A Multidisciplinary Approach to Predicting Aggression in Children, Adolescents, and Adults: Exploring the Role of Cardiovascular Psychophysiology, Neuropsychology, and Psychopathy

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A Multidisciplinary Approach to Predicting Aggression in Children, Adolescents, and Adults: Exploring the Role of Cardiovascular Psychophysiology, Neuropsychology, and Psychopathy

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Abstract

This thesis explored the function of biological, personality, and cognitive factors as predictors of violence and aggression in children, adolescents, and adults. Chapter 2 sought to understand biopsychosocial profiles of aggressive groups of children (*N* = 110). Children who engaged in more severe forms of aggressive behavior were highest in psychopathic traits, and most distinct from other aggressive and nonaggressive children on biological indices of prefrontal functioning. This group of children displayed fewer executive functioning deficits compared to other aggressive children, which may explain their ability to implement planned aggression. Chapter 3 included 60 adolescents from Emotional and Behavioral Difficulties (EBD) schools and 62 adolescents from a stratified community school sample (*N* = 696). The aim was to test the association between callous-unemotional (CU) traits and fearlessness using cardiovascular measures of sympathetic (pre-ejection period) and parasympathetic reactivity (respiratory sinus arrhythmia) during fear induction, and self-report measures of fear. Adolescents high in CU traits, from both samples, exhibited high levels of conduct problems and aggression. No group differences emerged on self-report of fear, but the high CU group did display a unique autonomic profile when experiencing fear. This pattern of biological reactivity, a coactivation of sympathetic and parasympathetic activity, may suggest adolescents high in CU traits are better able to manage fearful situations by remaining physiologically calm yet alert. This may explain why individuals with CU traits have been previously characterized as fearless. Chapter 4 included 182 female offenders, and aimed to predict misconducts over 9-months. Callous and antisocial psychopathic traits best predicted violence, while impulsivity and antisocial psychopathic traits predicted nonviolent misconducts. The key findings across all chapters show psychopathic traits, regardless of age and population type (forensic, clinical, and community), were related to high levels of aggressive and antisocial behavior, and a host of biological and cognitive differences.

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Declaration

I, Nicholas David Thomson, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis. I confirm that no part of the material offered has previously been submitted by me for a degree in this or any other University. This thesis was prepared in accordance with the guidelines outlined by Durham University's Graduate School and in the Department of Psychology's Postgraduate Handbook.

Statement of Copyright

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CHAPTER ONE

Introduction

Thesis Structure

This thesis explores the role of biological, personality, and cognitive factors as predictors of violence and aggression, and understanding possible mechanisms for those individuals who are most at risk for aggressive behavior. This thesis consists of five chapters. The first chapter provides a general introduction to the development of aggression, followed by an overview of the predictors used in the three studies of this manuscript, and concludes with the general aim of the thesis and specific aims of each study. Chapters two, three, and four are constructed in the format of journal articles to provide a more specific introduction and overview of the research literature and rationale of each study. Chapter five closes the thesis with a discussion of the three studies, and the associated clinical implications and theoretical considerations.

Introduction

Historically, societies have fallen victim to a small proportion of people who perpetually violate the rights of others and fail to abide by social norms. Although this group of individuals are typically small in number, they are responsible for a significant proportion of antisocial behavior and a substantial share of financial cost to society (Cohen, Piquero, & Jennings, 2010; Farrington, Ohlin, & Wilson, 1986; Piquero, Jennings, & Farrington, 2011; Schmitt & Newman, 1999). Within England and Wales, the rate of violence committed by adults has seen a reduction over the past 20 years, yet between 2014 and 2015 there were 1.3 million violent incidents reported (2 million incidents of antisocial behavior), with an estimate of two in every 100 adults falling victim to violence (Flately, 2015). Within recent years, proven violent offenses committed by young people (10-17 years) have increased most rapidly when compared to other forms of criminal behavior (e.g., drug, theft; Ministry of Justice, 2015). Prior research has shown that antisocial behavior, such as aggression, not only negatively impacts the victim and society, but also has detrimental developmental outcomes for the perpetrator, such as problems in lifelong adjustment, mental health, legal, social, occupational, and physical health (Jones, 2013; Odgers et al., 2008). Additionally, antisocial youth are more likely to die younger and of an unnatural or violent death than that of the general population (Sailas et al., 2006).

A great deal of research from various scientific disciplines have found that identifying risk factors during childhood and adolescence may help inform prevention and treatment programs. Intervention programs have been shown to have major positive effects on the child and for society, potentially saving society between $17.33 and $31.77 for every $1 spent on prevention and treatment based approaches (Farrington & Koegl, 2014). Furthermore, identifying risk factors in adult forensic populations may be relevant to understanding propensity for violent behavior, which may inform clinicians and practitioners regarding treatment effectiveness. The aim of reducing antisocial behavior through prevention and treatment is essential, but can only be achieved by understanding nomological factors driving antisocial behaviors.

Aggression

Aggression is the umbrella term given to behavior that causes intentional harm to other people or oneself (Anderson & Bushman, 2002; Dodge, 1991). Although not all aggressive behavior is violent, aggression and violence are often used interchangeably with the latter considered as a more severe form of aggression, causing more physical harm (Anderson & Bushman, 2002). Furthermore, aggression typically predicts antisocial behavior and the two overlap substantially, yet they have been considered as separate constructs at the individual level (Hartup, 2005). Within this thesis, the term aggression will encapsulate violent behaviors as well as emotional harm, while violence represents physical harm to another person. In addition, antisocial behavior and conduct problems include aggression, property damage, deceitfulness, and rule breaking, including criminal behavior.

Prior research has identified several classifications of aggressive behavior as a function of motive, form of behavior, and context. For instance, there are important theoretical distinctions between physical and nonphysical aggression (Tremblay, 2000), direct and indirect aggression (Crick & Grotpeter, 1995), and reactive and proactive aggression (Dodge & Coie, 1987). However, most researchers agree that children who are aggressive, regardless of form, are at a heightened risk for developing externalizing and internalizing problems and poor peer relations (Card & Little, 2006; Card, Stucky, Sawalani, & Little; Heilbron & Prinstein, 2008). This thesis will focus specifically on the (i) risk factors associated with children who display higher levels of reactive and proactive aggression, (ii) risk factors in adolescents who are high in callous-unemotional traits and at risk of showing higher levels of aggression and conduct problems, and (ii) identifying predictors for adult female violence and antisocial behavior.

Development of Aggression

Since the Middle Ages, rates of aggression and violence have seen a substantial decline across most European societies (Paquin, Lacourse, & Ouellet-Morin, 2015). However, because of the far-reaching adverse effects on society, aggressive behavior has remained an important topic. In the mid-1600s, living in a time when citizens were oppressed by their government, John Locke (1632 - 1704) posited that children were neither innately good nor evil, and instead the good or evil person was a product of societal influences (Anstey, 2003). However, Lombroso (1911, 2006) rejected this claim and suggested violent individuals are born from inherited traits. Several hundred years later there are still pockets of debate if the foundation of human behavior is a function of nature versus nurture (see Moore, 2013 for review). However, the vast majority of research support and favors an integration of both, and considers the nature versus nurture argument to be nonsensical in view of evidence of the interaction between biology and the environment (Paquin et al., 2015; Raine, 2002b; Rutter, 2006). The biosocial model, which has been further augmented as the biopsychosocial model, incorporates this interaction. The biopsychosocial model of aggression incorporates the multidisciplinary research approach to understand human behavior, drawing from biological, psychological, and the social sciences. Over the past 20-30 years, longitudinal studies using multidisciplinary measures have begun to establish a deeper understanding of the development of aggression from early childhood to adulthood.

Aggression during childhood is considered a normative behavior, but as children mature, aggression typically declines (Arsenio, 2004; Loeber & Hay, 1994; Tremblay et al., 1996). By the end of a child’s first year of life, children begin to develop the use of physical force (Tremblay et al., 1999), such as responding in protest – pushing, kicking, hitting, and throwing and breaking objects (Hay, 2005; Raine, Reynolds, Venables, Mednick, & Farrington, 1998). At the age of 14-15 months, children begin to engage in aggression towards siblings or peers, such as hitting or biting. By 17 months approximately 80% of children exhibit physical aggression (Tremblay et al., 1999). However, aggression problems are not typically perceived as problematic until school age, as before this time aggression may be considered as "normative" (Tremblay et al., 1999, p.20) and explained away by justifications such as "he is just going through the terrible twos" (Campbell, Shaw, & Gilliom, 2000). Between 2 to 3 years of age, approximately 70% of children exhibit frequent aggressive behavior (e.g., hitting others), declining to 20% by ages 4 to 5 years, and to 12% by ages 8 to 9 years (The NICHD of Early Child and Youth Development, 2004, p.42). Levels of aggression at age five years have been shown to be a more robust predictor of delinquency nine years later than poverty, family structure, mother's education, and gender (Bor, Najman, O'Callaghan, Williams, & Anstey, 2001). While the trajectory of early chronic aggressive behavior is well substantiated, there is limited research looking at risk factors for forms (e.g., goal-directed or in response to provocation) of aggression during middle childhood.

As children age, rapid development can be seen in their cognitive ability, social skills, and emotion and physiological regulation; therefore, it may be expected that mechanisms of aggressive behavior also change with age, which could also explain the development of different forms of aggression. It is around middle childhood that aggressive behavior becomes more diverse, such as the use of verbal aggression (e.g., teasing), bullying, fighting, property damage, and cruelty to animals. Prior research has suggested that middle childhood is not catalytic for aggressive behavior, and instead the aggressive behavior observed is a spill over from younger ages (Broidy et al., 2003; Liu, Lewis, & Evans, 2013; Nagin & Tremblay, 1999). This may suggest aggressive children have a predisposition towards aggressive behavior before entering into middle childhood and adolescence. However, there is substantial support that maturation plays an integral role in how aggression is implemented and inhibited. For instance, more cognitively complex forms of aggression, which require planning, self-control, and manipulation may only develop until middle childhood (Anderson, 2002). In line with this assertion, clinic-referred children who displayed high levels of aggression in response to perceived provocation were younger (4.4 years old) than children who used high levels of aggression to achieve a goal (6.8 years old; Dodge, Lochman, Harnish, Bates, & Pettit, 1997).

During middle childhood aggressive behavior starts to influence peer relationships. Children who show aggressive behavior may have difficulty regulating emotions, resulting in problem behaviors leading to social rejection by other children (Dodge et al., 1997; Evans, Fite, Hendrickson, Rubens, & Mages, 2015). Social rejection may push similarly aggressive children into the same social group, where aggressive behavior becomes normalized and reinforced (Vitaro & Brendgen, 2005). At the same time, not all aggressive children are rejected by their peers, and sometimes aggressors may be admired by other children for their social and physical dominance. Middle childhood seems to be an integral moment in a child's social and biological development, yet this is a cohort that is often overlooked in research.

While the majority of children decline in their aggressive behavior as they emerge into adolescence, there is a small percentage of individuals (approximately 5-10%) who continue to show chronic aggression throughout adolescence and into adulthood (Broidy et al., 2003; Moffitt, Caspi, Dickson, Silva, & Stanton, 1996). For example, Moffitt (1993) found that 86% of seven year old children with conduct disorder still displayed antisocial characteristics at age 15 years. However, some research has found that childhood physical aggression does not predict antisocial behavior in adolescence for girls, whereas it does for boys (Broidy et al., 2003). This may suggest that as early as middle childhood, aggressive behavior may be differently related to risk factors for males and females. Nevertheless, antisocial behavior within the first two decades of life is suggested to be similarly stable for boys and girls (when assessed within gender cohorts). However, a diagnosis of conduct disorder in girls is less likely to be retained into adolescence, and females are dramatically less likely than males to show antisocial behavior in adulthood: for every one female exhibiting antisocial behavior there are 10 males (Moffitt, Caspi, Rutter, & Silva, 2001).

Moffitt (1993, 2006) developed a dual taxonomy of conduct problems, which represented two groups of youth based on developmental onset and trajectory of antisocial behavior. Childhood-onset of severe conduct problems may be indicative of “life-course-persistent” antisocial behavior, whereas behavior problems starting in adolescence may be limited to the teenage years (Moffitt & Caspi, 2001). Based on prior research, the two can be distinguished by etiological differences as well as the trajectory into adulthood. Individuals in the childhood-onset group are exposed to childhood maltreatment, poor parenting strategies, family conflict, poverty, parents who exhibit antisocial behavior, and inherited neurodevelopmental risk factors (Johnson, Kemp, Heard, Lennings, & Hickie, 2015; McCabe, Hough, Wood, & Yeh, 2001; Moffitt & Caspi, 2001; Odgers et al., 2008). In adulthood, those who displayed childhood-onset continue to show greater levels of mental and physical health problems as well as more chronic perpetration of violent behavior (Odgers et al., 2008). In comparison, adolescent-onset youths showed less childhood history of externalizing psychopathology (e.g., attention deficit hyperactivity disorder), less neurological problems, and lower levels of aggression and violence during their teenage years (Moffitt et al., 1996; Moffitt, 1993, 2006). Moffitt and Caspi (2005) suggest adolescent-onset of antisocial behavior is near normative, primarily because biological maturation and social maturation (e.g., privileges and responsibilities) are mismatched – gaining greater social autonomy beyond their biological maturity. Furthermore, adolescents may pursue autonomy from parents by mimicking antisocial behavior in peers. However, because adolescent-onset teens do not have the same extensive childhood risk factors, delinquency is restricted to the adolescent years and, as adults, they mature into a more "conventional lifestyle" (Moffitt & Caspi, 2005 p.162).

