson, & Waller, 2004). Crick (1996) completed a prospective study of third, fourth, fifth and sixth graders and showed that IA significantly predicted peer rejection 6 months later. Indirectly aggressive behaviour has also been associated with psychopathology - in particular, increased levels of symptoms of borderline personality disorder, increased internalizing symptoms (e.g., anxious-depressive symptoms) and attention deficit/hyperactivity disorder in cross-sectional (Sebanc, 2003; Zalecki & Hinshaw, 2004) and longitudinal (Crick, Ostrov, & Werner, 2006; Murray-Close, Ostrov, & Crick, 2007) studies (for review see Heilbron & Pristein, 2008). For example, Murray-Close and colleagues (2007) found that, for both boys and girls, increases in children's relational aggression trajectories were associated with increases in internalizing (anxiety and depression) problems over a one-year period.

More recently, researchers have highlighted the need to understand whether a subset of indirectly aggressive individuals might actually be well-adjusted and that perhaps indirect aggression may be adaptive in some circumstances (Hawley & Vaughn, 2003; Hawley, 2003; Salmivalli & Kaukiainen, 2004; Sandstrom & Cillessen, 2010). This group of children appears to use coercive interpersonal skills effectively to gain popularity and control of a group (Hawley, 2003). Vaillancourt and Hymel (2006) found

that high IA was connected to higher perceived popularity (Vaillancourt & Hymel, 2006).

As well, use of IA has been linked to increased social (emotional) intelligence among

schoolchildren (Kaukiainen et al., 1999). Social intelligence is the ability to analyze the

social behaviour of others and modify one's behaviour in response, with the goal of

achieving desired social outcomes (Bjorkqvist & Osterman, 2000). This has led

researchers to posit that IA in childhood and adolescence is associated with both

adjustment and maladjustment (Smith, 2007; Vaughn & Santos, 2007). For example, one

study called IA in high school a 'double edged sword,' particularly for females because

high levels of IA was associated with lower levels of depressive symptoms but higher

levels of workplace victimization in emerging adulthood (Sandstrom & Cillessen, 2010).

Unlike PA research, a serious limitation of IA studies is that no longitudinal

studies to date have determined whether a trajectory of high IA is predictive of negative

and/or positive adjustment in emerging adulthood, particularly in comparison to those

with low indirect aggression. Another limitation to date is whether sex moderates the

relationship between IA trajectories and outcomes.

Outcomes Associated with Joint Trajectories of Physical and Indirect Aggression

Although there have been advances in our understanding of the developmental

consequences of physical aggression and indirect aggression on adjustment separately,

there have only been two short-term (1-2 year) prospective studies that have sought to

examine the effect of PA and IA concurrently on adjustment in childhood and

adolescence. Crick, Ostrov, and Werner (2006) reported that grade 3 students with peer-

nominated comorbid PA and IA symptomatology was the strongest predictor of poor

concurrent and future (one year later) social-psychological adjustment, including

depression/anxiety, somatic complaints and delinquency and aggression, compared to

those with only IA, PA or no aggression. Another short-term (2 year) longitudinal study

(Herrenkohl et al., 2009) examined the adjustment of a sample of seventh and ninth

graders and reported that the risk for continued aggression was the greatest for those with

comorbid PA and IA in year 1. These results also demonstrated that those with comorbid

PA and IA in year 1 were more likely to be binge drinkers at year 3, though those with IA

only were also likely to be binge drinkers, suggesting that IA may be an important

indicator for later maladjustment. These two combined PA and IA outcome studies

illustrate the importance of incorporating both forms of aggression when examining the

effect of the behaviours on adjustment and studying outcomes beyond just further

aggression and/or delinquency; however, given the evidence supporting the

distinctiveness of PA and IA behaviours, each with potentially different developmental

pathways, there is a serious gap in research on the outcomes of the joint developmental

trajectories of PA and IA.

Understanding the developmental relationships between behaviour (e.g. conduct

disorder, delinquency, aggressive behaviours) and emotional problems (e.g. depression

and anxiety) has been a major focus of research (Burke, Loeber, Lahey, & Rathouz, 2005;

Paquette Boots, Wareham, & Weir, 2011), particularly as it relates to the presence of one

disorder in childhood predicting another in adolescence. This can indicate an increased

risk for other disorders, a process often referred to as heterotypic continuity (Costello,

Mustillo, Erkanli, Keeler, & Angold, 2003). For example, evidence suggests that conduct disorders in childhood predict depression in adulthood, but not the other way around (Burke et al., 2005; Harrington, Fudge, Rutter, Pickles, & Hill, 1991; Harrington, Rutter, & Fombonne, 1996; Lahey, Loeber, Burke, Rathouz, & McBurnett, 2002). It is likely that conduct disorder and depression models of heterotypic continuity vary by sex (Paquette Boots et al., 2011). A review by Boylan and colleagues (2007) found a significant association across developmental periods between oppositional defiant disorder (a behavioural disorder that includes some symptoms of aggression) and depression. These authors encouraged more research on understanding the sequential comorbidity of behavioural disorders in childhood and subsequent emotional disorders (Boylan, Vaillancourt, Boyle, & Szatmari, 2007).

The Failure Model is a developmental theory of conduct problems and depression developed by Capaldi and Patterson to guide such research (Capaldi, 1992; Capaldi & Stoolmiller, 1999; Patterson & Capaldi, 1990). This model posits that delinquent behaviours (which include physical/overt aggression) elicit negative reactions from their environment, including peer rejection, difficult parental relationships and academic difficulties. These negative reactions disrupt the normal socialization process and ultimately lead to depressed mood. While the Failure Model was not developed specifically for understanding the relationship between PA, IA and emotional problems, it does provide a preliminary framework for the possible associations between such behaviours.

Summary of Gaps in Current Literature

In summary, we know several important things about PA and IA: (1) PA and IA are related yet distinct developmental constructs; (2) there is heterogeneity in the development of PA and IA behaviours throughout childhood and adolescence, (3) longitudinal studies indicate that high PA is linked to maladjustment using both person- and variable-centred analysis, and (4) some research suggests that IA may be linked over time to both superior adjustment and maladjustment (using variable-centred analysis). However, gaps remain in the literature, including: (1) a need to confirm the two-factor aggression model using youth self-report data to determine whether the model is invariant by sex and informant; (2) a need for IA longitudinal studies that span more than one developmental period to understand how IA changes developmentally and how these trajectories are associated with outcomes in emerging adulthood; (3) studies that simultaneously describe PA and IA group-based trajectories over multiple developmental periods and beyond late childhood; (4) research to determine whether membership in PA and IA joint trajectory groups predict diverse outcomes in emerging adulthood; and (5) studies that examine the effects of PA and IA on outcomes using a like analytical model, given the documented correlation between the aggression types and outcomes. It is the goal of this thesis and its projects to provide evidence on each of these knowledge and methodological gaps.

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Table 1. Overview of Physical and Indirect Aggression Longitudinal Studies using Group-Based Trajectory Modelling

Physical Aggression Longitudinal Studies					
Authors	**Sample**[1]	**Assessments**	**Assessment/ Instruments**[2]	**Trajectories (% of sample)**[3]	**Analysis**[4]
Barker et al. (2006)	N=1037 B Montreal Study M (W1) = 13 Canada	5 Waves (Annual; ages 13-17)	3-Proactive (PA), *3-Reactive (RA) Aggression* items	(1) Never observed (PA 58.7%, *RA 52.6%*) (2) Moderate desistors (PA 34.6%, *RA 40.8*) (3) High peaking group (PA 6.7%, *RA 6.6%*)	SPGB
Bongers et al. (2004)	N= 2076 B/G R = 4-18 Netherlands	Waves varied by cohort (Multiple birth cohort design)	CBCL Aggression subscale (P)	(1) Near zero (71%) (2) Low decreasers (21%) (3) High decreasers (8%)	SPGB
Broidy, Nagin et al. (2003)	N=535 B N=502 G Dunedin Sample M (W1)= 3 New Zealand	4 Waves (Biennial; ages 7, 9, 11, 13)	2-items on Rutter et al. (1970) Child Scales (T)	**PA (Male)** (1) Never (53%) (2) Low (38%) (3) Chronic (9%) **PA (Female)** (1) Stable low (57%) (2) Moderate decline (43%)	SPGB
Maughan et al. (2000) Study 1	N= 1419 B/G GSMS R (W1) = 9, 11, 13 United States	W1-W4 (Annual) Accelerated Cohort Design	CAPA interview (S, P) -7 CD behaviours focusing on aggression	(1) Stable-low (76.9%) (2) Declining (15.5%) (3) Stable-high (7.5%)	SPGB

Nagin and Tremblay (1999)	N= 1,037 B Montreal Study	Ages 6, 10, 11, 12, 13	Social Behaviour Questionnaire (Tremblay et al, 1991) Teachers report (3 items)	(1) Low (17%) (2) Mod-Desister (52%) (3) High-Desister (28%) (4) Chronic (4%)	SPGB
Brame, Nagin and Tremblay (2001)	N=926 B Montreal Study	Ages 13, 14, 15, 16, and 17	Self-reported PA (4 Items)	(1) None (64%) (2) Increasing (16%) (3) Decreasing (15%) (4) High (5%)	SPGB
Campbell et al (2010)	N=1081 B/G NICHD	Grades 1-6	CBCL :Teachers Report Form(T)	**Male** (1) None (64%) (2) Moderate Decreasing (13.5) (3) Moderate Increasing (16.1) (4) High Stable (6.4) **Female** (1) None (80.3) (2) Low Stable (15.3) (3) High Variable (4.5)	SPGB
NICHD Early Child Care Network (2004) AND Campbell et al (2006)	N=1195 B/G R = 2-9		See Above – Same study. Mother-rated CBCL	(1) Very Low (45%) (2) Low Stable (25%) (3) Moderate Decreasing (12%) (4) Moderate Stable (15%) (5) High Stable (3%)	SPGB

Cote et al. (2007)[±]	N=1183 B/G NLSCY R = 2-8	Ci-C4 (Biennial)	3 PA Items (P)	(1) Low (5%) (2) Low Desister (36.3%) (3) Moderate Desister (43.8%) (4) High (14.5%)	SPGB
Underwood et al. (2009)[±]	N=281 R = 9-13	Annual (W1-W4; Grade 3-7)	4 PA Items (T)	(1) Low (28%) (2) Moderate Decreasing (53%) (3) Stable High (19%)	SPGB

Indirect Aggression Longitudinal Studies

Authors	Sample[1]	Assessments	Assessment/ Instruments[2]	Trajectories (% of sample)[3]	Analysis[4]
Cote et al. 2007[±]	N=1183 B/G NLSCY R = 2-8	Ci-C4 (Biennial)	5 IA Items (P)	IA (1) Low (67.9%) (2) High Rising (32.01%)	SPGB
Underwood et al 2009[±]	N=281 R 9-13	Annual (W1-W4; Grade 3-7)	4 IA Items (T)	IA (1) Low Stable (55%) (2) High desisting (45%)	SPGB
Vaillancourt et al (2003)	N=1401 NLSCY R 4-10	C1-C4 (Biennial)	5 IA Items (P)	IA (1) Low Stable (65%) (2) Increasing (35%)	SPGB

[1] Sample: B=Boys; G=Girls; M=mean age, R=age range, W=wave.
 Studies: NLSCY=National Longitudinal Study of Children and Youth; NICHD Study of Early Child Care and Youth Development; GSMS=Great
   Smoky Mountains Study of Youth
[2]Informant: P=Parent; S=Self; T=Teacher
[3]Trajectory Groups: Terminology (i.e. low stable) kept the same as original publication
[4]Analysis: SPGB=Semi-parametric group-based modelling

±Joint trajectories of IA and PA presented

CHAPTER 2

OVERVIEW OF PROJECTS

The primary goal of this thesis is to address some of the limitations identifed in

the review of the literature by determining how IA and PA develop and relate to one

another throughout childhood and adolescence. A secondary goal is to understand how

the development of physical and indirect aggression predict adjustment in emerging

adulthood. The three dissertationprojects used cross-sectional and longitudinal data and

both variable-centred (structural equation modelling) and person-centred (group based

trajectory modelling) approaches to achieve these goals. The three Projects were

developed to address previously noted limitations in the aggression field, namely, 1) the

lack of evidence fora two-factor measurement structure of IA and PA applicable to

adolescent boys and girls, and 2) the lack of research on the outcomes in emerging

adulthood of joint trajectories formed by IA and PA.

Overlap in Projects

The material presented in Chapters 3 and 4 describe the relationship between IA

and PA. While Chapter 3 uses variable-centered analysis to confirm a two-factor structure

of IA and PA, Chapter 4 builds on this using a person-centered analysis to describe how

the two-factor model tested in Chapter 3 changes over time and is associated with

adjustment in emerging adulthood. Both studies are based on the same theory of the

association between IA and PA proposed by Bjorkqvist and colleagues (Bjorkqvist, 1994;

Bjorkqvist, Lagerspetz, and Kaukiainen, 1992; Bjorkqvist, Osterman, and Kaukiainen,

1992; Lagerspetz, Bjorkqvist, and Peltonen, 1988). The material presented in Chapter 5 is

based on the findings of Chapter 4.Given that PA and IA trajectories in childhood and adolescence are both associated with maladjustment in early adulthood, Chapter 5 investigates whether IA is still related with maladjustment (depression) when PA is adjusted for in the same statistical model. All three projects are described in greater detail below with particular attention to the research questions, methodology, key findings and implications of the project.

Project #1: Measurement Invariance of the 2-factor Indirect and Physical Aggression

Model: Parent and Youth as Informants

Objective

      To confirm a two factor model of aggression (physical and indirect aggression) and to examine the measurement invariance of this model by informant (parent and youth) and sex (boys and girls).

Research Questions

1. Is the two-factor aggression model previously reported in children using parent- and teacher-reports confirmed using youth self-report?

2. Are there sex-specific and informant-specific patterns in the two factor structure of aggression?

      Project #1 examines the previously hypothesized two-factor indirect and physical aggression model (Crick, 1995; Grotpeter & Crick, 1996; Lagerspetz, Bjorkqvist, & Peltonen, 1988; Macgowan, Nash, & Fraser, 2002; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003). This project represents the first study to examine this two-factor structure in adolescence using *self-report*, addressing two previously-noted limitations relating to the exclusive use of parent- and teacher-reports in this literature: 1) its inability to incorporate changes in informant over time (e.g. from parent report in childhood to self-report in adolescence), and 2) limitations in our understanding of the source of the

inconsistencies in levels of PA and IA symptoms reported by parents, teachers and children in males and females.

Key findings indicate a two-factor model of PA and IA using self-report of children aged 10-11 years, and that this factor structure was invariant by sex(boy and girl) and informant (parent and child). In other words, parents and children conceptualize aggression in the same way (i.e., two latent constructs of PA and IA) and that the strength of association among items (i.e., magnitude of the factor loadings for particular items) in the PA and IA constructs is invariant between groups. Given that informants change across developmental periods, these findings will be particularly important for future research as it may allow for the pooling of informant (i.e., parent and child)responses across developmental periods (see Rungtusanatham, Ng, Zhao, and Lee, 2008). As well, it will be useful for developing interventions that target PA and IA, particularly gender-specific interventions.

Project #2: A Longitudinal Examination of Physical and Indirect Aggression

Trajectories from Childhood To Adolescence: Sex Differences and Outcomes in

Emerging Adulthood

Objective

To describe the joint development of self-reported physical and indirect

aggression symptom trajectories in youth and to examine the association of these

trajectories with outcomes in emerging adulthood.

Research Questions

1. Among youth ages 10 to 15, what are the trajectories of indirect and physical

    aggression examined separately?

2. Is there an association between sex and the probability ofmembership in the

    trajectories of indirect and physical aggression examined separately?

3. What are the joint patterns of development of indirect and physical aggression

    trajectories?

4. Are there differential patterns of adjustment in emerging adulthood (ages 18 to 19) for

    the identified joint PA/IA trajectory groups?

Project #2 explored the temporal association between IA and PA in adolescence.

There is a need to examine the development of IA and PA throughout adolescence (ages

10 to 15) using self-reports to determine whether patterns identified in childhood are also

found in adolescence. As well, although IA and PA have been reported separately in the

past, no research has examined the longitudinal adjustment (in emerging adulthood – ages 18 and 19) of joint trajectories of both IA and PA concurrently.

Using group-based trajectory analysis, themodels identified 3 trajectories for PA (*no* PA, 32.5%; *moderate declining* PA 52.2%; and *high increasing* PA, 15.3%) and 3 trajectories for IA (*low decreasing* IA, 29.9%; *moderate declining* IA, 65.5%; and *high stable IA*, 4.6%).Analysis of the association between trajectory groups and outcomes in emerging adulthood showed that youth who follow *high* levels of PA, *high* levels of IA, and joint trajectories of *high* PA and *high* IA (Groups 8 and 9) report greater maladjustment (higher levels of depressive symptoms and antisocial behaviours) in early adulthood compared to their peers who follow *low* trajectories. The findings imply that: (1) programs to reduce aggressive behaviour problems in children and adolescence should focus on a broader set of aggressive behaviours that include IA; and (2) intervention efforts should be targeted at both sexes because both boys and girls endorse symptoms of PA and IA.

Project #3: Indirect and Physical Aggression in Childhood and Adolescence and

Depression in Emerging Adulthood: Sex Differences

Objective

To examine the associations between indirect and physical aggression in childhood and adolescence and depression in emerging adulthood when the covariation of IA and PA are taken into account.

Research Questions

1. What is the stability of IA and PA through childhood and adolescence?

2. Does PA mediate the relationship between IA and depression in emerging adulthood?

3. Are there sex-specific pathways from development of IA and PA in childhood and adolescence to depression in emerging adulthood?

