An Examination of Developmental Cascades of

Risk from Childhood to Adulthood

by

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Abstract

A robust body of research connects both antisocial behaviour and low self-control in childhood to a number of diverse problems in adulthood including antisocial and criminal behaviour, poor employment, mental health problems, and poor health (Caspi, Wright, Moffitt, & Silva, 1998; Champion, Goodall, & Rutter, 1995; Masten et al., 2010; Kosterman et al., 2010; Moffitt, Caspi, Harrington, & Milne, 2002; Moffitt et al., 2011; Wiesner et al., 2003). Although a significant body of research has identified a large number of risk and protective factors related to antisocial and criminal behaviour, we still lack an understanding of the developmental chain and causal mechanisms that lead to antisocial behaviour and related problems (Day, Wanklyn, & Yessine, 2014; Frick, 2012). The current study applied developmental cascade analysis to examine competing theoretical models regarding the mechanisms that connect parenting, self-control, antisocial behaviour, academic success and internalizing problems from ages 8 to 32. Data included 411 boys from the Cambridge Study of Delinquent Development study (CSDD). Results indicated the relationships between parenting, self-control, antisocial behaviour, and academic success are multidirectional. Parenting impacted antisocial behaviour and antisocial behaviour also impacted parenting from childhood into adolescence. Additionally, the study also found antisocial behaviour impacted self-control whereas there was only limited evidence for self-control impacting antisocial behaviour. While prior research has reported robust associations between self-control and antisocial behaviour (e.g., Pratt & Cullen, 2000), little research has tested potential

bidirectional relationships. These results have important implications for theories such as the general theory of crime (Gottfredson & Hirschi, 1990). Results examining life success at age 32 reported that the relationship between antisocial behaviour at age 14 and antisocial lifestyle at age 32 varied across two measures of self-control: impulsivity and daring. These results suggest that considering different aspects or dimensions of self-control on antisocial behaviour are important.

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An Examination of Developmental Cascades of Risk and Resilience from Childhood to Adulthood

Introduction

Antisocial behaviour, especially antisocial behaviour that begins in childhood, is related to later problems across multiple domains, including poor employment outcomes in adulthood, criminal behaviour, mental health problems and poor health (Caspi, Wright, Moffitt, & Silva, 1998; Champion, Goodall, & Rutter, 1995; Kosterman et al., 2010; Masten, 2010; Moffitt, Caspi, Harrington, & Milne, 2002; Wiesner, Vondracek, Capaldi, & Porfeli, 2003). Yet, how and why early antisocial behaviour is related to negative life outcomes is less clear. For example, early antisocial behaviour predicts later problems in employment (Caspi, Wright, Moffitt, & Silva, 1998; Champion et al., 1995; Masten et al., 2010; Wiesner et al., 2003). This relationship might be the result of a direct relationship where antisocial behaviour is stable from childhood to adulthood and antisocial behaviour directly impairs work performance. However, the relationship might also be indirect and mediated through other variables such as academic performance in adolescence. Early antisocial behaviour is related to academic problems (McLeod, Uemura, & Rohrman, 2012) and poor academic performance is related to negative employment outcomes (Ceci & Williams, 1997; Schneider, Kirst, & Hess, 2003; Sewell, Haller, & Portes, 1969). Yet, research also indicates academic problems are related to antisocial behaviour (Hoffmann, Erickson, & Spence, 2013), raising questions regarding the directionality of the relationship. Academic problems could have a direct relationship with later work problems and the relationship between

antisocial behaviour and later work problems is a spurious relationship explained by the relationship between academic problems and antisocial behaviour. The relationship between academic and work problems could be the result of a third variable such as self-control (Hoffman et al., 2013). It is also possible that more than one of these pathways is true, consistent with the concept of equifinality from developmental psychopathology which states an outcome can be reached by multiple pathways (Cicchetti & Rogosh, 1996).

Research has only recently begun to attempt to untangle the complex relationships and causal mechanisms between antisocial behaviour and associated factors. Dodge, Greenberg, Malone, and The Conduct Problems Prevention Research Group (2008) commented on the state of knowledge regarding how early conduct problems develop into more severe chronic problems stating, "It is not clear how predictor domains relate to each other, whether one domain mediates the impact of another domain, whether some domains account for redundant portions of outcome variance, and whether each domain provides unique increments in predicting violence in adolescence" (p. 1997). Although they were speaking specifically to violence, the statement applies for understanding antisocial behaviour more generally along with the negative outcomes related to antisocial behaviour. Though there is an extensive body of research on antecedents that predict antisocial behaviour along with the negative consequences of antisocial behaviour, there is currently little understanding of how factors interact and impact antisocial behaviour and other negative outcomes across development.

Different theoretical perspectives offer competing explanations for these relationships. The general theory of crime (GTC; Gottfredson & Hirschi, 1990) states that low self-control is the sole cause of antisocial behaviour and multiple developmental problems. Parenting quality is also important in early childhood, to the degree that it impacts self-control. After children reach about age 10 between group differences in self-control are relatively fixed over time. According to the GTC, the association between antisocial, academic, social, and internalizing problems are spurious relationships explained by low self-control. In contrast, the perspective from developmental systems theory is that while self-control is important, it is not a sole causal factor but is related to other factors in a transactional manner over time (Cox, Mills-Koonce, Propper, & Garie, 2010; Thelen & Smith, 2006). Finally, the developmental taxonomy (Moffitt, 1993) states that the relationships among these factors vary across different categories of offenders.

These different understandings have important implications for research and practice regarding antisocial behaviour and youth development. The GTC proposes that one (self-control) or two (parenting early in life) factors are sufficient to explain problematic and positive behaviours among youth. In addition, it suggests that self-control is formed in early childhood. If these tenants of the theory hold then all prevention efforts should be focused on parenting during the early years. In contrast, if developmental systems theory is true then there are multiple opportunities and entry points to enhance development across the life span. Finally, if the relationships vary based on different categories of youth as proposed by

Moffitt (1993) in the developmental taxonomy theory then research and interventions need to examine differences across groups.

The aim of the current research was to examine the relationships among antisocial behaviour, parenting quality, self-control, academic success, and internalizing from childhood to adolescence considering competing theoretical perspectives. In addition, how these factors relate to antisocial behaviour, employment success, and well-being in adulthood was also investigated. Mapping the relationships among factors over time can provide an opportunity to intervene upstream in the negative developmental chain and potentially prevent problems across multiple domains (Masten et al., 2005). In addition, mapping the relationships can help identify unidirectional and transactional relationships and whether these vary at different points in development.

Understanding Antisocial Behaviour: Risk Factor Paradigm

Developmental criminology is concerned with criminal behaviour across the life course, seeking to prevent and avoid the consequences of criminal behaviour by identifying its antecedents that increase the likelihood of criminal behaviour, referred to as risk factors (e.g., Farrington, 2006; Hawkins, Catalano, & Miller 1992; LeBlanc & Loeber, 1998) and antecedents that decrease the likelihood of criminal behaviour, referred to as protective factors (e.g., Loesel & Farrington, 2012). Both risk factors and protective factors are defined as correlates and as such can only offer limited guidance in identifying intervention targets. This ambiguity represents a current limitation in research, where there are a large number of correlates and

limited understanding of causal factors (Day, Wanklyn, Yessine, 2014; Frick, 2012; Walker, Bowen, & Brown, 2013).

Multiple frameworks have been proposed to prioritize and organize risk factors, including categorizing factors by domain, whether the factor is fixed or changes, and the proximity to the outcome (see Day et al., 2014 for a review). These organizational frameworks are helpful to navigate risk factors, but vary in their utility for understanding causal mechanisms. Other methods including meta-analyses have been employed to identify factors that demonstrate the strongest association with antisocial behaviour (e.g., Cottle, Lee, & Heilbrun, 2001) and cumulative risk indexes have been proposed to identify the cumulative impact of multiple risks (Evans, Li, & Whipple, 2013). Prioritizing risk factors that demonstrate an empirical relationship with antisocial behaviour, or calculating an overall risk score is useful when the goal is to determine the likelihood of future antisocial behaviour, but it is not sufficient if attempting to understand causal mechanisms and informing interventions to address or reduce risk (McMillan, Hastings, Salter, & Skuse, 2008). When attempting to identify targets for intervention, temporal ordering, third variable factors, and understanding how and when factors exert an influence is important.

Kraemer and colleagues (1997) suggest distinguishing predictor variables from correlates and focusing on predictor variables identified in longitudinal research. Time ordering of variables ensures the antecedent exerts its influence on the outcome and not the other way around. While identifying longitudinal relationships is an important step to identifying causal factors, it is not sufficient.

There is also a need to consider the developmental progression of the factors under study. As stated by Cole and Maxwell (2003) "Sometimes researchers appear to assume that measuring X before Y somehow makes it true that the construct X actually precedes Y in time. In many cases, the measure of Y (or M) actually assesses a condition that began long before the occurrence of X " (p. 561). Tremblay (Tremblay et al. 2004; Tremblay, 2010) levied a similar criticism on research on aggression on antisocial behaviour, arguing convincingly that antisocial behaviour, in particular aggression, does not peak in adolescence as suggested by age-crime curve relationships. Instead aggression is developmentally normative during the toddler years and then declines over time. Therefore, aggression and antisocial behaviour do not emerge in childhood, but rather fail to decline from the early years. Another example is the relationship between substance use and criminal behaviour. Initiating substance use at an early age is a robust predictor of persistent criminal behaviour (D'Amico, Edelen, Miles, & Morral, 2008; Dembo, Wareham, & Schmeidler, 2007; Hussong, Curran, Moffitt, Caspi, & Carrig 2004; Lipsey & Derzon, 1998). Though this is true, research earlier in development indicates that early conduct problems predict early initiation of substance use (Kim-Cohen et al., 2003; Reef, Diamantopoulou, van Meurs, Verhulst, & van der Ende, 2011) resulting in questions regarding the direction of the relationship.

Therefore, when attempting to identify causal relationships it is important to consider the developmental course of variables of interest and select appropriate methods to examine relationships. Developmental cascade analysis is a type of analysis well suited to address questions regarding the direction and timing of

relationships across variables over time. Developmental cascade analysis is a form of longitudinal structural equation modeling that tests cross-lagged effects while controlling for both concurrent associations as well as stability in each domain (Cole & Maxwell, 2003; Selig & Preacher, 2009). This allows the ability to test for indirect effects while accounting for prior levels of the mediator and outcome.

Developmental cascade analysis requires longitudinal data, and ideally involves at least three waves of data on at least three constructs (Masten, Burt, & Coatsworth 2006; Masten & Cicchetti, 2010).

Identifying the developmental chain of factors that impact positive and negative development can help identify which factors to target and when in development (Masten et al., 2005). “Developmental cascade models offer an important advance toward this goal [understanding the etiology of mental health and behavioural problems] because such models go beyond examining a set of predictors in relation to a set of outcomes by trying to map the mechanisms through which early risk factors affect subsequent outcomes over the course of development” (Lansford et al., 2011, p. 593).

Developmental cascades are not the only approach suitable for assessing developmental pathways and change. Developmental cascades focus on between individual differences whereas other approaches (e.g., latent growth models and latent difference models) are better able to test intra-individual differences (Selig & Preacher, 2009). These different approaches are better understood as complimentary rather than competing as both inter-individual differences and intra-

individual differences are important in understanding antisocial behaviour and development.

Theoretical Perspectives

There are several theories that propose to explain antisocial behaviour and other developmental problems. The current study draws on the GTC (Gottfredson & Hirschi, 1990), Moffitt's (1993, 2006) developmental taxonomy, and developmental systems theory (Thelen & Smith, 2006). These theories were selected because they are influential and have been subjected to significant empirical examination. Additionally, these theories offer competing viewpoints regarding how to best understanding the interrelationships among antisocial behaviour, academic performance, and internalizing problems.

Gottfredson and Hirschi (1990) propose that low self-control is the sole cause of crime, all forms of antisocial behaviour and related developmental problems. Self-control is proposed to form as a result of parenting practices from birth to about age 8 to 10, specifically parental monitoring and effective discipline in childhood. While parenting is the main influence on the development of self-control, the GTC does indicate other factors, for example school where teachers can teach self-control can also have an influence. Yet this influence is limited to childhood, once established at about age 10 self-control is believed to be stable throughout the remainder of the life course.

In contrast, developmental systems theory (Thelen & Smith, 2006) suggests that behaviour cannot be explained by specific isolated causal factors, but is better understood as the result of dynamic cascades across multiple systems. These

systems include many of the same domains implicated in other theories of antisocial behaviour, for example internal biological systems and cognitive systems along with external systems including social and environmental context. What distinguishes developmental systems theory is that systems are dynamic and inter-related over time. The implication is that no one domain or factor is understood as an antecedent or predictor of another factor, but relationships among systems are multidirectional. In addition, the interrelated nature of systems means change in one system can impact another system producing cascading effects over time.

From the perspective of developmental systems theory, behaviour is not set by genes, early childhood behaviours or experiences, the environment, or reward contingencies, but rather is interrelated with all of these considerations and open to change at any point in development. Change might occur more readily at some points in development, for example changes due to internal systems (e.g., puberty) or external systems (e.g., transitions to school), but change is not limited to these periods and can occur at any point.

Cascading theories are not unique to developmental systems theory. Multiple theories of criminal behaviour propose cascading processes where problems in one domain of functioning cascade into other domains resulting in an increasing number and severity of problems. For example, Moffitt's (1993, 2006) developmental taxonomy proposes criminal behaviour across the life course is the result of negative early developmental cascades that occur between the child and their environment. Young children who experience early risk including biological risk (e.g., difficult temperament and neuropsychological deficits) experience a cascade of

risk that begins with negative interactions between parents and children that result in early antisocial behaviour. As children with behavioural problems move into broader school and social settings, their behaviour results in negative experiences and problems in these settings. These problems can contribute to the escalation in the severity of their behaviour. Children who engage in early antisocial behaviour are more likely to persist in their behaviour over time. This pattern of behaviour is referred to as life course persistent offending (LCP). This is contrasted with those who do not experience significant levels of risk in childhood, but do offend in adolescence. Moffitt (1993) proposed these groups are qualitatively distinct in their etiology and pathways to offending. The antisocial behaviour of LCP offenders is due to internal factors and as such is less influenced by their environmental context. The antisocial behaviour of AL offenders is influenced by an environmental context including reward contingencies that support antisocial behaviour during adolescence. When the developmental context changes and they are able to attain adult roles, their offending desists.

These theories provide competing perspectives regarding the influence of factors linked to antisocial behaviour. Moffitt (1993, 2006) proposes different categories of offenders and with distinct etiologies that influence offending across the life-course whereas others propose general mechanisms that can apply to everyone. They also differ in how likely change is across development. Developmental systems theory propose change can occur at any point in development, though specific changes in systems might be more likely in different developmental periods (Cox et al., 2010). Alternately, both Moffitt (1993) and

Gottfredson and Hirschi (1990) suggest the developmental course for antisocial behaviour is set in childhood. Gottfredson and Hirschi (1990) state self-control is shaped by parenting behaviours up until about age 8 at which point it is stable across development. Moffitt (1993) proposes that two pathways of offending and both are set in childhood. One is persistent offending and the other is characterized by less severe offending in adolescence and desistence in adulthood. In contrast, according to developmental systems theory change can and does occur at any point in development.

Typologies of Antisocial and Criminal Behaviour

Moffitt's (1993) assertion that there are two categorically different groups of offenders is one of the key tenets of the developmental taxonomy. The developmental taxonomy was developed to explain the LCP and AL patterns of offending observed in a longitudinal cohort study conducted in the Dunedin birth cohort. The two patterns of offending described in the developmental taxonomy have been replicated in over 100 longitudinal studies worldwide (see Jennings & Reingle, 2012 for a review). Yet, a number of additional trajectories have also been consistently identified including low-level chronic offenders (LLC), engage in intermittent criminal behaviour across development. Childhood limited (CL) describing those with early conduct problems who desist from conduct problems prior to adolescence, and late starters (LS) who initiate criminal behaviour in adulthood (Fergusson, Horwood, & Nagin, 2000; Jennings & Reingle, 2012; Moffitt, Caspi, Dickson, Silva, & Stranton, 1996; Moffitt, 2006; Nagin & Tremblay, 1999). This is not surprising considering only half of the offenders in the Dunedin cohort fit

within the two trajectories Moffitt proposed. Therefore, the developmental taxonomy fails to account for multiple other patterns of offending and why some children who demonstrate significant antisocial behaviour in childhood do not persist.

Regarding the distinctions between LCP and AL offending, there is some evidence that childhood predictors of negative outcomes including hyperactivity, low verbal IQ, and low socioeconomic status are more common among those that show an LCP pattern of offending compared to an AL pattern (e.g., Moffitt & Caspi, 2001; Moffitt, Caspi, Rutter, & Silva, 2001). However, other longitudinal research has found childhood adversity is associated with the development of conduct problems in adolescence and therefore is not unique to childhood onset antisocial behaviour (Fergusson et al., 2000; Roisman, Monahan, Campbell, Steinberg, & Cauffman, 2010). In addition, there is evidence that antisocial peer affiliation - which Moffitt (1993) suggests is important in the offending of AL offenders and not LCP offenders - is important for both childhood onset offenders and adolescent onset offenders (LaCourse, Nagin, Tremblay, Vitaro, & Claes, 2003).

Furthermore, Walters (Walters, 2011; Walters & Ruscio, 2013) conducted taxometric analysis to assess whether AL and LCP antisocial behaviour were best represented as dimensional or categorical distinctions. Walters (2011) assessed whether there was a taxonic boundary between AL and LCP offenders using self-reported early behavioral problems in a cross-sectional sample of 2,175 youth ages 15 to 21 who reported committing a delinquent act. Results indicated AL and LCP offenders differed on the same underlying dimensions with LCP offenders higher on

the antisocial dimension. These results were true across gender, race, and age. In a subsequent study Walters and Ruscio (2013) assessed a longitudinal sample of 1,708 youth from ages 6 to fourteen. Results indicated continuous rather than categorical differences in antisocial behaviour both within each time of assessment and across the assessment periods.

Finally, engaging in antisocial behaviour during childhood is not sufficient to identify those who will persist in antisocial behaviour. Studies report more than half of the children who demonstrate early conduct problems do not persist in antisocial behaviour and offending across development (Odgers et al., 2008; Olson, Sameroff, Kerr, & Lunkenheimer, 2009). While this group does not demonstrate persistent antisocial behaviour, Moffitt (2006) reported in a follow up of the Dunedin cohort, that those who demonstrated early problem behaviour, but did not persist were more likely to be socially isolated and have mental health problems. This is consistent with the principle of *multifinality* in developmental psychopathology, where similar experiences (e.g., early risk) may produce a variety of outcomes including offending to anxiety and depression (Cicchetti & Rogosh, 1996).

Examining pathways that mediate the relationship between early risk and negative outcomes might connect early antisocial behaviour to different outcomes later in development might elucidate these relationships.