Subtypes of Aggression

Over the past 40 years, aggression is better understood by the form and motive for the behavior rather than as a homogeneous construct. This is a stance accounted for by legal systems for centuries - with distinct legal outcomes for crimes committed in response to provocation compared to predatory perpetration (Kempes, Matthys, de Vries, & van Engeland, 2005). Similarly, in the field of medicine, aggression has been dichotomized as impulsive and non-impulsive. Impulsive aggression is characterized by a loss of control accompanied by heightened levels of arousal, while non-impulsive aggression is goal-directed and accompanied by low arousal (Kempes et al., 2005; Viteiello & Stoff, 1997). Most notably and more recently, aggression has been conceptualized and termed as being reactive or proactive, which are distinguishable by the form and motive (Dodge & Coie, 1987), and each has been shown to have unique biological and psychological mechanisms (Babcock, Tharp, Sharp, Heppner, & Stanford, 2014). Aggressive behavior is one of the most frequent reasons for mental health referrals in children and adolescents (Armbruster, Sukhodolsky, & Michalsen, 2004). However, given that forms of aggression have been shown to have distinct adverse developmental outcomes (Hubbard, McAuliffe, Morrow, & Romano, 2010), identifying these forms of aggression early in development may help deter future aggressive and antisocial behavior. Furthermore, understanding mechanisms at the psychological, biological, and cognitive level may help inform clinicians to apply most appropriate forms of treatment, and assist in the development of prevention programs (Antonius et al., 2010).

Reactive aggression is characterized as an intense response to provocation or threat, and may be perceived as being "hot blooded" because there is a loss of emotional and behavioral control (Barratt, 1991; Berkowitz, 1993). Reactive aggression can best be understood by the frustration-anger theory of aggression (see Berkowitz, 1993; Dollard, Miller, Doob, Mowrer, & Sears, 1939). Thus, if an individual perceives a threat, feels provoked, or is frustrated, then he/she may respond with anger. This response induces autonomic reactivity, which prepares the body to deal with the situation, via fight, flight, or freeze responses. The main function is to respond in a way that is defensive to neutralize the risk (e.g., escaping or fighting). Reactive aggression does not always manifest in violence; it could take the form of verbal abuse, intimidation, or threats. It is important to recognize that reactive aggression may be advantageous in certain circumstances - from an evolutionary perspective reactive aggression may have offered an advantage when dealing with a legitimate and immediate threat. However, reactive aggression is most often studied as a function of maladaptive behavior, such that the response is above and beyond what is needed for the situation.

Prior research has suggested that reactive aggression results from problems with social information processing (Crick & Dodge, 1996; Dodge et al., 2015). Crick and Dodge (1996) proposed that the social information processing model includes five stages: (i) encoding of cues, (ii) interpretation of cues, (iii) clarification of goals, (iv) access of responses and (v) response decision. Children high in reactive aggression have been shown to have more problems with the first two stages: encoding of cues and interpretation of cues (Crick & Dodge, 1996; Schwartz et al., 1998). Thus, children, adolescents, and adults who reactively aggress may have *perceived* or *felt* threatened, which propelled them to respond with aggression. Poor interpretation and encoding of social cues may be why children higher in reactive aggression, who experience strong mood swings, have greater problems maintaining social relationships and are often rejected by their peers (Evans et al., 2015; Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001).

While reactive aggression is thought to be activated by hostile attributional biases, deviant social decision-making, which is further down the social-information processing stream, is considered central to why children engage in proactive aggression (Crick & Dodge, 1994, 1996). Proactive aggression is defined by aggression that is "cold-blooded", predatory, and used for personal gains, such as physical (e.g., financial), social (e.g., dominance), or psychological goals (e.g., feeling superior). In line with Bandura's (1973) social learning theory, proactive aggression may be learned through reinforcement of one's own behavior and by observing others (Huesmann, 1998). A child who intimidates others to achieve a reward (e.g., monetary gain, getting a toy) is reinforced by the positive outcome, which strengthens the negative behavior. It has been noted that proactive aggression is associated with psychopathy, and in children it is predictive of oppositional defiant disorder and conduct disorder problems in adolescence (Vitaro, Gendreau, Tremblay, & Oligny, 1998). Proactive aggression may therefore identify those children who are most at risk for severe antisocial behavior and psychopathology.

Although proactive and reactive aggression are highly correlated ($r = .70, \pm.15$; Vitaro & Brendgen, 2005), most researchers seem to agree they are distinctive in their emotional, cognitive, behavioral, and biological concomitants (Berkowitz, 2008; Fontaine, 2006). Therefore, identifying children based on their use of aggression could have advantageous effects on selecting (or developing) the most appropriate intervention for the child (Helseth, Waschbusch, King, & Willoughby, 2015). For instance, youth showing high levels of reactive aggression may benefit from interventions targeting false perceptions, poor inhibition, and anger management, while young people who display proactive aggression may benefit from interventions directly targeting their callous use of others to achieve a goal.

However, there have been criticisms over the variable-centered nature of bimodal aggression (Bushman & Anderson, 2001), primarily because variable-centered statistical analyses result in understanding variables and not people (Bergman & Magnusson, 1997; Laursen & Hoff, 2006; Magnusson, 2003). For example, the variable-centered approach shows reactive aggression is distinguished by hyperarousal and high anxiety (Scarpa, Haden, & Tanaka, 2010), whereas proactive aggression is characterized by hypoarousal and low anxiety (Scarpa & Raine, 1997). Thus, variable-centered studies show reactive and proactive aggression as having opposing psychological and biological correlates. However, research using person-centered methods have shown that purely proactive aggressors are rare (Vitaro & Brendgen, 2005, p.190), and instead, individuals who display high levels of proactive aggression also show high levels of reactive aggression (Centifanti, Fanti, Thomson, Demetriou, & Anastassiou-Hadjicharalambous, 2015; Marsee et al., 2014; Muñoz, Frick, Kimonis, & Aucoin, 2008). Thus, as variables, reactive and proactive aggression are related to different factors, but at the person-level an individual can display high levels of both proactive and reactive aggression. Therefore, findings from bimodal research may not generalize to people who display mixed aggression, which could impact the effectiveness of treatment.

At present, research using person-centered methods are sparse (Cui, Colasante, Malti, Ribeaud, & Eisner, 2016), and to date no research has employed a person-centered approach to understand aggression subgroups in preadolescent children. Therefore, it remains unknown if children who show mixed forms of aggression differ from reactively aggressive children in their executive function, neurobiological functioning, and psychopathy - all relevant predictors of aggression types using variable-centered models.

Predictors of Aggression

Prior research supports multidisciplinary techniques to assess aggressive behavior (Stoff & Susman, 2005). Typically, these may include social factors (e.g., peer and parental relationships, social economic status), biological factors (e.g., neurobiology), cognitive factors (e.g., executive functioning), and personality traits (e.g., psychopathy). Although there has been a call for multidisciplinary research (see Stoff & Susman, 2005, p.7), very few studies to date apply this practice in youth.

Personality

Psychopathy

The concept of psychopathy is characterized by a cluster of affective, interpersonal, and behavioral personality traits. People with high levels of psychopathic traits may act callously to others, manipulating other people to achieve a desired goal (e.g., social dominance, physical gain) without concern of consequence or care for the welfare of their victim. Psychopathic behavior was first introduced into the clinical field by French psychiatrist Philippe Pinel in the early 1800's. Pinel's depiction described intact intellectual functioning, diminished emotional affect, and poor impulse control (Gacono, 2000). At the time, the term *manie sans delire* ("madness without delirium") was used (Pinel, 1806 p.152). Prior to clinical descriptions of psychopathy as a disorder, descriptions of psychopathic behaviors have persisted in the historical literature. The presence of these early descriptions sparks debate about the evolutionary development of psychopathy (Blackburn, 2006; Levy, 2010). The origins of psychopathy seem primordial. Theophrastus (371-287 BCE), a student of Aristotle (384-322 BCE), detailed various personality patterns, one of which was labeled "The Unscrupulous Man" (Millon, Simonsen, Briket-Smith, & Davis, 1998, p.3). Theophrastus explained this man in an anecdote: he displayed callous emotions, manipulating others, while exhibiting both grandiosity for himself and lack of remorse for his recently swindled victim (Widiger, Corbitt, & Millon, 1991, p.63). Since Theophrastus and Pinel (1806) noted psychopathic behaviors, the field of psychopathy has undergone a great deal of progress. In the United States, Hervey Cleckley (1941) published his pioneering book called *The Mask of Sanity*, which was later updated four times during his lifetime to conform to current literature and his own more recent observations. Similar to the forefather of psychology, Sigmund Freud, building a foundation for understanding people's behavior that stand relevant 100 years on (Corsini & Wedding, 2011), Hervey Cleckley's (1941) observations and analyses hold validity and significance for current research. Cleckley's (1964) description of psychopathy consisted of 16 personality characteristics (see Table 1). Most of these characteristics are still used today in self-report and clinical measures of psychopathy (Furnham, Daoud, & Swami, 2009).

Table 1. Cleckley's (1941) 16 Personality Characteristics of Psychopathy

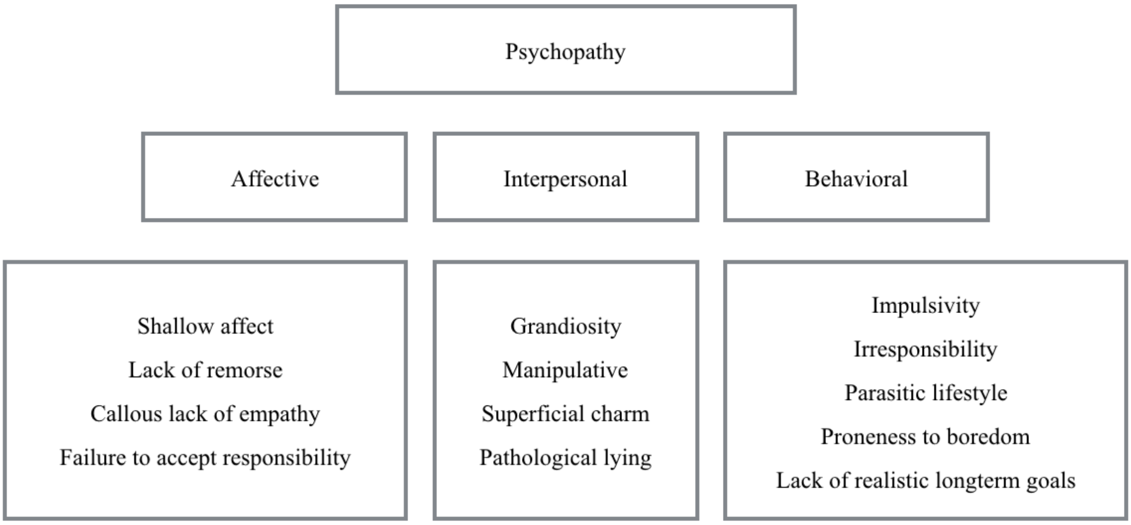
1.	Superficial charm and good intelligence
2.	Absence of delusions and other signs of irrational thinking
3.	Absence of "nervousness" or psychoneurotic manifestations
4.	Unreliability
5.	Untruthfulness and insincerity
6.	Lack of remorse and shame
7.	Inadequately motivated and antisocial behavior
8.	Poor judgment and failure to learn by experience
9.	Pathologic egocentricity and incapacity for love
10.	General poverty in major affective reactions
11.	Specific loss of insight
12.	Unresponsive in general interpersonal relations
13.	Fantastic and uninviting behavior with drink and sometimes without
14.	Suicide rarely carried out
15.	Sex life impersonal, trivial, and poorly integrated
16.	Failure to show any life plans

Cleckley (1964, p.362-363)

A less well-known psychiatrist from Scotland, David Henderson, published the *Psychopathic States* detailing his early clinical impressions, of three manifestations of psychopathic behavior. The first psychopathic state is called the predominately passive or inadequate, who parasitically lives off of society. The second state, the predominately aggressive, is considered the most violent and dangerous of the three psychopathic manifestations. The third, is the predominately creative psychopath, who Henderson describes as “near genius” (1938, p.112), and compared to individuals such as Joan of Arc. While people typically gravitate towards the “herd” (p. 133) for confidence, safety, and overall prosperity, Henderson (1938) suggested people with psychopathy do not need to seek social affiliation for these qualities. However, Henderson stated characteristics of psychopathy inevitably lead to “fatalism or despair, the reaction to which may be aggressive or passive” (1938, p.133). With that said, Henderson believed people with psychopathy were able to be rehabilitated, as psychopathy was a result of social emargination rather than being hereditary.