Project #3 examined the longitudinal relationship between PA and IA in childhood (ages 10 and 11) and adolescence (ages 14 and 15) and their association with depression in emerging adulthood (ages 18 and 19). Although previous research has shown the high stability between PA and IA through adolescence and the association of PA and IA with adverse outcomes in emerging adulthood, no longitudinal studies have linked PA, IA and these outcomes in the same statistical model. This is particularly important as it can provide a better understanding of whether IA predicts outcomes above and beyond PA.

Key findings indicate that PA in childhood and adolescence has a direct effect on depression in emerging adulthood and that physically aggressive behaviours are more

strongly associated with depression in early adulthood than indirectly aggressive behaviours in both males and females. In addition, for girls only, IA in childhood does have a latent effect on depression in emerging adulthood. Since IA is inherently related to social relationships, any alteration in 'normal' developmental processes may lead to failures in domains of functioning (e.g. academic failure) contributing to negative outcomes (e.g. depression) as described in the Failure Model (Boots et al, 2011; Patterson &Capaldi, 1990). These findings indicate that one potentially key focus of treatment should be for children who begin to demonstrate PA symptoms during childhood and for girls with IA symptoms as these groups may be at a greater risk for developing worsening behaviour and depression in emerging adulthood. In addition, although clinicians tend to focus more onphysical aggression, given the association between IA and depression it seems assessments and interventions should also also focus on the social and indirect forms of aggression, particularly for girls.

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CHAPTER 3

MEASUREMENT INVARIANCE OF THE 2-FACTOR INDIRECT AND PHYSICAL AGGRESSION MODEL: PARENT AND YOUTH AS INFORMANTS

Introduction

Aggression has received considerable theoretical and clinical attention in recent years, partly due to the serious negative short- and long-term individual and societal outcomes associated with it (Crick, 1995; Crick, Casas, & Nelson, 2002; Crick, Ostrov, & Werner, 2006; Herrenkohl, Catalano, & Toumbourou, 2009; Pajer, 1998). Recently, researchers have identified the need to disaggregate aggression into subtypes (i.e. indirect aggression (or social, relational, psychological) and physical aggression) and determine how they relate to each other over developmental periods (Tremblay & Cote, 2005).

Factor-analytic work on aggression has suggested that a two-factor model of physical aggression (PA) and indirect aggression (IA) may be informative as a means of measuring aggressive behaviours in childhood (Crick, 1995; Grotpeter & Crick, 1996; Lagerspetz, Bjorkqvist, & Peltonen, 1988; Macgowan, Nash, & Fraser, 2002; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003). Physical (or direct) aggression refers to a set of overt behaviours that are aimed at harming or injuring another person, like hitting someone and getting into direct contact fights (Dodge, Coie, & Lynam, 2006). Indirect aggression describes a set of covert behaviours that are socially manipulative, like rumour-spreading, talking behind someone's back, and encouraging others to dislike someone else, but do not involve physical force (Bjorkqvist, 1994; Crick & Grotpeter, 1995; Lagerspetz et al., 1988; Macgowan et al., 2002).

The two-structure model of indirect and physical aggression is rooted in the theory and studies of Bjorkqvist and colleagues (Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992; Bjorkqvist, 1994; Lagerspetz et al., 1988)

who reported that aggression in early childhood is common and varies over developmental periods. Bjorkqvist and colleagues propose that the best model of aggression is one that incorporates specific type (physical, indirect) and developmental phase (Bjorkqvist, 2001). They posit that as children mature and develop more advanced language and social-cognitive skills, the type of aggression changes from physical in early childhood to indirect in early adolescence (Bjorkqvist et al., 1992; Bjorkqvist, Osterman et al., 1992; Bjorkqvist, 1994; Lagerspetz et al., 1988). Recent studies have found support for Bjorkqvist and colleagues' developmental hypothesis, finding that PA is relatively common in the preschool years but gradually decreases during preschool and elementary school (Broidy et al., 2003; Côté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Tremblay, 2004). Indirect aggression, on the other hand, has been found to increase from early to middle childhood and adolescence (Cairns, Cairns, Neckerman, Ferguson, & Gariépy, 1989; Côté, Vaillancourt, Barker, Nagin, & Tremblay, 2007; Vaillancourt, Miller, Fagbemi, Côté, & Tremblay, 2007).

With a view to understanding how PA and IA are related to each other, two studies using a variable-centred approach have examined the measurement invariance between PA and IA using Confirmatory Factor Analysis (CFA) (Miller, Vaillancourt, & Boyle, 2009; Vaillancourt et al., 2003). Within the CFA framework, measurement invariance is used to determine the basic underlying structure of a construct(s) and uses Multiple Group Confirmatory Factor Analysis (MGCFA) to examine the change in the goodness-of-fit index (GFI) when cross-group constraints are imposed on a measurement model.

MGCFA is useful in determining whether the measurement structure is similar across different groups (e.g. males vs. females; parent vs. youth self-report).

Vaillancourt and colleagues (2003) used CFA to study the measurement invariance of PA and IA based on parent reports taken from the National Longitudinal Study of Children and Youth (NLSCY). The sample included children ages 6 to 11 (50% male) and found that a two-factor model of aggression was invariant across time and sex. Findings from this study illustrate that as children develop and mature, the type of aggression they use (indirect and physical aggression) remains consistent. Miller, Vaillancourt and Boyle (2008) sought to replicate and extend the findings of Vaillancourt and colleagues (2003) by using teacher reports and a slightly older age group (6 to 13 years of age). These authors also confirmed a two-factor model of PA and IA that was stable over time, but not invariant by sex. The lack of sex invariance was likely related to the lower factor loadings for the PA item "gets into many fights" for girls than boys and the low internal consistency of the PA measure at Time 3 (α=.51) for girls (Miller et al, 2009).

Both studies (Miller et al., 2009; Vaillancourt et al., 2003) used a variable-centred approach to determine the measurement structure of PA and IA and the predictive links between aggression types based on parent and teacher reports. However, to date, a two-factor model of indirect and physical aggression has not been examined using youth *self-reports*. Confirming the two-factor model in youth self-report is essential as informants change over developmental periods (particularly in adolescence, where self-report is a common method of measurement). In addition, reported rates of indirect and physical

aggression have been found to differ based on the sex of the child (Archer, 2004; Card,

Stucky, Sawalani, & Little, 2008; Tackett & Ostrov, 2010). For example, Archer (2004)

reported that in a meta-analysis of 78 studies, rates of indirect and physical aggression

differed between males and females, partly as a function of informant. These findings

were recently supported by a meta-analysis of 148 studies by Card and Colleagues (2008)

that reported non-significant differences in IA between males and females, but that rates

were moderated by informant. Although the differences reported were generally small,

parents reported females as being more indirectly aggressive than boys, yet males self-

reported that they were more indirectly aggressive than females. These differences were

not found for PA. Instead, males appear consistently more physically aggressive than

females regardless of the informant. Differences in rates of indirect and physical

aggression by sex of the child and the informant may be due to the context in which

children (males and females) and informants view the aggressive behaviours. However, it

may also be due to differences in the measurement structure of indirect and physical

aggression based on the sex of the child/youth and/or based on the informant. In order to

determine whether the differences in reported rates of indirect and physical aggression are

due to differences in the structure of the measurement of aggression (e.g. number of

factors, placement of items) or differences in the context in which the informant assesses

the symptoms, an analysis of the measurement invariance using youth and parents as

informants is required.

There are two main goals of this study. The first is to determine if the two-factor

model of aggression found in previous studies using parent and teacher reports (Miller et

al., 2009; Vaillancourt et al., 2003) applies to youth-reported PAand IA among 10-11 year old males and females. The second goal of this study is to test for measurement invariance based on youth and parent reports of aggression.

The implications of confirming a two-factor model of aggression that is invariant across youth- and parent-reported aggression are significant. Key informants change over developmental periods; parents have the most interaction with younger children, followed by teachers and peers for school-aged children. As we move towards adolescence, self-reports become increasingly important. Evidence that supports an unchanging measurement model of aggression across informants is important in drawing comparisons among independent studies, and in understanding the developmental trajectories of aggressive behaviour. In particular, confirming measurement invariance may allow for the pooling of informant (i.e., parent and child) responses and modeling of trajectories across child-adolescent developmental periods (see Rungtusanatham, Ng, Zhao, and Lee, 2008)

Method

Participants/Sample

Data from Cycle 3 (1998) of the Canadian National Longitudinal Study of Children and Youth (NLSCY) (Statistics Canada, 1999) were used. The NLSCY began in 1994 when a cohort of children was selected based on stratified, multistage probability sampling. Geographic areas in Canada were divided into clusters, and dwellings (households) served as the sampling units. From these sampling units, 22,831 children,

age 0-11 years, from 10 Canadian provinces were selected (children living on First

Nations reserves, residents of institutions, full-time Canadian Armed Forces members and

remote region residents were excluded from the study). Knowledge of either English or

French was required to participate in the NLSCY, a criterion that excluded 0.4% of

households (Special Surveys Division, 1996). At Cycle 1, up to four children per

household could be selected to participate. In subsequent cycles the number of children

was limited to two due to response burden for some families. The longitudinal sample

was followed every 2 years. Surveys were completed in the home using computer-

assisted interviews with the Person Most Knowledgeable (PMK) about the children,

which was the mother in 93% of cases. Youth aged 10-15 years completed the Youth Self

Report Survey (YSR). Full details of sampling procedures and assessments can be found

in the NLSCY User's Guide (Statistics Canada, 1999).

The youth sample comprised all youth ages 10 to 11 at Cycle 3 (n=2084) who

had been followed over time from Cycle 1 onward and who had complete data on all 8

PA and IA aggression items at Cycle 3 (n=1587). At Cycle 3, the parent sample

comprised all respondents of 10-11 year olds identified as part of the longitudinal study at

Cycle 1, with complete data on all 8 PA and IA aggression items (n=1826). Descriptive

statistics of both samples are shown in Table 1. Sampling weights, developed by Statistics

Canada, were applied to each participant for demographic data so that their responses

would be linked numerically to the general population of Canadian children aged 10-11

years in 1998/99 (Statistics Canada, 1999). The youth excluded from the study sample for

having incomplete data at Cycle 3 (n=497; 23.8% sample loss) were not significantly

different from the final sample (n=1587) on sex (male, 51.5% excluded versus 49.1% included; p=0.36) but differed on age with the excluded group being slightly younger (age 10, 63.7% excluded versus 56.4% included; p=0.004). The parents excluded from the study sample for having incomplete data at Cycle 3 (n=258; 12% loss) were not significantly different by sex of the child (male, 48.1% excluded versus 51.4% included; p=0.31) but the youth they were reporting on were older in the excluded group (age 10, 48.1% excluded versus 59.8%; p<0.001).

Measures

Parent-reported indirect and physical aggression at ages 10 to 11 was obtained through face-to-face interviews with the Person Most Knowledgeable (PMK, which will be referred to as 'parent' in the study) about the youth, who was a biological parent in 98% of the cases (Mother 91.4%; Father 6.6%; Other Guardian 2.0%), and with the youth through a self-report survey. Each parent was asked to rate their child on 3 PA and 5 IAitems. The same scale and items were reported by youth on the Youth Self-Report survey. The eight aggression items were presented in the same order for both parents and youth.

Physical Aggression. The three PA items were rated using a three-point Likert scale (often/very true; sometimes/somewhat true;never/not true). The stem question and 3 items were: How often would you say that _____ "gets into many fights," "kicks, bites, hits other children," and "physically attacks people" (Statistics Canada, 1995). Composite scores

were computed for "PA" by summing the numerical values associated with each response

option for the 3 items, creating a score ranging from 0 to 6. Higher scores indicated more

use of PA. Internal consistency for the composite score was $\alpha = .67$ for parent report and

$\alpha = .63$ for youth self-report.

Indirect Aggression. The 5 IA items were rated using a three-point Likert scale

(often/very true; sometimes/somewhat true; never/not true). The stem question and 5

items are: How often would you say that ____ "becomes friends with another as

revenge," "says bad things behind the other's back," "when mad at someone, gets others

to dislike him/her," "says to others: 'let's not be with him/her,'" and "tells the other one's

secrets to a third person" (Lagerspetz et al., 1988). Composite scores were computed for

IA by summing up numerical values associated with each response option for the 5 items,

creating a score ranging from 0 to 10. Higher scores indicated more IA. Internal

consistency for the composite score was $\alpha = .80$ for parent report and $\alpha = .70$ for youth

self-report.

Analysis

Structural Equation Modelling/Confirmatory Factor Analysis. The analysis was

completed in a series of steps, beginning with separate confirmatory factor analyses of the

two-factor model of aggression in the parent and youth samples, followed by a series of

tests of equivalence in the factor structure of aggression using multi-group confirmatory

factor analysis (MGCFA) where parents comprised Group 1 and youth were Group 2.

MGCFA provides a framework for testing the equivalence of the aggression instrument across group (e.g. youth and parents) or time (e.g. by age or cycle) (Byrne, 2010; Cheung & Rensvold, 2002; Meredith, 1993; Meredith & Teresi, 2006; Schmitt & Kuljanin, 2008). To determine the extent to which an instrument is equivalent across groups, Byrne (2008) suggests using measurement equivalence that focuses on the invariance of the items and factor loadings, and determines whether groups are perceiving and interpreting the items in the same way. The test for invariance involves a hierarchical set of 6 steps (Independent Baseline Models, Baseline Model, Configural Invariance, Metric Invariance, Scalar Invariance, and Strict Invariance) that start with the determination of a well-fitting baseline model, in each of the individual groups. The next step is to determine a well-fitting multi-group baseline model, where no equality constraints are imposed on any of the parameters; this step is often called the configural model. Configural invariance is used to determine that the same factors and pattern of factor loadings exist in all groups and is the basis for more complex models to be tested (Byrne, 2003). The next step in determining whether the structure of the model is operating in the same way between groups is to test for metric invariance, which examines the extent to which the magnitude of the factor loadings for particular items are the same between groups (Byrne, 2003; Gregorich, 2006; Schmitt & Kuljanin, 2008). Bollen (1989) posits that metric invariance is a prerequisite for making valid comparisons between groups (Bollen, 1989). Once metric invariance is established, the next step is to test for scalar invariance – evidence that item intercepts are invariant between groups (Gregorich, 2006). Finally, a test for the equality of the error variances, also known as strict invariance can be

performed to determine whether the residuals of the regression equations for each indicator are equivalent across groups (Schmitt & Kuljanin, 2008). However, the presence of strict invariance may be an overly stringent test and is not required to meaningfully establish measurement invariance (Byrne, 2010). Establishing measurement invariance (6 steps discussed above) is imperative to determining whether between-group differences in aggression are the result of true versus artificial differences attributable to the items and constructs having different meanings between groups.

Results were computed using AMOS 7.0 (Amos Development Corporation, 2008). Although the x^2 test of significance is often reported in measurement equivalence studies, it is highly sensitive to sample size and group balance (Brown, 2006; Kline, 2005; Singh, 2009). Although we report findings based on the x^2 test, it is not considered in the evaluation of single (baseline) model fit. Rather, based on research by Singh (2009) and Cheung and Rensvold (2002), we relied on four other goodness-of-fit indices (GFIs) for the single-group model: the Comparative Fit Index (CFI), Tucker-Lewis index (TLI), Incremental Index of Fit (IFI); and the Root Mean Square Error of Approximation (RMSEA). Several reviews of GFIs suggest the following 'rules of thumb' for determining overall model fit: RMSEA <0.06, TLI >0.95, IFI >0.95, and CFI >0.95 (Hu & Bentler, 1998; Singh, 2009). The RMSEA is the preferred GFI, as it is sensitive to model misspecification and provides confidence intervals (CI) about the precision of the estimate of fit (Byrne, 2010; Jackson, Gillaspy, & Purc-Stephenson, 2009; McDonald & Ho, 2002).

When determining the model fit of the nested MGCFA models, we used the criteria outlined by Cheung and Rensvold (2002) who propose that evidence for non-invariance should be based on the difference in CFI values, where Δ CFI is required to be ≤ 0.01. The change in critical values of this GFI is independent of model parameters and sample size. In addition, it is suggested that the relative fit of the nested models should be tested using the x^2 difference test, where statistical significance is a function of the difference in the x^2 value and corresponding changes in degrees of freedom. The x^2 difference test is used to determine whether the more constrained model resulted in a poorer model fit (x^2 difference is not significant) (Gregorich, 2006). However, this x^2 test is affected by the overall sample size and differences in sample size between groups (Brown, 2006). Rather than disregard the x^2 difference test due to this challenge it was decided to include it, with due attention to the influence of sample on the findings of statistical significance.

Results

Reported Rates of Aggression by Informant

Parent- and youth-reported scores on indirect and physical aggression are presented in Table 2. The mean scores for IA based on parent report was 1.15 (SD=1.70) for the total sample. However, there was a significant difference by sex, $t(1824) = -5.90$, p<0.001, with higher mean rates reported for females than males. Youth self-reported mean scores for IA were M = 1.68 (SD=1.89) for the total sample, with lower mean symptoms reported by females than males (M=1.78; SD=1.96), $t(1585) = 2.17$, p<0.05.

Parent-reported mean scores for PA were 0.55 (SD=0.94) for the total sample, with rates for males higher than females, $t(1824) = 4.76$, p<0.001. Similar rates were reported by youth. Self-reported mean scores were M = 0.65 (SD=1.08) for the total sample, with males reporting higher mean scores than females, $t(1585) = 8.37$,p<0.001.

Model Estimation

Measurement Invariance by Sex in Youth

First, we tested whether the two-factor structure would be found using youth self-reports of PA and IA. The two-factor unconstrained baseline model (Table 4 – Single Group Solution - Youth) showed good fit to the data x^2 (19) = 47.44, CFI = .987, RMSEA = .031 (90% CI = .020-.042), TLI = .981, IFI = .987, suggesting a robust two-factor structure of PA and IA using youth self-reports of aggression. The factor loadings across both latent variables are good and presented in Table 3 – Youth Report (standardized regression weights between .46 and .67).