Antisocial Behaviour, Self-Control, and Adult Outcomes

Self-Control: Definitions and Outcomes

Gottfredson and Hirschi (1990) describe self-control as the ability to delay gratification, plan for the future (i.e., consider the long term consequences of

behaviour), and persist in tasks. Failure in these areas is likely to result in problems in school, relationships, and involvement in antisocial behaviour. This definition is similar to, and sometime considered interchangeable with self-regulation, cognitive control, and executive functioning. Cognitive control is defined as the ability to inhibit behavioural responses, to plan, and shift attention (e.g., Diamond, 2006; Garon, Bryson, & Smith, 2008). In fact, self-control and behavioural regulation are often used synonymously and measures related to cognitive control and executive functioning are used to measure self-regulation (e.g., Brody & Ge, 2001; Eisenberg et al., 2005). This has led to questions regarding the relationship and potential overlap between self-control and the neuropsychological deficits described by Moffitt (1993) that characterize early risk for life course offending (Jackson & Beaver, 2013). There is also controversy regarding behavioural measures of self-control with some arguing they are tautological with the antisocial behaviour that are proposed to predict (Akers, 1991, 2008). Tittle, Ward, and Grasmick (2003) however report that behavioural measures do not demonstrate significant differences with attitudinal measures.

Despite these controversies the link between self-control and antisocial behaviour has received significant empirical support (e.g., Perrone, Sullivan, Pratt, & Margaryn, 2004; Pratt & Cullen, 2000; Pratt, Turner, & Piquero, 2004). The relationship between self-control and other developmental outcomes has also received considerable support. Self-control is related to a diverse number of long-term outcomes including academic success, employment success, mental health outcomes, physical health and eating behaviours, and social competence (e.g.,

Converse, Piccone, & Tocci, 2014; Evans, Cullen, Burton, Dunaway, & Benson, 1997; Tangney, Baumeister, & Boone, 2004; Schlam, Wilson, Shoda, Michel, & Ayduk, 2013). For example, children who are able to delay of gratification as measured by the delay of gratification task, often referred to as the Marshmallow test (Mischel, Shoda, & Rodriguez, 1989) are more successful in school and report better mental health (e.g., Mischel et al., 2011), and demonstrate a healthier body mass after 30 years (Schlan et al., 2013).

Moffitt et al. (2011) examined whether self-control in early childhood was able to predict life success outcomes at age 32 in the Dunedin cohort. Results indicated nearly half of children who displayed low self-control had convictions at age 32. Additionally, low self-control was related to some mental health problems, poor physical health, lower socio-economic status, and substance abuse problems. Moreover, these relationships were mediated through adolescent factors such as academic success and substance use. Yet, Ferguson et al. (2013) noted that the measure of self-control used included elements of antisocial behaviour. They examined the ability of self-control relative to antisocial behaviour to predict adult outcomes. Results indicated that though self-control was initially predictive of a large number of outcomes in adulthood, once estimates were adjusted for early antisocial behaviour, many of the relationships between self-control and adult life success were no longer significant.

Childhood Antisocial Behaviour and Life-Outcomes

Two lines of research that have supported the connections between childhood antisocial behaviour and adult outcomes include assessing differences

between trajectories of offending on life outcomes and assessing the ability of early risk to predict life success. A number of studies have examined different trajectories of offending and followed their life success and adult role attainment, with a specific focus on LCP and AL trajectories. These studies offer insights into differences in the impact of early (and persistent) versus later onset antisocial behaviour. Results from this research indicates both LCP and AL trajectories continue to offend into adulthood and differ from non-offenders in their life success (e.g., employment status, mental health outcomes) with LCP offenders experiencing more severe problems than AL offenders (Pulkkinen, Lyyra, & Kokko, 2009; Moffitt et al., 2002; Piquero, Daigle, Gibson, & Tibbetts, 2007). Later in adulthood (after about age 40) AL offenders are more likely to desist from offending and lead more successful lives with fewer differences from non-offenders. In contrast, LCP offenders demonstrate lower life success in multiple domains throughout adulthood. For example, Farrington, Ttofi, and Coid (2009) examined life success outcomes in the Cambridge Study of Delinquent Development (CSDD). Results indicated that AL offenders reported more problems in fighting, alcohol use, and offending at age 32 than non-offenders, but by age 48 AL offenders only differed from non-offenders on alcohol use. In contrast, persistent offenders (similar to LCP) demonstrated problems in multiple domains including housing, relationships, employment, substance use (alcohol and drug use), health, fighting, and offending (self-reported and convictions) compared to non-offenders at age 32. These problems were still present at age 48 with the exception of health, where there were no significant differences. Yet this study also found a late onset group of offenders who reported

worse outcomes compared to AL offenders, though better than LCP offenders. These results suggest earlier versus later onset of offending show different patterns of life success (measured by mental health outcomes, substance abuse, and employment) with earlier onset showing worse outcomes throughout adulthood. Put differently, early differences in antisocial behaviour demonstrate significant impacts in offending and other life success outcomes into adulthood. Yet, the presence of other trajectories such as a late onset offenders indicate early antisocial behaviour is not the only pathway connected to life success outcomes.

Studies that have investigated developmental cascades from childhood to adulthood report a similar pattern of results. A series of four studies (Burt, Obradović, Long, & Masten, 2008; Masten, Desjarding, McMormick, Kuo, & Long, 2010; Masten et al., 2005; Obradović, Burt, & Masten, 2010) examined the developmental cascades of externalizing behaviours, academic achievement, social competence, internalizing symptoms, and work performance from late childhood into adulthood (see Table 1). Data were drawn from Project Competence, a normative school cohort of children ($N = 205$) beginning at ages 8 to 12 (childhood) and followed up after 7 years (ages 15 to 19; adolescence), 10 years (ages 18 to 22; emerging adulthood), and 20 years (ages 25 to 29; adulthood). Different studies included a different combination of variables, depending on the focus of the research question.

Results from these studies can be summarized as follows: higher externalizing behaviour at ages 8 to 12 negatively impacted academic performance in adolescence (ages 15 to 19; Masten et al., 2005; Obradović et al., 2010), lower

academic performance in emerging adulthood (ages 18 to 22) was subsequently related to internalizing problems in adulthood (ages 25 to 29; Masten et al., 2005; Obradović et al., 2010). These results remained significant, in fact the associations were stronger when controlling for early parenting, SES, and IQ. Internalizing symptoms were also associated with lower levels of externalizing problems from adolescence to emerging adulthood (Masten et al., 2005). In another cascade, lower social competence in childhood was related to higher internalizing problems during adolescence (Burt et al., 2008; Obradović et al., 2010) and higher internalizing problems in adolescence were related to decreased externalizing problems in emerging adulthood (Burt et al., 2008). This highlights the complexity of different developmental paths. While social competence is generally related to increased externalizing problems (Bornstein, Hahn, & Haynes, 2010; Burt & Roisman, 2010; Tremblay, 2006), internalizing in adolescence has been found to be related to less externalizing problems (Farrington, 1995; Loeber & Keenan, 1994; Moffitt, 2002).

Table 1

Developmental Cascade Studies using Project Competence Data

Study	Age of assessments	Variables included	Three or more wave cascades	Additional cross-lagged relationships
Burt et al. (2008)	Ages 8-12 Ages 15-19 Ages 18-22 Ages 25-29	EXT, INT, SOC	SOC(8-12) -> INT (15-19) -> EXT (18-22)	SOC(18-22) -> INT(25-29)
Masten et al. (2010)	Ages 8-12 Ages 18-22 Ages 25-29	EXT, SOC, ACA, WRK	n/a	EXT(8-12) -> ACA (18-22) SOC(8-12) -> WRK (18-22)
Masten et al. (2005)	Ages 8-12 Ages 15-19 Ages 18-22 Ages 25-29	EXT, INT, ACA	n/a	EXT(8-12) -> ACA (15-19) ACA(18-22) -> INT (25-29) INT(15-19) -> EXT(18-22)
Obradović et al. (2010)	Ages 8-12 Ages 15-19 Ages 18-22 Ages 25-29	ACA, INT, SOC, (EXT ages 8-12)	EXT(8-12) -> ACA (15-19) -> SOC(18-22)->INT (25-29)	SOC(8-12) -> INT(15-19) ACA(18-22) -> INT(25-29)

Note. EXT: Externalizing, SOC: Social competence, INT: Internalizing, ACA: Academic performance, WRK: work

According to results from these studies, externalizing problems in childhood initiates a negative developmental cascade with effects into adulthood. Externalizing problems appear to be the driving influence that limits the success in other domains including school, work, and social competence either directly or indirectly. The only impact from other domains into externalizing problems was that higher internalizing problems in early adulthood were related to lower externalizing problems in adulthood.

Results from these studies highlight some strengths and limitations of the developmental cascade approach and contribute to research on externalizing behaviour. One of the strengths is the ability to consider the impact of multiple variables simultaneously over time. The impact of externalizing behaviours into other domains was found in late childhood and early adolescence and the impact carried forward over time through other domains. Externalizing during late adolescence and emerging adulthood did not impact other domains after earlier externalizing was accounted for. This result suggests externalizing in childhood to early adolescence might have a more negative impact on other domains than externalizing during adulthood, consistent with research on developmental trajectories of antisocial behaviour.

Another strength is the ability to assess the relative impacts of different variables while accounting for co-variation. For example, Obradović et al. (2010) initially found early internalizing symptoms set off a developmental cascade related to academic problems, however once early externalizing problems were included,

the relationship between internalizing and academic problems was no longer significant, and it was externalizing problems that initiated the cascade. This result highlights that developmental cascade analysis, like other forms of analysis, are sensitive to third variable effects. That is a variable not included in the model can explain or change the relationships among variables. This highlights the importance of carefully selecting the variables in the model, and considering potential third variable influences.

Important limitations of the project competence studies include grouping large age bands that might have significant variability within them, for example ages 8 to 12, and long time lapses between assessments (7 to 10 years) that may miss important interactions among these variables, especially during childhood and adolescence where there is significant developmental change.

Childhood Risk and Adolescent Pathways: Understanding the Developmental Chain

While evidence has not supported qualitative differences between children who engage in antisocial behaviour early and those who engage in antisocial behaviour in adolescence but not childhood, evidence does indicate that antisocial behaviour in childhood is related to problems in adolescence and life outcomes in adulthood (Pulkkinen et al., 2009; Moffitt et al., 2002; Moffitt et al., 2006; Piquero et al., 2007). Additionally, the developmental chain proposed by Moffitt (1993) where early experiences to poor parenting connects to antisocial behaviour in childhood, then problems in peer relationships and academic problems in a cascade of problems has received empirical support. This is also consistent with the work of

Patterson and colleagues (1989) who hypothesize a developmental chain where negative child behaviour and poor parenting practices reinforce each other over time in a negative spiral. Children's problem behaviour is proposed to result in more punitive and harsh parenting behaviours that subsequently increases antisocial behaviour by children setting off a cycle of coercion.

Dodge and colleagues (2008) conducted one of the few studies examining the developmental sequence between early adverse context and violent behaviour in adolescence. Using a sample of 754 children assessed annually from kindergarten until grade 11 they examined the connections between early adverse context in kindergarten to violence in adolescence. The model included seven factors empirically identified as predictors for violent behaviour in adolescence and proposed a sequential model where one factor predicted the next in a developmental chain. The proposed developmental chain is represented in Figure 1.

Figure 1

Developmental Chain tested by Dodge et al. (2008)

Results indicated support for the model with adverse context related to harsh parenting which was subsequently related to poor school readiness and early conduct problems. Their full sample included both a normative and a high-risk sample, and they assessed whether the results varied across the samples. Results indicated the strength of the connections was stronger for the normative than the high-risk sample, but results remained significant in both groups. While these results support the concept of a developmental chain and the connections between early adverse context to violence in adolescence, the influence of each individual variable is only measuring within a small window of time. For example, harsh

parenting in examined in preschool, but not considered at any other developmental stage. While there is some research that indicates parental monitoring has a stronger relationship during late childhood and early adolescence compared to earlier in childhood or later in adolescence (Pardini, Fite, & Burke, 2008), other research has reported the impact of parenting, including parental hostility, has an impact throughout adolescence (Hoeve et al., 2009).

Another approach that has been used to map the developmental pathways between areas of developmental competence including academic success and social competence and developmental problems including internalizing and externalizing problems (see Table 2) are cascade models. These models have examined how domains of competence (e.g., academic success and social competence) relate to developmental problems (typically internalizing or externalizing problems; Krueger, 1999) from childhood into adulthood. It is difficult to directly compare results across studies as they have used different samples, including at-risk samples (Blandon, Calkins, Grimm, Keane, & O'Brien, 2010; Moilanen, Shaw, & Fitzpatrick, 2010), affluent samples (Vaillancourt et al., 2013), and culturally diverse samples (Chen et al., 2010). While there is some consistency in the age range assessed across studies, differences in the timing of assessments limit comparability.

Despite these differences there are notable trends. First, not all factors are equally likely to have cross-domain impacts. Externalizing problems often produce cross-lagged effects into academic problems (Burt & Roisman, 2010; Chen et al., 2010; Englund & Siebenbrun, 2012; Moilanen et al., 2010; van Lier et al., 2012), social problems (Burt & Roisman, 2010; Chen et al., 2010; van Lier et al., 2012), and

broad adaptive functioning (Bornstien et al., 2013). In fact, of the nine studies identified that measure cascading effects of externalizing, only one (Bornstein et al., 2010) did not report cross-lagged effects. The cross-lagged effects of externalizing often continue to spread to other areas such as internalizing problems or produce a cycle of bidirectional effects representing worsening externalizing problems across development (e.g., Burt & Roisman, 2010; Moilanen et al., 2010; van Lier et al., 2012). In contrast, internalizing problems are more likely to be outcomes of other domains rather than generate cross-lagged effects (Burt & Roisman, 2010; van Lier et al., 2012).

In addition, the negative impact of externalizing problems is demonstrated across preschool (Bornstein et al., 2010), childhood (Burt & Roisman, 2010; Chen et al., 2010) and into adolescence (Burt & Roisman, 2010; Vaillancourt et al., 2013). A similar pattern of results is observed with both academic problems and social problems, there are cross-lagged impacts from preschool, across childhood, and into adolescence (Blandon et al., 2010; Bornstein, Hahn, & Suwalsky 2013; Burt & Roisman, 2010; Chen et al., 2010; Englund & Siebenbrun, 2012; Moilanen et al., 2010; Vaillancourt et al., 2013; van Lier et al., 2012).

One area where there is less consistency is regarding the directionality of relationships among externalizing problems with academic problems, social competence, and internalizing problems. While more studies have reported transactional results where externalizing both generates cross-lagged effects into other domains and is impacted by effects in these domains (Burt & Roisman, 2010; Englund & Siebruner, 2012; Moilanen et al., 2010; Vaillancourt et al., 2013; van Lier

et al., 2012), other studies have reported unidirectional relationships where low levels of competence (e.g., in academic and social domains) relate to lower levels of externalizing but not the reverse (Bandon et al., 2010; Bornstein et al., 2010), or unidirectional relationships where higher externalizing results in lower levels of competence but not the reverse (Chen et al., 2010).

Table 2

Summary of Developmental Cascade Research

Study	Sample	Age at Assessments*	Variables Measured	Significant Relationships Across Three or More Waves	Significant Cross-Lagged Relationships
Blandon et al. (2010)	440 at risk children	Age 4 Age 5 Age 6 Age 7	Cascade variables: EXT, SOC, PEER, ER, POP Control variables: EXT at ages 2 and 3	N/A	SOC4 -> EXT5 SOC5 -> EXT6 SOC6 -> EXT7 ER4 -> EXT5 ER5 -> EXT6 ER6 -> EXT7
Bornstein et al. (2010)	117 children	Age 4 Age 10 Age 14	Cascade variables: EXT, INT, SOC Control variables: Maternal education Intellectual functioning	SOC4->INT10->EXT14	SOC4 -> EXT10 SOC4 -> INT10 INT10 ->EXT14
Bornstein et al. (2013)	134 community sample of children	Age 4 Age 10 Age 14	Cascade variables: EXT, INT, ADP	EXT4->INT10->ADP14 ADP4->INT10->ADP14	EXT4 -> ADP10 EXT4 -> INT10 INT4->EXT10 INT10 ->ADP14 ADP4->INT10

Burt & Roisman (2010)	1,160 general population children	Age 5 Age 6 Age 8 Age 10 Age 15	Cascade variables: EXT, INT, ACA, SOC Control variables: Early maternal sensitivity (ages 6mo to 3 years) Early cognitive ability Early SES	EXT5->ACA6->INT8 EXT5->ACA6->EXT8 SOC8->EXT10->ACA15	EXT5 -> ACA6 EXT5 -> SOC6 EXT10-> ACA15 ACA6 -> EXT8 ACA6 -> INT8 SOC8 -> EXT10 SOC8 -> INT10
Chen et al. (2010)	1,140 children in China	Age 7 Age 8 Age 9 Age 10 Age 11	Cascade variables: AGG, SOC, ACA	ACA7-> SOC8->ACA9-> SOC10->ACA11 AGG7-> SOC8->ACA9-> SOC10->ACA11 AGG8 ->ACA9->SOC10-> ACA11 AGG9 ->SOC10->ACA11	AGG7 -> SOC8 AGG8 -> ACA9 AGG9 -> SOC10 SOC7 -> ACA8 SOC8-> ACA9 SOC10-> ACA11 ACA7 -> SOC8 ACA9 ->SOC10
Englund & Siebenbrun (2012)	191 children from low SES families	Age 7 Age 9 Age 12 Age 16	Cascade variables: EXT, INT, ACA Control variables: Gender SES Mother's age Minority status	INT7->EXT9->ACA12	INT7 -> EXT9 INT9 -> ACA12 ACA9 ->EXT12 ACA9-> INT12

Moilanen et al. (2010)	291 at risk boys from low SES families	Age 6	Cascade variables:	EXT6->ACA8->INT10	EXT6 ->ACA8
		Age 8	EXT, INT, ACA		EXT6 ->INT8
		Age 10		EXT8->ACA10->INT11	EXT8 ->ACA10
		Age 11	Control variables:		EXT11 -> INT12
		Age 12	Parenting quality at age 2 Intelligence Neighborhood adversity	EXT8->ACA10->EXT11-> INT12	ACA8 -> INT10 ACA10 ->INT11 ACA10->EXT11
Vaillancourt et al. (2013)	695 children from affluent families	Age 10	Cascade variables:	ACA11->EXT12->INT13	ACA10->EXT11
		Age 11	EXT, INT, ACA, VIC		ACA11->EXT12
		Age 12			ACA12->EXT13
		Age 13	Control variables:		EXT12->INT13
			Income Primary caregiver educational attainment Early academic success		INT10->VIC11 INT12->VIC13
van Lier et al. (2012)	1, 558 Canadian general population children	Age 6	Cascade variables:	EXT6->ACA7->INT8	EXT6 -> ACA7
		Age 7	EXT, INT, ACA, VIC		EXT6 -> VIC7
		Age 8		EXT6->VIC7->EXT8	EXT7->VIC8
				EXT6->VIC7->INT8	VIC6 ->EXT7 VIC7-> INT8 VIC7-> EXT8
				VIC6->EXT7->VIC8	ACA6->INT7 ACA7-> INT8

Note. *grades were converted to approximate age for ease of comparison across studies

EXT: Externalizing, SOC: Social competence, ER: Emotional regulation, VIC: Victimization, ADAP: Adaptive functioning

An important limitation of these studies is that they have only included early parenting as a control rather than examined its dynamic impact across development. Self-control has also been absent. Bandon et al. (2010) assessed emotional regulation from ages 2 to 6 and found it was related to later antisocial behaviour, but other studies have not yet accounted for these factors. This is an important area for research considering the central role of parenting and self-control in both theory and research regarding antisocial behaviour (Patterson et al., 1989; Pratt & Cullen, 2001; Tremblay, 2006) along with other developmental outcomes. Therefore, the degree that parenting and self-control might explain or mediate these relationships warrants further investigation.