More recently, Robert Hare built on Cleckley’s observation and developed a semi-structured clinical assessment of psychopathy: the Psychopathy Checklist (Hare, 2003a, 2003b). The checklist includes 20 items, and consists of three factors, affective, interpersonal, and behavioral traits (Cooke & Michie, 2001), which has since become one of the most widely used measures of psychopathy (Skeem & Cooke, 2010a). Figure 1 illustrates the three-factor model of the PCL-R. Several widely used questionnaire measures of psychopathic traits in adults and children, such as the Levenson Self-Report Psychopathy Scale (LSRP; Levenson, Kiehl, & Fitzpatrick, 1995) and the antisocial process screening device (APSD; Frick & Hare, 2001), also follow the three-factor model. Prior research has found the three-factor model to have meaningful relevance for predicting aggressive, violent, and antisocial behavior (Brinkley, Diamond, Magaletta, & Heigel, 2008; Sellbom, 2011).

Figure 1. Cooke & Michie (2001) Three-Factor Model of the PCL-R



The construct of psychopathy is considered one of the most robust predictors of violence in forensic, psychiatric, and community populations - including youth populations. The pervasiveness of psychopathy has been estimated to cost the criminal justice system $460 billion per annum (Kiehl & Hoffman, 2011). Not only have offenders with psychopathy been shown to commit twice as many violent crimes as offenders without psychopathy (Hare, 1999), but are five times more likely to recommit violent crimes (Serin & Amos, 1995), and are responsible for more severe forms of violence (Coid & Yang, 2011; Porter, Woolworth, Earle, Drugge, & Boer, 2003).

However, there has been fierce debate about concerns that the construct of psychopathy is becoming synonymous with the PCL-R (see Skeem & Cooke, 2010b). It is important to acknowledge that early clinical conceptions of psychopathy, such as Cleckley (1941), Karpman (1948), and Henderson (1938), attributed more emphasis to the affective and interpersonal characteristics that defined psychopathy. Whereas the PCL-R regards antisocial behavior and criminality as an integral factor of psychopathy (Skeem & Cooke, 2010a). Thus, the PCL-R might predict antisocial behavior because it predominately measures antisocial personality traits. Thus, the present thesis will use the three-factor model to limit the likelihood of psychopathy being over-reliant on the antisocial factor, and to determine which of the three factors best predicts violence and aggression.

Although research on psychopathy has been extensive in male forensic samples, research in female offender samples has not received the same level of attention (Verona & Vitale, 2006). This is surprising given that the little research done indicates that psychopathic traits may manifest differently in women than in men (Sprague, Javdani, Sadeh, Newman, & Verona, 2012; Sutton, Vitale, & Newman, 2002). For instance, psychopathy predicting violence is less consistent in female samples than in male samples, which may suggest the construct of psychopathy does not equally generalize as a risk factor to female populations (Salekin, Rogers, & Sewell, 1997; Vitale, Smith, Brinkley, & Newman, 2002; Weizmann-Henelius, Virkkunen, Gammelgård, Eronen, & Putkonen, 2015). Therefore, researchers have called for more studies to be conducted in female samples to develop clarity on the generalizability (and differences) of psychopathic traits in women (McKeown, 2010; Thomson, Towl, & Centifanti, 2016; Verona & Vitale, 2006). Another area of research that has begun to receive greater attention is the developmental perspective of psychopathy.

Callous-Unemotional Traits

It is only within the past 20-30 years that research has begun to direct attention towards the development of psychopathy by studying psychopathic traits in children and adolescents (Lynam & Gudonis, 2005). Clinicians and researchers have suggested callous-unemotional (CU) traits (the affective factor of psychopathy) in children and adolescents is a downward extension of adult psychopathy (Fanti, Panayiotou, Lazarou, Michael, & Georgiou, 2016; Kahn, Ermer, Salovey, & Kiehl, 2016). Youth with CU traits display a callous lack of remorse, guilt, empathy, and deficient affect (American Psychiatric Association, 2013; Blair, Leibenluft, & Pine, 2014) (Blair et al., 2014). CU traits are suggested to disentangle the heterogeneity within those children who show early-onset of conduct problem behavior

(Frick & Viding, 2009; Pardini & Frick, 2013). Prior research shows CU traits designate a severely antisocial and cruel cohort of youth (Frick & White, 2008). In particular, youth with CU traits exhibit higher levels of proactive aggression (Fanti, Frick, & Georgiou, 2009), goal-directed violence (Flight & Forth, 2007), violent recidivism (Basque, Toupin, & Côté, 2013), and conduct problems (Fontaine, Rijsdijk, McCrory, & Viding, 2010; Frick & Dantagnan, 2005). CU traits are considered to remain relatively stable throughout childhood and adolescence (Frick & White, 2008), and has been shown to predict psychopathic traits and antisocial personality disorder in adulthood (Burke, Loeber, & Lahey, 2007; Frick, Ray, Thornton, & Kahn, 2014). In sum, psychopathic traits and CU traits designate a particularly at-risk group of youth who engage in greater levels of aggressive and violent behaviors.

Youth with CU traits are also distinct from youth with behavior problems on biopsychosocial factors. At the biological level, youth with CU have diminished skin conductance response to provocation (Kimonis et al., 2008; Muñoz et al., 2008), lower heart rate to emotionally evocative films (Anastassiou-Hadjicharalambous & Warden, 2008), and lower resting respiratory sinus arrhythmia (de Wied, van Boxtel, Matthys, & Meeus, 2012). At the personality level, youth with CU traits have lower levels of anxiety (Dolan & Rennie, 2007; Pardini, Stepp, Hipwell, Stouthamer-Loeber, & Loeber, 2012), agreeableness, conscientiousness, neuroticism, openness, and extraversion (Roose, Bijttebier, Decoene, Claes, & Frick, 2010). Further, youth with CU traits are characterized by fearlessness, which may explain why they do not consider the risks associated with their behavior and the consequences of their actions (Barker, Oliver, Viding, Salekin, & Maughan, 2011; Fanti et al., 2016). Although fearlessness is considered the link between CU traits and antisocial behavior, research exploring biological factors during fear induction has been largely ignored. Understanding the biological disposition of youth with CU traits may offer a richer explanation of the association between CU traits, fearlessness, and aggression.

Biological Factors

Autonomic Nervous System

There are several theoretical explanations of the link between autonomic nervous system activity and antisocial behavior. Raine (2005) suggests low autonomic levels (e.g., low resting heart rate) during rest period may indicate fearlessness, and low resting autonomic activity has been shown to predict antisocial behavior. Thus, according to Raine's (1993) fearlessness theory, being fearless increases the likelihood of engaging in violent and antisocial behavior because fearless people are less concerned with consequences and risks linked with antisocial behavior (e.g., being caught, physical injury). A second theory is physiological underarousal may be an unpleasant state (Quay, 1965; Raine, 2002a). Therefore, the individual may pursue risky behaviors to seek out stimulation to increase their physiological state to "normal" or "optimum" levels (Schechter, Brennan, Cunningham, Foster, & Whitmore, 2012). Prior research has provided support for this theory by showing that antisocial behavior and stimulation-seeking behavior are both accompanied by low autonomic arousal (Raine, 2005). Thus, individuals who are hypoaroused may find physiological stimulation from antisocial behaviors, such as violence (Wilson & Scarpa, 2011).

More recently, Beauchaine (2015) has suggested resting autonomic nervous system activity may serve as an efferent marker of neurobiological functioning. For instance, respiratory sinus arrhythmia (RSA), a measure of parasympathetic activity, involves the synchrony of respiration and heart period and is influenced by a succession of neurological pathways derivative of the prefrontal cortex (see chapter 2 for more details). Interestingly, conduct disorder, callousness, and aggressive behavior have been associated with both poor prefrontal functioning and atypical RSA levels, such as low resting RSA (Beauchaine, Gatzke-Kopp, & Mead, 2007; Beauchaine, 2015; de Wied et al., 2012; Xu, Raine, Yu, &

Krieg, 2014). Therefore, aggressive individuals may display lower parasympathetic activity as they have prefrontal dysfunction.

Taken collectively, there is ample support that autonomic measures are associated with antisocial, aggressive, and violent behavior. However, to date, research is lacking in several specific areas. Firstly, little is understood about the association between parasympathetic resting activity and reactive and proactive aggression, and even less so about the profiles of children who use both types of aggression. Secondly, cardiovascular measures capturing both branches of the autonomic nervous system have been largely neglected in the research literature, especially in youth. Instead, a large proportion of research tends to focus on low resting heart rate as an indicator for fearlessness and a predictor of antisocial behavior (Calkins & Dedmon, 2000; Pine et al., 1998; Scarpa et al., 2010). However, heart rate is influenced by both the sympathetic and parasympathetic nervous system. Thus, heart rate is difficult to formulate clear interpretations about autonomic reactivity. Therefore, it remains unknown how antisocial youth physiologically respond when experiencing fear, and if this physiological profile represents being fearless.

Executive Function

Executive functioning can be defined as the self-regulation of emotion, thought, and actions that aid cognitive flexibility, working memory, and inhibitory control (Miyake et al., 2000). These skills depend on the integrity of neural systems of the prefrontal cortex (Séguin & Zelazo, 2005). During the same developmental stage that aggression typically declines, a rise in neurological maturation occurs, which facilitates rapid development in executive functioning. Séguin and Zalazo (2005) propose that the reduction in aggressive behavior is directly due to development in executive functioning, as children with intact executive functioning skills are better able to regulate their behavior (p. 307). Conversely, the authors propose that the small percentage of youth that continue to show aggression exhibit deficits in executive functioning (Séguin & Zelazo, 2005). However, Sequin and Zelazo (2005) acknowledge that literature testing the executive function and aggression hypothesis is sparse, and even 11 years after this publication there remains a lack of research in this area (Woltering, Lishak, Hodgson, Granic, & Zelazo, 2015).

Thus far, research has suggested adolescents with conduct problems display poor behavioral controls (e.g., inhibitory control, impulsivity; Herba, Tranah, Rubia, & Yule, 2006; Kim, Kim, & Kwon, 2001). In addition, Morgan and Lilienfeld (2000) conducted a meta-analysis that included 39 studies and found that overall, conduct disorder and antisocial personality disorder was related to executive functioning deficits. There is a fairly robust association between poor executive functioning performance and higher levels of aggression (Ellis, Weiss, & Lochman, 2009; Goldstein, Hahn, Hasher, Wiprzycka, & Zelazo, 2007; Séguin & Zelazo, 2005), but emerging evidence has suggested the association may be specific to the form of aggression displayed. For instance, reactive aggression is characterized by a poor ability to plan and inhibit behaviors (Ellis et al., 2009), whereas proactive aggression is not associated with the same deficiencies. This may not be surprising as proactive aggression requires more complex cognitive and behavioral requirements, such as manipulation, planning, and inhibitory control.

Thus, executive functioning plays an integral role in aggressive behavior in adults and children, however, less is known about the associations between executive functioning and the type of aggression used. Given that middle childhood is a time of rapid development, executive functioning may differentiate children who are able to use aggression to achieve a goal from those children who respond aggressively to perceived provocation. Identifying groups of aggressive children and understanding their cognitive profiles may help inform interventions on the specific needs of children who exhibit different forms of aggression. It may be that early intervention, targeting deficits in executive function may be effective for children who have difficulty managing complex information (e.g., social cues) and inhibiting responses to perceived provocation.

In adults, poor self-control has been associated with greater levels of rule-breaking behavior and has been regarded as a cause of crime (Hirschi & Gottfredson, 1994; Moffitt, 1993). However, evidence suggests there may be differences between adult males and females for impulsivity predicting violent and antisocial behavior (Komarovskaya, Loper, & Warren, 2007). For instance, in male offenders, impulsivity and poor inhibitory control has been shown to predict violent misconducts (Wang & Diamond, 1999). However, the same has not been consistently found for females (Komarovskaya et al., 2007). Instead, impulsivity has been shown to predict antisocial and aggressive behaviors for female offenders but not violence (Komarovskaya et al., 2007). Therefore, impulsivity in male samples may play a more general role in violent and antisocial behaviors, whereas for females, impulsivity may only be associated with rule-breaking behaviors.

The concept of executive functioning, particularly self-control, may be useful in understanding violence and antisocial behavior in female offenders (Komarovskaya et al., 2007). This is especially true because poor self-control is a core feature of psychopathy, mainly the antisocial dimension (Brinkley et al., 2008). The overlap between poor self-control and psychopathy may explain the mixed findings when predicting violence in female forensic populations. That is, a lack of self-control in women may not be enough of a characteristic to predict physically hurting another person, but may predict nonviolent rule-breaking behaviors (Komarovskaya et al., 2007). Instead, female violence may be more likely to occur when poor self-control is accompanied by antisocial characteristics (e.g., antisocial psychopathic traits; impulsivity, anger, frustration, and externalizing behavior; Brinkley et al., 2008).

Aims

General aims

The general aim of this thesis was to understand the role of personality, neuropsychological, and biological factors associated with aggressive and antisocial behavior in children, adolescents, and adults. The aim was to focus on neurobiological factors in children and adolescents to understand groups of youth who were most at risk for aggressive and antisocial behaviors. In adults, the overall aim was to understand how personality and behavioral factors contributed to predicting female violence and antisocial behavior.