To test the factorial invariance of the two-factor structure in male and female youths, we first tested an unconstrained baseline model (Table 4 - Single Group Solution – Male/Female) in both males and females to determine that the two-factor structure fit in each sex when no equality constraints were imposed on the model. In males, the model showed excellent fit, x^2 (19) = 40.11, CFI = .981, RMSEA = .038 (90% CI = .021-.054), TLI = .972, IFI = .981. In females, the model also showed excellent fit, x^2 (19) = 35.04, CFI = .984, RMSEA = .032 (90% CI = .014-.049), TLI = .977, IFI = .984, thus indicating the two-factor aggression model is confirmed in both male and female youth.

Next, we tested an unconstrained multi-group comparison baseline model (Table 4 -Measurement Invariance) to test for sex differences in the measurement model for youth. No equality constraints were imposed on the model and males served as the reference group. This model showed excellent fit to the data, x^2 (38) = 75.15, CFI = .983, RMSEA = .025 (90% CI = .016-.033), TLI = .974, IFI = .983, indicating that the same number of factors are in each group with the same pattern of fixed and free parameters (Cheung and Rensvold, 2002). We then tested whether the specific factor loadings (items) would vary across sex by constraining the factor loadings in both groups to be equal (Metric Equivalence). Model fit was excellent, x^2 (44) = 89.03, CFI = .978, RMSEA = .025 (90% CI = .018-.033), TLI = .973, IFI = .980, and did not show a loss in practical model fit after imposing equality constraints, Δ CFI = 0.005. Results suggest that the factor loadings on the two-factor aggression construct have the same meanings across sex. Finally, we constrained the measurement intercepts between the two groups to test for scalar invariance, this model showed a significant loss in model fit (x^2 difference = 91.42 with Δdf = 8) and a decrease in the CFI, IFI and TLI (>0.10), indicating that the two groups (males and females) report different mean levels of PA and IA.

Model Estimation – Testing Measurement Invariance between Parents and Youth

To determine measurement invariance of the two-factor aggression model, we first confirmed the two-factor model for parent-reported aggression, then completed the series of measurement invariance steps for the parent- and youth-reports (Table 5). Using the parent-reported data, the initial two-factor unconstrained model (Table 5 - Single

Group Solutions - Parent) showed a good fit to the data, x^2 (19) = 126.15, CFI = .972,

RMSEA = .056 (90% CI = .047-.065), TLI = .960, IFI = .972. Although the chi-square

statistic was significant, all of the GFIs exceeded the recommended fit criteria and

suggested a good model fit. These results confirm the results of Vaillancourt et al (2003)

supporting the uniqueness of the constructs of PA and IA using parent reports of

aggressive behaviour. The factor loadings across both latent variables (indirect and

physical aggression) were good (standardized regression weights were between .57 and

.71; Table 3).

In the first step of the analysis for measurement invariance of a two-factor

structure of aggression between informants (parent and youth) we tested an unconstrained

baseline model (Model 4 – Invariance across Informant – Configural Equivalence) where

no equality constraints were imposed on the model and parents served as the reference

group. This model showed excellent fit to the data, x^2 (38) = 173.59, CFI = .978, RMSEA

= .032 (90% CI = .028-.037), TLI = .967, IFI = .978, implying that both parents and

youth associate the same subset of aggression items with the same constructs.

The second step was to test the metric invariance between the two groups by

constraining the factor loadings to be equal between the youth and parent models. This

model showed good fit to the data, x^2 (44) = 188.78, CFI = .976, RMSEA = .031 (90% CI

= .027-.036), TLI = .970, IFI = .976, with no loss in practical model fit (Δ CFI, TLI, and

IFI were<0.01). This model indicates the strength of the relationship between the

aggression items and their underlying constructs are the same in both groups (Cheung &

Rensvold, 2002). Finally, scalar invariance was tested and there was a significant loss in

practical model fit (x^2 difference = 128.82 with Δdf = 8) and a decrease of >0.01 in the CFI, IFI and TLI values, indicating that the two groups (youth and parents) report different mean levels of PA and IA.

Discussion

The purpose of this study was to extend research supporting the distinction between indirect and physical aggression previously reported using teacher and parent reports in young children by using youth self-reports. Our results confirmed a two-factor model of aggression in a cohort of youth aged 10-11 years using both parent- and youth-reported data. We also determined that the two-factor structure was invariant between male and female youth in our sample using youth reports of aggression. We then tested the invariance of the two-factor structure between parent and youth informants. Results from these analyses suggest that parents and youth conceptualize aggression in the same way (i.e. two latent constructs of indirect and physical aggression), and that the strength of association among items in the indirect and physical aggression constructs is invariant between groups. However, scalar invariance could not be confirmed in either multi-group comparison, which was expected given the differences in mean rates of reported indirect and physical aggression between sexes in the youth-reported sample and between youth and parents.

This is the first study to replicate in youth self-reports the two-factor structure of indirect and physical aggression observed in parent and teacher reports. This is particularly important to the study of indirect and physical aggression, given the

dependence of these constructs on self-reports during adolescence. Given the importance

of understanding the change in PA and IA over development (see (Côté et al., 2007;

Underwood, Beron, & Rosen, 2009)), it is essential to extend the current state of research,

which stops short of explaining trajectories beyond age 8 using parent report (Côté et al.,

2007) and age 13 using teacher report (Underwood et al., 2009). As this was a cross-

sectional analysis these findings cannot theoretically support or refute Bjorkqvist and

colleagues'(Bjorkqvist et al., 1992; Bjorkqvist, Osterman et al., 1992; Bjorkqvist, 1994;

Lagerspetz et al., 1988) developmental hypothesis of PA and IA. However, it does

support their hypothesis that physical and indirect aggression are distinct, but related

forms of aggression in childhood and adolescence, and this two-factor model of

aggression is confirmed in both parents and youth informants. This finding permits the

testing of Bjorkqvist and colleagues' developmental theory beyond childhood into

adolescence/youth. In this study, measurement equivalence allows comparisons of groups

while taking into account that our results are not a mere artefact of measurement

differences. The finding of configural and metric invariance in both models gives a good

estimate of the structural similarities in the two-factor aggression construct between each

group. However, the lack of scalar invariance impedes our ability to interchange parent

scores for youth scores, as they are reporting different mean levels of symptoms and there

are low correlations between parent- and youth-reported PA and IA. In future longitudinal

studies where informants change between developmental periods (i.e. parents in

childhood and youth self-report in adolescence) it would be important to take into account

the change in informant and the change in developmental period, for example using a

piecewise growth curve model (Bryk & Raudenbush, 1992; Duncan, Duncan, & Stryker, 2006).

Given recent research (Card et al., 2008) suggesting differences in reported rates of PA in males and females, but little differences in IA, it is important to determine if this was due to measurement variance (lack of equivalence) or due to true mean differences in reported levels. Our findings indicate that these male-female differences in PA are 'real', not an artefact of measurement. It also appears that the reversal of male-female differences for parent versus youth report is also real. These findings, albeit cross-sectional, confirm a meta-analysis (Archer, 2004) of sex differences in both physical and indirect aggression, which found that averaged across age, when parents are the informant, females exhibit more IA than males, whereas using self-report methods, few sex differences emerge.

Empirical studies have shown that cross-informant correlations on ratings of problem behaviour tend to be low (Achenbach, McConaughy, & Howell, 1987; Andold et al., 1987; Bird, Gould, & Staghezza, 1992). This has prompted researchers to argue that assessment data should be collected from multiple informants because they contribute unique and important information. Offord and colleagues (1996) recommend that assessments provided by different informants be analyzed separately, and then combined, if needed (Offord et al., 1996); however, this does not preclude the need to understand whether the construct we are studying (for example, aggression) is invariant across informants. In essence, we need to confirm that parents and children are reporting on items that load onto constructs that do not vary by informant. For example, the

interpretation of the PA item "gets into many fights" may be understood as loading onto the construct of IA by parents, as they may interpret this to mean verbal arguments and/or disagreements. On the other hand, children and youth may interpret "gets into many fights" as PA, understanding the question to mean physical fighting. However, before we can combine information from informants, whether it is for cross-sectional or longitudinal purposes, it is important that we establish the existence of a common metric so that we can confidently contrast and compare information across time or group. These findings demonstrate that the two-factor model of PA and IA is robust when using adolescent self-reports, adding strength to previous research on the distinctiveness of these two types of aggression. In addition, the findings suggest that, the low levels of association between PA and IA among parent and youth-reports reflect meaningful differences in behaviour associated with the context. Using these same items to measure aggression, the results of this study suggest it is possible to make meaningful comparisons of aggression across groups in future studies.

When interpreting these findings, several limitations bear consideration. For example, the study sample is constrained to youth aged 10-11 years. Future research should examine if the two-factor structure found to be invariant between parents and youth (and sex) in this study is as robust through adolescence. Another important limitation is the sample loss due to missing data at both the respondent and the item level (e.g. specific items within the aggression instrument missing). An analysis of the missing data indicated the sample remained representative of the original sample for sex, which was important to this analysis. Furthermore, our findings are based almost entirely

(91.4%) on mothers' reports of their children's PA and IA. It will be important to replicate these findings with fathers as informants of aggression and determine whether they would perceive sons and daughters' aggression differently than mothers. Finally, although Maximum Likelihood Estimation has been found to be robust to mild violations of normality with large sample sizes (>500) (Lei & Lomax, 2005; Wang, Fan, & Willson, 1996), researchers seldom mention whether they examined their data for normality (Jackson et al., 2009). Normality was tested in each of the models and skewness and kurtosis were tested based on the values summarized by Lei and Lomax (2005). No normality violations of the parent models and only minor violations were found in the youth models. Minor violations of normality do not affect GFI, particularly the CFI, of large samples (>500) (Goa, Mokhtarian, & Johnston, 2008; Lei & Lomax, 2005) therefore transformation of the variables was deemed unnecessary in this study.

In summary, the results of this study provide evidence for the two-factor model of PA and IA in youth, as well as measurement equivalence for males versus females and parents versus youth. Given that informants change across developmental periods, these findings will be particularly important for future research on the developmental course of PA and IA. As well, it will be useful for understanding the effects of interventions among males and females and in determining predictors and outcomes of PA and IA.

Table 1. Baseline Demographic Characteristics.

	Sample
Sex	
Male	51.5
Age	
10 Years	56.3
Country of Birth	
Canada	94.6
Other*	5.4
Annual Total Household Income	
0 to $19,999	7.7
$20,000 to $39,000	22.7
$40,000 or more	69.6
PMK	
Age, mean years	$39.2^{5.5}$
Education, mean years	$12.7^{2.1}$†

* US, Filipinos, Chinese, French, Not stated; values are presented first for our study sample (N = 1587, unless otherwise stated). For 'age' and 'years of education', standard deviations are presented in superscript.
PMK = Person Most Knowledgeable (Parent in 98% of respondents)

Table 2. Mean Symptoms of Indirect and Physical Aggression by Informant and Sex.

	Indirect Aggression, Mean(SD)	Physical Aggression, Mean(SD)
Parent Report		
Total	1.15 (1.70)	0.55 (0.94)
Male	0.93 (1.50)	0.65 (1.03)
Female	1.39 (1.87)	0.44 (0.81)
Youth Self Report		
Total	1.68 (1.89)	0.65 (1.08)
Male	1.78 (1.96)	0.87 (1.24)
Female	1.57 (1.81)	0.43 (0.81)

*Standard deviations (SD) are presented in parentheses.

Table 3. Maximum Likelihood Estimates of the Factor Loadings on Physical and Indirect Aggression Constructs (Standardized).

Item	Youth Report*	Parent Report *
Physical		
Fights	.56	.57
Attacks	.67	.78
Kicks	.65	.69
Indirect		
Dislikes	.60	.68
Revenge	.46	.64
Behind	.60	.67
Avoids	.65	.71
Secret	.52	.65

*Baseline model CFA

Table 4. Tests of Measurement Invariance of Indirect and Physical Aggression in Male and Female Youth.

Models	X^2 (*df*)	X^2diff	Δdf	CFI	RMSEA (90% CI)	TLI	IFI
Single Group Solutions							
Youth	47.44 (19)			.987	.031 (.019-.042)	.981	.987
Male	40.11 (19)			.981	.038 (.021-.054)	.972	.981
Female	35.04 (19)			.984	.032 (.014-.049)	.977	.984
Measurement Invariance							
Configural Invariance	75.15 (38)			.983	.025 (.016-.033)	.974	.983
Metric Invariance	89.03 (44)	13.88	6	.978	.025 (.018-.033)	.973	.980
Scalar Invariance	180.45 (52)	91.42	8	.940	.040 (.033-.046)	.935	.940

*The sample sizes of the above models are: YSR *N*=1587 (where, YSR Female N=785; YSR Male N=802) and PMK *N*=1826

Table 5. Tests of Measurement Invariance of Indirect and Physical Aggression in Youth and Parents

	X^2 (*df*)	X^2diff	Δdf	CFI	RMSEA (90% CI)	TLI	IFI
Single Group Solutions							
Parent (PMK)	126.15 (19)			.972	.056 (.047-.065)	.960	.972
Youth (YSR)	47.44 (19)			.987	.031 (.020-.042)	.981	.987
Measurement Invariance (Informant)							
Configural Invariance	173.59 (38)			.978	.032 (.028-.037)	.967	.978
Metric Invariance	188.78 (44)	15.19	6	.976	.031 (.027-.036)	.970	.976
Scalar Invariance	317.60 (52)	128.82	8	.957	.039 (.035-.043)	.953	.957

*The sample sizes of the above models are: YSR *N*=1587 and PMK *N*=1826

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CHAPTER 4

A LONGITUDINAL EXAMINATION OF PHYSICAL AND INDIRECT
AGGRESSION TRAJECTORIES FROM CHILDHOOD TO ADOLESCENCE: SEX
DIFFERENCES AND OUTCOMES IN EMERGING ADULTHOOD

Introduction

Developmental Course of Physical Aggression

An abundance of research has helped to define and clarify developmental trajectories, precursors and potential outcomes of physical aggression (PA) (Herrenkohl, Catalano, & Toumbourou, 2009; Libermam, 2008; Tremblay, 2008; Tremblay, 2000; Tremblay& Cote, 2005). This research has demonstrated that physical aggression emerges early in life and is common during the toddler years (NICHD Early Child Care Research Network, 2004; Tremblay, 2000; Tremblay, 2004). It decreases gradually for most children by school age (Broidy et al., 2003; Côté, Vaillancourt, Barker, Nagin, & Tremblay, 2007; Côté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Nagin & Tremblay, 1999; Shaw, Gilliom, Ingoldsby, & Nagin, 2003) except for a small group who remain physically aggressive throughout adolescence (Bongers, Koot, Van Der Ende, & Verhulst, 2004; Brame, Nagin, & Tremblay, 2001; Broidy et al., 2003; Côté et al., 2007; Côté et al., 2006; Maughan, Pickles, Rowe, Costello, & Angold, 2000; Nagin & Tremblay, 1999; Underwood, Beron, & Rosen, 2009) and adulthood (Nagin, 1999).

To address potential heterogeneity in the course of PA throughout childhood and adolescence, researchers have recently begun to employ novel methods (e.g. growth curve and group-based trajectory modelling) and multiple informants (e.g. parents and teachers) to describe developmental trends in PA. When modelled using parent or teacher ratings in childhood and adolescence, three or four patterns of PA development typically emerge. Longitudinal studies using group-based trajectories have identified a large group of children that never exhibit PA across childhood and adolescence (53-80%), a group that

rarely use physical aggression across childhood and adolescence (17-77%), a group that follows a moderate and/or declining trajectory of physical aggression (15-53%), and a small group with a high and stable trajectory of physical aggression (3-19%) (Barker, Tremblay, Nagin, Vitaro, & Lacourse, 2006; Bongers et al., 2004; Brame et al., 2001; Broidy et al., 2003; Campbell, Spieker, Burchinal, Poe, & The NICHD Early Child Care Research Network, 2006; Campbell et al., 2010; Côté et al., 2007; Maughan et al., 2000; Nagin & Tremblay, 1999; Underwood et al., 2009). Sex differences in trajectories of PA have found that almost double the number of boys than girls exhibit PA during childhood but the differences begin to disappear in late adolescence (Bongers et al, 2004). Additionally, studies reporting sex differences using group-based trajectory analysis have consistently found that the proportion of boys is higher in the chronic or high trajectory groups (Crapanzano, Frick, & Terranova, 2010; Maughan et al., 2000).

Developmental Course of Indirect Aggression

Less is known about the development of the covert and insidious interpersonal form of indirect aggression (IA)(Bjorkqvist, 1994; Lagerspetz, Bjorkqvist, & Peltonen, 1988). IA describes a set of covert behaviours that are socially manipulative, like rumour-spreading, talking behind someone's back and encouraging others to dislike someone else, but do not involve physical force (Bjorkqvist, 1994; Crick & Grotpeter, 1995; Lagerspetz et al., 1988; Macgowan, Nash, & Fraser, 2002). In the literature, this form of aggression is referred to using different names: indirect aggression (Bjorkqvist, Osterman, & Kaukiainen, 1992), social aggression (Galen & Underwood, 1997), or relational

aggression (Crick & Grotpeter, 1995). However, researchers contend that all three terms are in essence referring to the same phenomenon (Archer & Coyne, 2005; Bjorkqvist, 2001). In this paper, the term indirect aggression(IA) will be used.