Parenting, Self-control, and Antisocial Behaviour: Origins and Developmental Outcomes

Parenting is a multidimensional construct and research often includes dimensions of responsiveness or support and behavioural control towards children (Steinberg, 2001). Responsiveness and support include demonstrating love, warmth, and empathy for the child and regulation refers to monitoring children's behaviour within clear and reasonable boundaries and providing an environment with clear expectations and consistent discipline (Davidov & Gresec, 2006; Dishion & McMahon, 1998; Holden & Miller, 1999).

Meta-analyses that capture studies from 1945 (Rothbaum & Weisz, 1994) up to 2010 (Hoeve et al., 2012) consistently report parental warmth (Loeber & Stouthamer-Loeber, 1986; Rothbaum & Weisz, 1994), attachment (Hoeve et al.,

2012) and behavioural control (Hoeve et al., 2009; Loeber & Stouthamer-Loeber, 1986) are robustly associated with conduct problems among youth.

Other parenting and family factors consistently linked to conduct problems include family structure (e.g., single parent home), antisocial behaviour of parents, parental psychopathology, and conflict in the home. Yet whether these factors are independently related to antisocial behaviour, or mediated through parental behaviours is not clear (Gorman-Smith, Tolan, Zilli, & Huesmann, 1996; Hartinger-Saunders, Rine, Wieczorek, & Nochajski, 2012; Loeber & Stouthamer-Loeber, 1986). For example, there is evidence that parents who experience depression or other forms of psychopathology are less responsive to their children and show compromised parenting (e.g., Campbell et al., 2004; Lovejoy, Graczyk, O'Hare, & Neuman, 2000), but other research has shown independent effects of distress on child externalizing and internalizing problems (Ciciolla, Gerstein, & Crnic, 2014; Wang et al., 2013).

Though parenting is robustly related to antisocial behaviour, two important questions remain regarding the nature of the relationship. First, is whether the direct impact of parenting is limited to early childhood or continues throughout adolescence, second, whether parenting practices and child behaviour are bidirectional, and whether this varies across development.

An ongoing area of debate is whether the impact of parenting is limited to childhood or continues throughout adolescence. Hoeve et al.'s (2009, 2012) meta-analyses reported parenting demonstrated a stronger relationship with delinquency at younger ages compared to mid to late adolescence, but this result was

confounded by measurement differences. Both multi-method and parent reports of attachment demonstrated a stronger relationship than youth reports and these types of assessments were more commonly used with younger children whereas youth reports were typically used with older adolescence. Recent longitudinal studies further support that parenting quality is prospectively related to antisocial behaviour and delinquency across development including preschool (Shaw, Hyde, & Brennan, 2012), early childhood (Nagin & Tremblay, 2001), late childhood and adolescence (Higgins, Jennings, & Mahony, 2010; Schroeder, Higgins, & Mowen, 2014), and into adulthood (Hoeve et al., 2008; Johnson, Giordano, Manning, & Longmore, 2011).

Patterson et al. (1989) proposed that the relationship between parenting and child behaviour is bidirectional rather than unidirectional from parenting to children. Though bidirectional relationships between parent and child behaviour are not new (e.g., Bell, 1968), they have garnered less empirical attention than unidirectional relationships (Pardini et al., 2008). Studies that have examined bidirectional relationships have generally supported these relationships, yet whether the direction of the relationship changes across childhood to adolescence is less clear.

Wang, Christ, Mills-Koonce, Peters, and Cox (2013) examined the relationship between maternal sensitivity and externalizing behaviour in a longitudinal study from ages 4 to 11 ($N = 1,364$). Maternal sensitivity was measured using observational methods and externalizing was measured using multiple raters. Across each assessment externalizing was related to later maternal sensitivity,

however, the reverse was not true. Similar results have been reported earlier in development where social competence and pro-social behaviour demonstrated in the first two years of life increased parental warmth (Barnett, Gustafsson, Deng, Mills-Koonce, & Cox, 2012). Therefore, evidence indicates children play an evocative role in parental behaviour beginning early in life.

Studies later in childhood and in adolescence indicate the influence of parenting might actually increase later in development. Gross, Shaw, and Moilanen (2008) examined maternal depression and disruptive behaviours between ages 5 to 15. Both caregiver ratings were used to measure disruptive behaviour to avoid shared variance effects. Disruptive behaviours and maternal depression each demonstrated cross-lagged effects both between ages 5 to 6 and in the transition to adolescence (ages 11 to 12), yet the relationship at ages 12 and 15 was unidirectional. Maternal depression at age 12 impacted child behaviour, but the reverse was not true.

Similarly, Pardini et al. (2008) examined bidirectional relationships teacher reports of youth conduct and parenting behaviours from ages 6 to 16. Results indicated cross-lagged effects of parenting and behaviour, but these varied by parenting behaviour and age. Poor parental monitoring was related to conduct problems between ages 9 to 13, but not ages 7 to 9 or 13 to 15. The impact of boys conduct problems on later parental monitoring was found when boys were aged 11 and older, but not younger. This might be due to the developmental changes that occur from childhood to adolescence which require a change in monitoring from direct observations to more indirect and relying on trust and communication with

children as they spend more time away from parents (Patrick, Snyder, Schrepferman, & Snyder, 2005). Yet, Keijsers, Loeber, Branje, and Meeus (2011) reported that a quality relationship between parents and boys demonstrated consistent reciprocal effects over time.

The developmental impact of parenting extends beyond antisocial behaviour to include internalizing problems or psychopathology, academic success, and cognitive development (Buehler, Benson, & Gerard, 2006; Ge, Best, Conger, & Simons, 1996; Goodwin et al., 2002; Gray & Steinberg, 1999; Kohn et al., 2010). For example, McKee, Colletti, Rakow, Jones, and Forehand (2008) conducted a review of research on parental warmth, hostility, and behavioural control on externalizing and internalizing problems among children with a depressed parent. Seventeen studies were identified that measured parenting behaviours of depressed parents and child outcomes. Results supported diffuse effects of parenting behaviour with low parental warmth, increased hostility, and control related to both internalizing and externalizing problems. Although these studies only were limited to families with parental depression, it replicates a pattern of results reported in other research (Goodwin et al., 2002).

Parenting and Self-Control

The GTC and empirical tests of the theory have focused less on the development of self-control than the link between self-control and antisocial behaviour. Yet, understanding the development of self-control is essential for intervention efforts. According to Gottfredson and Hirschi (1990) parental efficacy during the first early years up to about ages 10 influence the development of self-

control. After about age ten, rank order differences in self-control remain stable and individual differences in antisocial behaviour throughout development can be explained by differences in self-control.

Consistent with the GTC, studies report early childhood is an important period for the development of self-control. The ability to regulate emotion, regulate behaviour, focus and shift attending, and engage in goal directed behaviour increase rapidly in early childhood (Bell & Deater-Deckard, 2007). Though the GTC focuses on parental monitoring and control, research suggests that warm and responsive parenting early in development are important. Young children who are exposed to warm and responsive parenting are more likely to demonstrate self-regulation skills (Eisenberg et al., 2005; Sroufe, Duggal, Weinfield, & Carlson, 2000). Conversely, young children who are exposed to low warmth and responsiveness are more likely to experience difficulties in self-regulation (Deater-Deckard, Dodge, Bates, & Pettit, 1998; Rothbaum & Weisz, 1994). Hirschi (1994, 2004) broadened the concept of parenting efficacy to include parental affection and family climate. Research on the GTC has found that parental warmth and attachment are related to the development of self-control in childhood (Burt et al., 2006; Hay, 2001; Phythian et al., 2008).

Though there are fewer tests of the mediation hypothesis regarding self-control and antisocial behaviour, studies that have tested these relationships have generally supported a mediating relationship where self-control mediates the relationship between parenting and antisocial behaviour (Boisvert, Vaske, Taylor, & Wright, 2012; Jo & Jang, 2014; Simons, Simons, Chen, Brody, & Lin, 2007). Yet, partial mediation is not uncommon where there is still an independent relationship

between parenting and antisocial behaviour after accounting for the mediating influence of self-control and in the expected direction (Hay, 2001; Kort-Butler, Tyler, & Melander, 2011; Vazsonyi & Belliston, 2007).

Research that has assessed the directionality of parenting and self-control indicates that the path might not be parenting influences self-control in a unidirectional manner, but similar to parenting and externalizing, that relationships are best understood as bidirectional. Choe, Shaw, Brennan, Dishion, and Wilson (2014) examined the mediating role of inhibitory control (an aspect of self-regulation) between parental depression and externalizing at three time points from ages 2 to 4. Results indicated bidirectional relationships between parental depression and externalizing problems and that these results were mediated by inhibitory control. Yates, Obradović, and Egeland (2010) assessed 209 children and mothers at ages 2, 4, and 6. A cascade analysis of the relationship between contextual strain (measured by stressful life events, relationship tension, and low social support), parenting quality (parental responsiveness and behaviour management) with self-regulation at ages 2 and 4 and externalizing and academic achievement at age 6 were assessed. Structured observations, parent and teacher reports were used to measure each of the variables in the model. The cascade model that controlled for concurrent associations of constructs at each time point and stability of constructs across time did not find a relationship between parenting quality with children's self-regulation (ages 2 and 4) or externalizing problems (age 6). However, boys externalizing problems at age 2 were related to lower parenting quality at age 4.

Yet, results have not been consistent. Eisenberg and Colleagues (2005) found that parental warmth when children were age 9 predicted effortful control (an aspect of self-regulation) at age 11 and subsequent externalizing at age 13 with no bidirectional relationships. Brody and Ge (2001) conducted a cross-lagged analysis between self-regulation and warm and hostile parenting from ages 12 to 14. Results indicated children's self-regulation was related to harsh parenting while controlling for initial levels of the variables, but parenting did not produce cross-lagged effects.

Meldrum, Young, Hay, and Flexon (2012) examined reciprocal relationships between parental attachment and self-control at eleven time points between ages four to fifteen. Results indicated that parental attachment and self-control had a reciprocal relationship in childhood with the strength of the effect diminishing over time to non-significance after age 10. Though the relationship was reciprocal, the cross-lagged relationship for attachment on self-control was stronger than the reverse.

It is difficult to untangle the differences across these studies. Each study used a different measure of parenting and these different concepts and measures of parenting quality could contribute to the differences. Meldrum et al. (2012) focussed on parental attachment whereas Brody and Ge (2001) measured warmth and hostility while related are different constructs. Pratt et al. (2004) reported a notable exception where more discipline by parents at age 10 was related to lower self-control in subsequent ages. This finding might reflect increased severity or overcontrolling parents rather than consistency and fairness, however these considerations were not explored in the study.

Research supports that self-control is stable over time with moderate stability co-efficient after age 10 (about .35; Brody & Ge, 2001; Polakowski, 1994). There is also evidence of rank order change after age 10. In a study of African-American youth ($N = 750$) at ages 10 to 12 and 12 to 14, Burt et al. (2006) found evidence for stability, but also rank order change in self-control. These results coupled with studies that report continued transactional relationships between parenting and self-control after age 10 indicate Gottfredson and Hirschi's (1990) claim that self-control is set after age 10 does not have strong empirical support.

Additionally, though parenting is important in developing self-control there is evidence that school (Gottfredson, 2001; Turner, Piquero, & Pratt, 2005) and neuropsychological deficits are also related to the development of self-control (Jackson & Beaver, 2013). Yet how the relationships among parenting, self-control, school factors and antisocial behaviour connect is not well understood.

Summary

A large body of research indicates important relationships across parenting, self-control, antisocial behaviour and other developmental outcomes. The degree that these relationships conform to the tenants of the GTC is less clear. Self-control is predictive of multiple health and behavioural outcomes including antisocial behaviour. Further supporting the GTC, there is evidence that self-control mediates the relationship between parenting and antisocial behaviour (Boisvery et al., 2012; Jo & Jang, 2014; Simons et al., 2007). Yet parenting appears to demonstrate an independent impact on antisocial behaviour even after the mediating of the influence of self-control are accounted for (Hay, 2001; Kort-Butler et al., 2011;

Vazsonyi & Belliston, 2007). This suggests that the influence of parenting might be greater than the impact it has on self-control.

There is also evidence that the relationship between parenting and self-control is bidirectional rather than unidirectional. Higher levels of externalizing behaviours in early childhood (Yates et al., 2010) and across middle to late childhood (Wang et al., 2013) are related to subsequent poor parenting. It is not clear whether the relationship between antisocial behaviour and parenting is mediated through self-control. Limited empirical research has examined these relationships and existing research reports differing results (Brody & Ge, 2001; Eisenberg et al., 2005).

General Summary

Research suggests the connections between early antisocial behaviour and low self-control are mediated through adolescent behaviours (e.g. antisocial behaviour) and domains of competence (academic and social; Moffitt et al., 2011; Converse et al., 2014; Masten et al., 2010). There is evidence for both simple and multiple mediated paths across adolescence. For example, academic success in adolescence mediates the link between early self-control and adult work success (Converse et al., 2014). Other work has demonstrated more complex relationships across adolescence that includes multiple mediation referred to as cascading problems and bidirectional links between domains (Burt & Roisman, 2010; Moilanen et al., 2010). Most of the research assessing cascading problems, however, has not examined the impact of self-control and not examined pathways into adulthood. This leaves open the possibility that the complex relationships between

adolescent problems (e.g., antisocial behaviour, academic success, and internalizing problems) can be explained by low self-control as proposed by Gottfredson and Hirschi (1990).

The GTC suggests that low self-control is the sole causal factor that explains antisocial behaviour and related problems and the links between antisocial behaviour and problems in other domains can be accounted for by self-control (Gottfredson & Hirschi, 1990). Research has generally supported low self-control is related to antisocial behaviour and related problems and also that high self-control influences a number of positive outcomes (Tangney et al., 2004). However, many of the studies that have assessed the negative outcomes of low self-control have included aspects of antisocial behaviour (Fergusson, Boden, & Horwood, 2013). This limits the ability to determine whether self-control or antisocial behaviour explains the relationship with other outcomes and confounds the relationship between self-control and antisocial behaviour. The relative importance of self-control and early antisocial problems on adult life outcomes has rarely been tested. One of the few studies that did test both early antisocial behaviour and self-control on adult outcomes reported that antisocial behaviour demonstrated stronger effects than self-control (Fergusson et al., 2013).

Additionally, most of the empirical work on the GTC has focused on the link between self-control and antisocial behaviour. There is substantially less empirical work examining the GTC regarding the development of self-control, though this area of research has been growing in recent years (Brody & Ge, 2001; Burt et al., 2006; Eisenberg et al., 2005; Meldrum et al., 2012). Most studies have tested the

association between parenting and self-control or unidirectional relationships between self-control and parenting. This research indicates poor parenting is related to low self-control, but that a broader definition of parenting than parental management practices that includes parental warmth, attachment, and well-being are important in developing self-control and incomplete mediation indicating parenting is important above and beyond the development of self-control (Hay, 2001; Kort-Butler et al., 2011; Vazsonyi & Belliston, 2007).

Studies report mixed results regarding whether parenting impacts self-control beyond childhood with some research reporting results are significant in childhood, but not adolescence (Meldrum et al., 2012) and others reporting significant relationships in adolescence (Burt et al., 2006).

Research has found bidirectional relationships from externalizing to parenting in both early and late childhood (Gross et al., 2008; Pardini et al., 2008). If the nature of the relationships between parenting, self-control, and externalizing is bidirectional, this calls into question the unidirectional causality proposed by the GTC. Considering the paucity of research on this topic, this is an important area of future empirical work.

Another research gap is regarding the impact of parenting on self-control and antisocial behaviour through childhood and adolescence. Though a large body of work has studied parenting and antisocial behaviour, much of this work has examined parenting at a static period of time. This limits the ability to assess whether the importance of parenting or the nature of the impact of parenting shifts across development. It is currently unclear whether the impact of parenting varies

from childhood to adolescence. Questions regarding the strength and directionality of relationships are not limited to parenting and antisocial behaviour, but apply to other areas including academic success and internalizing problems. Research indicates these factors are linked in a developmental change across childhood and into adulthood (Blandon et al., 2010; Calkins et al., 2010; Masten et al., 2005; Moilanen et al., 2010; Vaillancourt et al., 2013), but the specifics regarding how they are linked remains unclear.

Finally, whether the developmental path that connects parenting, self-control, antisocial behaviour, and other youth development outcomes such as academic success and internalizing problems apply to all youth or whether children who engage in early antisocial behaviour follow a different path and are less influenced by external factors is not clear.

The Present Study

The present study aimed to extend prior research by exploring the connections between parenting, early antisocial behaviour, low self-control, academic success, and internalizing problems from childhood and into adulthood. Few studies have spanned such a broad developmental period. In particular the study examined whether the connections among parenting, self-control, antisocial behaviour and other youth development outcomes (academic success) were best explained by the general theory of crime with unidirectional relationships from parenting to self-control, and self-control, or whether additional paths based on empirical tests of the GTC and other theories are needed to better understand these relationships. In order to test these questions a series of nested structural equation

models were constructed to test different possible relationships among study variables based on theory and research.

The first theoretical model included pathways consistent with the GTC. This involved paths from parenting to self-control, and from self-control to antisocial behaviour, academic success, and internalizing problems. These paths were included at each age. Though the GTC proposed the influence of parenting on self-control is limited in early childhood up to age 10, there is evidence to suggest that parenting continues to impact self-control in late childhood (Eisenberg et al., 2005) and adolescence (Burt et al., 2006; though see Meldrum et al., 2012 for conflicting results).

The second model added additional direct paths from parenting quality to antisocial behaviour, academic success, and internalizing problems. Also, paths from academic success were connected to antisocial behaviour. This model was constructed based on research that parenting quality, including warm supportive parenting, effective discipline, and parental conflict are robustly associated with antisocial behaviour, academic success, and internalizing problems (Goodwin et al., 2002; Kohn et al., 2010). Additionally, there is evidence that academic success has direct impacts on both antisocial behaviour and internalizing symptoms in childhood and adolescence (Burt & Roisman, 2010; Englund & Siebenbrun, 2012), though little research has examined self-control as a potential mediator. Additionally, much of the research that has examined the parenting, self-control, and antisocial behaviour path proposed by the GTC has reported that parenting still

demonstrates a direct effect while accounting for self-control as a mediator (Hay, 2001; Kort-Butler et al., 2011; Vazsonyi & Belliston, 2007).