Specific aims

Study 1. To identify and examine the profiles of aggressive subgroups of typically developing children, using neurobiological, neuropsychological, and personality measures.

Study 2. To investigate the biological and emotional profiles of fear reactivity in adolescents with callous-unemotional traits.

Study 3. To examine personality and behavioral predictors of antisocial and violent behavior in female offenders.

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CHAPTER TWO

Proactive and Reactive Aggression Subtypes in Typically Developing Children: The Role of Psychopathy, RSA, and Executive Functioning

Abstract

A small proportion of children, representing 5% to 10% of the population, repeatedly engage in antisocial behaviors early in life (Moffitt, 1993). The aim of the present study was to assess whether groups of aggressive children differed on psychopathic traits and prefrontal functioning consistent with the objectives of their aggression - reactive or proactive. Including 110 typically developing children (8-11 years), a latent class analysis was used to identify highly aggressive groups based on reactive and proactive aggression. Consistent with prior research, these groups included a low aggression group, a high reactive aggression group, and a mixed (high reactive and proactive) aggression group. Results show the reactive group was higher than the low group on impulsive psychopathic traits. The mixed group was highest on all dimensions of psychopathic traits. The mixed group was lower on resting respiratory sinus arrhythmia, an efferent marker of prefrontal functioning. Executive functioning differentiated the groups further, with the reactive group performing worse on planning, verbal concept formation, and cognitive flexibility tasks, while the mixed group only performed worse on inhibitory control. The mixed group performed better on motor speed than the reactive and low groups. These findings indicate psychobiological and executive functioning differences that may explain why a small group of children are able to callously premeditate and plan acts of aggression, while children who exhibit high levels of reactive aggression show problems in cognitively managing their behavior.

Keywords: psychopathy, respiratory sinus arrhythmia, executive function, proactive aggression, reactive aggression

Introduction

Middle childhood is a period of dramatic social, biological, and cognitive change (Beauchaine, 2015; Woltering, Lishak, Hodgson, Granic, & Zelazo, 2015). A child's development helps play a role in healthy social and emotional functioning. Although aggression is prevalent during early childhood, in typically developing children these behaviors decline with age (Séguin & Zelazo, 2005; Tremblay et al., 1996). However, it has been noted that a small number of children (5-10%) continue to commit greater levels of aggressive behavior that continue through the teen years into adulthood (Moffitt, 1993; Tremblay et al., 2004). Although research on aggression has largely focused on drawing etiological and phenomenological distinctions between reactive and proactive aggression, there has been a growing interest in identifying children who pose the greatest risk of high levels of aggressive behavior. In particular, it is not uncommon to find youth who only engage in high levels of aggression that is in response to perceived provocation or threat (reactive aggression; Dodge & Coie, 1987). However, finding youth who only engage in aggression used to achieve a goal (e.g., social dominance, physical gain [proactive aggression; Dodge & Coie, 1987]) is rare (Muñoz, Frick, Kimonis, & Aucoin, 2008). Instead, youth who use proactive aggression also tend to be higher in reactive aggression (see Centifanti, Fanti, Thomson, Demetriou, & Anastassiou-Hadjicharalambous, 2015; Dodge & Coie, 1987; Marsee et al., 2014). Although prior research has suggested cognitive functions differentiate proactive aggression from reactive aggression, studies involving psychophysiological and neuropsychological indices have been sparse (Gao, Tuvblad, Schell, Baker, & Raine, 2015; Woltering et al., 2015). The present study explored whether and how measures of prefrontal functioning: executive functioning, psychophysiology, and psychopathy differentiated groups of aggressive children.

Reactive and Proactive Aggression

The fundamental difference between aggression functions is that proactive aggression is goal-directed and predatory (Pardini, Raine, Erickson, & Loeber, 2014). Proactive aggression has been linked to psychopathic traits and lower psychophysiological activity (e.g., low resting heart rate; see Raine, Fung, Portnoy, Choy, & Spring, 2014). The neuroscience of proactive aggression has been suggested to be more complex than that of reactive aggression, because of the cognitive demands the behavior requires (see Reidy, Shelley-Tremblay, & Lilienfeld, 2011). For instance, reactive aggression, characterized as a hostile response to minor or perceived provocation or threat, has been associated with poor behavioral control and emotional hyper-reactivity (Crick & Dodge, 1996; Dodge et al., 2015; Fite, Becker, Rubens, & Cheatham-Johnson, 2014). Further, when viewing angry faces, youth high in reactive aggression have higher amygdala activation and diminished orbitofrontal cortex activation (Coccaro, McCloskey, Fitzgerald, & Phan, 2007), suggesting heightened attention to social threat. Proactive aggression, in contrast, requires planning. Indeed, when compared to an immediate reaction to provocation – as in reactive aggression - proactive aggression can be a drawn-out process (Reidy et al., 2011).

Although distinctions of aggression subtypes have clear empirical value, there have been several criticisms over the variable-centered nature of examining reactive and proactive aggression, such as the generalizability from variables to people and not accounting for the co-occurrence of reactive and proactive aggression (see Anderson & Bushman, 2002). An alternative approach is person-centered research, which has been used to identify groups of adolescents based on their use of proactive and reactive aggression. These groups include a low aggression group, a reactive aggression group, and a “mixed group” who show both reactive and proactive aggression (Centifanti et al., 2015; Marsee et al., 2014; Muñoz et al., 2008). The mixed aggression group typically makes up about 10% of the sample population in research studies on aggression (Centifanti et al., 2015; Marsee et al., 2014; Muñoz et al., 2008), which is consistent with the proportional estimates of those children who continue to be highly aggressive into adulthood (Fanti & Henrich, 2014; Fanti, Panayiotou, Lazarou, Michael, & Georgiou, 2016; Moffitt, 1993). Prior research has found adolescents in the mixed aggression group to have higher arrest rates and delinquency (Marsee et al., 2014). Further, mixed aggressive adolescents have been shown to have increased emotional and behavioral dysregulation (Centifanti et al., 2015; Marsee et al., 2014). Youth who exhibit only reactive aggression are typically the largest of the two aggressive groups identified (25-45% of sample sizes; Marsee et al., 2014). These youths have been found to be aggressive in response to provocation, even provocation that is ambiguous or minor (Muñoz et al., 2008).

A person-centered approach has yet to be conducted in children. Identifying groups of children based on their use of reactive and proactive aggression is essential for understanding individuals rather than variables (Smeets et al., 2016). Examining group differences on neurobiological functioning, executive functioning, and personality may begin to explain how two dissimilar types of aggression, reactive and proactive, can co-occur in a child and how these children differ from those who only reactively aggress.

Psychopathy

Children who show greater aggression versatility (i.e., who use both proactive and reactive aggression) may be characterized in childhood by high levels of psychopathic traits. Indeed, youths who display mixed aggression have been shown to display higher levels of callous-unemotional (CU) traits (Muñoz et al., 2008), which generally relates to adult levels of psychopathy (Lynam, Caspi, Moffitt, Loeber, & Stouthamer-Loeber, 2007).

In adult populations psychopathy is considered a reliable predictor of aggressive behavior, and identifies a group of individuals who engage in chronic aggressive behavior (Blais, Solodukhin, & Forth, 2014). In youths, psychopathy has been shown to be associated with proactive aggression but not reactive aggression (Raine et al., 2006). However, differences emerge with the dimensions of psychopathy. Psychopathy consists of three dimensions: callous-unemotional, impulsivity, and narcissism (Frick & Hare, 2001; Muñoz & Frick, 2007). The impulsivity dimension has been found to relate to reactive aggression (Fite, Stoppelbein, & Greening, 2009) and the narcissism dimension to relate to proactive and reactive aggression (Muñoz Centifanti, Kimonis, Frick, & Aucoin, 2013). The CU dimension has been shown to designate a particularly aggressive subgroup who are most likely to display highly aggressive behavior - both reactive and proactive - and to develop severe antisocial behavior in adulthood (Frick, Ray, Thornton, & Kahn, 2014). Thus, preadolescent children classified in a mixed versus reactive subgroups would be expected to differ on the different dimensions of psychopathic traits just like older youths do.

Neuroimaging research has suggested that reduced grey matter volume in the left orbitofrontal cortex (OFC) may differentiate youth with conduct problems and CU traits, from youth with only conduct problems (Sebastian et al., 2015). The OFC is part of the paralimbic region, which is involved with autonomic and response inhibition functions, and is shown to have an important role in social and emotional behavior, and risk-taking (De Brito et al., 2013; Rule, Shimamaura, & Knight, 2002). This suggests that youth with a combination of CU traits and behavior problems (e.g., aggressive behavior) are neurobiologically distinctive from youth with behavior problems and without CU traits (Blair, Leibenluft, & Pine, 2014). Further, CU traits have been associated with diminished physiological reactivity to violent videos (Fanti, Panayiotou, Kyranides, & Avraamides, 2015), poorer recognition of fear in others (Muñoz, 2009), and a callous lack of concern for hurting people (Pardini, 2006). Of note, then, children with CU traits may display particular emotional poverty that is not characteristic of the other dimensions of psychopathy. Since the mixed aggressive group has been shown to be higher on CU traits, it could be that they would show low emotional arousal as measured by psychophysiology, which can be considered a marker of prefrontal functioning. The reactive aggressive group may show deficits in prefrontal activity but in a different way, such as cognitive dysfunction as evidenced by neuropsychological assessment.

Psychophysiology and Aggression

By way of the structural neural network of the autonomic nervous system (ANS), prefrontal cortex (PFC) function is converted into vagal activity (Beauchaine, 2015; Thayer, Hansen, Saus-Rose, & Johnsen, 2009). Thus, vagal activity may be considered as an efferent marker for PFC functioning (Beauchaine, 2015). The autonomic nervous system (ANS) consists of two branches, the sympathetic nervous system (SNS) and parasympathetic nervous system (PNS). In healthy individuals both SNS and PNS are tonically active, and while heart rate can be considered a function of both branches of the ANS, the vagus nerve serves as a tonic inhibitor of heart rate (Levy, 1990). Neural control over the cardiovascular system seems to derive from a bidirectional network between the PFC (mPFC and OFC), cingulate, and insulate cortices to the amygdala (see Thayer et al., 2009 for full review). Activation of the central nucleus of the amygdala incurs a succession of inhibitory responses via the nucleus solitary tract, the vagal motor neurons in dorsal motor nucleus and the nucleus ambiguus, providing inhibitory input by the PNS to the sinoatrial node (Uijtdehaage & Thayer, 2000). While the SNS prepares the body for mobilization to deal with a situation (such as a threat), the PNS controls homeostasis of the body during rest. The PNS is associated with vagally mediated response whereby heart rate is decreased and becomes rhythmic to respiration. Psychophysiological indices of PNS may be considered as markers of neurobiological function that play an integral role in social adjustment (Beauchaine et al., 2015). Although ANS reactivity reflects physiological change because of situational contexts (Porges, 2007; Scarpa, 2015), resting states of ANS mark a child’s biological disposition to respond to the environment, internally and externally, prior to the occurrence of an event (such as attention, emotion regulation, engaging in social communication; Porges, 2007; Thayer & Lane, 2009). Therefore, it is important to consider baseline models of neurobiological functioning in its effects on dispositions for proactive and reactive aggression.

Executive Function and Aggression

Executive functions (EF) are neurocognitive skills that facilitate the successful implementation of top-down goal-directed behavior (Zelazo, 2015). EF skills can be considered a function of attention modulation applied in different modalities, such as attention over time (working memory), selective attention (inhibitory response), and attention to switching between tasks, operations or mental states (cognitive flexibility; Goldstein, Nailer, Princiotta, & Otero, 2014; Miyake et al., 2000; Woltering et al., 2015). It has been proposed that EF occurs hierarchically, concurrently, and interactively to influence goal-directed behaviors (Ellis, Weiss, & Lochman, 2009; Zelazo & Müller, 2002). Neuroimaging and lesion studies have indicated that PFC functioning is integral to EF skills. In particular, performance on planning (Unterrainer et al., 2004), cognitive flexibility (Barbey, Colom, & Grafman, 2013; Zakzanis, Mraz, & Graham, 2005), concept formation (Lie, Specht, Marshall, & Fink, 2006), and inhibitory control (Milham, Banich, Claus, & Cohen, 2003; Taylor, Barker, Heavey, & McHale, 2015) have been linked to the dorsolateral prefrontal cortex (dlPFC), an area of the brain found to be associated with regulation of aggressive social behavior (Achterberg, van Duijvenvoorde, Bakermans-Kranenburg, & Crone, 2016). Of note, other brain regions have also been associated with poor EF skills or activation during EF tasks (e.g., anterior cingulate cortex; Milham et al., 2003; Taylor et al., 2015), which suggests that no single area of the brain, let alone PFC, is indicative of EF performance, and instead EF is part of a complex interconnected neural circuits derivative of many areas within the brain (Otero & Barker, 2014 p. 29).