Early research on the development of IA was conducted using cross-sectional designs (Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Bjorkqvist, Osterman et al., 1992). Longitudinal studies are more recent. The results of the first three longitudinal group-based studies have shown that IA starts as early as preschool and that most children show low levels of IA (55-68%) during early childhood, exhibit high-rising levels (32-35%) in later childhood (6-10 years) and then high-desisting levels (45%) in early adolescence (9-13 years) (Côté et al., 2007; Underwood et al., 2009; Vaillancourt, Miller, Fagbemi, Côté, & Tremblay, 2007). Sex differences in IA have been conflicting, with some studies finding more girls than boys exhibiting high IA behaviours (Kaukiainen et al., 1999; Salmivalli, Kaukiainen, & Lagerspetz, 2000) while others report no sex differences in the frequency of IA behaviours(Archer, 2004; Coyne, Archer, & Eslea, 2006). The most recent group-based trajectory study (Vaillancourt et al., 2007) of 4- to 10-year-olds reported that girls were significantly more likely to be in the high or increasing IA trajectory groups.

Joint Development of Physical and Indirect Aggression

Physical and indirect aggression are highly correlated(Card, Stucky, Sawalani, & Little, 2008). Crick and colleagues (1997) found high correlations between these behaviours for both preschool boys ($r = .76$) and girls ($r = .73$) based on teacher-reports.

During childhood and adolescence, several studies have reported moderately strong correlations for PA and IA for both boys and girls (Crick, Casas, & Mosher, 1997; Côté et al., 2007; Kaukiainen et al., 1999; Underwood et al., 2009; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003). For example, using longitudinal data, Cote and colleagues (2007) reported that during childhood the magnitude of the correlation between physical and indirect aggression using parent reports increased with age, from $r = 0.27$ at age 4 to $r = 0.42$ at age 8. Crick and colleagues (2006) reported sex-specific correlations between PA and relational aggression using peer reports, in 3rd grade $r = 0.80$ for boys and $r = 0.64$ for girls, in 4th grade $r = 0.72$ for boys and $r = 0.56$ for girls. Using teacher reports, Underwood and colleagues (2009) reported moderate to high correlations between PA and relational aggression from grade 3 ($r = 0.79$ for boys; $r = 0.79$ for girls) to grade 7 ($r = 0.67$ for boys; $r = 0.63$ for girls). In sum, it appears that, irrespective of informant, PA and IA are moderately correlated across several age ranges. Therefore, since PA and IA tend to co-occur, a more thorough understanding of the developmental course of aggression will most likely come through longitudinal research that follows both PA and IA trajectories simultaneously (Underwood, Galen, & Paquette, 2001).

One influential theory on the joint development of PA and IA is that of Bjorkqvist and colleagues, who propose that the best model of aggression is one that incorporates specific type (PA, IA) and developmental phase (Bjorkqvist et al., 1992; Bjorkqvist, Osterman et al., 1992; Bjorkqvist, 1994; Lagerspetz et al., 1988). Bjorkqvist and colleagues posit that as children mature and develop more advanced language and social-cognitive skills, the type of aggression changes from physical in early childhood to

indirect in early adolescence. However, it was not until recently that researchers have begun to explore the joint development of PA and IA over time. Todate, we are aware of only two studies that have examined the joint developmental trajectories of physical and indirect aggression (Côté et al., 2007; Underwood et al., 2009).

Underwood and colleagues (2009) followed a sample, aged 9 to13 years (n=281) from one school district in the United States, annually to determine the trajectories of PA and IA. Using teacher reports exclusively, they found that mean overall levels of physical and indirect aggression decreased over time. Specifically, using semi-parametric-group-based-trajectory-modelling-methods (SPGBMM) they reported two distinct trajectory groups within IA (stable-low; high-declining) and three distinct trajectory groups within PA (stable-low; moderate-declining; high-stable). The authors then extended their analysis to look at joint trajectories over this age group and found six varying joint trajectories. They emphasize that in their six groups, PA and IA develop similarly over time; that is, high levels of physical aggression are accompanied by high levels of indirect aggression and vice versa. These findings do not support Bjorkqvist and colleagues' (1994) developmental theory of aggression. Using a multi-nominal logit model to predict joint trajectory membership based on a set of family variables, Underwood et al. (2009) found that membership in the high increasing joint trajectory group was predicted by having unmarried parents, being an ethnic minority, having a maternal authoritarian parenting style and experiencing permissive parenting styles. Underwood et al. (2009) reported that a significantly higher proportion of boys were in the high increasing IA-high PA group while girls were significantly more likely to be in the low IA-PA group.

Côtéand colleagues (2007) used the National Longitudinal Study of Children and Youth (NLSCY) to examine the developmental trajectories of PA and IA in 1183 children 2 to 8 years of age. Using parent reports, the authors found 4 distinct PA trajectories (Low; Low-Desister; Moderate-Desister; High) and 2 distinct IA trajectories (Low; High-Rising). When joint trajectories were developed, most children (62.1%) exhibited declining or low levels of IA. However, there was a large group (14.2%) that simultaneously followed joint trajectories of moderately declining PA and rising IA, providing modest support for Bjorkqvist et al's developmental hypothesis (1994). Côté and colleagues used childhood (age 2) variables to predict trajectory group membership and reported that young motherhood and hostile parenting were associated with the high physical/indirect aggression trajectory group. In this study, there was no difference in the proportion of boys and girls in the high IA-high PA trajectory group or the low IA-low PA trajectory group. However, girls were significantly more likely to be in the high IA: declining PA group, again supporting Bjorkqvist's hypothesis.

Outcomes of Physical and Indirect Aggression

Identifying outcomes of trajectory groups is an important step in confirming the existence and usefulness of multiple trajectory group classes (Ialongo, 2010) and, to date, several group-based studies have highlighted the serious negative outcomes, antisocial behaviour in particular, of individuals with high PA trajectories (Brame et al., 2001; Broidy et al., 2003; Campbell et al., 2006; Nagin & Tremblay, 1999; Tremblay& Cote, 2005). On the other hand, there have been no studies to date that have sought to

understand the outcomes of group-based trajectories for IA and no longitudinal studies of outcomes of joint trajectories in late adolescence and adulthood. Recent short-term longitudinal studies have highlighted the need to understand how trajectories high in both PA and IA affect adjustment in adulthood. In childhood, two short-term longitudinal studies (Crick, Ostrov, & Werner, 2006; Herrenkohl, Catalano, Hemphill, & Toumbourou, 2009) have determined outcomes of PA and IA. Crick, Ostrov, and Werner (2006) reported that having comorbid IA and PA in grade 3 was the strongest predictor of poor concurrent and future (oneyear later) social-psychological adjustment, including depression/anxiety, somatic complaints and delinquency and aggression, compared to those with only IA, PA or no aggression. A second short-term (2 year) longitudinal study (Herrenkohl et al., 2009)examined the adjustment of a sample of seventh and ninth graders and reported that having IA and/or PA in grades 7 to 9 increased the risk of having the same type of aggression 1 and 2 years later. It also appears that type of aggression mayaffect outcomes, with IA being a unique predictor of binge drinking and PA uniquely predicting marijuana use. These two combined IA and PA outcome studies illustrate the importance of incorporating both forms of aggression when examining the effect of the behaviours on adjustment and studying outcomes beyond just further aggression and/or delinquency.

Current Study

The results of existing studies of PA and IA indicate that for most children both types of aggression develop similarly through childhood with increases in PA

accompanied by increases in IA (Côté et al., 2007; Underwood et al., 2009). However, studies to date on joint trajectories of PA and IA have limitations. First, they have reported joint trajectories of PA and IA in relatively young samples (ages 2-8 and 9-13), and none have followed children during the transition into high school, a particularly important developmental period (Barber & Olsen, 2004; Benner & Graham, 2009). Second, although there are studies that report on the long-term outcomes of PA and IA separately(Crick et al., 2006; Herrenkohl et al., 2009), no studies to date have explored the outcomes of joint physical and indirect aggression trajectories that are measured independently of the trajectories in emerging adulthood.

The aims of this paper were to extend current research and investigate the joint development of self-reported physical and indirect aggression trajectories in boys and girls from age 10-15 using semi-parametric-group-based-trajectory-modelling developed by Nagin(Nagin, 1999; Nagin, 2005). Specifically, this paper sought to answer the following three research questions: (1) Using group-based trajectory modelling, what are the specific patterns of development of IA and PA considered separately in a community-based sample of children aged 10 to 15?; (2) Given the group-based trajectories of IA and PA found in this study, what are the joint patterns of development of IA and PA?; and (3) Are there differential patterns of adjustment in emerging adulthood (ages 18-19) for the single IA and PA trajectory groups and the joint trajectory groups?

Method

Participants

Data were from Cycles 1 (1994), 2 (1996), 3 (1998) and 5 (2002) of the Canadian

National Longitudinal Survey of Children and Youth (NLSCY) (Statistics Canada, 1995;

Statistics Canada, 1997; Statistics Canada, 1999; Statistics Canada, 2005) . The study

began in 1994 with data collection on a cohort of 22,831 children aged 0-11 years, living

in 13,439 households (86.3% response) across Canada. Children were identified using a

stratified, multistage probability sample design based on area frames in which dwellings

(residences) were the sampling units. At Cycle 1, up to 4 children per household were

selected to participate. In subsequent cycles, the number of children was capped at 2 due

to response burden for some families. The longitudinal sample was followed every 2

years. Surveys were completed in the home using computer-assisted interviews with the

Person Most Knowledgeable (PMK) about the children. Youth aged 10-15 years also

completed the Youth Self Report Survey (YSR). Full details of sampling procedures and

assessments can be found in the NLSCY User's Guides 1, 2, and 3(Statistics Canada,

1995; Statistics Canada, 1997; Statistics Canada, 1999) .

The sample cohort eligible for this study included allyouth aged 10 and 11,

selected to be followed longitudinally at Cycle 1 of the NLSCY (n=2488). To be included

in the analysis, they had to have complete data on both the PA and IA items in at least 1

of the 3 cycles. Among eligible youth, 49.4% had complete PA and IA data available at

all three cycles while 46.1% had complete data in one or two complete cycles. The final

sample included 2338 (94%) of the 2488 eligible respondents. Half (50%) of the sample

were male. Sampling weights, developed by Statistics Canada, were applied to each

participant for demographic data and trajectory models so that their responses would be

linked numerically to the general population of Canadian children aged 10-11 years in

1994/1995 (Statistics Canada, 1995).

Missing data

The statistical approach used in this study, PROC TRAJ (described below), can

model the trajectories of respondents with some missing data using full information

maximum likelihood (FIML) (Little & Rubin, 2002; Nagin & Odgers, 2010; Schafer &

Graham, 2002). Youth excluded from the analysis who provided no information at all

during the 3 cycles of data collection did not differ from those providing information at 1

or more cycles on: age of reporting parent (t=-1.912, p>0.05), living in a single parent

home (20.4% excluded versus 17.7% included; p=0.239), or a home from the lowest

income bracket (18.4% excluded versus 14.2% included; p=0.107). However, excluded

youth were more likely to be boys (6.9% boys versus 4.5% girls; p=0.006).

Of the 2338 participants involved in the longitudinal analysis, at ages 18 and 19

(Cycle 5) 1615 respondents (69%) had data on at least one outcome and 1337 respondents

had data on all three outcomes. No difference was found between trajectory group

membership of those with all three outcomes (1337) versus respondents available for the

trajectory analysis (2338), x^2(5, N=2338) = 3.38, p=0.64. Comparison of Cycle 1 IA and

PA scores revealed that there was no significant difference in Cycle 1 PA scores between

those included in the outcomes analysis versus not included [0.67 versus 0.73; t(2057)=-

1.37, *p*=0.17)]; however, those included had significantly lower Cycle 1 IA scores [1.89 versus 2.11; *t*(2038)=-2.53, *p*=0.01].

Measures

The youth self-reported PA and IA at each cycle. Each youth was asked three physical aggression and five indirect aggression items using a three-point Likert scale (often/very true = 2; sometimes/somewhat true = 1; never/not true = 0).

Physical Aggression. The three physical aggression items were as follows: How often would you say that you "get into many fights," "kick, bite, hit other children," and "physically attacks people" (Statistics Canada, 1995). Composite scores were computed for "Physical Aggression" by summing the values attached to the 3 items, creating a score ranging from 0 to 6. Higher scores indicated more use of physical aggression. This scale showed adequate internal consistency across each cycle with coefficient alphas ranging from 0.56 to 0.71.

Indirect Aggression. The five indirect aggression items were as follows: How often would you say that you "become friends with another as revenge," "say bad things behind the other's back," "when mad at someone, get others to dislike him/her," "say to others: 'let's not be with him/her,'" and "tell the other one's secrets to a third person" (Lagerspetz et al., 1988). Composite scores were computed for "Indirect Aggression" by summing up the values attached to the 5 items, creating a score ranging from 0 to 10. Higher scores

indicated more use of indirect aggression. This scale showed adequate internal
consistency across each cycle with coefficient alphas ranging from 0.72 to 0.74.

Outcome Measures

We selected a number of Cycle 5 (age 18-19 years) variables that were available
and conceptually and empirically related to outcomes of PA and IA behaviours. Three
mental health variables were included: delinquent behaviours, depression, and emotional
intelligence.

Delinquent behaviours were measured using six self-reported delinquency questions. The
four-category response scales for each delinquency item ranged from never (0), to five
times or more in the past year (4). Items include: In the past 12 months, how many times
have you "fought with someone to the point where they needed care for their injuries,"
"intentionally damaged or destroyed anything that didn't belong to you," "stolen
something," "sold drugs," "attacked someone with the idea of seriously hurting him/her,"
and "carried a weapon with the purpose of defending yourself in a fight." Due to the
relatively serious nature of the six violent or property-related delinquency items used in
this analysis, each question was broken down into two categories, (0) never committed
the delinquent act or (1) committed it at least once. The six items were summed to create
a score of 0 to 6, with higher scores indicating more delinquency. This scale showed good
internal consistency with a coefficient alpha of .75.

Depressive symptoms were measured using 12 items from the CES-D developed by (Radloff, 1977)and validated with the NLSCY sample (Poulin, Hand, & Bourdreau, 2005). This score provided a measure of the frequency of depressive symptoms by focussing on the occurrence and severity of symptoms during the previous week. This scale is not a diagnostic tool for clinical depression; it provides an indication of high depressive symptomology. Items include: "I felt depressed," "I felt I could not shake off the blues even with help from my family and friends," and "I felt that everything I did was an effort." The 12 items were scores on a scale of 0 (rarely or none of the time) to 3 (most or all of the time), the items were summed to create a score ranging from 0 to 36, with higher scores indicating more depressive symptoms.This scale showed good internal consistency with a coefficient alpha of .84.

Emotional intelligence was measured using the 15-item Emotional Quotient Inventory Youth Version (EQ-i:YV) (BarOn& Parker, 2000; BarOn, 2004). This measure comprises five major dimensions of emotional intelligence (intrapersonal, interpersonal, adaptability, stress management, and general mood) with 3 items per dimension. Items include: "I like doing things for others," "I can easily describe my feelings," and "I can understand hard questions". Participants respond to each item on a 5-point Likert scale: (1) very seldom true or not true, (2) seldom true, (3) sometimes true, (4) often true, and (5) very often true or true. All 15items were summed with a possible range of 0 to 45, with higher scores indicating well developed emotional/social capacity.

Data Analysis

Group Based Trajectory Modelling

To determine whether distinct longitudinal trajectory profiles of PA and IA could be identified a semi-parametric group-based approach was used (Jones & Nagin, 2007; Nagin, 2005; Nagin & Odgers, 2010). This approach provides an empirical basis for determining the number of classes and the shapes of the trajectories (PROC TRAJ macro in SAS;(Jones & Nagin, 2007)). A detailed description of the statistical rationale underlying the TRAJ estimation procedure is provided elsewhere (Nagin, 1999). Briefly, the analyses of distinctive developmental groups are developed by first modelling the number of trajectory groups/classes, and then modelling the distinctive trajectory shapes (e.g. stable, increasing, and desisting). The model with the lowest Bayesian Information Criterion (BIC) was selected as the optimal model (D'Unger, Land, McCall, & Nagin, 1998; Jones, Nagin, & Roeder, 2001; Nagin, 2005). Models with 1 to 5 groups were estimated and linear and stable trajectory shapes were estimated. We started with all trajectory shapes as linear and backward elimination of high-order trajectories was utilized. Very strong or significant differences between BIC scores are considered in the range of 10 or more units (Raftery, 1995), as supported by the Bayes' criterion calculation (eΔBIC between comparator models). A more parsimonious model was maintained when the higher-order growth coefficient was not statistically significant ($p>0.05$) and the BIC value decreased(Nagin, 2005). The BIC rewards parsimony and, thus, tends to favour models with fewer groups. The censored normal model option in PROC TRAJ was

utilized since the psychometric scaled data in this study was skewed towards the scale minimum(Nagin, 2005).

For each subject the semi-parametric group approach provides 1) the probability of belonging to each trajectory group, and 2) the assigned trajectory group based on the highest probability. According to Nagin (2005) individuals in a given trajectory should have high probability (0 to 1) of assignment in their group and low probability of assignment to the other identified groups, with mean probabilities equal to or greater than 0.7 implying satisfactory fit. When multiple alternate models presented with similar BIC scores, the selection of the best model was based on a combination of (1) the lowest BIC score, (2) significant growth coefficients, (3) posterior probabilities of >70%, and finally (4) the most parsimonious model.

Joint trajectories of PA and IA were then estimated using the PROC TRAJ procedure and the parameter estimates from the single trajectory models identified in the first step of analysis. The purpose of the joint trajectory procedure is to estimate the conditional and joint probabilities of each PA and IA trajectory group in relation to each other. The joint probabilities will reflect the proportion of youth estimated to belong simultaneously to trajectories of PA and IA (i.e., the probability of following high physical aggression and high indirect aggression), whereas, the conditional probabilities will identify the probability of PA trajectory group membership conditional on IA trajectory group membership and vice versa(Nagin, 2005).