The third model included bidirectional results from antisocial behaviour to parenting, self-control, academic success, and internalizing problems. An additional path from academic success to self-control was tested. This model was partly based on Patterson et al.'s (1989) theory that negative interactions between antisocial behaviour with parenting and school are related in a bidirectional relationship over time. Though less research has investigated bi-directional results, there is empirical support for these relationships (Yates et al., 2010; but see Eisenberg et al., 2005). Academic success might also demonstrate bidirectional relationships with self-control with some research suggesting that school factors can impact self-control (Burt et al., 2006). The prior models examined some of the different ways in which parenting, self-control, antisocial behaviour, academic success, and internalizing are linked based on theory and prior research. In order to explore whether there are additional linkages among these factors all possible cross-lagged relationships will be tested across variables. This model included paths from internalizing to all other study variables and academic success to parenting. No predictions are made regarding the influence of protective factor as research has indicated potential protective effects of internalizing on externalizing behaviour during adolescence (Loeber et al., 2008, Loeber & Keenan, 1994; Farrington, 1995), but results have also indicated internalizing is related to other factors that increase the risk for externalizing problems such as peer victimization (Vaillancourt et al., 2013).

It is hypothesized that the bidirectional model will provide the best fit for the data. That is the model that includes the pathways associated with the GTC, direct pathways from parenting to antisocial behaviour and related outcomes, bidirectional links between academic success and antisocial behaviour, paths from antisocial behaviour to parenting, self-control, and parenting. These results would suggest that the GTC is important, but not sufficient to explain the relationships among parenting, self-control, antisocial behaviour and related problems. The full transactional model is not expected to have a significant improvement based on past studies that have generally found internalizing is more likely to be an outcome associated with impacts in other domains rather than generating cascades (Burt & Roisman, 2010; van Lier et al., 2012).

Regarding the pathways between childhood antisocial behaviour and adult outcomes, the following research question and hypotheses were examined. Do adolescence transitions mediate the relationship between childhood risk and adult life success? It is hypothesized that early antisocial behaviour and self-control will predict antisocial behaviour, employment success, and psychopathology in adulthood. No hypotheses regarding the relative strength of the relationship between antisocial behaviour or self-control on adult outcomes were made. Much of the research assessing the link between childhood antisocial behaviour or self-control on adult outcomes is limited by using measures that conceptually overlap with both self-control and behaviour problems, or focus either on antisocial behaviour or self-control and do not consider the impact of both (Fergusson et al., 2013).

It is hypothesized that early self-control and antisocial behaviour will be mediated through adolescent pathways. Specifically that academic success will mediate the pathway between early antisocial behaviour and self-control and employment success and that internalizing problems in adolescence will mediate the pathway between early antisocial behaviour, self-control, and adult psychopathology. It is further hypothesized that the mediation pathways will be bidirectional with academic success impacting externalizing in adolescence and connecting to both antisocial behaviour and employment success in adulthood. No hypotheses are made regarding the impact of internalizing problems and antisocial lifestyle at age 32. Internalizing has been both related to lower antisocial behaviour in the transition to adulthood (e.g., Masten et al., 2005) and more antisocial and criminal behaviour (e.g., Zara & Farrington, 2005). Finally, based on research that has found antisocial behaviour is related to more internalizing problems in adulthood antisocial behaviour in adolescence is expected to be connected to higher psychopathology in adulthood (Moffitt et al., 2002; Piquero et al., 2007; Pulkkinen et al., 2009).

The final two research areas included examining whether the pathways that connect parenting, self-control, antisocial behaviour, academic success, and internalizing problems from childhood to adulthood varied for high-risk children. Similarly, the study investigated whether the pathways from childhood to adulthood varied for high-risk children. Based on prior research that has reported similar pathways in high-risk samples (Dodge et al., 2008) it is hypothesized that paths will be invariant across groups.

Methods

Participants

Data for the current study is drawn from the Cambridge Study in Delinquent Development (CSDD), a prospective longitudinal survey of 411 males. The study first assessed boys at ages 8 to 9. The sample represents all boys ages 8 to 9 who attended 6 state primary schools in a working class neighbourhood in London (West, 1969). One of the strengths of the CSDD is the high rate of retention of the sample. Ninety- five percent of the sample that was still living was retained at age 18 and 94% was retained at age 32 (Farrington, 2007). Another strength of the study is the use of multiple sources of information. At ages 8, 10, and 14 families were interviewed by trained social workers. Teachers and peers completed information regarding the boys at ages 8, 10, and 14 and boys also completed a number of assessments that are included. Official records of convictions were recorded beginning at age 10, the age of criminal responsibility in the United Kingdom.

Data were collected at ages 8, 10, 12 (teacher ratings), 14, 16, 18, 21, 25, 32, and 48. At age 16 the study no longer collected information from the school, peers, or family, but interviews were conducted with the boy. The constructs measured also changed substantially beginning at age 16. Therefore, it was not possible to use consistent measures from adolescence into adulthood, however attempts were made to select conceptually similar measures on the constructs of interest. Ages 21 and 25 were not included as only a subgroup of participants were assessed at this age. Ages 16 and 18 were not included as the measures at this age differed from

those in childhood and adulthood. Therefore, the ages selected within the current study were 8, 10, 14, and 32.

A number of reliability and validity checks have been conducted with the CDDS data. For example, participants were generally randomly assigned to an interviewer. This allowed the ability to investigate interviewer effects, and these were rarely found. In addition, information obtained from interviews were also checked with official records where possible. For example, the boys reported birth rate was checked against hospital records. In general, reliability and validity checks generally reported the participants were truthful (West & Farrington, 1977).

Measures

Early Adversity and Risk. An early risk measure that included eight risk variables in childhood were coded as present or absent and summed with a range from 0 to 8. The measure was a composite of: job skill level of parents (low skill job versus professional), education level of parents (any post-secondary school or specialized training), income level of family (adequate or inadequate), any separations from parents, criminal history of parents (any criminal history or no criminal history), low verbal IQ, and low non-verbal IQ of the boy. Low non-verbal IQ was defined as scoring at an IQ below 90 on Raven's Progressive Matrices (Raven, 1947; Shaw, 1969). Low verbal IQ was coded as scoring below the bottom quarter on verbal comprehension. These variables were selected as they capture aspects of contextual risk and individual risk proposed by Moffitt (1993) as relevant to the LCP pathway.

Parenting Quality. Parenting quality was proposed as a latent variable that included measures reflecting parental warmth/hostility, parental mental wellness/distress, and conflict in parental marriage at ages 8, 10, and 14. Each of the measures was coded based on interviews with the families by social workers. A parental attitude variable was used to code parental warmth. Maternal attitude was divided across loving/warm, anxious/neurotic, overprotective, and neglecting or cruel. Paternal attitude was divided across loving/warm, passive, and neglecting or cruel. A composite of parental warmth was coded on a scale of 1 to 4, where 1 represented both parents were warm or a single parent was warm, 2 was one parent warm one minor issues, 3 both parents minor issues or a single parent with minor issues, and 4 if either parent demonstrated neglect or cruelty.

Mothers and fathers were rated regarding their level of distress based on interviews with a social worker on a 3 point scale (no issues, some issues, and severe issues) at ages 8, 10, and 14. These scores were averaged across parents into an overall parental well-being/distress variable. Parental conflict was rated as either normal, or bad. The scale that parental conflict was rated on varied over time, at age 8 it was coded dichotomously as either normal or bad. The items used at other ages were recoded to the same scale as age 8. Each item was coded so high values represented low quality parenting.

Antisocial Behaviour (ages 8 to 14). Antisocial behaviour was assessed using a combination of interviewer ratings of behaviour problems based on interviews with the families and teacher ratings of behaviour problems and disruptiveness in class. Items measuring conduct disorder (conduct and behavioural

problems) at ages 8, 10, and 14 were used. These were based on social worker interviews with parent and information from school. The rating scales of conduct disorder were inconsistent across time. At age 8 conduct disorder was coded on a 3 point scale (well behaved, moderate bad behaviour, severe bad behaviour). At age 10 a 4 point scale was used (no problems, minimal problems, moderate problems, severe problems). At age 14 another 3 point scale was used (no problems, minor problems, major problems). The 4 point scale was recoded into a three point scale by combining no problems and minimal problems.

Separate items of teacher ratings of behavioural problems in the classroom at ages 8, 10, and 14 were also used. Teacher ratings of disruptive or troublesome behaviour in the classroom were also coded on different scales over time. At ages 8 and 14 a 3 point scale with higher scores reflecting more behaviour problems was used (e.g., good behaviour, some problems, naughty) whereas at age 10 a four point scale from least to most of problem behaviour was used and included an extreme problems group. Problem behaviour at age 10 was recoded so that those with high and extreme problems were grouped together. Once scores were recoded to the same scale, a combined measure was developed.

The combined measure of antisocial behaviour was coded into a 5 point scale. A score of 1 was coded when the boy was rated with minimal problems in the conduct disorder and teacher rating measure. A score of 2 was coded when the boy was rated as having minimal problems on either conduct disorder or teacher ratings, but moderate problems on the other. A score of 3 was coded when the boy was rated as having minimal problems on either conduct disorder or teacher

ratings, but high problems on the other. A score of 4 was coded when the boy was coded as having some problems on either conduct disorder or teacher ratings and high problems on the other. Finally, a score of 5 was coded when both conduct disorder and teacher rating indicated a high level of behavioural problems.

Although convictions were recorded beginning at age 10, only a small number of children were convicted at age 10 (1.4%, $n = 6$). Considering this is an extreme split and well below the 90/10 split that has been suggested as acceptable (e.g., Field, 2005) the variable was not included. Convictions were not used at age 14 as this would result in changing the antisocial behaviour construct from ages 8, 10, and 14 and limit the ability to examine cascading effects at this age.

Antisocial Lifestyle (age 32). Antisocial lifestyle at age 32 was defined as a latent variable comprised of the following dichotomous variables: convictions in the last five years (none, any), self-reported offending in the last five years (none, any), self-reported fighting (no, yes), and other self-reported antisocial behaviour (e.g., theft from work). Convictions were recoded using official records and monitoring and minor offences (e.g., drunkenness) were excluded (Farrington et al., 2006).

Academic Competence. Academic competence was proposed as a latent variable that included teacher ratings of the boys standing in class (1-3), a composite measure of the boys performance in academic tasks (e.g., reading ability; scored from 1-3) and a composite measure of teacher ratings related to academic engagement that was based on attendance/truancy, effort, and engagement of the boy in school (scored from 1-4). Each item was coded so that high scores represented higher ability.

Position in class was coded based on teacher's ratings as to whether there were subjects that the boy was very good in (scored as no/yes) and any subjects that the boy was very bad in (scored as no/yes) at ages 8 and 10. These items were coded into a single item that coded on a three point scale: a 1 was coded when there the boy performed very badly in at least some subjects and did not perform very well in others; a 2 was coded when there were both subjects the boy was very good and others the boy was very bad in; a 3 was coded when the boy was very good in some subjects and not very bad in others. At age 14 their standing was based on a single item that asked teachers to rank the boy's position in class (top quarter, middle half, and bottom quarter).

Performance in academic tasks was coded based on the boys performance on tests related to arithmetic, reading, and verbal ability. At age 8 two items that reflected the boys reading ability were used. These items were coded onto a 4 point scale with higher scores reflecting poorer performance. At age 10 items reflecting the boys performance on math, English, and verbal tests were used. Math and English were coded onto a 4 point scale and verbal into a 3 point scale with higher items reflecting more problems. At age 14 an item reflecting the boys reading ability was used. This item was coded on a scale from 1 to 5 where 1 reflected above average ability, 3 average ability, and 5 poor ability. First, all items were reverse coded so that higher scores reflected better academic performance. Next, to bring all of the items onto the same scale a new composite measure was created at each age where 1 represented poor performance, 2 represented average performance, and 3 represented above average performance. At each age the scores were averaged

across the different performance measures. The composite score was then divided into the bottom quarter, middle (about 50%), and top quarter.

Academic engagement was coded using items that measured attendance and the boys level of effort in the class. Attendance was rated differently across ages. At age 8 it was coded dichotomously (satisfactory attendance, poor attendance), at age 10 it was coded on a 5 point scale (from good to poor), and at age 14 on a 3 point scale (never absent, occasionally, frequently). In order to code items on the same scale the items at ages 10 and 14 were coded dichotomously (never or rarely and frequently). Level of effort was coded consistently on a 3 point scale at each age (does not care, average, tries hard). All items were recoded so that higher values reflected better attendance or effort. Academic engagement was coded by averaging the scores across attendance and effort.

Self-Control. Self-control was proposed as a latent variable that included impulsivity and sensation seeking/daring behaviour. Impulsivity was measured using psychomotor impulsivity. These measures were coded by creating a composite of scores on the Porteus maze, the spiral maze, and the tapping test at ages 8 and 10. High scores on these tests suggest careless, clumsy, or impulsive behavior (West & Farrington, 1973) and these psychomotor measures have been used to assess self-control in other studies (e.g., Polakowski, 1994). Scores on each of these tests were coded into low, low average, high average, and high score. A composite impulsivity measure was created by averaging the scores across the three tests and multiplying this score by the number of tests, resulting in an item that ranged from 1 to 12. At age 14 two scores on the spiral maze were available and

were averaged to produce a single spiral maze score. The method that was used at other ages was then repeated

Rating of the boy's behaviour as sensation seeking or daring was recoded at each age though the rater varied across ages. At age 8 the rating was made based on parent interviews, at age 10 a peer rating was taken, and at age 14 a teacher rating. Although the rater was distinct, the questions used and construct measured were similar so these items were used. The rating scales varied slightly across ages between a 3 point scale at ages 8 and 14 (cautious, average, daring) and 4 point scale at age 10 (scored from least to most daring). Each item was coded so that high scores represented higher lower daring. At age 10 the middle two scores were combined to represent an average level of daring and result in a 3 point scale similar to the other ages.

Internalizing/Mental Health. Internalizing at ages 8, 10, and 14 was measured based on social worker ratings of the boy's level of distress. These were coded as no symptoms, minimal, and moderate or severe. Minimal reflected a couple symptoms, but that did not impair functioning to a significant extent. Moderate or severe represented distress that impacted functioning in at least on area of their life. At age 8 an independent rater examined the information and found of the 411, there were very different results in 11 cases. Eight of these were adjusted by the social workers after consultation with the independent rater.

At age 32 mental health was measured using The General Health Questionnaire (GHQ; Goldberg, 1972). The GHQ contains 12 items and is commonly used to measure anxiety and depression (Weich & Lewis, 1998). Similar to prior

research (Farrington et al., 2009), a score of 5 and above was used to code mental health as either poor.

Employment Success. Employment success was a latent variable comprised of the following dichotomously coded variables: low skill job, low pay, employment status, and stability of employment. Job skill was defined as manual jobs that require little training, employment status was defined as employed versus unemployed at the time of data collection, and the number of jobs was used to measure job stability.

Analysis Plan

Tests of Model Fit

The appropriateness of the model for the data was assessed through measures of model fit. These were used in evaluating the results for the measurement and structural model. The Chi Square goodness of fit test compares the observed and expected outcome covariances. A non-significant value indicates a good fit, yet this approach has been criticized as it is sensitive to larger sample sizes (Tanaka, 1987). Other indicators of model fit include the root mean square error of approximation (RMSEA; Browne & Cudeck, 1992) which compares the fit to a saturated model where the total available data points are equal to the number of parameters in the model, the comparative fit index (CFI; Bentler, 1990), and Tucker-Lewis index (TLI; Tucker & Lewis, 1973). Lower scores on RMSEA represent a better fit with .08 indicating an acceptable fit and .05 reflecting a good fit (Hu & Bentler, 1999; McDonald & Ho, 2002). Higher scores on CFI and TLI represent better scores with .90 reflecting an acceptable fit and .95 a good fit CFI (Hu & Bentler,

1999). Rather than rely on a single fit measure, it is generally recommended to evaluate multiple measures when determining model fit (Yuan, 2005). Research examining the optimal cut-offs for fit indices has mainly focused on continuous outcome variables, although they appear to generalize to polytomous data (Yu, 2002). Finally, a scaled chi-square difference test was used to examine change in nested models (Satorra & Bentler, 2001). A scaled chi-square test is recommended when using robust estimators for missing data such as those employed in the current analysis (e.g., MLR, WLSM) required a chi square difference test be used to compare models (Muthen & Muthen, 2011).

Testing Cascade Models (ages 8 to 14)

Measurement Models

Structural equation modeling involves a measurement model and a structural model. The measurement model specifies how the latent variables that define the constructs under investigation are measured and the structural model tests the relationships or paths among the variables in the model. Latent variables provide more accurate estimates of measurement error than path analysis with manifest variables (Geiser, 2013). Therefore, for the current study, whenever possible, latent variables were proposed. However, the use of latent variables is not always possible, either when multiple measures are not possible, or when latent variables do not demonstrate adequate measurement invariance.

Measurement invariance broadly refers to the degree that measurement generalizes across groups or time. When a measure is invariant across time it is understood to measure the same construct in an equivalent manner over time. That

is, the measures assess the same construct over time in a similar manner (Vandenberg & Lance, 2000). Establishing measurement invariance is a necessary step in assessing change in latent variables over time.

Therefore, testing the measurement invariance of the measurement model is a necessary step before testing the structural models in the cascade analysis. Measurement invariance is often defined on a continuum from weak to strong invariance. Tests of measurement invariance often progress in a forward manner from weaker to more stringent forms of invariance. To advance and test the next most stringent form of measurement invariance the weaker form of measurement invariance must be met.

The lowest form of invariance is configural or factorial invariance that assesses whether the observed variables demonstrate a similar factor structure across groups. If configural or factorial invariance is not met this means the construct of interest differs between groups. Factorial invariance can be tested using Exploratory Factor Analysis (EFA) and examine whether the same number of factors are found across time (Muthen & Muthen, 2009). Once factorial invariance is identified the next step is to test metric or weak invariance. Metric invariance examines whether the factor loadings operate in a similar manner across groups. If metric invariance holds, then a one unit change at one time is equal to a one unit change at another period in time. To test metric invariance factor loadings are held equal across time and model fit indices are compared with configural invariance. If the model fits significantly worse when factor loadings are equal than in configural invariance, then the model does not meet the requirements for metric invariance.

The next test is whether the intercepts or thresholds (for continuous and categorical variables respectively) are equal across time, referred to as scalar or strong invariance. A failure to achieve scalar invariance indicates differential item functioning across time. When scalar invariance is not met, it is not possible to compare the item means or thresholds across time. Though there are stricter forms of invariance, including equality of variances and covariances across groups and factor means (Vandenger & Lance, 2000), obtaining scalar or metric invariance is required for rank order stability of difference that is required for cascade analysis (Cole & Maxwell, 2003).