EF ability is integral to a child's social development, and has a fairly robust association with aggression (Ellis et al., 2009; Goldstein, Hahn, Hasher, Wiprzycka, & Zelazo, 2007; Séguin & Zelazo, 2005), antisocial behavior (Morgan & Lilienfeld, 2000), and adult criminality (Moffitt et al., 2011). Poor EF ability has been associated with peer problems (Holmes, Kim-Spoon, & Deater-Deckard, 2016), while good EF has been shown to influence altruistic behavior (Aguilar-Pardo, Martínez-Arias, & Colmenares, 2013). Thus, testing executive function in youth may explain why some children are able to adeptly respond to social situations for personal gain (e.g., manipulation), and why others fail to inhibit aggressive behavior in response to perceived provocation.

Poor planning performance of EF ability has been associated with higher reactive and proactive aggression in young children (3-6 years; Poland, Monks, & Tsermentseli, 2015). However, during middle childhood, poor planning and inhibitory control was associated with only reactive aggression during this developmental period (9-12 years; Ellis et al., 2009). In theory, when compared to reactively aggressive children, children who are proactively aggressive should be better able to plan and inhibit their behaviors, and manage to cognitively switch between operations in order to achieve goal-directed action. It may be that children who use both proactive and reactive aggression display somewhat similar EF profiles of children who only engage in reactive aggression (i.e., poor inhibitory skills), but still have an intact cognitive ability to plan and switch between operations or mental states to carry out proactive aggression. However, this possibility has yet to be examined.

The Present Study

This is the first study to date to examine aggression subtypes and important personality, neuropsychological, and psychophysiological correlates in preadolescent children, known to be a developmental period where EF may differentiate subtypes of aggression (Ellis et al., 2009). Since psychophysiological indices reflect efferent markers for neurobiological functioning in the PFC, a strong association between ANS activity and executive functioning is unsurprising (Marcovitch et al., 2010; Staton, El-Sheikh, & Buckhalt, 2009). However, few studies exist that include neurobiological indices and executive functioning measures to understand how different subgroups of aggressive children might differ on these indices (Gao et al., 2015; Woltering et al., 2015).

Based on prior research, a latent class analysis was used to identify three hypothesized aggression groups based on self-report. The groups were validated by teacher report of reactive and proactive aggression. The reactive and mixed group were expected to not significantly differ on reactive aggression, so they would be similar in aggression severity. It was hypothesized that group differences would be driven by psychophysiological, neuropsychological, and personality factors. Children who were in the mixed aggression group were expected to score the highest on callous, narcissistic, and impulsive psychopathic traits when compared to the low aggression group. Because of the association between impulsivity and reactive aggression, the reactive group were expected to be higher than the low group in impulsive psychopathic traits. When examining psychophysiological factors, it was hypothesized the mixed and reactive aggression groups to have low resting RSA. When investigating executive functioning group differences, it was expected the reactive aggression group to perform poorest across all EF domains (inhibition, planning, cognitive flexibility, and concept formation), and the mixed aggression group to perform poorly on inhibition tasks, but not to perform worse than the low aggression group on planning, cognitive flexibility, and concept formation.

Method

Participants

Sixty boys and 50 girls (*N*=110, M_{age} = 9.9 years, *SD* = 0.71, age range: 8-11 years) were recruited from two primary schools in the North East of England. Both schools were ranked in the third quintile (within the national average) of students receiving free school meals. Participant ethnicity was reported by the child's teacher, with the sample including White British (96%), Black British (2%), and Asian British (2%). Using the Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2011) the mean full scale IQ (FSIQ-2) for the sample was 98.06 (*SD* = 11.86). Children who would be between the ages of eight to 11 years at the time of study administration were included in the recruitment process. The recruitment success rate was 97%, with four students declining or unable to participate. Participants were excluded from the study if they were taking medication (*n* = 1) or had physical impairments (e.g., visual impairment) that would affect performance on executive functioning tasks (*n* = 2).

Procedure

Information sheets detailing the scope of the study and consent forms were sent home to caregivers four weeks prior to the beginning of the study. Reminders were sent home to parents of children who expressed interest but a consent form had not been received. Once parent consent was received assent was then obtained from the child. Participants were tested individually in a quiet room within the school. Participants completed the psychophysiological assessment, self-report questionnaires, and IQ testing during the same session. The executive functioning task occurred on a different day, but within three days of the first administration session. Participants received a small gift for participating in the study. The study was approved by the Ethics Committee at the University of Durham.

Measures

Psychopathic traits. The Antisocial Process Screening Device (APSD; Frick & Hare, 2001) was completed by the child's teacher to measure psychopathic traits. The APSD was created from the Psychopathy Checklist-Revised (Hare, 1991) to measure psychopathic traits in children and adolescents, and for use in both forensic and community populations (Muñoz & Frick, 2007). The APSD has been used with samples from ages four to 18 years (Munoz & Frick, 2012). The APSD consists of 20-items yielding a total score with each item rated on from 0 (Not at all true) to 2 (Definitely true). Prior research has supported the dimensional construct of the APSD (Frick, Bodin, & Barry, 2000), with five items measuring impulsivity (e.g., "Engages in risky or dangerous activities"), seven items for narcissism (e.g., "Uses or "cons" other people to get what s/he wants"), and six items representing callous-unemotional traits (e.g., "Does not show feelings or emotions"). The CU scale includes five items reverse coded (e.g., "Is concerned about the feelings of others"). In the present sample the Cronbach's alpha coefficient for APSD total score (0.91), and the three dimensions (narcissism = 0.87; impulsivity = 0.80; CU = 0.84) suggests good reliability, and was consistent with prior research (see Lochman et al., 2014).

Self-Report of Reactive and Proactive Aggression. Participants completed the reactive–proactive aggression questionnaire (RPQ; Raine et al., 2006) to measure reactive and proactive aggression. The RPQ is suitable for children with a reading age of eight years (Fung, Raine, & Gao, 2009). In the present study, the researcher read aloud the RPQ to each child to avoid any problems with reading ability. The 23-item scale captures physical and verbal aggression. The reactive and proactive aggression subscales consists of 11 items (e.g., "Gotten angry or mad or hit others when teased") and 12 items (e.g., "Hurt others to win a game"), respectively. Each item is reported on a 3-point scale ranging from 0 (Never) to 2 (Often). Consistent with prior research (see Raine et al., 2006), high proactive-reactive intercorrelations (0.67, p <.01) were found. The Cronbach's alpha coefficient for the total (α = 0.89), reactive (α = 0.86), and proactive (α = 0.80) scales were considered good and consistent with prior research (see Raine et al., 2006).

Teacher-Report of Reactive and Proactive Aggression. Teachers completed the Proactive/Reactive Aggression Scale (PRA; Dodge & Coie, 1987), which captures proactive and reactive aggressive behavior. The full scale consists of 6-items, with responses ranging from 1 (Never true) to 5 (Almost always true). The proactive scale (e.g., "This child uses physical force [or threatens to use force] in order to dominate other kids") and reactive scale (e.g., "When this child has been teased or threatened, he or she gets angry and easily strikes back") each consist of 3-items. The total score (α = 0.92), reactive (α = 0.94), and proactive (α = 0.93) subscales had good internal consistency, and is consistent with past samples of this age group (see Evans, Pederson, Fite, Blossom, & Cooley, 2015).

Intelligent Quotient. The Wechsler Abbreviated Scale of Intelligence second edition (WASI-II; Wechsler, 2011) is a brief measure of intellectual functioning for people of ages six to 89 years. The present study used the FSIQ-2, which an estimate of intelligence comprised of the Vocabulary (a measure of comprehension knowledge) and Matrix Reasoning (a measure of fluid reasoning) subtests. In youth, the FSIQ-2 has been found to have good internal consistency (0.93) and test-retest reliability (0.85; 2011). Correlations among the FSIQ-2 and the Wechsler Intelligence Scale for Children-III (WISC-III) have been high (0.85). Administration time was approximately 15 minutes for each child.

Executive function

The Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) was administered as a test battery for measures of executive functioning; planning, rule learning, concept formation, inhibition, and cognitive flexibility. The D-KEFS is a widely used clinical neuropsychological and research measure of executive functioning, and is age appropriate for children as young as eight years (Homack, Lee, & Riccio, 2005).

Tower Test. The D-KEFS Tower Test (TT; Delis et al., 2001) is an updated version of the Tower of Hanoi, which measures planning, goal setting, rule learning, problem-solving, and perseverative responding skills (Stephens, 2014). Using different colored and sized wooden disks, participants were asked to stack the disks on one of three wooden pegs to match a picture. Participants were instructed to follow two rules, they were to move only one disk at a time, and a large disk could not be placed on a smaller disk. Further, the participant was informed that the aim of the task was to create the picture (which remained opposite the participant throughout the condition) in as fewest amount of moves possible. Before the participant began the condition, disks were placed in a prearranged order (starting position) and a new picture was presented (ending position; see examiners manual for more details [Delis et al., 2001]). There were a total of nine conditions, with each condition increasing in difficulty. Participants were timed to ensure they did not surpass the maximum completion time. The TT was terminated when the participant had either completed all conditions or after three consecutive condition failures. Performance on the TT was calculated based on a Total Achievement Score, which takes into account the number of moves used to complete the condition. Higher scores indicate better performance (fewer number of moves within the time-limit). Administration time was approximately 15 minutes per child.

Sorting Test. The D-KEFS Sort Test (DST; Delis et al., 2001) is considered a measure of concept formation. Participants were required to sort six cards into two groups of three cards. Participants completed two card sets (card set 1 and card set 2). Each card set had eight possible combinations of sorts (e.g., size, color, shape, meaning of words printed on the cards). The number of correct sorts for card set 1 and 2 were summed for a total score (number of correct sorts). Following each sort, the participant was asked to explain how the groups of cards were created, at which point the participant gave a verbal explanation (e.g., "this group are all small shapes and this group are all large shapes"). Verbal description was scored in accordance with the examiner's manual (see Delis et al., 2001) for accuracy and level of abstraction with a maximum score of 4-points per sort. Higher scores indicate better performance on both conditions. The DST was completed when the maximum number of sorts had been made, the participant indicated she/he could not make any more sorts, or four minutes of cumulative sorting time had elapsed (per card set). The DST is favored over the Wisconsin Card Sorting Test (WCST) as there are 16 possible sorts (eight in each set), compared to only 3 in the WCST, increasing task sensitivity and minimizing ceiling effects (Delis et al., 2001). Further, the DST was designed to reduce the role on inhibitory control so that concept formation is the focus measure (Libon et al., 2012), and provides a measure of verbal ability to explain the sorting concepts abstractly.

Color Word Inference Test. The D-KEFS color word inference test (CWIT) measures inhibition and cognitive flexibility (Delis et al., 2001). The CWIT consists of four testing conditions, each condition was timed and the participant was asked to complete the condition as quickly as they could without making any errors. In the first condition the participant was asked to verbally name a series of color squares, and in the second condition read aloud a series of words written in black ink, these words were the name of colors (i.e., blue, green). Condition one and two serve as a baseline for the participant's performance on color naming and reading, and are used to calculate difference scores for conditions three and four. The third condition is similar to the classic stroop procedure that measures inhibition (Delis et al., 2001). The participant was asked to name the color of the ink the word was printed in (e.g., "blue" for a word written in blue colored ink). However the ink color of the word was incongruent to the written word (i.e., the word blue was written in red ink). Therefore, the participant had to inhibit the reading of the word, and say aloud the color of the ink.

Condition four was similar to condition three, with one important difference. The participant was instructed that if the word had a box around it, they were to read the word and not name the color of the ink (e.g., if the word “blue” was written in red ink and was in a box, the participant would read aloud the word “blue”). Condition four required the participant to use a similar strategy as condition three (i.e., color ink naming), but additionally use a reversed strategy for those words within a box (i.e., word reading). Condition four measured inhibition and cognitive flexibility. In accordance to the user manual (see Delis et al., 2001), the present study used the completion time difference scores for the two primary measures (inhibition = condition 3 - condition 1; inhibition/switching = [condition 1 + condition 2] - condition 4). Lower scores indicate better performance (faster completion times). The CWIT took approximately 10 minutes to administer for each child.

Trail Making Test. The D-KEFS Trail Making Task (TMT; Delis et al., 2001) was designed to assess cognitive flexibility, an ability to switch back and forth between tasks, operations, or mental states (Miyake et al., 2000). The TMT consists of a series of five different conditions; visual scanning, number sequencing, letter sequencing, number-letter switching, and motor speed. All five conditions were presented on an 11 X 17 inch area, providing longer trails and more stimuli interference than other Trail Making measures (Delis et al., 2001). The first three tests (visual scanning, number sequencing, and letter sequencing) measure fundamental abilities that are needed to complete the number-letter switching. The visual scanning condition requires the participant to cross out all the 3s on the paper, which are amongst other numbers and letters. The number sequencing condition requires the participant to draw a line from circles numbered from 1-16 in numerical order. These numbers are among other circles with letters (as distractors). The same procedure is followed for the letter sequencing condition, however, instead of numbers the participant is required to connect letters from A to P (with numbers as distractors). The number-letter switching conditions requires the participant to connect numbers and letters in an alternating switching order (i.e., 1-A-2-B-3-C-4…) until the participant reaches the final letter (P). The last condition, motor speed, requires the participant to trace over a dotted line that connects empty circles. The aim for all conditions is to complete the task as quickly as possible. If an incorrect move or bypassed connection was made the examiner placed an "X" over the wrong connection, and the participant was told to continue from the last correct connection. The stopwatch continues running during each condition, including if an error/correction was made. Lower scores on all conditions indicate better performance (faster completion time).