Outcomes of Joint Trajectory Membership

Using the group membership identified in the joint PA/IA trajectory analysis, Analysis of Variance (ANOVA) with Bonferroni post hoc tests (*p*<.05) was used to examine the predictive validity of group membership for the outcomes delinquency, depression, and emotional quotient at ages 18 and 19. In particular we were interested in testing the following three contrasts: (1) whether a trajectory of high IA versus moderate or low IA differentially predicted outcomes in the single trajectory analysis; (2) whether a trajectory of high PA versus moderate or no PA trajectories differentially predicted outcomes in the single trajectory analysis; and (3) whether belonging to a certain joint trajectory group (e.g. high PA and high IA trajectories) predicted adjustment in the outcomes.

Sex Differences

Sex differences in joint trajectory group membership were tested by comparing the proportions of boys and girls in each joint trajectory group (vs. all others). For example, the sex difference in the proportion of boys and girls in the low PA–low IA trajectory group was compared to the proportion of boys and girls in all the other groups combined. This was reported using odds ratios.

Results

Descriptive Statistics

Mean PA and IA scores for males and females ages 10 to 15 are shown in Table 1. The average level of both IA and PA symptoms for the sample decreases between ages 10

to 15. Sex analysis shows that males have significantly higher PA scores across all three time points, whereas no differences were found between boys and girls for IA scores across the three time points. The correlations between the IA assessments at different Cycles varied between 0.19 and 0.42 and were all statistically significant (Table 2). The correlations between the PA assessments at the different Cycles varied between .27 and .35 and all were statistically significant. The correlations between IA and PA remained stable over time (r = .37 at Cycle 1; r = .39 at Cycle 2; r = .38 at Cycle 3) and all were statistically significant (p<0.01).

Group Based Trajectory Models

The model fit results of the univariate indirect and physical aggression trajectories are shown in Table 3.

Trajectories of Physical Aggression.

Three trajectory groups of physical aggression between 10 to 15 years were identified and provided maximum fit and proposed the most parsimonious solution. For self-reported ratings of physical aggression, the BIC for the three-group model (-6152.62) was better than the two-group model (-6167.48) or the four-group model (-6143.69) and was the most parsimonious model. The mean posterior probability scores, indexing the degree to which each youth fit the trajectory they were assigned, ranged from 0.63 to 0.80 with a mean of 0.74. The three group-predicted trajectories are depicted in Figure 1. Most youth (52.2%) followed a moderate-declining trajectory, 32.5% followed a no PA

trajectory, and 15.3% followed a high-increasing trajectory. Sex analysis for the three

trajectory groups shows that there are significantly more girls in the no PA trajectory

group (58.2% girls; p<0.001) but more boys in the moderate-declining trajectory group

(53.1% boys; p<0.05) and the high-declining trajectory group (61.6% boys; p<0.001).

Trajectories of Indirect Aggression.

Three trajectory groups of IA between 10 to 15 years were identified and provided

maximum fit and the most parsimonious solution. For self-reported ratings of IA, the BIC

for the three-group model (-10126.09) was better than the two-group model (-10171.81)

or the four-group model (-10117.45). The mean posterior probability scores of the three-

group model, indexing the degree to which each youth fit the trajectory they were

assigned to, ranged from .77 to .82 with a mean of .80. The three group trajectories are

depicted in Figure 2. Most youth (65.5%) followed a moderate-declining trajectory,

29.9% followed a low-declining trajectory, and 4.6% followed a high-stable trajectory.

Sex analysis for the three trajectory groups shows that there are significantly more girls in

the low-declining trajectory group (54% girls; Odds Ratio (OR) 1.39; p<0.05); slightly

less girls belonged to the moderate-desisting trajectory group (47.3% girls; OR .80;

p<0.05) but similar rates of girls and boys were found in the high-stable trajectory group

(47.2% girls; OR .92; p>0.05).

Probabilities of Joint Trajectories Membership of Indirect and Physical Aggression.

The same youth reported on both PA and IA at each of the three cycles, thus

allowing for the modelling of both types of aggression jointly. The 3x3 combination

indicates that there are 9 possible joint trajectory groups. Seven groups of youth with

distinct developmental patterns of PA and/or IA were identified (see Table 4). The first

part of Table 4 shows the proportion of youth in each group. The rows represent the three

IA groups and the columns represent the three PA groups.

The largest group consisted of 41.6% following a moderate-declining indirect

aggression trajectory and a moderate-increasing physical aggression trajectory (Group 5).

A group (20%) of the youth followed a low IA trajectory and a no PA trajectory (Group

1). A group (12.5%) of youth followed a moderate declining IA trajectory and a high

increasing PA trajectory (Group 8). Finally, approximately 7% followed a high-stable IA

trajectory and high-stable PA trajectory (Group 9). Virtually no youth (1%) followed a

high IA trajectory and zero PA (Group 3) and no youth were in groups 6 and 7.

Probabilities of PA conditional on IA

The second part of Table 4 represents the youth's conditional probabilities of PA

given their IA trajectory. Youthlow on IA were most likely to follow either the noPA

trajectory (p=.650) (where p is probability) or the moderate declining PA (.345). Youth

in the moderate declining IA trajectory group were most likely to follow the moderate

declining PA group (p=.669). Finally, those following the high stable IA trajectory group

were most likely to be following the high increasing PA trajectory groups (p=.985).

Probabilities of IA conditional on PA

The third part of Table 4 presents the youth's conditional probabilities of IA given

their PA trajectory. Youth in the no PA trajectory group were most likely to follow low

IA trajectory (p=.710). Youth following the moderate declining PA group were most likely to follow the moderate declining IA group (p=.794). Finally, youth following the high increasing PA group were most likely to be following the moderate declining IA group (p=.644).

Taken together, the conditional probability results indicate that the risk for highly physically aggressive children to also be highly indirectly aggressive is lower (p=.356) than the risk than for highly indirectly aggressive children to also be highly physically aggressive (p=.985).

Sex differences in group trajectory membership

Table 5 represents the proportion of boys and girls in each joint trajectory group and the odds ratio predicting group membership with sex. Results indicate no significant differences in the proportion of girls and boys following groups 5 and 9. However, boys were more likely to be in groups 4 (Low IA-Mod. Desist PA) and 8 (Mod. IA-High Increase PA) while girls were more likely to be in groups 1 (Low IA-Low PA) and 2 (Mod. IA-Low PA).

Outcomes in Emerging Adulthood

In total, 1615 (69%) respondents were available at Cycle 5.Of this group, 1379 had data on depression, 1404 on delinquency, and 1369 on emotional quotient. Overall mean differences in self-reported depression, delinquency and emotional quotient by trajectory groups for the single PA and single IA trajectories are presented in Table 6.

Pairwise comparisons show that, in general, higher trajectories predicted higher mean scores of depressive and delinquency outcomes and lower mean scores of emotional quotient. Specifically, respondents in the Hi IA trajectory group had significantly higher scores of delinquency (1.1 versus .43; p<0.001) and lower scores on the emotional quotient scale (28.3 versus 31.3, p<0.001) than the Low IA group. Respondents in the Hi PA trajectory group had higher depression (9.1 versus 7.2; p<0.001), higher delinquency (1.3 versus .37; p<0.001), and lower emotional quotient scores (27.1 versus 31.3; p<0.001) than those in the No PA group.

For the joint trajectories (Table 4), groups 1, 2 and 4 were combined for the analysis into one group since preliminary results indicated no significant differences between these groups, thus allowing for ease in interpretation. Findings show that youth who followed the high PA-moderate desisting IA (Group 8) and the high PA-high IA joint trajectories (Group 9) showed the most differentiation with other trajectories on all three outcomes (see Table 6).For example, respondents in Group 8 and 9 had significantly higher delinquency scores (e.g., 1.1 versus .42; p<0.001) than those in the low or moderate IA - no or moderate PA groups.

Discussion

To our knowledge, this study is the first to estimate joint developmental trajectories of male and female PA and IA and to examine how these trajectories relate to outcomes in emerging adulthood. We identified three trajectories of PA (no PA, 32.5%; moderate declining PA 52.2%; and high increasing PA, 15.3%) and three trajectories of

IA (low declining IA, 29.9%; moderate declining IA, 65.5%; and high stable IA, 4.6%). The physical aggression trajectory groups are similar to those described in previous studies (Barker et al., 2006; Bongers et al., 2004; Broidy et al., 2003; Maughan, 2005), with no PA symptoms reported by a large group of children and adolescents.PA tends to decrease with age for most, except for a small group of children and youth with chronically high PA. It is worth pointing out that the symptom levels (intercepts) of the PA trajectory groups are actually all fairly low compared to the symptoms levels of the IA groups

The IA trajectory groups are similar to those described in previous studies (1 low and 1 high group) except for the small group of respondents (4.6%) found in the high stable IA trajectory in this sample (Côté et al., 2007; Underwood et al., 2009; Vaillancourt et al., 2007). There are several differences in this study that may explain the finding of a small third group: our respondents were slightly older compared to the others [ages 10 to 15 versus 2 to 10 (Côté et al., 2007) and 9 to 13 (Underwood et al., 2009)]; and we had a larger, more representative sample (than Underwood et al., 2009) and relied on youth self-report versus parent (Côté et al., 2007) or teacher report (Underwood et al., 2009). It may be that, on average, youth are using more IA behaviours throughout adolescence; however, other studies are needed in late adolescence to explore this further.

Consistent with previous work (Broidy et al., 2003; Côté et al., 2007; Tremblay et al., 1996; Underwood et al., 2009) males manifested higher PA trajectories. Findings for IA indicate no sex differences in the high IA group and slightly more boys than girls in the moderate IA trajectory group. There has only been one other reported group-based

trajectory study of IA that has reported sex differences, making conclusions and comparisons between studies difficult. Vaillancourt and colleagues (2007) reported in their sample of 4- to 10-year-olds using parent-reports from the NLSCY, that girls were significantly more likely to be in the high-increasing IA group compared to boys. Given the scarcity of research on the development of aggression, particularly IA, more longitudinal studies are needed to confirm these findings and further understand sex differences in the development of IA through childhood and adolescence.

An examination of the joint association of the PA and IA trajectories indicated that approximately half of the respondents (47%) belonged to the *moderate declining* IA trajectory and *moderate declining* PA trajectory groups perhaps indicating that co-occurrence of PA and IA through adolescence is not atypical. The presence of a low IA trajectory and no PA trajectory group (20%) indicate that for many, development does not include any of these behaviours. This was similar to findings reported by Cote et al. (2007) where during childhood almost 40% followed joint trajectories of low IA and low or low-declining PA. Very few respondents (7%) exhibited high PA and IA trajectories. Finally, unlike Bjorkqvist's and colleagues' developmental theory of indirect and physical aggression, this study found that no respondents belonged to an increasing IA and declining PA joint trajectory group. Using the same measures of PA and IA, but with a younger age group and using parent-reported measures, Cote and colleagues' (2007) findings also did not support Bjorkqvist's theory. Recent studies(Côté et al., 2007; Underwood et al., 2009) have found that PA and IA develop similarly over childhood and adolescence; that increases in PA are associated with increases in IA and vice versa. The

results of this study partially support these previous findings – that high IA trajectories are almost always associated with high PA trajectories; however, high PA trajectories can occur alone and that girls are more likely to use high IA than high PA.

Little is known about the relation of child and adolescent joint trajectories of PA and IA and outcomes in emerging adulthood. Several studies have shown that trajectories of moderate and high PA are predictive of serious maladjustment in late adolescence and emerging adulthood, particularly antisocial behaviours (Brame et al., 2001; Broidy et al., 2003; Campbell et al., 2006; Lacourse et al., 2002). This study reiterated these findings; youth following a high PA trajectory were more likely to show adjustment problems in emerging adulthood, including significantly higher depressive symptoms and lower emotional quotient/intelligence symptoms. Outcomes of IA trajectories in emerging adulthood are less understood. The present study found that youth with higher trajectories (high-stable; moderate) have more maladjustment in emerging adulthood than those on the low trajectory. This is the first study to report outcomes of group-based trajectories of IA in adolescence; however, a comprehensive review of concurrent and short-term longitudinal indirect aggression outcome studies in adolescence and emerging adulthood support these findings (Heilbron & Prinstein, 2008). As well, a recent study by Herrenkohl and Colleagues (2009) found that relational aggression in grades 7 to 9 predicted a variety of negative outcomes, such as binge drinking, 1 and 2 years later.

The joint trajectory results indicate that youth following joint trajectories of high IA and high PA (9) are at risk for serious maladjustment, this is the first study to report these findings. Youth following trajectories of high IA and high-increasing PA (9) had

more maladjustment at ages 18 and 19 than the group following trajectories of low IA and no PA (1). Interestingly, the group following trajectories of moderate-declining IA and high-increasing PA (8) showed maladjustment on more outcomes than their peers following high IA: high PA (9) trajectories. This may be due the larger sample, thus increasing the statistical power, as well more males were following the moderate-declining IA and high-increasing PA (8) compared to the high IA-high PA (9) joint trajectory group.

In summary, these results show that youth who follow high levels of PA, high levels of IA and joint trajectories of high PA and high IA (Groups 8 and 9) are at an increased risk of maladjustment in emerging adulthood compared to their peers following low trajectories. These findings have important significance for prevention and intervention efforts. Programs that aim to reduce aggressive behaviour problems in children and adolescence should focus on a broader set of aggressive behaviours that include IA. Traditionally, programs have targeted adolescents engaged in PA and these results suggest that children and adolescence who engage in IA behaviours are at similar risk for maladjustment in emerging adulthood. These findings also highlight that although sex differences exist in the rate and frequency of symptoms across development, both boys and girls are likely to endorse symptoms of PA and IA, and intervention efforts should be targeted at both sexes accordingly. Finally, these findings indicate that although PA and IA are independent measurement domains (albeit highly-related constructs) they are related to similar maladjustment in emerging adulthood, leading to questions about whether the one may serve as a proxy to the other in future studies and whether the

combination of both PA and IA is adding anything above and beyond the single PA and IA trajectory analysis. In addition, based on the joint trajectory analysis, it appears that those with PA are more likely to have IA than those with IA also having PA, which may reflect differences in the severity of the PA items compared to the IA items. Future research should look at outcomes of IA while taking into account levels of PA symptoms and determine whether this association matters for maladjustment. Methodologically, it is possible that there is more heterogeneity in IA than what was found in this current study. Even though three trajectory groups supported the best fitting model, research has shown that with externalizing behaviour problems (including PA), increasing the age range, having more developmental periods, and increasing the number of assessments of the behaviour effects the number of groups and distribution of individuals within the groups (van Dulmen, Goncy, Vest, & Flannery, 2009), this should be explored in future IA and PA group-based trajectory studies.

When interpreting these findings, several limitations bear consideration. For example, the study sample is constrained to youth aged 10-15 years. In the future it would be advantageous to develop longitudinal trajectories starting at an earlier age, particularly since research has shown that peak levels of PA may be during toddler years (Tremblay, 2000).However, innovative research methods that take into account an inevitable change in informant (typically from parent to youth) would need to be employed. Another major limitation is sample loss. Although group-based trajectory modelling using FIML allowed for inclusion of respondents with partial data, there were still some differences between respondents who were included versus excluded from the analysis. As well, there was a

large sample loss of outcomes at ages 18-19 years of age. Longitudinal sample loss is often inherent to longitudinal community-based studies; it would be ideal to confirm these findings using other samples, particularly those with less sample loss. Although, this study was meant to highlight trends in adjustment at ages 18-19, future studies should carefully follow youth into emerging adulthood and utilize tracking methodology that would ensure a higher response rate. Finally, the breadth and availability of outcomes at ages 18 and 19 years of age were limited, particularly as there was no measure of PA, thus it was decided to include delinquency at age 18 and 19 given the measurement overlap between PA and delinquency. As well, there is definitely a need to further understand outcomes of aggressive trajectories in emerging adulthood beyond those available for analysis in this study – particularly for IA, where very little longitudinal work has been completed.

Table 1.Means and standard deviations of indirect and physical aggression for boys and girls across three biannual assessments.

Time	Physical Aggression							Indirect Aggression						
	Overall		Boys		Girls			Overall		Boys		Girls		
	M	SD	M	SD	M	SD	t	M	SD	M	SD	M	SD	t
Time 1	.69	1.02	.90	1.15	.49	.82	-9.39*	1.98	1.99	1.97	1.90	2.00	2.09	.385
Time 2	.58	1.06	.77	1.20	.39	.87	-7.80*	1.71	1.88	1.68	1.87	1.75	1.89	.861
Time 3	.51	1.00	.64	1.13	.38	.84	-5.43*	1.45	1.72	1.41	1.68	1.49	1.68	.965

M=Means; SD=Standard Deviations; t=t-test; * p>0.001

Table 2.Bivariate correlations between indirect and physical aggression symptom scales across three biannual assessments.

	1	2	3	4	5	6	7	8	9
1. PA T1	--	.34	.27	.37	.15	.10	.07*	.19	-.16
2. PA T2		--	.35	.23	.39	.20	.04**	.16	-.15
3. PA T3			--	.12	.16	.38	.09	.35	-.20
4. IA T1				--	.36	.19	.12	.08	-.12
5. IA T2					--	.42	.06*	.004**	-.08
6. IA T3						--	.07*	.12	-.13
7. Depression							--	.16	-.40
8. Delinquency								--	-.17
9. Emotional Quotient									--

PA=Physical Aggression; IA=Indirect Aggression; T1=Time 1, T2=Time 2, T3=Time 3
Correlations are significant at p<0.01 except *(p<0.05) and **(p>0.05)

Table 3. Parameter estimates of the best-fitting indirect and physical aggression trajectory models.