If measurement invariance is not met at the metric or scalar level, the invariance can potentially be included in the model by freeing the constraints for some factors or factor loadings. There is no set agreement regarding how much invariance can be modeled, but a minority of items can potentially be modeled (Bryne, Shavelson, & Muthen, 1989; Steenkamp & Baumgartner, 1998).

Testing Structural Models

A series of nested structural models were designed to test study research questions and hypotheses. Consistent with recommendations from Cole and Maxwell (2003) the first model was a baseline model that includes stability paths and allows all factors at a specific time to correlate. The second model (self-control model) tested cross-lagged relationships consistent with the GTC (Gottfredson & Hirschi, 1990) including paths from parenting to self-control and self-control to externalizing, academic performance, and internalizing at each time point. This model tested whether the paths of the GTC fit the data better than the baseline

model. The third model (direct effects model) tested whether including paths from parenting to antisocial behaviour, academic performance, and internalizing and academic performance to antisocial behaviour better fit the data. The fourth model (reciprocal effects model) included paths that tested bidirectional relationships from antisocial behaviour to parenting, self-control, academic performance, and internalizing problems, and self-control to parenting. The fifth model includes all possible cross-lagged relationships (see Figure 2 for baseline and hypothesized models).

Figure 2

Hypothesized Cascade Models

a. Baseline Model

b. Self-Control Model

c. Direct Effects Model

Note. par = parenting, sc=self-control, aca = academic success, antib =antisocial behaviour, int = internalizing

d. Bidirectional model

e. Full transactional

Note. par = parenting, sc=self-control , aca = academic success, antib =antisocial behaviour, int = internalizing

These models were constructed to test the different ways that theory and research suggests parenting, self-control, antisocial behaviour, academic problems, and internalizing might be related. The self-control model tests whether the paths associated with the GTC are the best fit for the data. The GTC was tested first as it is a parsimonious model and has significant empirical support. The direct effects model examined whether adding paths that include direct relationships from parenting to youth development (academic success, antisocial behaviour, and internalizing) and academic success to antisocial behaviour and internalizing problems provided a better fit to the data than the GTC. If true this might indicate that the paths associated with the GTC are not sufficient to explain the study variables. The last model tests all possible paths.

The model that provides the best fit to the data, indicated by a change in chi-square difference scores will be retained as the final model. Once the best fitting model is selected, the specific relationships among the variables within the model will be examined to assess whether they are consistent with study hypotheses. For example, if the third direct effects model was the best for the data, this would potentially indicate that additional direct relationships should be considered beyond the path from parenting to self-control, and self-control to antisocial behaviour, academic problems, and internalizing. However, the pattern of results including the significance of different study paths also needs to be considered (Kline, 2010).

Measurement and Structural Models into Adulthood

A different approach to the analysis was required when testing the relationships between externalizing and self-control in childhood and life-success in adulthood. The change in measures used and data collected from adolescence to adulthood meant it was not possible to use comparable measures. Additionally, parenting was not tested in the adult models the relationships between parenting and adolescent variables were explored fully in the adolescent model and therefore not included in the adult model.

Though the measures changed between adolescence and adulthood, the constructs measured were conceptually similar. Academic success is similar to employment success other research that has used similar measures of academic and employment have treated these constructs as analogous (e.g., Masten et al., 2005). Internalizing problems was also similar to psychopathology in adulthood in that both measure psychological well-being. First, CFA's were run with employment success and antisocial lifestyle in adulthood to see whether the observed variables fit into a latent construct. Four indicators were proposed to load onto each latent variable.

Nested structural equation models were used to test three different structural models from ages 10, 14, and 32. The baseline model included paths measuring the continuity of similar constructs over time and correlations among factors within each assessment wave. The second model included mediation paths from antisocial behaviour and self-control to academic success and internalizing in adolescence and employment success and psychopathology in adulthood. The final

model included bidirectional paths from academic success and internalizing to other study variables to assess bidirectional relationships.

*Figure 3**Models Examining Early Self-Control, Antisocial Behaviour, and Life Success**a. Baseline Model* *b. Antisocial and Self-Control Mediation Model*

Note. sc=self-control , aca = academic success, antib =antisocial behaviour, int = internalizing, employ=employment success, antil=antisocial lifestyle, psy=psychopathology

c. Full Cross Lagged Mediation Model

Note. sc=self-control , aca = academic success, antib =antisocial behaviour, int = internalizing, employ=employment success, antil=antisocial lifestyle, psy=psychopathology

Results

Data Screening and Descriptive Statistics

Prior to analysis, data were screened for missing data, outliers (univariate and multivariate), skewness, kurtosis, normality, linearity and homoscedasticity. The proportion of missing data ranged from none to 20.7%. There were 40 variables included in the analysis. Of these 40 variables, 11 had less than 5% of missing data, 21 had between 5% to 10% of missing data, 6 had 10% to 15%, and 2 variables were missing 20% (see Table 3). Little's MCAR test was significant ($\chi^2(2,943) = 3,287.169, p < .01$) and separate variance t-tests were examined. Considering 29 had more than 5% of missing data 850 t-tests were produced. Of these 78 were significant at the $p < .001$ level. Considering the majority of the data has less than 15% of missing data and results from the separate variance t-tests, the data were assumed to be Missing at Random (MAR). When MAR is assumed, estimating missing values rather than deleting values is recommended (Allison, 2003; Enders & Bandalos, 2001; Schafer & Graham, 2002). Missing data were estimated using robust maximum likelihood (MLR) and weighted least squares with mean and variance adjusted (WLSMV) estimators (for continuous and categorical variables respectively) to estimate values of missing data in Mplus version 7.2 (Muthen & Muthen, 2011). WLSMV assumes the observed categorical variable is influenced by an underlying continuous latent response variable and uses threshold parameters to distinguish between categorical responses rather than intercepts (Finney & DiStefano, 2006; Millsap & Yun-Tein, 2004).

Considering the sample size for the study is large (over 200), more weight was put into visual inspection of the histograms and Q-Q plots than the z-scores for calculating zscores for skewness and kurtosis, though these were calculated and considered (Field, 2005). Parental warmth, parental well-being, and internalizing were all heavily skewed with a strong floor effect at each age. Though MLR and WLMV estimators are robust against normality, data were treated as ordinal. When data have a strong floor or ceiling effect the variables should be treated as ordinal to avoid biased estimates (Muthen & Muthen, 2011).

There were no univariate outliers located in any of the study variables. Using Mahalanobis distance to screen for multivariate outliers at each age ($\chi^2(10) = 23.209, p < .001$; $\chi^2(9) = 21.666, p < .001$), 14 cases were identified as multivariate outliers at $p < .001$ (3.4% of the sample). Deviations from multivariate normality were not severe with no large jumps in values, and therefore all cases were retained for analysis.

Table 3

Descriptive Statistics for Individual Items (N = 411)

Item	Informant	Range	Mean	SD	% Miss
Family Functioning					
Parental Marriage age 8	Parents	0-1	.230	.421	5.8%
Parental Marriage age 10	Parents	0-1	.137	.340	14.1%
Parental Marriage age 14	Parents	0-1	.160	.367	8.5%
Parental Well-Being age 8	Parents	1-3	2.041	1.007	7.5%
Parental Well-Being age 10	Parents	1-3	1.939	.990	12.2%
Parental Well-Being age 14	Parents	1-3	2.080	1.065	11.2%
Parental Warmth age 8	Parents	1-4	1.956	1.144	5.6%
Parental Warmth age 10	Parents	1-4	1.857	1.113	12.7%
Parental Warmth age 14	Parents	1-4	1.938	1.105	9.5%
Academic Functioning					
Academic Performance age 8	Teacher	1-3	1.895	.783	.2%
Academic Performance age 10	Teacher	1-3	2.099	.700	6.1%
Academic Performance age 14	Teacher	1-3	1.938	.754	10.0%
Standing in Class age 8	Teacher	1-3	2.000	.677	2.2%
Standing in Class age 10	Teacher	1-3	2.135	.635	6.3%
Standing in Class age 14	Teacher	1-3	1.196	.703	9.7%
Academic Engagement age 8	Teacher	1-4	1.880	.613	4.4%
Academic Engagement age 10	Teacher	1-4	1.979	.632	6.1%
Academic Engagement age 14	Teacher	1-4	1.962	.592	9.7%
Self-control					
Impulsivity age 8	Teacher Performance measures	1-12	6.088	2.443	.5%

Impulsivity age 10	Performance measures	1-12	5.861	2.443	.5%
Impulsivity age 14	Performance measures	1-12	5.581	2.145	1.2%
Daring age 8	Social Worker	1-3	.963	.599	7.8%
Daring age 10	Peers	1-3	.927	.699	14.1%
Daring age 14	Teacher	1-3	1.28	.725	8.0%
Internalizing					
Internalizing age 8	Social Worker	1-3	.725	.826	7.1%
Internalizing age 10	Teacher	1-3	.515	.719	12.2%
Internalizing age 14	Teacher	1-3	1.044	.722	6.3%
Antisocial Behaviour					
Antisocial Behaviour age 8	Teacher & Social Worker	1-5	2.545	1.132	0%
Antisocial Behaviour age 10	Teacher & Social Worker	1-5	2.655	1.129	0%
Antisocial Behaviour age 14	Teacher & Social Worker	1-5	2.491	.986	0%
Early Adversity					
Early adversity	Family	0-8	2.607	1.799	0%
Antisocial Lifestyle age 32					
Any self reported offences (last 5 years)	Self-report	0-1	.225	.418	8%
Any convictions (last 5 years)	Official Records	0-1	.146	.354	0%
Gets into fights	Self-report	0-1	.371	.483	8.3%
Self-reported antisocial behaviour	Self-report	0-1	.530	.500	20.1%

Employment Success age 32

Employed	Self-report	0-1	.219	.314	8.3%
Low skill job	Self-report	0-1	.253	.415	8.5%
Low pay	Self-report	0-1	.258	.435	20.7%
Number of jobs	Self-report	0-1	.258	.440	8.8%

Psychopathology age 32

General Health Questionnaire (5 or more)	Self-report	0-1	.248	.264	8%
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Cascade Analysis from ages 8 to 14

Measurement Model

The first step in examining the measurement model was to conduct an exploratory factor analysis to investigate whether the factors corresponded to the proposed latent variables for the study and whether the number of factors and indicators of factors was similar at each time. Though EFA is not commonly used in measurement invariance, considering the variables were not from validated scales, confirming the pattern of results was an important first step (Muthen & Muthen, 2009).

Proposed latent variables included family functioning, academic success, self-control, and antisocial behaviour. Eight observed variables were included and anticipated to load onto three factors that would represent parenting quality (three variables), academic success (three variables), and self-control (two variables). The correlation matrix was scanned to assess whether any variables correlated very low or high could suggest problems with factorability (Tabachnick & Fidell, 2007; See Table 4). Examination of the correlation matrix of the study variables indicated that three variables had correlations of over .80, although these were variables at across different ages and were not a concern. In addition, some variables had low correlations, but most of these were across assessment periods. The one exception is impulsivity and daring which demonstrated low, and at ages 10 and 14 insignificant correlations.

Table 4

Correlations among Manifest Variables

	1	2	3	4	5	6	7	8	9	10	11
1. pwarm8	-										
2. pwb8	.393***	-									
3. pmar8	.461***	.486***	-								
4. acadp8	-.137**	-.138**	-.142*	-							
5. acap8	-.032	-.04	-.112*	.382***	-						
6. aceng8	-.133**	-.079	-.161*	.377***	.354***	-					
7. imp8	-.017	.032	-.053	.249***	.306***	.172***	-				
8. dar8	.101**	-.114*	-.121*	.080	.038	.248***	.159**	-			
9. pwarm10	.856***	.317***	.418***	-.207***	-.125*	-.136**	-.060	.055	-		
10. pwb10	.358***	.594***	.321***	-.151***	-.038	-.092	-.055	-.131**	.436***	-	
11. pmar10	.403***	.440***	.768***	-.153***	-.103*	-.049	.040	-.047	.499***	.427***	-
12. acadp10	-.039	.067	-.199*	.515***	.440***	.205***	.176**	.027	-.171***	-.027	-.212***
13. acap10	-.079	-.068	-.246**	.482***	.759***	.360***	.353***	.083	-.199***	-.104***	-.161*
14. aceng10	-.018	-.002	-.251***	.240***	.356***	.345***	.176**	.186**	-.161***	-.010	-.223***
15. imp10	-.041	-.003	.022	.131*	.250***	.233***	.349***	.077	-.103***	-.034	.007
16. dar10	.059	-.026	-.120	.008	.062	.211***	.072	.300***	.034	.055	-.135*
17. pwarm14	.729***	.271**	.410***	-.101	-.108**	-.110*	-.092	.119**	.813***	.305***	.448***
18. pwb14	.222**	.453***	.356***	-.008	-.130**	-.153**	-.161**	-.163**	.243***	.604***	.336***
19. pmar14	.350***	.386***	.586***	-.237***	-.310**	-.274***	-.095	.040	.355***	.351***	.818***
20. acadp14	-.054	-.072	-.093	.179*	.198**	.258***	.143**	.194***	-.047	-.065	-.165*
21. acap14	-.052	.01	-.175*	.322***	.585***	.291***	.326***	.208**	-.133***	.004	-.205***
22. aceng14	-.047	-.075	-.067	.103	.213***	.264***	.095	.181***	-.090	-.012	-.130*
23. imp14	-.091	.116*	.051	.184	.185***	.148***	.267***	-.034	-.143***	-.041	-.051
24. dar14	.001	-.117*	-.024	.074	.044	.107**	.077	.267***	-.025	-.069	-.077

Note. pmar= parental marriage, pwb = parental mental well-being, pwarm=parental warmth, pot= performance on academic tests, pic=position in class, acen=academic engagement, imp=impulsivity, dar=daring.

Table 4 (cont.)

Correlations among Manifest Variables

	12	13	14	15	16	17	18	19	20	21	22	23
13. acap10	.622***	-										
14. aceng10	.326***	.390***	-									
15. imp10	.071	.21	.121*	-								
16. dar10	-.126**	.054	.236***	.079	-							
17. pwarm14	-.118	-.108**	-.123	-.028	.080	-						
18. pwb14	-.066	-.259**	-.172***	-.089	-.087	.333***	-					
19. pmar14	-.105	-.29	-.239***	-.089	-.148*	.483***	.419***	-				
20. acadp14	.149	.21	.252***	.267***	.097*	-.045	-.110*	-.289***	-			
21. acap14	.484***	.622***	.315***	.180***	.132***	-.136***	-.172	-.282***	.514***	-		
22. aceng14	.093	.295***	.248***	.177***	.200***	-.114**	-.251	-.174**	.464***	.394***	-	
23. imp14	.168*	.206***	.079	.271***	-.035	-.158***	-.037	-.098	.113*	.216***	.071	-
24. dar14	.033	.141**	.146	.045	.226***	.032	-.118	-.165	.275***	.263	.519***	.034

Note. pmar= parental marriage, pwb = parental mental well-being, pwarm=parental warmth, pot= performance on academic tests, pic=position in class, aceng=academic engagement, imp=impulsivity, dar=daring.

Three separate EFA's were run (at ages 8, 10, and 14) using Oblique Geomin rotation as it was expected that the resulting factors would not be orthogonal (i.e., they would be correlated). Results did not support the hypothesized model. Three factor and four factor solutions failed to converge at age 8. Neither the one or two factor solution provided an adequate fit to the data with RMSEA above .80 at age 10 (see Table 5). The three factor solution at ages 10 and 14 were examined to assess the pattern of results. Factor loadings at or above .30 were considered reliable measures of the factor (Brown, 2006). Results indicated parental warmth, well-being, and marriage generally loaded onto separate factor consistent with hypotheses, but impulsivity and daring did not group together at any age (see Table 6).

Table 5

Model Fit Statistics for EFA: Parenting, Academic Success, and Self Control

	χ^2 (df)	CFI	TLI	RMSEA (90% CI)
Age 8				
One Factor	165.087 (20), $p < .001$	.676	.546	.133 (.106-.144)
Two Factor	34.123 (15), $p < .001$	.937	.864	.063 (.000-.089)
Age 10				
One Factor	147.173 (20), $p < .001$	.676	.546	.124 (.106-.144)
Two Factor	49.631(13), $p < .001$	.907	.779	.083 (.059-.108)
Age 14				
One Factor	134.486 (20), $p < .001$	.724	.614	.119 (.100-.138)
Two Factor	43.065 (15), $p < .001$	.928	.892	.075 (.051-.101)

Table 6

Geomin Rotation Rotated Loadings from Three Factor Model EFA

Items	Age 10			Age 14		
	F1	F2	F3	F1	F2	F3
pmar	.688	-.033	.034	.512	-.044	-.222
pwb	.652	.019	.143	.597	.025	.032
pwarm	.780	-.043	-.109	.527	.021	.024
pot	-.046	1.05	-.002	.167	.011	.923
pic	-.006	.046	.754	-.104	-.454	.268
acen	.026	.477	.213	-.075	-.079	.567
imp	.029	.000	.058	-.216	.036	.109
dar	.023	-.308	.498	.042	-.858	-.040

Note. pmar= parental marriage, pwb = parental mental well-being, pwarm=parental warmth, pot= performance on academic tests, pic=position in class, acen=academic engagement, imp=impulsivity, dar=daring.

The failure for the observational factors related to self-control to hang together suggest, that these two alone are not sufficient to identify a latent self-control construct. Yet, considering the items used different measures of self-control, their factorial invariance will be further tested in a CFA. CFA provides different options to address measurement issues in CFA including allowing for indicators to correlate over time or creating an indicator specific factor related to the type of measurement (Geiser, 2013).

A second set of EFAs were run with 6 indicators (eliminating the two measures of self-control) to assess whether parenting and academic success loaded together. Fit indices supported a two-factor solution and factor loadings were consistent with parenting quality and academic success (see Tables 7 and 8). The

items related to parenting quality and academic success hung together in separate factors at ages 8, 10, and 14 with no cross loadings.