Psychophysiological Recording and Reduction. Respiration and electrocardiogram (ECG) were recorded continuously over a 2-minute rest period at 1000 Hz using Biopac system (MP150-BIOPAC Systems Inc., Goleta, CA) connected to a MacBook Pro running AcqKnowledge software version 4.3 (Biopac Systems). Respiration and ECG were recorded using BioNomadix module transmitter, which was secured around the child's chest. Recorded data were analyzed offline using AcqKnowledge 4.3 software (BIOPAC Inc.). Respiration was recorded using RSPEC-R amplifier with a wireless respiration belt transducer. To ensure the belt was placed at maximum point of sensitivity, the child was asked to exhale, at full exhalation the respiration belt was fastened around the abdomen of the child. To measure cardiac activity, participants were fitted with three self-adhesive pre-jelled Ag-AgCL ECG electrodes using the standard lead-II configuration (distal right collarbone, lower left rib, and lower right rib [ground]). To accommodate a 10 minute stabilization period, participants completed questionnaires. Prior to recording, participants were instructed to relax and sit still for two minutes.

Psychophysiological Measures. ECG data were resampled at 250 Hz. ECG waveforms were visually inspected for artifacts. Respiratory Sinus Arrhythmia (RSA) was derived from the respiration amplifier (RSPEC-R) with a band-pass frequency fixed at 0.707Hz and

0.05Hz. RSA was computed using AcqKnowledge automated function for RSA analysis, which applies the validated peak-valley method (Grossman, van Beek, & Wientjes, 1990). RSA values reflect the millisecond difference between the minimum and maximum R-R intervals during each respiration cycle. Lower vagal activity is reflected by lower RSA values, and higher vagal activity is reflected by higher RSA values (Gruber, Harvey, & Johnson, 2009).

Data analytic plan

To identify groups of aggressors a latent class analysis (LCA) was conducted with MPlus 7.2 (Muthén & Muthén, 1998-2012), using the reactive and proactive aggression subscales of the Reactive-Proactive Questionnaire (RPQ). LCA is a person-centered latent variable method that, within a heterogeneous sample, is able to identify groups of individuals. Multiple fit indices were used to identify the best fitting model. Fit indices that indicate the optimal class, included the Lo-Mendel-Rubin Adjusted Likelihood Ratio Test (LMRT), Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), sample-size adjusted BIC (ABIC), entropy values, and mean posterior probabilities. LMRT assesses if the model with k classes provides a significantly (p <.05) better fit than the model with k–1 classes. If the LMRT did not reach significance (p >.05), the model with k–1 fewer latent classes was selected. Additionally, the model with the lowest AIC and BIC suggests a better fitting model. Values for entropy and posterior probabilities of latent class membership range from 0 to 1, with higher values indicating more accurate classification of individuals. Average posterior classification probabilities should exceed 0.70 (Roeder, Lynch, & Nagin, 2012). The RPQ (self-report) was used over the PRA (teacher-report) for several reasons. Later analyses included teacher-report of psychopathic traits, therefore using child-report of aggression to classify groups would provide a multi-informant representation of the individual, a multi-informant approach is considered a more accurate reflection of the child's behavior (Doctoroff & Arnold, 2004; Ostrov et al., 2009). Additionally, the RPQ has many more items than the PRA (23-items, 6-items, respectively), allowing respondents to have greater variance in their answers increasing the likelihood of finding a less restricted reflection of aggression groups. Further, the RPQ has been widely used and validated cross-culturally (Tuvblad, Dhamija, Berntsen, Raine, & Liu, 2015), and has been applied extensively in psychophysiological research (Xu, Raine, Yu, & Krieg, 2014; Zhang & Gao, 2015).

Univariate analysis of variance (ANOVA) were conducted to test if the aggression groups accurately reflected the teacher ratings of proactive and reactive aggression, and to determine if there were significant age and IQ differences. To assess if males or females were overly represented in any of the groups a Chi-square test was conducted. To assess group mean-level differences in psychopathy, resting state of psychophysiology, and executive functioning measures ANOVAs with post hoc comparison were conducted. To account for modest group size differences (largest/smallest = >1.5; Stevens, 1996), Gabriel's procedure was used for post hoc analyses as this method is designed to accommodate unequal group sizes (Ricotti et al., 2016) and has greater power than other methods (e.g., Tukey, R-E-Q-W-Q) when samples are not equal (Agresti, 2002, 2015; Lowie & Bregtje, 2013). When homogeneity of variance was not met Games-Howell post hoc procedure was used with a more stringent α level of .01 (Tabachnick & Fidell, 2007). Because recent research has indicated that motor speed on the trail making test (TMT) may be more associated with executive function than primary motor function (see Camilleri et al., 2015), multivariate analysis of variance (MANOVA) was used. A MANOVA was favored over an ANCOVA as it allows for comparison in performance on fundamental skills (i.e., motor speed) as well as the primary measure of interest (number-letter switching). Further, MANOVA accounts for performance on the fundamental skills tests while assessing group differences on the number-letter switching condition. Effect sizes (partial eta squared [η_p^2]) are reported to indicate the percentage of variance explained by the effect, as either small (.01), medium (.06), or large (.14; Cohen, 1988 p. 22).

Results

Correlations Among Main Study Variables

Table 2 shows the bivariate zero-order correlations. Proactive and reactive aggression were positively and significantly related to the total score of psychopathy and the three dimensions (impulsivity, narcissism, and CU traits). A lower resting RSA was associated with higher proactive aggression. Poorer performance on the switching test on the Trail-Making Test (TMT), color word inference test (CWIT), card sorting test (both number of correct sorts and description of sorts) was associated with higher levels of proactive aggression and reactive aggression. However, poorer performance on the CWIT inhibition and switching condition was only related to reactive, and not proactive aggression.

Higher total score of psychopathic traits, CU traits, and narcissism was associated with low RSA. Narcissism was not associated with performance on the main EF measures. With two exceptions, both CU traits and impulsive psychopathic traits were associated with poorer performance on all main EF measures. The exceptions were that CU traits was associated with poorer performance on CWIT inhibition/switching measure, but impulsivity was not. Also, the tower task was not associated with any of the psychopathy dimensions. RSA was not associated with any of the EF tests.

Table 2. Summary of Correlations, Means, and Standard Deviations for the Main Study Variables

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Age	-									
2. RPQ Total	-.01	-								
3. RPQ PA	-.03	.88**	-							
4. RPQ RA	.00	.94**	.67**	-						
5. APSD Total	-.05	.53**	.53**	.45**	-					
6. Narcissism	-.07	.36**	.35**	.31**	.90**	-				
7. Impulsivity	-.11	.56**	.55**	.48**	.88**	.69**	-			
8. Callous-Unemotional	-.07	.53**	.55**	.45**	.85**	.65**	.68**	-		
9. RSA	.04	-.18	-.22*	-.13	-.25**	-.20*	-.17	-.28**	-	
10. WASI-II (FSIQ-2)	.01	-.18	-.17	-.17	-.28**	-.12	.32**	-.30**	-.10	-
11. TMT Switching	-.08	.24*	.25*	.20*	.19*	.04	.25**	.26**	-.09	-.42**
12. CWIT Inhibition	-.22*	.29**	.30**	.24*	.27**	.18	.25**	.32**	-.08	-.10
13. CWIT Inhibit/switching	-.07	.21*	.13	.23*	.23*	.16	.17	.28**	-.11	-.11
14. CST Correct Sorts	.15	-.24*	-.21*	-.23*	-.24*	-.17	-.22*	-.24*	-.01	.25**
15. CST Description	.12	-.27**	-.31**	-.20*	-.25**	-.16	-24*	-.29**	.11	.31**
16. Tower Task	.02	-.08	-.10	-.06	-.05	-.08	-.03	-.02	-.12	.12
M	9.97	11.75	2.74	9.01	8.24	2.02	2.63	2.98	4.34	98.06
SD	.71	7.27	3.32	4.62	7.68	2.87	2.86	2.66	.71	11.86

Note. RPQ = Reactive Proactive Questionnaire; PA = Proactive aggression; RA = Reactive aggression; APSD Total = Antisocial Process Screening Device total score; RSA = Respiratory sinus arrhythmia; WASI-II (FSIQ) = Wechsler Abbreviated Scale of Intelligence mean full scale IQ; TMT = Trail Making Test (higher scores indicate a slower completion time); CWIT = Color Word Inference Task (higher scores indicate a slower completion time); CST = Card Sorting Task (higher scores indicate more correct sorts and better description score).
*p <.05, **p<.01

Identifying Aggression Groups

Table 3 presents the fit indices for the 2-through 4-latent class models for reactive and proactive aggression groups. The AIC, BIC, ABIC, and LMRT favored the 3-class model over the 2-class model. When comparing the 4-to the 3-class model the AIC, BIC, and ABIC favored the 4-class model; however, these differences were marginal. When comparing 4- to the 3-class model on the entropy value, the 3-class model was preferred. The LMRT indicates the 3-class model was a significantly better fit than the 2-class model, but the 4-class model was not a significantly better fit than the 3-class model. This suggests the best model for the data was the 3-class. Further, the 3-class model classified people with a high degree of accuracy (low aggression group .97; reactive aggression group .88; and mixed aggression .99). Importantly, the 3-class model was most similar to prior research, which has also found the 3-class model (see Muñoz et al., 2008). Additionally, the proportion of participants in the mixed (n = 10, 9%), reactive (n = 28, 25.5%), and low aggression group (n = 72, 65.5%) is consistent with prior studies that include community samples of adolescents (see Centifanti et al., 2015), and a slightly lower proportion than detained samples (see Marsee et al., 2014; Muñoz et al., 2008).

Table 3. Fit Indices for Latent Class Models of Self-Report Proactive and Reactive aggression

Classes	AIC	BIC	ABIC	Entropy	LMRT
2	1155.59	1174.49	1152.37	0.92	75.95
3	1120.93	1147.93	1116.33	0.89	37.97**
4	1107.67	1142.77	1101.69	0.88	17.99

Note. AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; ABIC = sample-size adjusted Bayesian Information Criteria; LMRT = Lo-Mendel-Rubin Adjusted Likelihood Ratio Test. **$p < .001$.

The low aggression group was significantly lower on reactive (*M* = 7.11, *SD* = 3.63) and proactive aggression (*M* = .81, *SD* = .91) than the reactive group ($p < .001$, $p < .001$, respectively) and the mixed group ($p < .001$, $p < .001$, respectively). Further, the mixed group scored higher than the reactive group on both reactive (*M* = 16.40, *SD* = 3.69; *M* = 11.25, *SD* = 3.46, $p = .001$, respectively) and proactive aggression (*M* =11.00, *SD* = 1.69; *M* = 4.75, *SD* = 1.38, $p <.004$, respectively).

Group Descriptives

Table 4 displays the means and standard deviations of self-and teacher-reports of proactive and reactive aggression, and scores on IQ for the total sample and the low, reactive, and mixed aggression group. A series of ANOVAs were conducted to assess if the groups differed on teacher-report of proactive aggression, reactive aggression, IQ, and age. For measures where the homogeneity of variance assumption was not met (i.e., teacher-report of aggression), Games-Howell post hoc procedure was conducted for follow-up comparisons (α level of .01; Tabachnick & Fidell, 2007), and for all other measures Gabriel's procedure was used for post hoc comparison. Aggression groups differed significantly on teacher-report of reactive ($F(2, 107) = 15.92$, $p <.001$, $\eta_p^2 =.23$) and proactive aggression ($F(2, 107) = 30.59$, $p <.001$, $\eta_p^2 = .37$). Post hoc Games-Howell comparisons indicated the reactive group (*M* = 5.57, *SD* = 2.87) was significantly higher than the low group on reactive aggression (*M* = 3.99, *SD* =1.53, $p = .024$). Further, the reactive group (*M* = 4.79, *SD* = 2.89) was higher than the low group on proactive aggression (*M* = 3.39, *SD* = .99, $p = .047$). The mixed group was significantly higher in reactive (*M* = 7.50, *SD* = 2.76, $p = .007$) and proactive aggression (*M* = 8.60, = 3.98, $p = .006$) than the low aggression group. Compared to the reactive group, the mixed was significantly higher on proactive aggression ($p = .04$) but not reactive aggression ($p = .177$). The low (*M* = 99.24, *SD* = 11.49), reactive (*M* = 96.64, *SD* = 12.66), and mixed (*M* = 93.60, *SD* = 11.92) groups did not significantly differ on IQ scores ($F(2, 107) = 1.27$, *p*

= .286, $\eta_p^2 = .02$), or age ($F(2, 107) = 0.39$, $p = .673$, $\eta_p^2 = .01$). Males were not significantly overly represented in the low (53%), reactive (57%), or mixed (60%) groups ($x^2(2) = 0.29$, $p = .87$). Overall, the teacher-reports of proactive and reactive aggression validate the self-report aggression classes. Because groups did not significantly differ on gender, IQ, or age these were not included as covariates in further analyses.