Classes (average posterior probability; % estimated population)	β0 (constant)	p	β1 (constant)	p
Physical Aggression				
1. High-Increasing (0.79; 15.3)	1.01	<0.001	0.22	0.02
2. Moderate-Declining (0.80; 52.2)	0.76	<0.001	-0.69	<0.001
3. None (0.63; 32.5)	-9.03	<0.001	-1.35	<0.001
Indirect Aggression				
1. High-Stable (0.80; 4.6)	6.21	<0.001		
2. Moderate-Declining (0.82; 65.5)	2.71	<0.001	-0.34	0.003
3. Low (0.77; 29.9)	0.36	0.54	-0.45	0.01

Table 4. Joint and conditional probabilities of physical and indirect aggression.

Indirect Aggression	Physical Aggression		
	None	Moderate Declining	High Increasing
Probabilities of Joint Trajectory Membership (Totals 100)*			
Low	.200 (1)	.108 (4)	.000 (7)
Moderate Declining	.081 (2)	.416 (5)	.125 (8)
High-Stable	.001 (3)	.000 (6)	.069 (9)
Probabilities of PA Conditional on IA			
Low	.650	.345	.000
Moderate Declining	.131	.669	.200
High-Stable	.008	.007	.985
Probabilities of IA Conditional on PA			
Low	.710	.206	.000
Moderate Declining	.288	.794	.644
High-Stable	.002	.001	.356

*Numbers in parentheses indicate the trajectory group number.

Table 5. Female sex and trajectories of indirect and physical aggression.

Trajectory Groups	% Girls	OR	95% CI
1. Low IA-No PA	56.8	1.50**	1.24-1.81
2. Mod. IA-No PA	62.6	1.80**	1.32-2.47
4. Low IA-Mod. Decline PA	41.0	0.70*	0.48-1.01
5. Mod. IA-Mod. Decline PA	47.6	0.88	0.75-1.04
8. Mod. IA-High Increas PA	35.1	0.52**	0.39-0.68
9. High IA-High Increas PA	46.7	0.90	0.61-1.32

The reference group was all other respondents not included in the specified group
    OR Odds Ratio, *CI* Confidence Interval **p<0.01; *p<0.05
N.B. Group 3, 6 and 7 were removed from this table as there are no respondents in these groups.

Table 6. Predicting emerging adulthood mean outcomes by trajectory group.

Outcome by model	Single Trajectories[1]			Joint Trajectories[2]				Partial eta[2]	Significant Class Differences[3]
	1	2	3	1	5	8	9		
Indirect Aggression (110)									
Depression	7.2	8.2	9.0					.01	2>1
Delinquency	.43	.73	1.1					.02	3,2>1; 3>2
Emotional Quotient	31.4	29.5	28.3					.03	3,2<1
Physical Aggression (111)									
Depression	7.2	8.1	9.1					.01	3,2>1
Delinquency	.37	.66	1.3					.07	3,2>1; 3>2
Emotional Quotient	31.3	30.0	27.1					.05	3,2<1; 3<2
Joint Physical and Indirect Aggression									
Depression				7.4	8.0	9.1	9.0	.01	8>1
Delinquency				.42	.64	1.4	1.1	.06	9,8,5>1; 9,8>5
Emotional Quotient				31.1	30.0	26.6	28.2	.05	9,8,5<1; 8<5; 9<1

[1] Indirect aggression, 1 = low; 2 = moderate-declining; 3=High-stable; Physical Aggression, 1 = None; 2 = Moderate-declining; 3 = High-increasing. [2]Joint trajectory groups, 1 = Includes joint trajectory groups 1 (low IA-No PA), 2 (Moderate IA-No PA) and 4 (Low IA-Moderate declining PA); 5 = Moderate IA-Moderate Declining PA; 8 = Moderate IA-High Increasing PA; 9 = High IA-High Increasing PA. [3]Class differences significant at <0.05 (only reported significant mean differences).

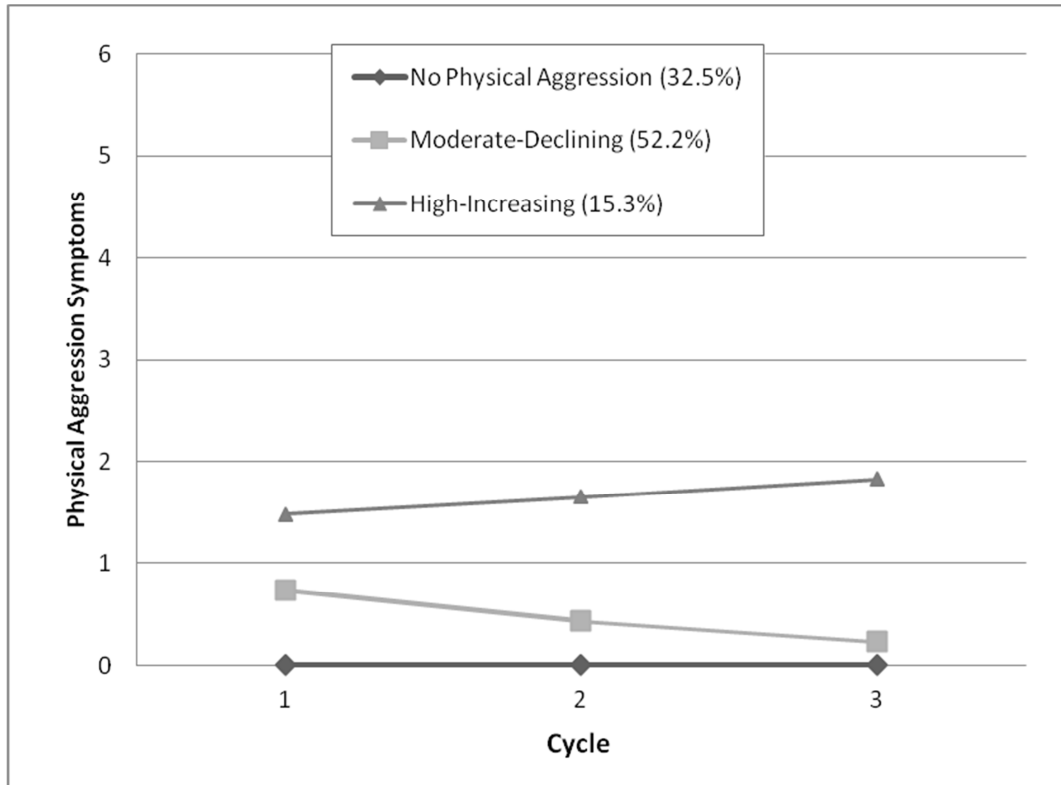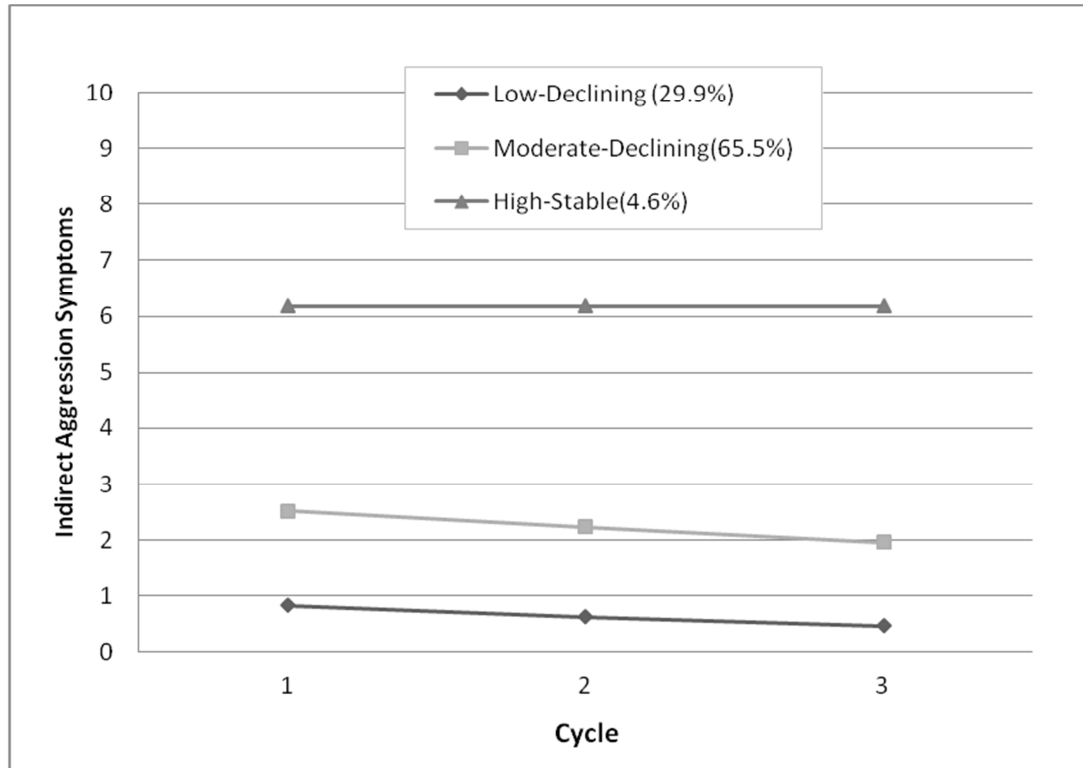**Figure 1.** Trajectory groups for physical aggression symptoms (Predicted values).

Figure 2. Trajectory groups for indirect aggression symptoms (Predicted values).

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CHAPTER 5

INDIRECT AND PHYSICAL AGGRESSION IN CHILDHOOD AND
ADOLESCENCE AND DEPRESSION IN EMERGING ADULTHOOD:
SEX DIFFERENCES

Until recently, research on aggression in childhood and adolescence has focused largely on physical aggression (PA). Several researchers have explained the developmental sequelae and consequences of physically aggressive behaviour. Longitudinal studies have demonstrated that aggression is one of the best predictors of future behavioural and psychological problems, notably delinquency and depression (Farrington, 1991; Hawkins et al., 1998; Herrenkohl, Catalano, & Toumbourou, 2009; Huesmann, Eron, Lefkowitz, & Walder, 1984; Lipsey & Derzon, 1998; Tolan & Gorman-Smith, 1998).Almost double the number of boys than girls report PA during childhood; however, these differences begin to disappear in late adolescence (Bongers, Koot, Van Der Ende, & Verhulst, 2004). Maladjustment related to PA has led clinicians and researchers to develop numerous prevention and intervention strategies (Boisjoli, Vitaro, Lacourse, Barker, & Tremblay, 2007; Burke, Loeber, & Birmaher, 2002; Conduct Problems Prevention Working Group, 2000; Curtis, Ronan, & Borduin, 2004; Tremblay, Pagani-Kurtz, Masse, Vitaro, & Pihl, 1995), as well as to try and understand a highly related and less understood form of aggression, indirect aggression (IA), which has also been linked to serious maladjustment.

Indirect aggression (IA)– also called "social aggression", "indirect bullying" or "relational aggression" (Bjorkqvist, 2001) - is a related form of aggression that describes a set of covert behaviours that are socially manipulative, like rumour spreading, talking behind someone's back and encouraging others to dislike someone else, but does not involve physical force (Bjorkqvist, 1994; Crick & Grotpeter, 1995; Lagerspetz, Bjorkqvist, & Peltonen, 1988; Macgowan, Nash, & Fraser, 2002). Studies of sex

differences in the development of IA have been inconsistent, with some studies finding more girls than boys exhibiting IA behaviours (Salmivalli, Kaukiainen, & Lagerspetz, 2000), more boys than girls exhibiting IA behaviour (Salmivalli & Kaukiainen, 2004; Tomada & Schneider, 1997), with others reporting no sex differences in the frequency (Archer, 2004; Coyne, Archer, & Eslea, 2006).

Indirectly aggressive behaviours are associated with an increased risk for later peer rejection and decreased peer acceptance, lower perceived popularity, fewer friends and an increase in relationally aggressive peer relationships in both cross-sectional (Johnson & Foster, 2005; Prinstein & Cillessen, 2003; Werner & Crick, 2004) and short-term longitudinal studies (Cillessen & Mayeaux, 2004; Cillessen & Borch, 2006; Crick, Ostrov, & Werner, 2006; Murray-Close, Ostrov, & Crick, 2007; Rose, Swenson, & Waller, 2004). IA has also been associated with behavioural and psychological problems – in particular, an increase in borderline personality disorder symptoms, internalizing symptoms (e.g. anxious-depressive symptoms) and delinquency (Crick & Grotpeter, 1995; Crick et al., 2006; Ellis, Crooks, & Wolfe, 2009; Heilbron & Prinstein, 2008; Murray-Close et al., 2007).

Although great advances have been made in the study of PA and IA and behavioural and psychological adjustment in recent years, there remain two major limitations: i) the lack of prospective studies across multiple developmental periods; and ii) the lack of studies that account simultaneously for the effects of both PA and IA. Longer term prospective studies are important for understanding the development of these behaviours and determining critical periods for early identification and intervention (Crick et al.,

2006). Although a few prospective studies of both PA and IA have been completed to date, they have focused mainly on short-term follow-up studies in childhood (Crick et al., 2006; Herrenkohl, Catalano, Hemphill, & Toumbourou, 2009) or have focused exclusively on adjustment associated with social relations in adolescence (Cillessen & Mayeaux, 2004; Crick, 1996). Questions of change or the progression of behaviour over time requires a longitudinal design in which both PA and IA are considered concurrently and adjustment is assessed at a later time point. There remains a need to establish the developmental consequences of PA and IA using prospective designs across multiple developmental periods and with outcomes that have been associated with both PA and IA. Furthermore, given that past studies have shown that PA and IA are moderately correlated (Card, Stucky, Sawalani, & Little, 2008; Crick, Casas, & Mosher, 1997; Côté, Vaillancourt, Barker, Nagin, & Tremblay, 2007; Kaukiainen et al., 1999; Underwood, Beron, & Rosen, 2009; Vaillancourt, Miller, Fagbemi, Côté, & Tremblay, 2007)and develop concurrently (Cleverley et al, 2011; Côté et al., 2007; Miller, Vaillancourt, & Boyle, 2009; Underwood et al., 2009; Vaillancourt, Brendgen, Boivin, & Tremblay, 2003) it is important to determine whether IA adds significantly to our understanding of children's future adjustment problems above and beyond that associated with PA (Herrenkohl et al., 2009). Recent research has shown that although the combination of PA and IA is a particularly powerful risk factor for maladjustment during childhood, IA is uniquely associated with outcomes – particularly anxious/depressive symptoms (Crick et al., 2006). Similar to studies on the concurrent development of PA and IA, studies on outcomes of both types of aggression are based on a single developmental period and

have short follow-up periods (e.g. 1 year). Thus there remains a need to determine

whether these findings extend beyond a single developmental stage.

Understanding the developmental relationships between behaviour (e.g. conduct

disorder, delinquency, aggressive behaviours) and emotions (e.g. depression and anxiety)

has become a focus of recent research (Burke, Loeber, Lahey, & Rathouz, 2005; Paquette

Boots, Wareham, & Weir, 2011). This process is often referred to as heterotypic

continuity when the presence of one behavioural disorder in childhood and adolescence is

associated with an increased risk for other disorders (Costello, Mustillo, Erkanli, Keeler,

& Angold, 2003). For example, evidence suggests that conduct disorder in childhood

predicts depression in adulthood, but not the other way around (Burke et al., 2005;

Harrington, Fudge, Rutter, Pickles, & Hill, 1991; Harrington, Rutter, & Fombonne, 1996;

Lahey, Loeber, Burke, Rathouz, & McBurnett, 2002). It is likely that conduct disorder

and depression models of heterotypic continuity vary by sex (Paquette Boots et al., 2011).

The developmental theory guiding these analyses is the Failure Model developed by

Patterson and Capaldi (1990). The Failure Model posits that a child or youth who

demonstrates delinquent behaviours (which include physical/overt aggression) elicits

negative reactions from their environment, including peer rejection, difficult parental

relationships and academic difficulties (Patterson & Capaldi, 1990). These negative

reactions disrupt the normal socialization process and ultimately lead to depressed mood.

While the Failure Model has not been applied to indirect forms of aggression, the linkage

between IA and difficult social relationships (e.g. peer rejection) has been documented in

the past (Cillessen & Mayeaux, 2004; Cillessen & Borch, 2006) leading to

recommendations that this model be tested with more covert forms of aggression (e.g. IA) (Paquette Boots et al., 2011). As well, it would be advantageous to determine whether the Failure Model operates similarly for boys and girls in a longitudinal sample when both PA and IA are taken into account simultaneously.

The aim of this paper was to investigate whether PA and IA predict depressive symptoms in emerging adulthood when both types of aggression are entered into the same model. The following hypotheses were examined. First, we predicted that both PA and IA would show significant stability from late childhood to early adolescence, such that respondents who were elevated for either or both behaviours would stay elevated. We further hypothesized that, given the Failure Model, both PA and IA in late childhood and adolescence will be related to depression, and that the association will be stronger at ages closer to the outcomes (e.g. age 15 versus age 11). Finally, we predicted that the magnitude of the effects of PA, IA, and depression would vary, with the relationship between PA and depression being greater for boys than girls but that for IA it would be greater for girls than boys.

Method

Participants

Data came from Cycles 1 (1994), 3 (1998) and 5 (2002) of the Canadian National Longitudinal Study of Children and Youth (NLSCY) (Statistics Canada, 1995; Statistics Canada, 1997; Statistics Canada, 1999; Statistics Canada, 2005). The NLSCY began in 1994 with data collection on a cohort of 22,831 children aged 0-11 years, living in 13,439

households (86.3% response) across Canada. Children were identified using a stratified, multistage probability sample design based on area frames in which dwellings (residences) were the sampling units. At Cycle 1 up to 4 children per household could be selected to participate. In subsequent cycles the number of children was capped at 2 children due to response burden for some families. The longitudinal sample was followed every 2 years. Surveys were completed in the home using computer-assisted interviews with the Person Most Knowledgeable (PMK) about the children. Youth aged age 10-15 also completed the Youth Self Report Survey (YSR). Full details of sampling procedures and assessments can be found in the NLSCY User's Guides 1, 3, and 5 (Statistics Canada, 1995; Statistics Canada, 1997; Statistics Canada, 1999).