Table 7

Model-fit Statistics for EFA: Parent and Academic Indicators

	χ^2 (df)	CFI	TLI	RMSEA (90% CI)
Age 8				
One Factor	165.087 (20), $p < .001$	.676	.546	.133 (.106-.144)
Two Factor	1.740 (4), $p > .05$	1.00	1.03	.000 (.000-.045)
Age 10				
One Factor	136.376 (9), $p < .001$	.677	.462	.186 (.152-.198)
Two Factor	6.936 (4), $p > .05$	.993	.972	.042 (.032-.061)
Age 14				
One Factor	56.260 (9), $p < .001$	.823	.706	.114 (.102-.126)
Two Factor	5.272 (4), $p > .05$	.995	.982	.028 (.010-.037)

Table 8

Geomin Rotation Loadings from Two Factor EFA

	Age 8		Age 10		Age 14	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
pmar	.743	.021	.710	-.002	.501	-.231
pwb	.615	.033	.687	-.173	.756	.011
pwarm	.655	.001	.753	-.018	.392	-.231
pot	-.117	.635	.033	.833	-.194	.472
pic	-.006	.638	-.008	.751	-.148	.605
acen	-.007	.632	-.060	.441	.016	.841

Note. pmar= parental marriage, pwb = parental mental well-being, pwarm=parental warmth, pot= performance on academic tests, pic=position in class, acen=academic engagement

Once consistency in the latent variables across time was identified, this was confirmed in a CFA (see Table 9). Next, a series of nested CFA's were run to test the invariance of the academic success and parenting quality measurement models (see Figures 4 and 5 for measurement models). Initial models did not fit the data,

indicated by correlations greater than 1 among factors, meaning the model is not properly identified and the results uninterpretable (Chen et al., 2001; Kline, 2010). Similar to other research, it was necessary to allowing for correlated errors of indicators across time accounting for using similar or the same measures over time (Bollen, 1989). Results from models without addressing shared measurement variance (i.e., correlated errors and an indicator specific factor) are not reported. These models demonstrated problems with identification as indicated by correlated factors above 1. Therefore, the results are not interpretable (Chen et al., 2001; Kline, 2010).

First, regarding parenting quality a series of CFAs were tested to assess metric and scalar invariance (see Table 10). The baseline model with no equality constraints fit the model well. The next test of metric invariance also fit the data well and did not result in a significant drop in chi-square or CFI indicating observed differences in factor loadings did not differ substantially over time. Holding the thresholds equal over time to test for scalar invariance resulted in a significant decrease in model fit with a significant scaled chi-square test though only a minor decrease in CFI. Other measures including the RMSEA and TLI still demonstrated a good fit for the data. Sources of invariance were examined to test how many thresholds might be impacting this change. Results indicated freeing the threshold related to conflict in marriage at age 8 improved the model. When this parameter was freed chi-square test and scaled difference tests were both non-significant. Therefore, this parameter will be freed when testing the structural models.

Figure 4

Measurement Model for Parenting Quality

Note. pmar= parental marriage, pwb = parental mental well-being, pwarm=parental warmth

Table 9

Confirmatory Factor Analysis Loadings for Parenting Quality

	Age 8		Age 10		Age 14	
	Par	R^2	Par	R^2	Par	R^2
pmar	.736	.542	.781	.611	.724	.525
pwb	.676	.457	.634	.402	.590	.371
pwarm	.592	.351	.634	.402	.609	.348

Note. pmar= parental marriage, pwb = parental mental well-being, pwarm=parental warmth,

Table 10

Model-fit Indices and Nested Model Comparisons from Invariance Testing of Parenting Quality

Invariance Models	X^2	df	CFI	TLI	RMSEA (90% CI)	Contrast	ΔX^2	df	ΔCFI
Parenting^a									
a. Configural invariance	25.541	16	.998	.997	.026 (.000-.053)	-	-		-
b. Weak Invariance (threshold invariance)	25.341	20	.997	.993	.040 (.005-.067)	b vs. a	1.702	4	-.001
c. Strong invariance (threshold and intercept)	50.713**	26	.993	.990	.048 (.028-.068)	c vs. b	31.453***	6	-.004
d. Partial invariance (one threshold free)	34.837	25	.997	.996	.031 (.000-.054)	d vs. b	10.959	5	.003

* $p < .05$, ** $p < .01$, *** $p < .001$

The same plan of analysis was followed for academic success. An initial CFA was run to confirm model fit (see Table 11). The baseline model with no constraints demonstrated an adequate fit to the data according to CFI and a liberal interpretation of RMSEA ($RMSEA < .80$). Scalar invariance showed a significant decrease in model fit with a significant scaled chi-square test and decrease in CFI of greater than .01. Examining the source of invariance indicated three thresholds needed to be freed for the chi square difference test to revert to non-significance (position in class and performance on tests at age 10 and academic engagement at age 14). The chi-square test and scaled chi-square difference tests were both non-significant when these parameters were free (see Table 12). However, this required freeing about one-third of the indicators and leaving only one indicator at age 10. Although it is possible to model invariance, it is recommended that this only be done if a minority of parameters are invariance and to leave at least two factors to measure a latent variable (Byrne, Shavelson, & Muthén, 1989; Kline, 2010). The current measurement model would only leave academic engagement to measure the parameter at age 10.

Figure 5

Measurement Model for Academic Success

Note. *pic* = position in class, *pot*=performance on academic related tasks, *aceng* = academic engagement

Table 11

Confirmatory Factor Analysis Loadings for Academic Success

	Age 8		Age 10		Age 14	
	<i>Aca</i>	<i>R</i> ²	<i>Aca</i>	<i>R</i> ²	<i>Aca</i>	<i>R</i> ²
<i>Pic</i>	.647	.413	.721	.456	.535	.444
<i>Pot</i>	.436	.565	.623	.555	.523	.552
<i>Aceng</i>	.785	.235	.534	.442	.634	.343

Note. *pic* = position in class, *pot*=performance on academic related tasks, *aceng* = academic engagement

Table 12

Model-fit Indices and Nested Model Comparisons from Invariance Testing of Academic Success

Invariance Models	X^2	df	CFI	TLI	RMSEA (90% CI)	Contrast	ΔX^2	df	ΔCFI
Academic Success^a									
a. Configural invariance	66.220***	19	.968	.940	.078 (.051-.097)	-	-	-	-
b. Weak Invariance (threshold invariance)	55.152***	23	.978	.966	.058 (.031-.862)	a vs b	3.620	4	.01
c. Strong invariance (threshold and intercept)	104.489***	29	.949	.937	.080 (.051-.103)	b vs c	55.335 **	6	-.029
d. Partial invariance (three thresholds free)	63.846***	26	.975	.967	.058 (.038-.087)	b v. d	8.964	4	-.003

^a allowing for correlated residuals in all models, * $p < .05$, ** $p < .01$, *** $p < .001$

As academic success did not demonstrate invariance over time, the decision was made to use a manifest variable for the structural models. The manifest indicator measuring position in class was retained for further analysis. Position in class measured to how a person performs in class academically rather than their performance on academic related tasks such as reading ability. Measures related to academic success have been used more commonly in prior research (e.g., Chen et al., 2010; Vaillencourt et al., 2013).

A CFA was used to assess whether creating indicator specific factors or correlating residuals could be used to create a latent construct. Results indicated neither approach fit the data. Each approach resulted in factors that correlated above 1. Considering self-control plays a central role in one of the theoretical framework under study and the lack of agreement regarding how to best measure (see Akers, 1991, 2008) both manifest indicators of self-control were retained and tested in the structural models separately.

Structural Models

Structural models were run separately for impulsivity and daring. The results between the two measures were highly consistent and therefore are discussed together. The baseline model provided a good fit to the data, indicated by RMSEA of below .05 (.034 and .041 respectively; see Table 13). All variables were stable across both time periods. Antisocial behaviour demonstrated higher stability between ages 8 to 10 ($\beta = .622-.639$) than 10 to 14 ($\beta = .277-.294$). This is not surprising considering the there was a 2 year gap is between 8 and 10 and a 4 year gap between ages 10 to 14. Parenting was highly stable across both time points with

stability co-efficients of over .80. Internalizing, academic performance, and self-control were all moderately stable across both time points (see Tables 14 and 15).

The self-control model added paths from parenting to self-control and self-control to antisocial behaviour, academic performance, and internalizing problems for a total of 8 paths. The self-control model significantly improved the fit over the baseline for both the impulsivity and daring models (see Table 13). Of the eight paths included in the models one was significant, and two approached significance in the daring models (see Table 14). The next model added direct paths from parenting to externalizing, internalizing, and academic performance and also paths from academic performance to antisocial behaviour and internalizing for a total of ten new paths. This model significantly improved the fit from the self-control model in the models that used the impulsivity measure ($\Delta X^2 (10) = 26.772, p < .01, \Delta CFI = .06$), but results only approached significance with the daring model (see Table 13). Though the bidirectional model did not demonstrate a significant improvement of fit for the daring models, the pattern of significant cross-lagged paths was significant across both models was similar (see Table 17).

The bidirectional model included 12 new paths testing relationships between antisocial behaviour with parenting, academic performance, internalizing, and self-control. A reciprocal relationship between parenting and self-control was also tested. The reciprocal paths model significantly improved the fit in both the impulsivity model ($\Delta X^2 (12) = 45.859, p < .01$) and the daring model ($\Delta X^2 (12) = 36.405, p < .01$). There were slight differences in what paths were significant across both models. In the impulsivity model, higher levels of antisocial behaviour at age

10 were related to poorer parenting at age 14 and also poorer academic performance at age 14. Antisocial behaviour at age 8 was related to lower impulsivity at age 10, though this only approached significance. The relationship between parenting at age 10 and internalizing at age 14 also changed from significant in the direct effects path, towards trending towards significance in the impulsivity bidirectional model. In the daring model higher antisocial behaviour at ages 8 and 10 were related to lower academic performance at ages 10 and 14, though this difference only approached significance at age 8 (see Table 18).

The final model was a fully transactional model that includes all remaining cross-lagged paths. This model did not show a significant increase in model fit for either the impulsivity or daring models. Most of the cross-lagged relationships were the same as the bidirectional model (see Table 19). Overall, the bidirectional paths model provided the best fit for both the impulsivity model and the daring model. This is the last model that provided a significant improvement over the previous model. In addition, the fit indices indicated an overall good fit for the data (see Table 13).

Table 13

Results from Nested Cascade Models Ages 8 to 14

	X^2 (df)	df	CFI	TLI	RMSEA (90% CI)	Contrast	ΔX^2 (df)	df	ΔCFI
Impulsivity									
1. Baseline Model (stability and correlation)	250.022***	152	.978	.970	.034 (.025-.044)	-	-	-	-
2. Model 2 (self-control)	224.756***	144	.976	.965	.037 (.027-.046)	2 vs 1	23.408**	8	-.002
3. Model 3 (direct effects)	195.344**	134	.982	.971	.033 (.023-.043)	3 vs 2	26.772**	10	.006
4. Model 4 (bidirectional)	156.478*	122	.990	.982	.026 (.011-.038)	4 vs 3	45.859***	12	.008
5. Model 5 (full transactional)	149.257*	112	.989	.979	.028 (.014-.040)	5 vs 4	6.314	10	-.001
Daring									
1. Baseline Model (stability and correlation)	271.291***	152	.965	.951	.044 (.035-.052)	-	-	-	-
2. Model 2 (self-control)	248.9643***	144	.969	.955	.042 (.033-.051)	2 vs 1	23.543**	8	.004
3. Model 3 (direct)	227.588***	134	.974	.959	.040 (.031-.050)	3 vs 2	17.397+	10	.008
4. Model 4 (Bidirectional)	189.609***	122	.972	.957	.041 (.032-.050)	4 vs 3	36.405**	12	-.002
5. Model 5 (full transactional)	175.943***	112	.981	.965	.037 (.026-.047)	6 vs 5	15.696+	10	.009

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 14

Standardized Stability path co-efficients: Impulsivity Models

			Baseline		Self-Control		Direct		Bidirectional		Transactional	
			<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE
Stability Paths												
Anti8	->	Anti10	.639***	.040	.672***	.051	.487***	.061	.477***	.050	.470***	.051
Anti10	->	Anti14	.277***	.054	.264***	.059	.280***	.070	.302***	.057	.293***	.057
Par8	->	Par10	.857***	.049	.853***	.051	.895***	.045	.784***	.061	.883***	.055
Par10	->	Par14	.868***	.051	.861***	.047	.869***	.051	.905***	.052	.766***	.076
Imp8	->	Imp10	.463***	.051	.414***	.058	.439***	.060	.357***	.046	.358***	.046
Imp10	->	Imp14	.386***	.046	.344***	.061	.370***	.062	.302***	.044	.301***	.044
Acap8	->	Acap10	.700***	.121	.495***	.046	.796***	.165	.469***	.050	.438***	.053
Acap10	->	Acap14	.695***	.138	.300***	.068	.435***	.113	.183*	.089	.078	.069
Int8	->	Int10	.701***	.067	.714***	.066	.420***	.062	.436***	.063	.440***	.063
Int10	->	Int14	.552***	.056	.555***	.056	.424***	.066	.421***	.067	.422***	.066

Note. par=parenting, acap = academic performance, antib =antisocial behaviour, int = internalizing, imp=impulsivity

* $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 15

Standardized Stability path co-efficients: Daring Models

			Baseline		Self-Control		Direct		Bidirectional		Transactional	
			<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE	<i>B</i>	SE
Stability Paths												
Anti8	->	Anti10	.622***	.039	.672***	.051	.469***	.049	.474***	.057	.487***	.060
Anti10	->	Anti14	.294***	.053	.264***	.059	.310***	.062	.276***	.063	.299***	.067
Par8	->	Par10	.849***	.048	.853***	.051	.891***	.049	.800***	.060	.869***	.055
Par10	->	Par14	.863***	.050	.861***	.047	.878***	.051	.887***	.051	.769***	.076
Dar8	->	Dar10	.414***	.059	.414***	.058	.451***	.047	.241***	.064	.201**	.065
Dar10	->	Dar14	.374***	.062	.344***	.061	.352***	.044	.238***	.070	.160**	.071
Acap8	->	Acap10	.718***	.142	.653***	.156	.869***	.149	.433***	.054	.436***	.054
Acap10	->	Acap14	.597***	.135	.512***	.124	.210***	.061	.135+	.071	.104	.072
Int8	->	Int10	.709***	.065	.714***	.066	.423***	.063	.428***	.064	.427***	.064
Int10	->	Int14	.701***	.071	.698***	.069	.407***	.062	.412***	.062	.424***	.067

Note. par=parenting, acap = academic performance, antib =antisocial behaviour, int = internalizing, dar=daring

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 16

Standardized cross lagged paths: Self-Control Models

			Impulsivity		Daring	
			<i>B</i>	SE	<i>B</i>	SE
Self-Control Paths						
Par8	->	Sc10	.002	.066	.041	.054
Par10	->	Sc14	-.077	.073	-.120 ⁺	.073
Sc8	->	anti10	.028	.056	.097 ⁺	.053
Sc10	->	anti14	.012	.052	-.059	.061
Sct8	->	acap10	.002	.077	.056	.057
Sc10	->	acap14	.293***	.058	.155	.068
Sc8	->	int10	.065	.064	.083	.055
Sc10	->	int14	-.066	.067	.009	.066

Note. par = parenting, acap = academic performance, antib =antisocial behaviour, int = internalizing, sc=self-control

⁺*p* < .10, * *p* < .05, ***p* < .01, ****p* < .001

Table 17

Standardized cross lagged paths: Direct Effects Models

			Impulsivity		Daring	
			<i>B</i>	SE	<i>B</i>	SE
Self-Control Paths						
Par8	->	Sc10	.041	.054	.010	.069
Par10	->	Sc14	-.120 ⁺	.073	-.079	.067
Sc8	->	anti10	.097 ⁺	.053	-.042	.048
Sc10	->	anti14	-.059	.061	-.005	.052
Sc8	->	acap10	.056	.057	-.034	.074
Sc10	->	acap14	.272**	.068	.118	.067
Sc8	->	int10	.083	.055	.017	.059
Sc10	->	int14	.009	.066	-.019	.062
Direct Paths						
Par8	->	anti10	.188**	.062	.177**	.062
Par10	->	anti14	.028	.075	.021	.074
Par8	->	acap10	.091	.093	.103	.096
Par10	->	acap14	-.054	.082	-.060	.082
Par8	->	int10	.258**	.084	.264**	.084
Par10	->	int14	.177*	.080	.176*	.079
Acap8	->	antib10	-.027	.043	-.021	.043
Acap10	->	antib14	.055	.061	.078	.058
Acap8	->	int10	.035	.059	.040	.059
Acap10	->	int14	.007	.062	.007	.062

Note. par = parenting, acap = academic performance, antib = antisocial behaviour, int = internalizing, sc = self-control

⁺*p* < .10, * *p* < .05, ***p* < .01, ****p* < .001

Table 18

Standardized cross lagged paths: Bidirectional Models

Cascade Path			Impulsivity		Daring	
			<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Self-Control Paths						
Par8	->	Sc10	.039	.069	.072	.087
Par10	->	Sc14	.010	.067	.044	.087
Sc8	->	anti10	-.079 ⁺	.048	-.047	.045
Sc10	->	anti14	-.005	.052	-.077	.059
Sc8	->	acap10	-.034	.074	-.088	.123
Sc10	->	acap14	.252 [*]	.056	.135 [*]	.068
Sc8	->	int10	.017	.059	.072	.055
Sc10	->	int14	-.019	.062	.011	.076
Direct Paths						
Par8	->	anti10	.177 ^{**}	.062	.183 ^{**}	.061
Par10	->	anti14	.021	.074	.026	.072
Par8	->	acap10	.103	.096	.064	.084
Par10	->	acap14	-.060	.082	-.024	.082
Par8	->	int10	.264 ^{**}	.079	.263 ^{**}	.088
Par10	->	int14	.176 ⁺	.084	.166 [*]	.085
Acap8	->	antib10	-.021	.043	-.033	.046
Acap10	->	antib14	.078	.058	.053	.061
Acap8	->	int10	.040	.059	.041	.066
Acap10	->	int14	.007	.062	.019	.073

Reciprocal Paths						
Antib8	->	par10	-.059	.058	-.002	.062
Antib10	->	par14	.120*	.060	.097	.063
Antib8	->	acap10	-.115	.094	-.132+	.070
Antib10	->	acap14	-.142*	.076	-.178*	.070
Antib8	->	int10	-.049	.067	-.012	.071
Anti10	->	int14	.037	.066	.034	.074
Antib8	->	Sc10	-.102+	.054	-.309***	.054
Antib10	->	Sc14	-.044	.060	-.244**	.060
Sc8	->	par10	-.100+	.054	.043	.066
Sc10	->	par14	-.033	.055	.013	.074
Acap8	->	Sc10	.013	.052	-.114*	.062
Acap10	->	Sc14	.187**	.047	-.014	.079

Note. par = parenting, acap = academic performance, antib =antisocial behaviour, int = internalizing, sc=self-control

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 19

Standardized cross lagged paths: Transactional Models

			Impulsivity		Daring	
Cascade Path			<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Self-Control Paths						
Par8	->	Sc10	.054	.077	.039	.088
Par10	->	Sc14	.009	.075	-.013	.019
Sc8	->	anti10	-.077+	.046	-.070	.047
Sc10	->	anti14	-.008	.051	-.060	.058
Sc8	->	acap10	.072	.054	-.049	.062
Sc10	->	acap14	.238***	.056	.086	.071
Sc8	->	int10	-.032	.056	.094+	.055
Sc10	->	int14	-.017	.061	.026	.075
Direct Paths						
Par8	->	anti10	.163**	.062	.162*	.064
Par10	->	anti14	.013	.073	.009	.074
Par8	->	acap10	.035	.086	.043	.088
Par10	->	acap14	-.063	.083	-.066	.084
Par8	->	int10	.279**	.086	.277*	.086
Par10	->	int14	.168*	.082	.172*	.083
Acap8	->	antib10	-.028	.044	-.036	.048
Acap10	->	antib14	.077	.057	.077	.059
Acap8	->	int10	.033	.066	.043	.067
Acap10	->	int14	.050	.068	.032	.072