Table 4. Aggression Subgroup Means and Standard Deviations on Teacher-and Self-Report Proactive/Reactive Aggression, IQ Scores (FSIQ-2), and Age (in years)

Classes	Low Group (n = 72)	Reactive Group (n = 28)	Mixed Group (n = 10)	Total Sample (N = 110)
SR-RA	7.11 (3.63)	11.25 (3.46)	16.40 (3.69)	9.01 (4.62)
SR-PA	.81 (.91)	4.75 (1.38)	11.00 (1.69)	2.74 (3.32)
TR-RA	3.99 (1.53)	5.57 (2.87)	7.50 (2.76)	4.71 (2.34)
TR-PA	3.39 (.99)	4.79 (2.89)	8.60 (3.98)	4.22 (2.51)
FSIQ-2	99.24 (11.49)	96.64 (12.66)	93.60 (11.92)	98.06 (11.86)
Age	9.99 (0.73)	9.88 (0.69)	10.08 (0.57)	9.97 (.71)

Note. SR-PA = self-report proactive aggression; SR-PA = self-report proactive aggression; TR-PA = teacher-report proactive aggression; TR-RA = teacher-report reactive aggression; FSIQ-2 = full scale IQ.

Psychopathic Traits

To assess if the groups differed on psychopathic traits, ANOVAs were conducted on the total score of psychopathic traits and the three dimensions; narcissism, impulsivity, and CU traits. For measures where the homogeneity of variance assumption was not met (i.e., impulsivity), the Games-Howell post hoc procedure was used for follow-up comparisons, and for all other measures Gabriel's post hoc comparison was used. Table 5 displays the means, standard deviations, and difference significance values. Groups differed significantly on total scores of psychopathic traits ($F(2, 107) = 21.69$, p <.001, $\eta_p^2 = .29$). Post hoc analysis indicated the mixed group (M = 20.60, SD = 6.11) was significantly higher than the reactive

(*M* = 9.14, *SD* = 7.17, $p < .001$) and the low group (*M* = 6.18, *SD* = 6.34, $p < .001$). There were no significant differences between the low and reactive group on total scores. Group differences were observed for narcissism ($F(2, 107) = 7.49$, $p = .001$, $\eta_p^2 = .12$), impulsivity ($F(2, 107) = 23.65$, $p < .001$, $\eta_p^2 = .31$), and CU traits ($F(2, 107) = 24.02$, $p < .001$, $\eta_p^2 = .31$). Post hoc tests show the reactive group (*M* = 3.36, *SD* = 3.26) was significantly higher than the low group (*M* = 1.72, *SD* = 2.04, $p = .047$) on impulsivity, and the mixed group (*M* = 7.10, *SD* = 2.03) was higher than both the reactive ($p = .001$) and low groups ($p < .001$). No significant differences emerged between the low aggression and reactive aggression groups on CU traits and narcissism. Post hoc tests indicated the mixed group (*M* = 5.10, *SD* = 2.42) was significantly higher on narcissism than the low (*M* = 1.56, *SD* = 2.73, $p < .001$) and reactive groups (*M* = 2.11, *SD* = 2.77, $p = .008$). In addition, the mixed group (*M* = 7.50, *SD* = 2.22) was higher on CU traits than the low (*M* = 2.29, *SD* = 2.16, $p < .001$) and reactive groups (*M* =3.14, *SD* = 2.42, $p < .001$). Overall, the reactive aggression group had higher levels of impulsivity than the low aggression group. However, the most distinct differences in psychopathic traits emerged for the mixed aggression group. Children in the mixed group had the highest levels of psychopathy across all dimensions. Of note, the effect size of group differences was largest for CU traits and impulsivity, each explaining 31% of the variance.

Table 5. Mean Level Differences of Psychopathic Traits Between the Subgroups

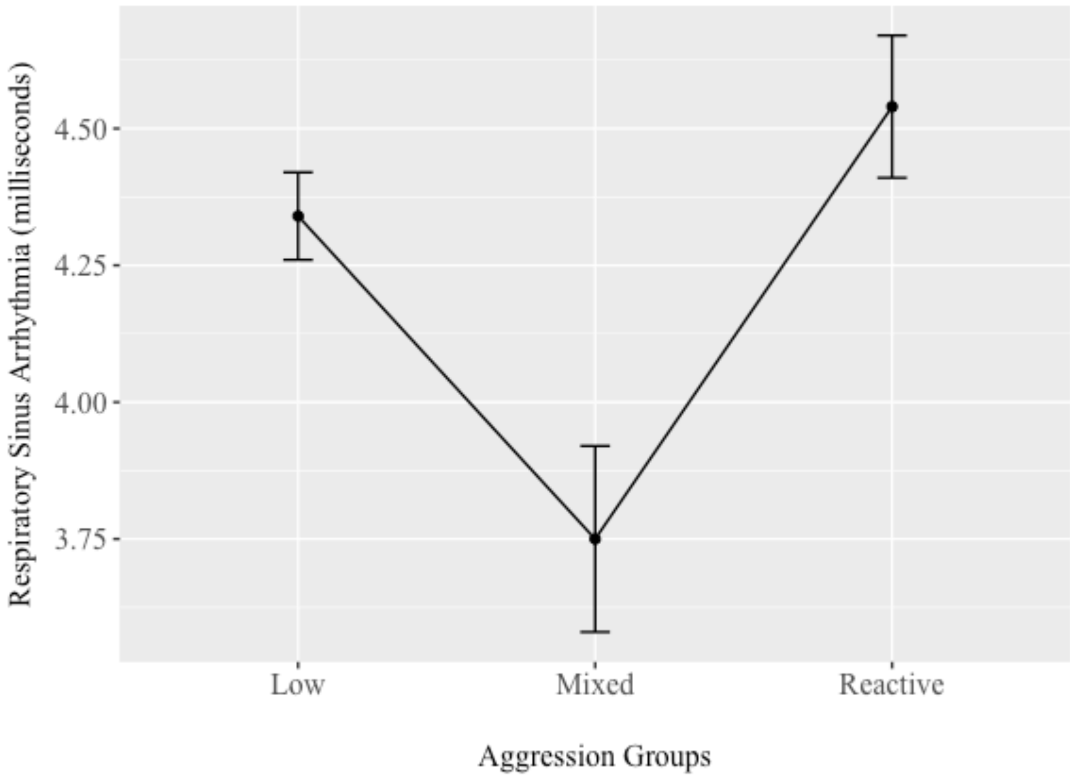
	Low Group *M* (*SD*)	Reactive Group *M* (*SD*)	Mixed Group *M* (*SD*)	*F*
APSD	6.18 (6.34)	9.14 (7.17)	20.60 (6.11)	21.69**
CU	2.29 (2.16)	3.14 (2.42)	7.50 (2.22)	24.02**
Narcissism	1.56 (2.73)	2.11 (2.77)	5.10 (2.42)	7.49*
Impulsivity	1.72 (2.04)	3.36 (3.26)	7.10 (2.03)	23.65**

Note. APSD = Antisocial process screen device total score; CU = Callous-Unemotional traits. *p<.01, **p<.001.

Psychophysiological Profiles

To assess if groups were different on resting levels of RSA, ANOVAs were conducted. Groups were different on RSA ($F(2, 107) = 4.84$, $p = .010$, $\eta_p^2 = .08$). Post hoc tests showed the mixed group ($M = 3.75$, $SD = .87$) were significantly lower on RSA than the low ($M = 4.35$, $SD = .66$, $p = .017$) and reactive groups ($M = 4.54$, $SD = .69$, $p = .005$). Figure 2 illustrates the aggression group differences for RSA with error bars representing 95% confidence intervals.

Figure 2. Mean RSA by Aggression Groups



Note. Higher RSA indicates greater parasympathetic activity; Error bars indicate 95% confidence intervals.

Executive Functioning Profiles of Aggression Groups

Table 6 displays the means, standard deviations, and difference significance values of executive functioning tests by group. Significant group differences on the Tower Test were observed using ANOVA ($F(2, 107) = 5.12$, $p = .008$, $\eta_p^2 = .09$). Post hoc comparisons indicated the reactive (*M* = 14.93, *SD* = 2.47) scored significantly lower than the mixed (*M* = 17.30 *SD* = 3.53, *p* = .047) and the low group (*M* = 16.72, *SD* = 2.47, *p* = .009). Overall, children in the reactive aggressive group performed significantly worse on the Tower Test, which requires an ability to plan effectively, maintain rules and develop new strategies, and employ a perseverative responding style. Interestingly, the mixed and low groups did not significantly differ in this executive function ability.

Table 6. Mean Level Differences of Executive Functioning Between the Subgroups.

	Low Group *M* (*SD*)	Reactive Group *M* (*SD*)	Mixed Group *M* (*SD*)	*F*
Tower Test[a]				
Total achievement score	16.72 (2.47)	14.93 (3.01)	17.30 (3.53)	5.12**
Card Sorting Test[a]				
Correct card sorts	7.97 (2.10)	6.86 (2.09)	7.50 (2.46)	2.79
Correct sort descriptions	26.50 (7.87)	21.75 (9.55)	21.60 (6.87)	4.19*
Color-Word Inference Test[a]				
Inhibition	35.93 (14.97)	41.32 (14.98)	47.50 (15.16)	3.35*
Inhibition/Switching	24.43 (14.95)	28.18 (25.78)	36.00 (22.17)	1.80
Trail-Making Test[b]				
Visual scanning	31.21 (11.68)	30.68 (9.55)	26.20 (6.53)	0.94
Number sequencing	54.65 (19.05)	60.39 (28.59)	54.40 (17.03)	0.74
Letter sequencing	59.71 (24.24)	63.00 (17.48)	66.50 (20.05)	0.53
Motor speed	40.25 (13.68)	42.75 (16.29)	29.50 (9.89)	3.30*
Switching	134. 08 (47.12)	160.93 (47.68)	159.70 (62.69)	3.68*

Note. [a]Analysis of variance (ANOVA); [b]Multivariate analysis of variance (MANOVA).
*p<.05, **p<.01.

Differences on the Card Sorting Test, using two principle measures (number of correct sorts and number of correct sort descriptions) were assessed using ANOVA. Groups were not significantly different on the number of correct sorts ($F(2, 107) = 2.79$, $p = .066$, $\eta_p^2 = .05$). However, significant group differences were observed on the number of correct card sort descriptions ($F(2, 107) = 4.19$, $p = .018$, $\eta_p^2 = .07$). Post hoc comparisons indicated the reactive group ($M = 21.75$, $SD = 9.55$) was lower than the low aggression group ($M = 21.60$, $SD = 8.87$, $p = .027$). No other significant differences emerged. When compared to the low aggressive group, the reactive group did not perform as well at describing how the cards were sorted.

Significant group differences emerged for the Color-Word Inference Test (CWIT) inhibition condition ($F(2, 107) = 3.35$, $p = .039$, $\eta_p^2 = .06$). Post hoc tests suggested the mixed group ($M = 47.50$, $SD = 15.16$) performed significantly worse than the low aggression group ($M = 35.93$, $SD = 14.97$, $p = .040$). No significant group differences emerged for the CWIT inhibition/switching condition ($F(2, 107) = 1.80$, $p = .170$, $\eta_p^2 = .03$). Overall, the children in the mixed group performed worse on the inhibition task when compared to the low aggression group.

To test for group differences on the five Trail-Making Tests ([TMT] visual scanning, number sequencing, letter sequencing, motor speed, and number-letter switching), a multivariate analysis of variance (MANOVA) was conducted. A MANOVA was favored over an analysis of covariance (ANCOVA) as it allows for group differences to be observed on the fundamental skills TMT (e.g., visual scanning, number sequencing). Further, when interpreting group differences on the main TMT measure (number-letter switching) a MANOVA was used to account for performance on the TMT fundamental skills. As recommended by Tabachnick and Fidell (2007), Pillai's Trace was interpreted as it is robust for unequal sample sizes (p. 252). There was a significant difference between aggression groups on the combined dependent variables ($F(10, 208) = 1.97$, $p = .039$, $\eta_p^2 = .09$). However, there were no group differences on three of the fundamental skills tests: visual scanning ($F(2, 107) = .94$, $p = .394$, $\eta_p^2 = .02$), number sequencing ($F(2, 107) = .74$, $p = .480$, $\eta_p^2 = .01$), and letter sequencing ($F(2, 107) = .53$, $p = .590$, $\eta_p^2 = .01$). There were significant group differences for motor speed ($F(2, 107) = 3.30$, $p = .041$, $\eta_p^2 = .06$). Post hoc analysis revealed the mixed group performed significantly better (M =29.50, SD = 9.89), with a faster mean completion time, than the reactive group (M = 42.75, SD = 16.29, p = .029) and the low group (M = 40.25, SD = 13.68, p =.043). Controlling for the TMT fundamental skills, group differences were observed for the number-letter switching TMT ($F(2, 107) = 3.68$, $p = .028$, $\eta_p^2 = .06$). Post hoc comparisons indicated the reactive group (M =160.93, SD =47.68) scored significantly higher than the low group (M = 134.08, SD = 47.12, p =.037). Overall, the mixed group were faster on the motor speed test than the reactive and low group, while the reactive group performed poorer on the number-letter sequencing test than the low aggression group.