The sample cohort for this study included all youth aged 10 and 11, selected to be followed longitudinally at Time 1 of the NLSCY (n=2488) who had completed all items on at least one of the PA and IA assessments at Cycle 1, and PA and IA assessments at Cycle 3, and complete depression items at Cycle 5. In total, 67% of the study participants had available data at Cycle 5 (n=1655), and, of these, 1375 had at least one complete assessment of PA and IA at either Cycle 1 and/or Cycle 3. Thus the final sample included 1375 of the 2488. Sampling weights, developed by Statistics Canada, were applied to each participant for demographic data so that their responses would be linked numerically to the general population of Canadian children aged 10-11 years in 1998/99 (Statistics Canada, 1999). For ease of interpretation and understanding, Cycle 1 will be referred to as Time 1 (ages 10-11), Cycle 3 as Time 2 (Ages 14-15) and Cycle 5 as Time 3 (Ages 18-19).

Missing data

The statistical approach used in this study, SEM (described below), can model data of participants with some missing data using full information maximum likelihood (FIML) in AMOS (Jones et al., 2001). Youth excluded from the analysis for not meeting the inclusion criteria (described above) (n=1113; 44.7%) were not significantly different than the final sample (n=1375) on age (age 10, 50.6% excluded versus 49.7% included, p=0.315) and living in single parent home at Time 1 (single parent, 19.2% excluded versus 16.7% included, p=0.372). However, those excluded were more likely to be boys (56.1% excluded versus 47.5% included were boys, p=0.007) and living in a home from the lowest income bracket at Time 1 (19.0% excluded versus 10.8% included, p<0.001). Comparison of Cycle 1 PA and IA scores revealed those who were excluded had higher IA scores [IA, 2.10 versus 1.90; $t(2047)$=-2.300, p=.020] but similar PA scores [PA, 0.74 versus 0.66; $t(2071)$=-1.762, p=0.08] than those included in the sample.

Measures

Youth self-reported Aggression. Each youth was asked five indirect aggression and three physical aggression items using a three-point Likert scale (often/very true = 2; sometimes/somewhat true = 1; never/not true = 1) at both Time 1 and Time 2.

Physical Aggression. The three physical aggression items were: How often would you say that you "get into many fights," "kick, bite, hit other children," and "physically attack

people" (Statistics Canada, 1995). Composite scores were computed for "Physical

Aggression" by summing the values attached to the 3 items, creating a score ranging from

0 to 6. Higher scores indicated more use of physical aggression. This scale showed

adequate internal consistency with coefficient alphas of .58 at Time 1 and .72 at Time 2.

Indirect Aggression. The five indirect aggression items were: How often would you say

that you "become friends with another as revenge," "say bad things behind the other's

back," "when mad at someone, get others to dislike him/her," "say to others: 'let's not be

with him/her,'" and "tell the other one's secrets to a third person" (Lagerspetz et al.,

1988). Composite scores were computed for "Indirect Aggression" by summing the

values attached to the 5 items, creating a score ranging from 0 to 10. Higher scores

indicated more use of IA. This scale showed good internal consistency with coefficient

alphas of .69 at Time 1 and .73 at Time 2.

Outcome Measure

Depressive symptoms were measured using 12 items from the CES-D developed by

(Radloff, 1977) validated with the NLSCY sample by Poulin and Colleagues (2005). This

score provided a measure of the frequency of depressive symptoms by focussing on the

occurrence and severity of symptoms during the previous week. This scale is not a

diagnostic tool for clinical depression; rather it quantifies levels of depressive

symptomology. Items include: "I felt depressed," "I felt I could not shake off the blues

even with help from my family and friends," and "I felt that everything I did was an

effort". The 12 items were scored on a scale of 0 (rarely or none of the time) to 3 (most or all of the time) and these score values were summed to create a total scale score from 0 to 36, with higher scores indicating more depressive symptoms. This scale showed good internal consistency with a coefficient alpha of .84.

Analysis

Descriptive statistics were conducted using PASW Statistics Version 18.0 (IBM Inc., 2010b). Paired t-tests, bivariate correlations and contingency tables were used to examine the demographic characteristics and the association among study variables, particularly PA, IA and depression.

Structural Equation Modelling/Confirmatory Factor Analysis.

Hypotheses were tested by examining PA and IA and their associations with depression in a structural equation model. First, we examined the stability of the wave-to-wave associations of PA and IA from late childhood (ages 10/11 or Time 1) to adolescence (ages 14/15 or Time 2). Second, we determined the association between PA and IA at both Time 1 and Time 2 and depression in emerging adulthood (ages 18/19 or Time 3). Finally, we determined whether sex had an effect on the associations between PA and IA with depression using multiple group confirmatory factor analysis (MGCFA).

We used structural equation modelling (SEM) in AMOS 19.0 (IBM Inc., 2010a) with full information maximum likelihood (FIML) estimation to quantify associations between PA and IA assessed during childhood (age 10/11) and adolescence (age 14/15)

and levels of depressive symptoms in emerging adulthood (age 18/19). The analysis was completed in a series of steps, beginning with a structural equation model (SEM: path analysis) of PA and IA at ages 10/11, ages 14/15 and depression at ages 18/19, followed by MGCFA for sex (boy/girl). Figure 1 shows the path analysis for the associations that will be tested in this analysis.

We tested the invariance of the measurement structure with AMOS using a multi-group modelling procedure, first testing invariance across time using the total sample (1375) followed by tests of cross-sex group invariance (sample split by sex). The first step was to test whether a two-factor model for each of the two time periods and the outcome depression fit the data well. Thus, a model was specified with a total of four observed factors (PA and IA at Time 1 and physical and indirect aggression at Time 2) and one outcome variable (depression). Residual variances of the same indicator were allowed to correlate across the two time points and all observed factors were free to correlate both concurrently and across the two time points (i.e., the correlations among observed variables at Time 1 and the correlations among error variances at Time 2). No equality or cross-group equality constraints (i.e., across time or sex) were imposed in this initial baseline model; thus, all factor loadings, residual variances, and correlations among the latent factors were freely estimated. The second step was to test cross-sex group invariance. Multiple group confirmatory factor analysis provided a framework for testing the equivalence of the model across sex (Byrne, 2010; Cheung & Rensvold, 2002; Meredith, 1993; Meredith & Teresi, 2006; Schmitt & Kuljanin, 2008). With a goal of determining whether or not there were sex differences in the model of PA and IA at Time

1 and Time 3 predicting outcomes at Time 3, we constrained the structural weights (regression weights) to be equal across boys and girls and tested the change in model fit from the unconstrained model. A multiple-group analysis also provided the means for testing the statistical significance of observed differences between girls and boys in the strengths of associations between PA and IA in childhood and depression in emerging adulthood. The multiple-group analysis also aided in determining whether the effect of PA and IA on adjustment differed by sex and, if so, where the differences occurred.

Although the χ^2 test of significance is often reported in measurement equivalence studies to assess model fit, it is highly sensitive to sample size and group balance (Brown, 2006; Kline, 2005; Singh, 2009). In addition to reporting χ^2 test results, we drew on research by Singh (2009) and Cheung and Rensvold (2002), and focussed on four other goodness-of-fit indices (GFIs) - the Comparative Fit Index (CFI), Tucker-Lewis index (TLI), Incremental Index of Fit (IFI), and the Root Mean Square Error of Approximation (RMSEA). Several reviews of GFI's suggest the following 'rules of thumb' for determining overall model fit: RMSEA <0.06, TLI >0.95, and CFI >0.95 (Hu & Bentler, 1998; Singh, 2009). The RMSEA is the preferred GFI, as it is sensitive to model misspecification and provides confidence intervals (CI) about the precision of the estimate of fit (Byrne, 2010; Jackson, Gillaspy, & Purc-Stephenson, 2009; McDonald & Ho, 2002). In addition, of over 30 indices reviewed by Marsh and colleagues (1998) the TLI was the only incremental fit index that was relatively independent of sample size (Marsh et al., 1988).

Results

Descriptive Statistics and Bivariate Relation Amongst Study Variables

Means, standard deviations and correlations for ratings of PA and IA symptoms at Time 1 (ages 10-11) and Time 2 (ages 14-15) and depression at Time 3 (ages 18-19) are presented in Table 1. The mean level of IA symptoms for the sample decreased between ages 10/11 to ages 14/15 and PA decreased between ages 10 /11 to ages 14/15. Analysis by sex shows that females have significantly higher depression scores at Time 3 and boys have significantly higher PA scores at both Time 1 and 2, whereas no differences were found between boys and girls for IA scores at Time 1 and 2. The correlations between the IA assessments at Time 1 and Time 2 was .13 and statistically significant (p<0.01) (see Table 2). The correlations between the PA assessments at Time 1 and Time 2 was .28 and statistically significant (p<0.001). The correlations between PA and IA at each time point remained similar over time (r = .35 at Time 1; r = .34 at Time 2) and all were statistically significant (p<0.05). These correlations were stronger for boys (Time 1, r = .44; Time 2, r = .41) than girls (Time 1, r = .22; Time 2, r = .25). The association between IA at Time 1 and depression at Time 3 reveal a correlation of .14 (p<0.01), approximately double the size of the correlation between IA at Time 2 and depression at Time 3 (.06; p<0.05). As well, the correlation between Time 1 IA and Time 3 depression was stronger for girls (r = .17) than for boys (r = .12). The correlations between PA at both Time 1 and Time 2 and depression at Time 3 reveal correlations of .07 (p<0.05) and .08 (p<0.05) respectively.

Baseline Model for the Stability of Aggression

Figure 1 displays the results of fitting the baseline model to the entire sample.

This model tests the predictive relations between the PA and IA constructs and the

concurrent correlations over the two time assessments. All latent correlations and paths

were freely estimated and no cross-group equality constraints were imposed in this initial

model. The SEM of the stability of PA and IA from ages 10/11 to 14/15 to depression in

emerging adulthood showed good fit to the data χ^2 (2) = 0.96, CFI = 1.00, RMSEA = .000

(90% CI = .000-.000), TLI = 1.00, IFI = 1.00. The correlation between Time 1 PA and IA

was significant (.43, p<0.001) as was the correlation for the residuals for Time 2 (.31,

p<0.001). Stability estimates, which refer to the standardized regression coefficients

between the successive measurement points, were: from Time 1 to Time 2, .26 (p<0.001)

for PA .21 (p<0.001) for IA.

Association between Childhood Aggression and Depression in Emerging Adulthood

Next, we tested the predictive relations between PA and IA at Time 1 and Time 2

to depression at Time 3. Standardized regression coefficients for this model (see Figure

1)show that IA at Time 1predicted increases in depression scores at Time 3 (β = .07;

p<0.05), while controlling for PA at Time 1 and 3. On the other hand, only Time 2 PA,

not Time 1 PA, predicted increases in Time 3 depressive symptoms (β = .12; p<0.05),

while controlling for IA at Time 1 and 3.

Sex Effects

The measurement model described above served as the basis for examining whether the path structure was invariant across sex. A multi-group analysis provided the means for testing the statistical significance of observed differences between girls and boys in the strengths of associations between physical and indirect aggression and depression. No equality constraints were imposed on the model and boys served as the reference group. This model showed good fit to the data, x^2 (4) = 3.24, CFI = 1.00, RMSEA = .000 (90% CI = .000-.037), TLI = 1.00, IFI 1.00. Standardized regression weights (see Figure 3) show that for boys, only the path between Time 2 PA and Time 3 depression was significant (β = 0.17; p<0.05), while for girls the path between Time 2 PA and Time 3 depression was significant (β = 0.11; p<0.05) as was the path between Time 1 IA and Time 3 depression (β = 0.09; P<0.05). We then tested whether the specific associations between paths would vary across sex by constraining the regression weights in both groups to be equal. Model fit was good, x^2 (10) = 9.51, CFI = 1.00, RMSEA = .000 (90% CI = .000-.030), TLI = 1.00, IFI = 1.00, and did not show a loss in practical model fit after imposing equality constraints, Δ CFI = 0.00.

Discussion

The aim of the present study was to examine the relationship of PA and IA with depression in early adulthood. Guided by Failure Theory, it was hypothesized that PA at Time 1 and Time 2 would be associated with depression at Time 3. This theory was extended to include IA, a more covert form of aggression.

Consistent with other research (Crick et al., 2006; Kokko & Pulkkinen, 2005; Miller et al., 2009; Vaillancourt et al., 2003), both PA and IA were found to be stable from late childhood to adolescence. Wave-to-wave correlations were significant for both PA (r =.28) and IA (r =.13) between Time 1 and Time 2. The link between child and adolescent aggression was also confirmed using MGCFA: for both sexes there was good stability from Time 1 to Time 2 (age 10/11 to 14/15) for both PA and IA, however, boys had higher coefficients for both PA and IA from Time 1 to Time 2. Findings also indicate that IA, and not PA, at an early age (10-11 years)has a direct effect on depression in emerging adulthood. However, PA at Time 2 (ages 14-15) is associated with depression in emerging adulthood but not IA at Time 2.

These findings confirm the importance of childhood behaviours (such as aggression) on maladjustment in emerging adulthood, particularly for depression. The Failure Model posits that social, academic and relationship failures associated with early aggressive behaviours are severe and pervasive. Although this study did not test all of the aspects of the Failure Model (e.g. the moderating impact of academic failure on depression), it did highlight that for boys and girls PA has a direct and more potent influence on depression in emerging adulthood than IA. This is a novel finding, although research to date has provided evidence, particularly with boys (Burke et al., 2005; Campbell, Spieker, Burchinal, Poe, & The NICHD Early Child Care Research Network, 2006; Capaldi & Stoolmiller, 1999), for the association between conduct and antisocial behaviours in childhood and depressive symptoms in emerging adulthood. However, no studies to date have determined whether IA is also a predictor. Another important finding

is that, for girls only, IA in childhood did have a delayed effect on depression in emerging adulthood. Since IA is inherently related to social relationships, any alteration in the 'normal' developmental processes may lead to the cascade of negative processes described in the Failure Model (Boots et al, 2011; Patterson & Capaldi, 1990). Possible explanations for the delayed effect of IA may be that the timing of the assessments coincided with developmental transitional periods, the age range for Time 1 (age 10/11), which would be prior to puberty for most girls, and Time 2 (ages 14/15), which was assessed during the transition to high school, both Time periods coincide with changes in social relationships (Barber & Olsen, 2004; Benner & Graham, 2009). These transitional periods should be assessed in future research, particularly as they relate to the development of both PA and IA symptoms in both boys and girls (Rutter, 1996).

A particularly important finding is that the relationships or associations between study variables (see Table 1 and Table 2) were not very strong. This may have been due to the limitations of the study variables and design (see below) but may also have been due to the length of time between assessments, as there is four years between study time points. During these two-four year periods several extraneous variables (particularly as the time periods that coincide with transitions between elementary school, high school and graduation) could have affected the associations between PA, IA and depression. Other limitations also need to be considered. An important limitation is the limited range of the PA and IA items used in the NLSCY. For example, the PA measure is based on three items, providing a possible score of 0 to 6, and the findings indicate a very small mean score for Time 1 and Time 2 (0.70 and 0.50). Although there were few violations in

normality (an assumption of SEM) this may have affected the strength of the effects between PA, IA and depression. As well, differential reliability may have impacted the results in that the reliability of the PA and IA measures increased from Time 1 to Time 2 (e.g. Cronbach's alpha for PA increased from 0.58 at Time 1 to 0.72 at Time 2). In addition, although sex specific reliability shows that the cronbach's alphas for IA at both Time 1 and Time 2 were similar for boys and girls, Time 1 PA was significantly lower for girls (0.38), compared to boys (0.63), indicating this scale may not be adequately measuring physical aggression in girls, particularly at the younger age (10-11). The change in reliability of the variables in the model may have impacted the magnitude of the associations between PA, IA and the outcome depression.

Another limitation, measures of PA and IA for ages 10/11 and 14/15, were included to provide information across multiple developmental periods (late childhood and adolescence); however, it would be advantageous to have included assessments earlier in childhood and later in adolescence. Finally, the sample loss due to missing data at both the respondent and the item-level (i.e. specific items within the aggression instrument missing) must be considered. However, in this study using FIML in the SEM analysis did aid in the inclusion of respondents with missing PA and IA measurements at Time 1 or Time 2, declining the percentage of respondents dropped from the analysis. Missing data is inherent to most longitudinal population-based studies and the NLSCY is no exception.

Implications

These findings indicate that one potentially key focus of treatment should be for children who begin to demonstrate PA symptoms during childhood and for girls with IA symptoms, as these groups may be at a greater risk for developing worsening behaviour and depression in emerging adulthood. In addition, it may be the case that clinicians do not take into account the indirect forms of aggression and focus more on the overt physical displays of aggression especially in boys. Yet, at least the early presence of IA (particularly with girls) appears to be associated with a latent effect on depressive symptoms in emerging adulthood, even when controlling for PA. The Failure Model may provide a framework for this finding, where children who use high levels of IA during childhood and adolescence may have strained personal relations and are perhaps alienated from forming healthy social relationships, as reported in previous research (Crick & Grotpeter, 1995; Ellis & Zarbatany, 2007; Grotpeter & Crick, 1996; Sebanc, 2003).