Reciprocal Paths

Antib8	->	par10	-.084	.054	.003	.062
Antib10	->	par14	.156*	.062	.074	.064
Antib8	->	acap10	-.099	.066	-.140*	.071
Antib10	->	acap14	-.215**	.065	-.246*	.076
Antib8	->	int10	-.063	.068	-.020	.069
Anti10	->	int14	.036	.066	.026	.081
Antib8	->	Sc10	-.095+	.055	-.312**	.060
Antib10	->	Sc14	-.045	.061	-.342***	.081
Sc8	->	par10	-.087	.054	.031	.053
Sc10	->	par14	-.047	.054	-.017	.062
Acap8	->	Sc10	-.095	.055	-.111+	.063
Acap10	->	Sc14	.188**	.064	-.050	.078

Full Transactional

Int8	->	antib10	.041	.047	.058	.050
Int10	->	antib14	.041	.067	.022	.067
Int8	->	par10	.012	.054	.017	.060
Int10	->	par14	.065	.076	.082	.081
Int8	->	SC10	.014	.059	.081	.065
Int10	->	SC14	.059	.076	.200*	.081
Int8	->	aca10	-.037	.055	.053	.064
Int10	->	aca14	.004	.063	.134+	.076
Aca8	->	par10	-.043	.064	-.068	.056
Aca10	->	par14	.053	.064	.083	.069

Note. par = parenting, acap = academic performance, antib =antisocial behaviour, int = internalizing, sc=self-control
 + $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 6

Final Cascade Models

a. Impulsivity

b. Daring

Note. Only significant cross-lagged paths are shown for ease of presentation. All correlations are shown with non-significant relationships in gray

Note. par = parenting, acap = academic performance, antib = antisocial behaviour, int = internalizing, imp = impulsivity, dar = daring

Table 20

Correlations between Factors in the Final Model: Impulsivity

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. par8	-													
2. par10	.885***	-												
3. par14	.738***	.832***	-											
4. acap8	-.209**	-.187*	-.184*	-										
5. acap10	-.062	-.317**	-.191**	.475***	-									
6. acap14	-.095	-.131*	-.101	.127**	.167**	-								
7. antib8	.364***	.299**	.310***	-.401***	-.266**	-.186*	-							
8. antib10	.361***	.166	.419***	-.268***	-.287***	-.257*	.575***	-						
9. antib14	.130**	.129***	.050	-.051	-.041	-.245**	.163**	.286** *	-					
10. int8	.304***	.268***	.233***	-.141*	-.070	-.056	.239**	.178*	.057	-				
11. int10	.379***	.031	.312***	-.077	-.185*	-.071	.140*	.270* **	.095	.503** *	-			
12. int14	.312***	.316***	.369***	-.057	-.074	.085	.118**	.213**	.121*	.259* **	.481** *	-		
13. imp8	-.016	-.097	-.116*	.225***	.199*	.159*	-.290**	-.224**	-.056	-.072	-.033	-.037	-	
14. imp10	-.008	-.132	-.118	.132*	-.073	.281**	-.199**	.007	-.038	-.041	.067	-.017	.390***	-
15. imp14	-.022	-.070	-.154	.139*	.215*	.047	-.133*	-.147* *	.047	-.031	-.029	-.040	.164	.316** *

Note. par=parenting, acap = academic performance, antib =antisocial behaviour, int = internalizing, , imp=impulsivity, correlations represented between factors at east time in figure 6a are bolded

* $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 21

Correlations between Factors in the Final Model: Daring

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. par8	-													
2. par10	.884***	-												
3. par14	.744***	.838***	-											
4. acap8	-.211**	-.184**	-.174**	-										
5. acap10	-.092	-.162	-.182*	.456***	-									
6. acap14	-.092	-.130**	-.127	.195**	.149*	-								
7. antib8	.363***	.309***	.300***	.400***	-.292**	-.211***	-							
8. antib10	.367***	.190*	.408***	-.265**	-.174	-.248***	.570***	-						
9. antib14	.126**	.130*	.061	-.054	-.040	-.223**	.175*	.288***	-					
10. int8	.305***	.272**	.234*	-.165**	-.029	-.033	.223**	.166***	.054***	-				
11. int10	.379***	.032	.313**	-.076	-.110	-.066	.141*	.265***	.085	.502**	-			
12. int14	.313***	.319***	.367***	-.060	-.075	.072	.116	.210***	.129*	.260**	.486***	-		
13. dar8	-.052	-.004	-.020	.063	.054	.095	.316***	-.209**	-.080	.035	.080	.031	-	
14. dar10	-.024	-.033	-.030	-.010	-.152	.150	-.305***	-.107	-.152*	-.016	.070	.021	.326***	-
15. dar14	-.058	-.059	-.056	.063	.063	.197**	-.203***	-.291***	-.415***	-.033	-.047	.119	.129	.294**

Note. par = parenting, acap = academic performance, antib = antisocial behaviour, int = internalizing, dar=daring, correlations represented between factors at east time in figure 6b are bolded

* $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

The final models were fairly consistent across measures of self-control. In both models lower quality parenting at age 8 was related to higher levels of antisocial behaviour at age 10. Higher quality parenting at ages 8 and 10 was related to fewer internalizing symptoms at ages 10 and 14, though this result only approached significance in the path from age 10 to 14 in the impulsivity model.

There were also notable differences between the impulsivity and daring models. Impulsivity model at age 8 approached significance with antisocial behaviour at age 10 and parenting quality at age 10. Antisocial behaviour at age 8 was related to impulsivity at age 10, but not from ages 10 to 14. In the daring model the path from antisocial behaviour to daring was significant from ages 8 to 10 and ages 10 to 14. Another pathway from higher antisocial behaviour at age 8 was related to lower self-control (both impulsivity and daring) at age 10 and subsequent academic performance at age 14. Also, though academic performance demonstrated cross-lagged effects into self-control, when this occurred varied across models. Higher academic performance was related to lower daring behaviour from ages 8 to 10 in the daring model. Higher academic performance at age 10 was related to lower impulsivity at age 14 in the impulsivity model.

Finally, a moderating effect was tested with the final models. A risk variable based on early childhood risk experiences was used to identify the top quarter on the risk measure. Multiple group analysis was conducted to assess whether the model paths were significant across groups. Only cross-lagged models were held to be equal across groups identified as high risk and others. The model did not converge. This is likely due to the model complexity and sample size. The risk

variable was recalculated to test those who were above and below the mean on risk.

Again the model failed to converge.

Life Success in Adulthood

Results from the measurement models indicated that the indicators loaded onto both antisocial lifestyle at age 32 and employment success at ages 32 (See Figures 7 and 8 and Tables 22 and 23)

Figure 7

Measurement Model for Antisocial Lifestyle at Age 32

Note. convic= convictions, sroff = self-repored offending, fight=fights, antis=antisocial behaviour.

Table 22

Confirmatory Factor Analysis Loadings for Antisocial Lifestyle at Age 32

	Aca	R^2
sroff	.493	.413
con	.529	.565
fights	.693	.235
antis	.847	.494

Note. convic= convictions, sroff = self-repored offending, fight=fights, antis=antisocial behaviour.

Figure 8

Measurement Model for Employment Success at Age 32

Note. employ=employment status, lskill=low skill, lpay=low pay, numj=number of jobs

Table 23

Confirmatory Factor Analysis Loadings for Employment Success at Age 32

	Aca	R ²
Emply	.900	.802
Lskill	.347	.310
Lpay	.557	.301
Numj	.839	.704

Note. employ=employment status, lskill=low skill, lpay=low pay, numj=number of jobs

A series of nested structural equation models tested different relationships from childhood risk to adult life success, measured by antisocial behaviour, employment success, and psychopathology. The baseline model that included within time correlations and continuity paths did not provide a good fit for the data for either the impulsivity ($X^2 = 214.888$ (103), $p < .001$, RMSEA = .051, CFI = .829, TFI = .772) or daring model ($X^2 = 222.084$ (103) $p < .001$, RMSEA = .041, CFI = .904, TFI = .848). The mediated model provided a significant improvement in fit over the

baseline, and the full cross-lagged model provided an improved fit over the mediated model for both impulsivity and daring models (see Table 24 and Table 25). Fit indices provided mixed support for the cross-lagged model. RMSEA were below .50 which indicates a good fit, however CFI and TLI were just at or below .90. Modification indices were examined to assess whether there were any modifications to improve the fit of the model. Though there were some potential modifications that could have been made to improve fit, these did not make conceptual sense (e.g., reverse time paths). Therefore, the cross-lagged model was retained as the final model. Multiple group analysis were run by dividing the sample into high and low risk and while fixing cross lagged paths to be equal across groups. The model failed to converge. Increasing the number of iterations did not solve the problem.

Table 24

Model Fit Examining Pathways into Adult Life Success: Daring Model

	$X^2 (df)$	RMSEA (90% CI)	CFI	TLI	Contrast	$\Delta X^2 (df)$	ΔCFI
1. Continuity	222.084 (103)***	.041 (.029-.052)	.904	.848		-	-
2. Mediation	174.975 (97)***	.044 (.034-.055)	.875	.825	1 vs 2	51.642 (6) ***	-.039
3. Cross-lagged	149.764 (85)***	.042 (.031-.048)	.932	.889	2 vs 3	32.478(12)***	.044

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Table 25

Model Fit Examining Pathways into Adult Life Success: Impulsivity Model

	$X^2 (df)$	RMSEA(90% CI)	CFI	TLI	Contrast	$\Delta X^2 (df)$	ΔCFI
1. Continuity	214.888 (103)***	.051 (.042-.061)	.829	.772		-	-
2. Mediation	182.963 (97)***	.046 (.036-.057)	.836	.057	1 vs 2	36.632 (6)***	.007
3. Cross-lagged	144.107 (85)**	.041 (.029-.052)	.905	.849	2 vs 3	27.952 (12)**	.069

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 9

Pathways to Adult Life Success

a. Impulsivity

b. Daring

Significant paths are in black and non-significant paths are in grey. Correlations are not shown for ease of presentation.

Note. aca = academic performance, antib =antisocial behaviour, antib32= antisocial lifestyle, int = internalizing, Employ = employment, Psy=Psychopathology

Table 26

Correlations between Factors in the Final Adult Model: Impulsivity

	1	2	3	4	5	6	7	8	9	10	11
1. employ32	-										
2. antil32	.575***	-									
3. antib14	.179**	.278***	-								
4. acap14	.283**	-.266***	-.254***	-							
5. dar14	.125*	-.299***	-.429***	0.22	-						
6. antib10	-.293***	.283***	.258***	-.197***	-.231**	-					
7. dar10	.156**	-.260***	-.111*	.077	.191*	-.248**	-				
8. acap10	.092	-.060	-.057	.122*	.027	-.323***	-.102*	-			
9. psy32	.372***	.229***	-.098*	.029	.076	-.062	-.036	.028	-		
10. int14	-.059	.043	.155*	-.007	.051	.213**	-.002	-.080	-.110	-	
11. int10	-.048	.038	.085	.011	-.037	.232**	.053	-.106*	-.05	.337	-

Note. Empl=employment success, antil=antisocial lifestyle, antib=antisocial behaviour, dar=daring, acadp=academic performance, psy=psychopathology, int=internalizing

Table 27

Correlations between Factors in the Final Adult Model: Daring

	1	2	3	4	5	6	7	8	9	10	11
1. employ32	-										
2. antil32	.572***	-									
3. antib14	-.188	.320***	-								
4. acap14	.360	-.343***	-.234**	-							
5. imp14	-.179**	.167	.307***	-.299**	-						
6. antib10	.082	-.057	-.058	.138*	-.320	-					
7. imp10	.369***	-.233**	-.102	.019	-.053	.018	-				
8. acap10	-.172	.042	.145	.028	.219**	-.088	-.115*	-			
9. psy32	.138*	-.099	-.046	.291**	-.136	.063	.015	-.041	-		
10. int14	.136**	-.033	.022	.082	-.148	.154*	.027	-.030	.277**	-	
11. int10	-.057	.018	.079	.023	.271**	-.104	-.041	.330***	.034	-.030	-

Note. Employ=employment success, antil=antisocial lifestyle, antib=antisocial behaviour, dar=daring, acadp=academic performance, psy=psychopathology, int=internalizing

Table 28

Standardized Stability and Continuity Paths from Impulsivity and Daring Models into Life-Success

			Impulsivity		Daring	
			<i>B</i>	SE	<i>B</i>	SE
Aca14	->	Emp32	.365***	.070	.348***	.069
Int14	->	Psy32	.124 ⁺	.075	.125 ⁺	.075
Antib14	->	Antil32	.402***	.072	.414***	.072
Antib10	->	Antib14	.278***	.057	.341***	.051
Sc10	->	Sc14	.321***	.051	.242***	.053
Int10	->	Int14	.401***	.054	.401***	.054
Acadp10	->	Aca14	.301***	.042	.223***	.058

Note. Empl=employment success, antil=antisocial lifestyle, antib=antisocial behaviour, dar=daring, acadp=academic performance, psy=psychopathology, int=internalizing

Table 29

Standardized Paths from Mediated Impulsivity and Daring Models into Life-Success

			Impulsivity		Daring	
			<i>B</i>	SE	<i>B</i>	SE
Sc14	->	Emp32	.188**	.071	.116*	.087
Antib14	->	Emp32	.266*	.079	.178**	.077
Aca14	->	Emp32	.160*	.069	.183**	.070
Sc14	->	Psy32	.024	.073	.046	.086
Antib14	->	Psy32	.089	.080	.067	.080
Int14		Psy32	.024	.073	.103	.080
Sc14	->	Antil32	.109	.071	.354***	.054
Antib14	->	Antil32	.416***	.073	.222**	.078
Antib10	->	Antib14	.354***	.054	.300***	.050
Sc10	->	Antib14	-.040	.056	-.080	.053
Antib10	->	Sc14	-.155**	.049	-.262	.053
Sc10	->	Sc14	.286**	.043	.214	.063
Acadp10	->	Aca14	.231**	.054	.184**	.054
Int10	->	Int14	.310***	.052	.305***	.052

Note. Empl=employment success, antil=antisocial lifestyle, antib=antisocial behaviour, dar=daring, acadp=academic performance, psy=psychopathology, int=internalizing

Table 30

Paths from Cross-Lagged Impulsivity and Daring Models into Life-Success

			Impulsivity		Daring	
			<i>B</i>	SE	<i>B</i>	SE
Sc14	->	Emp32	.099	.065	-.018	.080
Antib14	->	Emp32	-.086	.070	-.065	.076
Aca14	->	Emp32	.340***	.072	.222***	.072
Int14	->	Emp32	-.167*	.069	-.247**	.079
Sc14	->	Psy32	.025	.067	.076	.116
Antib14	->	Psy32	.088	.076	-.036	.076
Aca14	->	Psy32	.000	.051	.000	.076
Int14	->	Psy32	.102	.079	.118	.087
Sc14	->	Antil32	.004	.069	.305**	.084
Antib14	->	Antil32	.249**	.069	-.076	.076
Aca14	->	Antil32	.289**	.073	.248**	.074
Int14	->	Antil32	.015	.071	-.058	.072
Antib10	->	Antib14	.324***	.050	.248**	.048
Sc10	->	Antib14	.000	.051	-.055	.050
Acadp10	->	Antib14	.048	.049	.022	.048
Int10	->	Antib14	.004	.053	.036	.050
Antib10	->	Sc14	-.074	.051	-.386**	.061
Sc10	->	Sc14	.260**	.041	.176**	.067
Aca10	->	Sc14	.113*	.057	-.042	.064
Int10	->	Sc14	-.074	.051	.164	.064
Antib10	->	Int14	.131**	.052	.149*	.059
Sc10	->	Int14	-.033	.052	.010	.285
Acadp10	->	Int14	-.013	.055	-.014	.058
Int10	->	Int14	.294**	.053	.285*	.056
Antib10	->	Aca14	-.277**	.056	-.231**	.055
Sc10	->	Aca14	.247**	.054	.066	.059
Acadp10	->	Aca14	.044	.059	.075	.058
Int10	->	Aca14	.094	.057	.078	.058

Note. Empl=employment success, antil=antisocial lifestyle, antib=antisocial behaviour, dar=daring, acadp=academic performance, psy=psychopathology, int=internalizing

Discussion

The current study investigated the longitudinal relationships among parenting, self-control, academic success, internalizing and antisocial behaviour from childhood into adolescence. The study further examined the links between self-control, academic success, internalizing, and antisocial behaviour in adolescence to adult antisocial lifestyle, employment success, and psychopathology. This is the first study to simultaneously test longitudinal pathways across these variables. The study tested nested structural equation models developed based on the general theory of crime (Gottfredson & Hirschi, 1990), developmental systems theory (Cox et al., 2010; Thelen & Smith, 2006), and empirical tests of these theories.

A self-control model was constructed that included pathways from parenting to self-control, and self-control to antisocial behaviour and related outcomes (academic success and internalizing problems) based on the GTC (Gottfredson & Hirschi, 1990). This was compared to a model that included additional direct paths from parenting to academic success, and antisocial behaviour. This model was developed based on studies that have reported parenting exerts a direct relationship on antisocial behaviour after considering the mediating influence of self-control (Hay, 2001; Kort-Butler et al., 2011; Vazsonyi & Belliston, 2007). This model also included direct paths from academic success onto antisocial behaviour. The next model included paths from antisocial behaviour to all other study variables. This model tested bidirectional influences from antisocial behaviour to other study variables. The relationships are consistent with Patterson and colleagues coercion theory (1989) and prior research that has reported

transactional relationships between antisocial behaviour and parenting (Gross et al., 2008; Pardini et al., 2008) and antisocial behaviour with academic success (Burt & Roisman, 2010; Moilanen et al., 2010). A transactional model that included then all remaining cross-lagged relationships did not demonstrate a significant improvement as measured by the chi-square difference tests. An additional goal of the study was to assess whether paths varied for high-risk children in line with the developmental taxonomy (Moffitt, 1993), however the moderation model could not be interpreted.

It was hypothesized that the bidirectional model would be the best fit for the data. This model included the paths outlined in the GTC and other theoretical and empirically based paths. Results from chi-square difference tests indicated the bidirectional model provided the best fit to the data. Chi-square difference tests and multiple fit indices indicated the bidirectional model significantly improved on the direct effects model and also demonstrated a good fit to the data. The paths within the model provided only partial support for the hypotheses. It was hypothesized that the model would include significant paths from parenting to self-control, self-control to antisocial behaviour, academic success, and internalizing problems, direct paths from parenting to antisocial behaviour, academic success, and internalizing, and finally bidirectional paths from antisocial behaviour to parenting and academic success. Only some of the hypothesized paths were significant. These are discussed in more detail below.

Multiple Measures of Self-Control: Multidimensional Self-Control

Two separate measures of self-control were used in the current study including an impulsivity measure of psychomotor control and a rating of how daring

the child's behaviour was. Though these two measures were proposed as indicators of a latent self-control construct, the items measuring self-control did not hang together in an EFA, and did not fit together in a CFA.

The failure of measures of self-control to hang together might be a measurement issue. Latent factors with only two indicators tend to provide poorer fits than models with three or more (Kline, 2010). The impulsivity and daring measures might also capture different dimensions of self-control. There is some debate in the literature regarding whether self-control is best understood as a unitary construct or a multidimensional construct (e.g., King, Lengua, & Monahan, 2013). Specifically, there is some evidence that self-control might be comprised of a sensation-seeking factor and an impulsivity factor (Burt & Simons 2013; Burt et al., 2014). The daring and impulsivity measures included in the current study are consistent with these dimensions. Daring was measured using other's ratings of the boys' sensation seeking and daring behaviour. Impulsivity was a performance based measure, operationalized using a task that measured motor self-control. Motor measures of self-control are commonly used to assess impulsivity related to self-regulation (e.g., Bezdjian, Tuvblad, Wang, Raine, & Baker, 2014; Dimoska, Johnstone, Barry, & Clarke, 2003), but are less commonly used in testing self-control as conceptualized by the GTC. Also, it is important to note prior research examining impulsivity and daring reports that they are correlated (Burt et al., 2014), but they were not significantly correlated in the current study, except at age 8. Despite the lack of association between the two measures, many of the results were consistent across these measures of self-control from childhood to adulthood. This is

consistent with Tittle and colleagues (2003) work that demonstrated different measures of self-control show similar relationships with outcomes of interest.

In the final models from ages 8 to 14 there were similar relationships across impulsivity and daring models with different developmental timing. Academic performance at age 8 was related to lower levels of daring at age 10 but not from ages 10 to 14. When impulsivity was assessed academic performance at ages 10 was related to lower impulsivity age 14, but not from ages 8 to 10. Similarly antisocial behaviour was related to daring at both ages, but only from ages 8 to 10 in the impulsivity model.

In the final models from ages 10 to 32, antisocial behavior at age 10 was related to daring at age 14 and then subsequent antisocial behaviour at age 32. These paths were not significant in the impulsivity model. The difference across measures might reflect age related differences in the relationship between academic performance and different aspect of self-control. Prior research has suggested different aspects of self-control might have distinct developmental progressions and predictors across adolescence (Burt et al., 2014; King et al., 2013).

Parenting and Self-Control: The Development and Stability of Self-Control

The current study provides an important contribution to research on a component of the GTC that has received less empirical investigation, the development and stability of self-control. Moreover, the present study examined cascading relationships across a time of important transition in the GTC (ages 8 to 14). According to the GTC while parenting still impacts self-control in mid childhood (represented between ages 8 to 10 in the current study), the influence is no longer significant after about age 10 when between individual differences in self-control

are believed to be set (captured between ages 10 to 14 in the current study).

Evidence for a time limited relationship between parenting and self-control has been mixed with little research spanning this particular developmental period. Meldrun et al. (2010) found that parental attachment was related to self-control prior to age 10, but not after age 10 in a cross-lagged path analysis. Other research reports parenting continues to impact self-control into adolescence, but these results did not control for prior levels of self-control (Burt et al., 2006; Hay & Forrest, 2006).

First, consistent with the GTC and prior research (Burt et al., 2006), self-control demonstrated moderate stability across from ages 8 to 10 and ages 10 to 14. Contrary to the hypotheses, results from the current study did not find any significant cross-lagged relationships from parenting to self-control. In fact the only path was a path from impulsivity at age 8 to parenting at age 10 that approached significance. There are two potential limitations to the current study that could impact the absence of significant paths from parenting to self-control. First, while the study aimed to capture the time before and after self-control is hypothesized to stabilize between individuals, it could be that this study was a little late to capture the relationship between parenting and self-control. Gottfredson and Hirschi (1990) place 10 as the upper bound limit as to when self-control is fully developed, yet it could be that the stability of self-control was already well-established by age 8 in the current sample. Yet, paths from antisocial behaviour and academic success to self-control were significant indicating the non-significant path from parenting to self-control is not likely due to missing the developmental window before self-control becomes fixed.

Another possibility is the absence of a measure regarding parental monitoring and control, which according to the GTC are key to the development of self-control, might explain the lack of a relationship. Yet, the latent parenting variable used in the current study is consistent with other research on the GTC that has reported a relationship from parenting to self-control (Burt et al., 2006; Hay, 2001). Another consideration is the raters used to measure self-control. Recently, Meldrum, Young, Burt, and Piquero, (2013) examined the impact of using maternal versus self-report ratings to measure self-control using a large sample of youth ($N = 1,365$). Results indicated self-control was related to delinquency and parenting across raters, but the strength of the relationship was nearly three times as strong when using adolescent self-reports of self-control rather than maternal reports of self-control. Considering this, the different results found in this study compared to prior research might be influenced by the use of teacher and peer ratings and a psychomotor performance measure of impulsivity. Therefore, rater effects might impact study results, but this raises important questions regarding the robustness of the relationship.

Additionally, this is not the first study that has failed to find that parenting impacts self-control. Results from this study are consistent with some other studies that employed a cross-lagged method. Brody and Ge (2001) did not find parenting was related to self-control across ages 12 to 14. Yates et al. (2010) also failed to find a cross-lagged effect from parenting to self-control from ages 2 to 6. Yates et al. (2010) also included parental control suggesting this result is not due to the measure of parental quality. Taken together, there is evidence in early childhood (2-6; Yates et al., 2010), mid-childhood to adolescence (8-14; the current study) and

adolescence (12-14; Brody & Ge, 2001) that has failed to find a relationship from parenting to self-control when accounting for prior levels of self-control. These studies do not form a consensus, as other studies have found a link between parenting and self-control, including one that used a cross-lagged method (Eisenberg et al., 2005), but these inconsistencies highlight the need for future research.

It was hypothesized that there would be a bidirectional relationship between parenting and antisocial behaviour, and this relationship would be mediated through self-control. Results supported the bidirectional relationship between parenting and antisocial behaviour, but did not support self-control as a mediator. Though few studies have investigated the bidirectional relationship between self-control and parenting, past research has indicated that self-control impacts parenting in childhood (e.g., Brody & Ge, 2001; Yates et al., 2010). Yet these studies did not measure antisocial behaviour. Therefore, antisocial behaviour might have been driving the relationship between low self-control and parenting.

The bidirectional results found between antisocial behaviour and parenting found in the current study were mostly consistent with the relationships proposed by Patterson et al. (1989) and found in prior research (Pardini et al., 2008; Choe et al., 2014) with cross-lagged relationships between poor parenting practices and antisocial behaviours. In the impulsivity model, parenting at 8 connected to antisocial behaviour at age 10, and antisocial behaviour at age 10 was related to more negative parenting at age 14. In the daring model, parenting at age 8 was related to antisocial behaviour at age 10, but antisocial behaviour at age 10 was not related to subsequent parenting. Antisocial behaviour at age 8 did not impact

parenting at age 10 in either model. This is somewhat distinct from past research over the same period of development that found bidirectional links at each age (Keijsers et al., 2011).

The results also reported that parenting was related to antisocial behaviour from ages 8 to 10, but not ages 10 to 14. This might suggest that the impact of parenting on antisocial behaviour becomes more indirect as youth transition from childhood to adolescence. In contrast, parenting was related to internalizing between both ages 8 to 10 and 10 to 14, although the strength of the relationship only approached significance between ages 10 to 14 in the daring model.

Self-Control, Antisocial Behaviour, and Related Outcomes in Adolescence

Based on the robust connection between self-control and antisocial behaviour (Perrone, Sullivan, Pratt, & Margaryn, 2004; Pratt & Cullen, 2000; Pratt et al., 2004) and other related outcomes (Evans et al., 1997; Tangney et al. 2004), it was hypothesized that self-control would demonstrate significant cross-lagged paths into antisocial behaviour, academic functioning, and internalizing problems. Only partial support was found for this hypothesis. The path between impulsivity at age 8 to antisocial behaviour at age 10 approached significance. No other paths from self-control to antisocial behaviour were significant in either the impulsivity or daring models. While the pathways from self-control to antisocial behaviour were not significant, the paths from antisocial behaviour to self-control were significant. Higher antisocial behaviour was related to higher impulsivity and daring over time. This raises some questions regarding the directionality of the relationship between self-control and antisocial behaviour. Though prior research demonstrates a robust

connection between self-control and antisocial behaviour, the bidirectional relationships have rarely been tested.

One variable that is was not measured in the current study and could help explain the relationship from antisocial behaviour to social control is peer relationships. Children who engage in antisocial behaviour are more likely to associate with antisocial peers (Dodge et al., 2008). Antisocial peer groups can have a significant social influence and normalize and reinforce antisocial behaviour. This might also involve reinforcing and supporting daring and impulsive behaviour as well.

Regarding other outcomes, a bidirectional relationship was found between self-control and academic success. These results add support to other literature that reports that self-control continues to change across development and that factors beyond parenting are relevant to the development of self-control (Burt et al., 2014; King et al., 2013). Specifically, results from the current study found academic success was related to increased self-control. The relationship between academic success and impulsivity was found after the time that the GTC proposes changes in self-control are fixed. This study appears to be the first to examine bidirectional relationships from academic success into self-control. Therefore, it is possible that school engagement and enjoyment of school promotes behaviour that contribute to both self-regulation and academic success including persistence at tasks such as homework and focusing efforts on more academic pursuits. Alternately, those who demonstrate lower academic success might be more likely to disengage from school limiting the influence of the potential positive influence of socialization influences in the school. Additionally, DeBaryshe, Patterson, and Capaldi (1993) reported the

links between antisocial behaviour and academic achievement are mediated through academic engagement. Further research is needed to both replicate this result and better understand the mechanisms that help explain the relationship.

Antisocial Behaviour, Self-Control, and Life Success in Adulthood

The current study aimed to address a further gap in knowledge regarding how self-control and antisocial behaviour in childhood connected to antisocial lifestyle and other measures of life success in adulthood, in particular employment success, and psychopathology. Prior research reports childhood antisocial behaviour and self-control predict criminal behaviour in adulthood, employment success, relationship status, and mental health outcomes in adulthood (Moffitt et al., 2011). Yet there has been little examination as how self-control and antisocial behaviour relate to each other to impact adolescence and adult outcomes.

Prior studies have reported the general pathway is that early childhood antisocial behaviour and self-control impact adolescent behaviour which then subsequently impact adult outcomes (Converse et al., 2014; Moffitt et al., 2011). This includes early antisocial behaviour influencing specific adolescent behaviour such as academic success in adolescence which then carry forward to employment success in adulthood (Converse et al., 2014). It also includes more complex patterns of mediation where antisocial behaviour in childhood impacts academic success in adolescence which subsequently relates to mental health problems in adulthood (e.g., Masten et al., 2005). Yet, most studies that have examined complex mediation paths have not examined self-control.

Three structural equation models were used to examine mediation across childhood antisocial behaviour, self-control and employment success, antisocial

lifestyle and psychopathology at age 32. The first model was a baseline model that included within time correlations and continuity paths over time. The second model tested paths from antisocial behaviour and self-control in childhood, to academic success and internalizing problems in adolescence. This model included similar pathways between adolescence and adulthood with paths from self-control and antisocial behaviour at age 14 to employment and psychopathology at age 32. The final model included all cross-lagged paths. This model tested paths from academic performance at age 10 to antisocial behaviour and self-control at age 14. Cross-lagged paths were also included from internalizing at age 10 to antisocial behaviour and self-control at age 14. Finally, similar cross-lagged paths were included from adolescence into adulthood. The full cross-lagged models provided the best fit for the data based on chi-square difference tests and overall fit statistics. However, these models only provided an adequate fit to the data.

Results from the impulsivity model indicate antisocial behaviour at age 10 set in motion a negative developmental cascade into academic problems in adolescence. Lower academic success in adolescence was subsequently related to lower employment success and higher antisocial lifestyle at age 32. In the daring model antisocial behaviour at age 10 was also related to higher daring in adolescence and subsequent antisocial lifestyle at age 32. Results from the current study demonstrate many similarities to results from the Project Competence data (e.g., Masten et al., 2005).

One important difference in the current study is that no variables in the model predicted psychopathology at age 32. None of the study variables predicted adult psychopathology, including internalizing problems at age 14. This was

contrary to hypothesis and inconsistent with prior research has linked both internalizing problems from adolescence to adulthood (e.g., Masten et al., 2005) and demonstrated relationships from early antisocial problems with psychopathology in adulthood (e.g., Moffit, 2006). The use of an external rater of a child's internalizing instead of a self-report measure of the child's internal well-being might have impacted results, but internalizing was significantly correlated with other study variables in the expected direction, demonstrating a significant positive correlation with antisocial behaviour.

These models support that early antisocial behaviour and self-control are mediated through adolescent outcomes, but the pattern of mediation and how these variables relate to each other over time is more complex than self-control and/or antisocial behaviour driving adolescent behaviours in a unidirectional manner. It is also important to note that in the daring model, daring at age 14 was connected to antisocial lifestyle at age 32, not adolescent antisocial behaviour. This is distinct from the impulsivity model that found antisocial behaviour at age 14 and not impulsivity were related to antisocial lifestyle at age 32. Though research has robustly demonstrated a relationship between self-control and antisocial behaviour, less research has examined how these two variables related over time.

Limitations and Directions for Future Research

Though this study has strengths, the results must also be considered in light of its limitations. First, the study was not able to examine the research question regarding whether the paths found in the study varied by childhood risk level. Though prior research has reported similar pathways across risk level (e.g., Dodge et al., 2008) research using developmental cascades is relatively recent and further

research is needed to examine distinct pathways. Considering this is the first study to examine the interrelationships among parenting, self-control, academic success, externalizing, and internalizing problems prior research is needed to both replicate results and examine whether they apply differently to high-risk youth.

The structural equation models tested in this study relied on a mixture of manifest and latent variables. Although the analysis plan initially limited the use of manifest variables, the measurement model for self-control and academic success did not demonstrate invariance over time. As a result, manifest indicators of these variables were used. Manifest variables are limited as they do not provide the assessment of measurement error that latent variables account for. It is difficult to assess whether this results in more liberal or conservative tests as manifest variables can either under or overestimate errors (Kline, 2010).

Research has identified a large number of factors related to antisocial behaviour and the current study only included a subset of these. The study variables have both theoretical and empirical relevance to antisocial behaviour, yet there are other additional variables that might impact this relationship. For example, social competence is another important consideration in the developmental chain (Bornstein et al., 2010; Burt & Roisman, 2010). How social competence influences the relationships across parenting, self-control, antisocial behaviour, academic success, and internalizing is an important area for further study. Other variables such as substance abuse are also important to explore in future research, as prior research has indicated substance abuse is linked to self-control, antisocial behaviour, and negative adult outcomes (D'Amico et al., 2008; Dembo et al., 2007; Hussong et al., 2004; Lipsey & Derzon, 1998; Moffitt, 2006). Although the study did

not include these variables, the patterns of results from the study provide considerations for future research in this area.

The sample used for the current study, the CSDD, is a sample of boys who were assessed in the 1960's. Therefore, the exact developmental timing found within the current study might not directly apply to children and youth today as there are some aspects of the developmental context that have shifted over time. For example, the extended adolescence and developmental period referred to as emerging adulthood are a more recent phenomenon (Arnett, 2000). Therefore, there is a need to replicate these results with a more recent cohort of youth. It is important to note that although this study includes data collected in the 1960's a great deal of foundational knowledge in developmental criminology and understanding antisocial behaviour was founded on early longitudinal cohorts and these results still hold up today (e.g., Laub, Nagin, & Sampson 1998; Laub & Sampson, 2011). Therefore, the general pattern of results are expected to apply in a similar sample of youth today, though there might be some differences in the developmental timing of results due to differing social contexts.

Additionally, the current study only included males. These results then should not be assumed to generalize to females. Whether the pathways of antisocial behaviour among males and females are similar or distinct is a topic that is much debated in the current literature (Andrews et al., 2011; Chesney-Lind & Shelden, 2003). Future research should be conducted with females and consider gender specific research and pathways.

Conclusion: Implications for Theory, Research, and Practice

Results from the current study have important implications for theories of antisocial behaviour and child development. Though Gottfredson and Hirschi (1990) proposed that parenting influences the development of self-control and self-control causes crime, considering the results of the current study, self-control might be better understood as inter-related with antisocial behaviour and related outcomes across time. It is possible that self-control was casually related to antisocial behaviour earlier in development and then they become linked over time. Yet, research earlier in development suggests that bidirectional relationships between antisocial behaviour and self-control begin as early as age 2 (Yates et al., 2010).

Results were also supportive of the paramount role that parenting plays in development, but also highlights the importance of child behaviour on parenting. Though these ideas are not new (Bell, 1968; Patterson et al., 1989), it is only recently that they have been gaining more empirical attention (e.g., Keijsers et al., 2011; Pardini et al., 2008).

The transactional nature of factors over time is consistent with developmental systems theory (Cox et al., 2010; Thelen & Smith, 2006). Study variables did not equally impact each other over time. For example, parenting influenced externalizing behaviour in childhood and not adulthood and internalizing did not produce any cascading effects in the final model. An important area of future research is to explore the concentrated developmental windows of change in factors. These are periods of development when a system is undergoing significant change. This can include an internal biological system such as puberty, or a social system such as school transitions (Cox et al., 2010). These windows of natural change can offer an opportunity to intervene to enhance development.

The transactional relationships across time found in the current study offer both encouragement and challenges for interventions. The encouragement is that there are multiple opportunities to change and improve outcomes across childhood and through adolescence. Yet, there is still an importance to address antisocial behaviour, especially early in development before problems cascade. The challenge is that when problems occur, they are likely to result in cascading impacts over time. Therefore, interventions will need to address problems across multiple domains.

Finally, in relation to the risk factor paradigm, results from the study clearly indicate the need to move beyond bivariate associations towards identifying causal processes at different points in development. While the limitations of the current study do not allow for the ability to make causal influences, results clearly indicate differences between within time associations of antisocial behaviour and what factors influence antisocial behaviour across time after accounting for the influence of related factors. These results add further evidence to the growing movement advocating for moving beyond risk factors to identifying processes and causal factors. The current study reinforced the importance of parenting and self-control in late childhood and early adolescence. The current study also highlighted the importance of considering developmental timing in understanding development. There were more cross-lagged relationships into antisocial behaviour at age 10 than at age 14. These results are also consistent with other research that indicates the importance of a risk or protective factor varies by when in development it occurs (Dahlberg & Potter, 2001). A better understanding of what factors are important and when can potentially enhance interventions to be developmental appropriate for children and youth.

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