Future research will further disentangle the unique and shared effects of PA and IA on adjustment, while taking into account both forms of aggressive behaviour. As well, there is a need to understand whether PA and IA affect other outcomes in emerging adulthood beyond depression, like delinquency and social relationships. These lines of research should be pursued with samples of both boys and girls, given the findings that models of PA, IA and depression varied by sex and that the paths between aggression and maladjustment have been found to be different for boys and girls (Costello et al., 2003).

Finally, the Failure Model presents an opportunity to understand the effects of PA and IA on adjustment later in life, particularly for mood disorders, like depression. As

depression is one of the most costly medical illnesses in society and the number one cause of sick days (Greenberg et al., 2003; Stephens & Joubert, 2001; Stewart, Ricci, Chee, Hahn, & Morganstein, 2003), it is imperative to further understand how particularly common behaviours of childhood, like PA and IA, influence depression in later development.

Table 1. Study variables and sample demographics.

|	M (SD) Overall	Range	M (SD) Boys	M (SD) Girls	t
Indirect Aggression, T1	1.9 (1.9)	0-10	2.0 (1.9)	1.9 (1.9)	1.4
Indirect Aggression, T2	1.5 (1.7)	0-10	1.5 (1.8)	1.5 (1.7)	0.2
Physical Aggression, T1	0.7 (1.0)	0-6	0.9 (1.2)	0.4 (0.8)	8.6**
Physical Aggression, T2	0.5 (1.0)	0-6	0.7 (1.2)	0.3 (0.8)	5.9**
Depression, T3	8.0 (5.9)	0-31	7.4 (5.5)	8.6 (6.2)	3.7**
Youth age*	51.5 (0)				
Youth sex*	49.2 (0)				

*Youth age (0=10; 1=11) and youth sex (0=Boy; 1=Girl) percentages reported
M=Mean; SD=Standard Deviation; t=t-test; T1=Time 1; T2=Time2; T3=Time 3**
$p<0.001$

Table 2. Correlations among study variables and by sex (boys/girls).

|	1.	2.	3.	4.	5.
1. Indirect Aggression, T1	--	**.13***(.17*/.10)	.35*(.44*/.22*)	**.10***(.08/.09)	**.14***(.12*/.17*)
2. Indirect Aggression, T2		--	.05 (**.11**/-.03)	**.34***(.41*/.25*)	**.06** (.08/.04)
3. Physical Aggression, T1			--	**.28***(.27*/.20*)	**.07** (.11*/.09)
4. Physical Aggression, T2				--	**.08** (.09/.10)
5. Depression, T3					--

Values in bold indicate $p<0.05$; and * $p<0.01$

Figure 1. Structural equation model of physical aggression, indirect aggression, and depression.
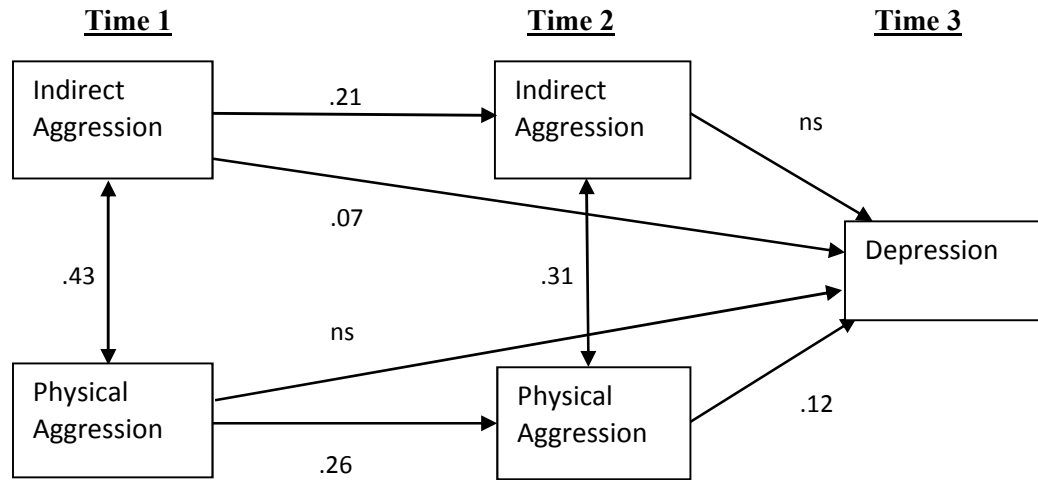
Note. Standardized coefficients are reported. All paths reported are statistically significant at *p* <.05; ns = not statistically significant

Figure 2. Structural equation model of physical aggression, indirect aggression, depression by sex.
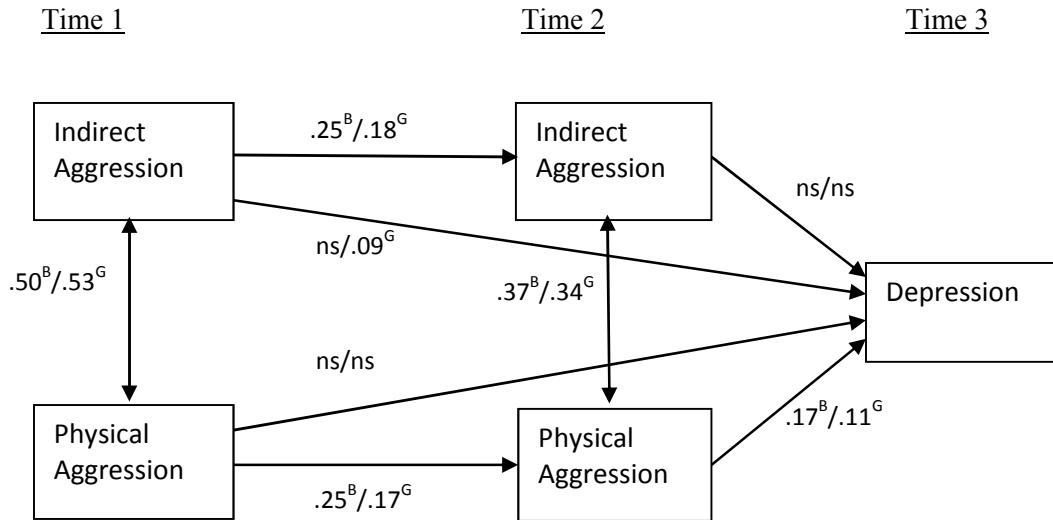
Time 1   Time 2   Time 3

Note. Standardized coefficients are reported. All paths reported are statistically significant at *p* <.05. G = girls; B = boys; NS = not statistically significant

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CHAPTER 6

GENERAL DISCUSSION

Two related developmental behavioural processes, physical and indirect aggression, are a normative feature of child development. However as children grow, the focus on appropriate use and regulation of aggression is key to successful development – particularly sincehigh symptoms of one or both forms of aggression can be associated with maladjustment. The preceding chapters (Projects 1, 2, 3 described in chapters 3, 4 and 5) provide insight into the development of physical aggression (PA) and indirect aggression (IA) in childhood and adolescence and the outcomes associated with high levels of these behaviours in emerging adulthood. The three dissertation projects were developed to address two previously noted limitations in the aggression field, namely1) the lack of evidence fora two-factor measurement structure of PA and IAapplicable to adolescent boys and girls, and 2) the lack of research on the outcomes in emerging adulthood of joint trajectories formed by PA and IA. In the first Project, the structural relationship between the items and factors for PA and IA by sex and informant were described; in the second paper, the developmental trajectories of PA and IA and links with respective outcomes in young adulthood using group-based trajectory analysis were explored; and finally, in the third paper, the temporal relationships between variation in PA, IA and one outcome in particular, depression, were described using structural equation modeling.

The findings of this dissertation confirm the importance of exploring heterogeneity in the development of PA and IA, particularly as it evolves from childhood

through to adolescence. Project 1 established the importance of sex and informant in the measurement of PA and IA. Although separate constructs, PA and IA are highly correlated and share common variance (Project 1). The majority of children (perhaps the "normative" phenotype of the development of aggression) follow trajectories of declining PA and IA; however, a small group of children will not, underscoring the importance of using group-based trajectory modelling (Project 2) to characterize and investigate that heterogeneity. The finding in Project 2 that trajectories of high IA, high PA and joint trajectories of high PA and IA all predicted maladjustment in emerging adulthood led to the hypothesis tested in Project 3: Does IA predict outcomes above and beyond PA? Findings from Project 3 confirmed the importance of taking into account the shared variance when establishing relationships between forms of aggression in childhood and adolescence and depression in emerging adulthood (Project 3).

Theoretical and Research Implications

In addressing the research objectives of this dissertation, it is apparent that group differences do exist in the development of aggression in childhood and adolescence. Using group-based trajectory analysis groups of high, moderate and low PA and IA were identified. Although this study was novel in that it used self-reported assessments of both PA and IA behaviour, these findings largely confirm other longitudinal group-based studies of PA and IA when studied separately. This investigation found that almost half of the respondents followed moderate-declining IA and moderate-declining PA trajectories over time. This does not fully support Bjorkqvists' theory of aggression development, as most adolescents exhibited downward trajectories of IA over time, rather than upward

trajectories as the theory posits (Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992; Bjorkqvist, 1994; Lagerspetz, Bjorkqvist, & Peltonen, 1988). The longitudinal nature of this study and the use of person-centered analysis, as opposed to the cross-sectional nature of the studies used to initially develop Bjorkqvist' theory, allowed for a more rigorous understanding of the development of aggression beyond that of Bjorkqvist's theory.

This research also suggests that due to the shared variance in forms of aggression, both PA and IA need to be considered in the same measurement model when investigating relations with outcomes. Project 2 highlighted that high trajectories of both PA and IA were related to increased depression symptoms in emerging adulthood; however, Project 3 provided further evidence that the pathways to depression are more complicated when the shared variance of PA and IA is considered. Factoring this in, the findings indicate that IA, and not PA, at an early age (10-11 years) has a direct effect on depression in emerging adulthood. However, PA at Time 2 (ages 14-15) is associated with depression in emerging adulthood but not IA at Time 2. However, further sex-based analysis suggests that there appear to be sex differences in the timing and strength of the association between IA and depression but no such differences between PA and depression. These findings suggest that sex needs to be considered when investigating the relationship between the development of aggressive behaviours and psychiatric morbidity in emerging adulthood

Methodological Limitations

Although many of the findings of this dissertation are novel, they need to be viewed in light of the methodological limitations present . First, despite the fact that Project 1 confirmed the two-factor model of PA and IA based on youth- and parent-reported data, it is likely that the expression of PA and IA changes over time, requiring different items based on the developmental stage of the respondent and particularly later in adolescence. Unfortunately, such analysis was not possible in the current investigation due to the lack of data collected beyond age 15 and the limited number of items available to assess PA and IA. In addition, the limited number of items available for analysis (e.g. three PA items) may have limited the reliability of the measure and may have affected the size of the groups found in the group-based trajectory modelling. For example, in Project 2 the mean baseline number of PA symptoms in the three groups were approximately 0, 0.5, and 1.5. Only having three items allows for limited variability in scores.

Similarly, this investigation was exclusively based on secondary analysis of the National Longitudinal Study of Children and Youth (NLSCY). Although there are several advantages to using secondary data (e.g. cost-saving and access to a large nationally-representative sample) limitations do exist, most notably missing data. Each of the three projects had varying amounts of missing data, specifically; 23.8% in Project 1, 6.0% in Project 2, and 44.7% in Project 3. In an attempt to handle missing data in this dissertation, various analytical methods were employed – including Full Information Maximum Likelihood (FIML) for the group-based trajectory analysis (Nagin & Odgers, 2010) and

Maximum Likelihood Estimation (MLE) for the structural equation modelling (Byrne, 2010).

Another issue that warrants consideration was the use of the group-based trajectory modelling analytical technique, also known as latent class growth models. The use of this modelling technique was central in determining the differences that exist in response patterns over time of PA and IA. However, as with many novel analytical techniques, group-based modelling is not without its critics (commentary see Sampson & Laub, 2005). Issues with the group-based trajectory modelling technique include the assumption of distinct trajectory groups, identification of groups that are not theoretically relevant, and the sensitivity of the methodology to sample size and length of follow up.

One of the most prominent concerns is the faulty perception that group-based modelling leads to the identification of 'distinct' groups of individuals (Brame, Paternoster, & Piquero, 2011; Skardhamar, 2010). This critique, however, is a result of how researchers interpret the product of these methods, rather than an actual disadvantage of the analytical methodology (Brame et al., 2011). In fact, even the developer of the method (Nagin, 2005) has warned against the reification of the trajectory groups found using his methodology. Thus, in this dissertation, groups were not referred to as absolute and distinct, as this modelling approach does not determine actual group membership rather the probability of group membership (Brame et al., 2011). What cannot be lost in this specific critique is the usefulness of this analytical method with its improved ability

to understand common risk factors and outcomes related to the heterogeneous groups (Brame et al., 2011).

Another concern of group-based modelling is that it can identify groups that are not theoretically significant or meaningful (Sampson & Laub, 2005; Skardhamar, 2010). Group-based modelling will always identify a number of groups, but those groups may not be meaningful or supported by external validators. As a result, investigators are encouraged to (1) compare trajectory groups on risk factors and outcomes, and (2) ensure that the model is testing a heterogeneous theory about the behaviour(s). First, trajectory groups can be compared on relevant characteristics, which can be done after having classified persons to specific groups and then comparing the groups based on risk factors and/or outcomes (Nagin, 2005; Nagin & Odgers, 2010). Second, as group-based modelling is meant to test a specific theory of the heterogeneous development of a behaviour, researchers should provide theoretical rational for the use of group-based modelling (Brame et al., 2011; Nagin & Tremblay, 2005; Skardhamar, 2010). In this dissertation, the a priori hypothesis that there are different groups of adolescents with different trajectories of aggression was based both extensive literature (see Table 1: Chapter 1) and the theory used to guide Projects 1 and 2 – Bjorkqvists' developmental theory of aggression.

Critics of group-based modelling have suggested several methodological aspects of the study may affect the number of groups identified, specifically the sample size and length of follow up, which can lead tothe spurious groups or multiple groups when in fact a single group exists(Eggleston, Laub, & Sampson, 2004; Skardhamar, 2010). Sampson,

Laub, and Eggleston (2004) suggested that the number of trajectory groups identified by the group-based technique may vary with sample size, with a larger sample yielding more groups. However, researchers have reported that the number of trajectories in the preferred model were unaffected by sample sizes of greater than 200 cases (D'Unger, Land, McCall, & Nagin, 1998; Nagin, 2005; Sampson et al., 2004). Given that the sample for Project 2 was over 2,000, the number of groups should be relatively stable. Finally, another critique is that the length of follow-up may also affect the number and shape of the trajectories (Eggleston et al., 2004). Nagin and colleagues highlight that trajectories only model the pattern of behaviour that has been observed during a particular period of time and problems only arise when trajectories are used to draw conclusions outside of the time period examined (Nagin & Tremblay, 2005; Nagin, 2005). This critique equally applies to other longitudinal analytical techniques, not just group-based trajectory modelling (Garner, 2007). An advantage of this dissertation over much of the previous aggression research was the sample used for Project 2 was purposefully selected to cross over both the childhood and adolescent developmental periods (ages 10 to 15). Ideally the aggression items in the NLSCY would have followed the sample beyond 15; however, this is a limitation inherent to the use of secondary data.

Future Research

The findings of this dissertation suggest a number of avenues for future research, including:

1. The importance of using both variable-centred and person-centred analytical methods when seeking to understand the development of behaviours which are highly correlated and share variance, such as PA and IA. Person-centred analysis allows for the description of how groups of individuals develop similarly over time and for more than one behaviour or disorder, while variable-centered analysis is particularly important when seeking to understand the association with predictors and outcomes on behaviours. This is especially important for behaviours which are highly correlated (e.g.PA and IA). Both person- and variable-centred analysis provide unique, yet complementary, information about the development of behaviour.

2. The development and subsequent evaluation of targeted interventions for both PA and IA. Although, there has been a history of developing interventions for children with PA, there is a lack of interventions for IA. Project 2 reported that the majority of youth follow moderate trajectories of either IA and/or PA through adolescents. Broad based school interventions targeting reducing symptoms of IA and PA may prove to be an effective population health approach. As well, these programs should start early in childhood, continue into emerging adulthood, and target both boys and girls. Leadbeater and colleagues (2003) W.I.T.S program at the University of Victoria and the PRAISE program by Leff and Colleagues (2010) at the University of Pennsylvania are examples of two recently developed broad based interventions. As well, online resources such as PREVNet (2011)

provide numerous resources for teachers, parents, children and the public on the prevention of aggression and bullying.

3. Study and description of other outcomes in emerging adulthood, particularly related to educational attainment, relationships, economic indicators, housing, and mental illness. As identified in Project 2, outcomes (e.g. depression, delinquency) are differentially associated with trajectory group membership, with those in trajectory groups of higher rates of PA and IA being associated with maladjustment in emerging adulthood.

4. An understanding of the mediating and moderating mechanisms which underlie this developmental process. Given the established link between IA, PA and depression found in Project 3 and the moderating effect of sex, more studies are needed to unravel the relationship between IA, PA and sex.

5. Disaggregation and understanding of the subtypes of aggression in order to fully understand the developmental taxonomy of the behaviour. Further, understanding subtypes of aggressive behaviour will likely lead to the improved understanding of their relationship with each other developmentally, to risk factors and outcomes, and to the development of targeted interventions.

In Conclusion

Understanding the development of PA and IA through childhood and how PA and IA are related to each other throughout the stages of development should assist in planning innovative strategies to support healthy development. Evidence from Project 2

clearly highlights the importance of identifying a minority of children who report

atypically high levels of PA and IA and intervening to protect them from associated

maladjustment (e.g. high levels of depression and deliquency). Despite the vast individual

and societal consquences of aggression, our understanding of the development of this

behaviour, particularly in girls, remains limited, which underscores the need for continued

investigations using longitudinal data with both person- and variable-centered analytical

methods.

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