Discussion

The present study found children who were reactively aggressive displayed more executive functioning deficits and high levels of impulsive psychopathic traits, whereas the mixed aggression group were distinguished by atypical RSA activity, poor inhibitory control, and high levels of callous, narcissistic, and impulsive psychopathic traits. This may indicate that children who only aggress in response to provocation have attention modulation difficulties, as evidenced by global executive function difficulties. However, children who show mixed forms of aggression - to achieve a goal as well as in response to provocation, may have neurobiological differences (as indexed by low resting RSA), as well as problems with selective attention. Taken together, the latter may indicate abnormalities in PFC functioning. For instance, selective attention has been associated with activation in the dorsolateral prefrontal cortex, which is a region of the brain compromised in adult psychopaths during selective attention tasks (Hoppenbrouwers et al., 2013; Rodman et al., 2016). Further, low resting RSA is characteristic of children high in callous-unemotional traits (de Wied, van Boxtel, Matthys, & Meeus, 2012; Wagner et al., 2015) who have been shown to have neurological differences in the orbitofrontal cortex (Sebastian et al., 2015) a region of the brain associated with autonomic and response inhibition functions (De Brito et al., 2013; Rule et al., 2002). Prior research suggests psychopathic traits, neurobiology, and executive functioning may play an important role in defining subtypes of aggressive behavior (Ellis et al., 2009; Raine et al., 2006; Xu et al., 2014), and the present findings suggest this is also shown in aggressive subgroups of typically developing preadolescent children.

The results regarding reactive aggression demonstrated this group was lowest in the ability to plan, to persist in goal-directed behavior, and to manage to switch between cognitive operations. Although the reactive aggression group did not differ on concept formation ability, they did perform most poorly on describing the concepts accurately. Taken together, and based on prior neuroimaging research, this may suggest reactively aggressive children have attention modulation difficulties linked to PFC functioning (Coccaro et al., 2007). These children may experience poor attention, which makes it difficult for them to appropriately manage social interactions (Holmes et al., 2016), and have difficulties interpreting social situations (Raine et al., 1994). These cognitive deficits may explain why reactive aggression has previously been associated with greater hostile attributional biases (Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001) and peer-problems (Evans, Fite, Hendrickson, Rubens, & Mages, 2015). Of note, the reactive group did not perform significantly worse on selective attention (inhibitory response), but were higher than the low aggression group on impulsive psychopathic traits. This may suggest children who only reactively aggress may be more accurately defined by greater behavioral or psychopathy-based impulsivity (i.e., acting without thinking, risk-taking; White et al., 1994), rather than the cognitive ability of poor selective attention (inhibitory control). Therefore, reactive aggression may not be a direct function of poor cognitive inhibitory control. Instead, these children have been found to misperceive benign social cues for hostile intent (see Dodge et al., 2015), which may be exacerbated by deficits in global executive functions, especially managing and switching between cognitive operations (e.g., perspective taking) and thinking about long term effects of behaviors. These children are therefore more prone to become enraged (Berkowitz, 1993) but not out of poor inhibitory control, and instead based on the false perception of threat or provocation (Crick & Dodge, 1994, 1996; Helseth, Waschbusch, King, & Willoughby, 2015).

RSA arousal (i.e., baseline levels) – an efferent marker of PFC function, is suggested to have an integral role in social adjustment (Beauchaine et al., 2015). Correlations showed that low RSA was associated with proactive aggression but not reactive aggression. Yet, using a person-centered model, low RSA characterized children who displayed high levels of both proactive and reactive aggression, and these children also exhibited the highest levels of psychopathic traits. Importantly, children and adolescents with behavioral problems and high levels of psychopathic traits have been shown to have lower resting RSA (see de Wied, van Boxtel, Matthys, & Meeus, 2012; Wagner et al., 2015). Therefore, the mixed aggression group, characterized by the highest levels of psychopathic traits, may display atypicality in their neurobiology, which supports prior assertions that children with psychopathic traits are neurobiologically distinct from children who display high levels of aggression but low levels of psychopathic traits (Blair et al., 2014).

Compared to reactive aggression, proactive aggression is hypothesized to require more prolonged and complex cognitive processes (Reidy et al., 2011). Although the mixed group displayed similarly high levels of reactive aggression compared to the reactive group, they did not exhibit cognitive impairments to the same extent as the reactive group, and they did not show difficulties compared to the low aggression group in the ability to plan, persevaratively respond to achieve a goal, cognitively switch between operations, and develop abstract formations. This may indicate that although proactive aggression requires intact cognitive skills, proactive aggression is not solely dependent on executive functioning skills. Instead, here it is proposed that children who perpetrate goal-directed and predatory aggression are most accurately described by their manipulative, callous use of others, and risk-taking behavior in addition to being cognitively able to perform complex and planned goal-directed aggression.

An important finding was the mixed aggression group outperformed both the low aggression and reactive aggression groups on motor speed. Motor speed performance is associated with the multiple-demand network, which extends over specific regions within the prefrontal and parietal cortex (Duncan, 2010). Camilleri and colleagues (2015) have suggested motor speed can be considered a measure of executive motor control (and not primary motor function). Therefore, based on this assertion the mixed group displayed optimum performance in executive motor control. Unfortunately, prior research on good motor speed performance and aggression is sparse. Nevertheless, prior research has shown children high in psychopathic traits engage in risky behaviors (Salekin, 2016), and indeed the mixed aggression group were highest in psychopathic traits. In theory then, it may be that children in the mixed group find themselves in more physically challenging and risky situations (e.g., physical fights, risky-play), which has been shown to advance a child's executive motor control development (Lavrysen et al., 2015; Sandseter & Kennair, 2011). This may explain the mixed group's superior ability in executive motor control, however more research is needed to test this assumption.

The present findings must be interpreted with several limitations in mind. While the sample size was comparable to prior research using similar indices (see Muñoz et al., 2008), there may be a lack of generalizability to children with more serious levels of aggressive behavior. Thus, future research using the similar multidisciplinary indices in clinical samples may be warranted to explore the replicability of the findings in children with serious behavioral problems. Furthermore, in this preadolescent sample pubertal timing was not accounted for, which has been shown to be associated with RSA (El-Sheikh, 2005) and externalizing behaviors (Dimler & Natsuaki, 2015). Even with these limitations in mind, meaningful results have been found. This is the first multidisciplinary study to begin to elaborate on the co-occurrence of proactive and reactive aggression in preadolescents, and to demonstrate how these children differ across cognitive, neurobiological, and psychopathic indices from children who display only reactive forms of aggression. Also, using a multi-informant approach, the three aggression groups found in prior adolescent samples (Marsee et al., 2014) were confirmed with preadolescent children.

Aggressive behavior in young children is typical (Séguin & Zelazo, 2005; Tremblay et al., 1996) but as children develop they start to better regulate emotions and selectively inhibit aggressive behaviors (Blair et al., 2016). However, there are small numbers of children who continue to display high levels of aggression (Moffitt, 1993). Early identification of aggressive groups of children and understanding the cognitive, neurobiological, and psychological profiles is an important endeavor for advancing and individualizing treatment and prevention programs. The present findings suggest that aggressive children are indeed a heterogeneous group, both as a function of aggression type and as distinct cognitive, neurobiological, and psychological profiles. Children who use aggression only in response to perceived provocation or threat may have trouble managing complex cognitive processes, which may suggest information-processing deficits (Crick & Dodge, 1996) leading to false encoding of social cues (Raine et al., 1994). In contrast, children exhibiting high levels of reactive and proactive aggression have little deficits in these executive functions and actually outperform on executive motor control. However, mixed aggressive children do display difficulty in cognitive inhibitory control and exhibit low RSA levels, which may indicate atypical neurobiological function associated with the

PFC. At the psychological level, mixed aggressive children are perceived by their teachers as more callous, narcissistic, and impulsive than other aggressive and nonaggressive children. Taken together, the mixed group may use aggression in a variety of ways because they callously lack concern for others, and have the cognitive and psychological ability to manipulate and predatorily implement goal-directed behaviors.

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CHAPTER THREE

Callous-Unemotional Traits and Fearlessness: A Cardiovascular Psychophysiological Perspective in Two Adolescent Samples

Abstract

Youth with callous-unemotional traits are characterized as fearless. However, biological and behavioral evidence in adolescents is lacking in support of this assertion. Using cardiac measures of sympathetic (pre-ejection period) and parasympathetic (respiratory sinus arrhythmia) reactivity to 3D and virtual reality fear induction, two adolescent samples were assessed to see if youth high in CU traits were biologically and behaviorally distinct from youth low on CU traits. Study 1 included 60 adolescents from Emotional and Behavioral Difficulties (EBD) schools, and Study 2 included 62 adolescents from a stratified community school sample ($N = 696$). Adolescents high in CU traits from both studies showed higher levels of conduct problem behavior and low prosocial behavior. No significant differences emerged for most measures of self-report of emotional reactivity to fear and reflective situational fear. However, in study 1 and 2 adolescents high in CU traits showed the same autonomic pattern of coactivation of the sympathetic and parasympathetic nervous system. Post hoc testing showed the high CU group did not display hypoarousal to fear. Thus, adolescents with CU traits seem to respond to fear at the biological level by increasing both branches of the autonomic nervous system. Coactivation of the autonomic nervous system occurs in a minority of people, and has been said to characterize those individuals who are unemotional to threatening situations (Alkon et al., 2003; Del Giudice, Ellis, & Shirtcliff, 2011). Coactivation to threat or thrilling situations enables the individual to respond in a way that enables them to maintain “tight self-control” (Del Giudice et al., 2011 p.19), which may give the appearance of fearlessness. Thus, adolescents with CU traits respond to fearful events but in a way that may be considered as optimal for managing threat.

Keywords; Callous-Unemotional traits, fearlessness, pre-ejection period, respiratory sinus arrhythmia

Introduction

Callous-Unemotional traits, a DSM-5 specifier for conduct disorder, has been used to characterize youth who are emotionally cold and display a deficit of concern for the welfare of others (American Psychiatric Association, 2013); often acting cruelly and callously towards people with the intention to cause physical or emotional harm in order to achieve a goal (Pardini & Byrd, 2012). Youth with CU traits lack emotionality (Essau, Sasagawa, & Frick, 2006) and are considered hypoactive in their emotional responses (Frick & Viding, 2009; Sebastian et al., 2015), which adds to the portrayal of these youth as being fearless perpetrators, showing little concern for the harmful consequences of their actions (Fanti, Panayiotou, Lazarou, Michael, & Georgiou, 2016). Without concern for repercussion, youth with CU traits unsurprisingly continue to show high levels of problematic behaviors into adolescence, such as delinquency, police contact, and aggression (Frick et al., 2003; Frick, Stickle, Dandreaux, Farrell, & Kimonis, 2005).

Fanti and colleagues (2016), and Frick and Morris (2004) have proposed children with CU traits are characterized by fearlessness. Longitudinal studies support this assertion, with findings showing that fearless temperament at age 2 years predicted higher levels of CU traits in adolescence (Barker, Oliver, Viding, Salekin, & Maughan, 2011). Further, fearlessness has been linked with insensitivity to punishment (Nichols et al., 2015) and conduct problems (Barker et al., 2011; Fanti et al., 2016), including aggression (Raine, Reynolds, Venables, Mednick, & Farrington, 1998). Fear plays an integral role in a child's social development. If a child learns that certain behaviors, such as fighting, have negative consequences (e.g., parental/teacher punishment, physical injury) the next time the child contemplates fighting he may experience fear of the negative consequences, which could in-turn curb the inappropriate behavior (Matthys, Vanderschuren, & Schutter, 2013). The fear of consequence may be manifested through physiological and/or emotional states (e.g., hyperarousal or feelings of guilt). However, if children do not fear the ramifications of their actions, the social learning process is inhibited and children may not learn that negative behavior results in negative consequences (Matthys et al., 2013). Thus, without fear, youth with CU traits may be at risk for perpetrating chronic aggression and conduct problems into adulthood. However, to date the association between CU traits and physiological and emotional fearlessness still remains untested in community and clinical adolescent samples.

Twin studies have shown that at age 7 years, high levels of CU traits are under strong genetic influence (Viding, Blair, Moffitt, & Plomin, 2005). Also, high levels of antisocial behavior have been found to be under greater genetic influence in children high in CU traits than children low in CU traits (Viding, Jones, Frick, Moffitt, & Plomin, 2008). Thus, youth high in CU traits are more likely to have inherited antisocial behavior, rather than explicitly from environmental sources as found in youth with conduct problems and low CU traits (Viding et al., 2005, 2008). Recent examination of the heterogeneity indicates children with CU traits may be fearless, at the biological level. For instance, the amygdala, a key region for fear, has been shown to be less reactive to fearful faces in youth high in CU traits (Jones, Laurens, Herba, Barker, & Viding, 2009; Marsh et al., 2008). In addition, youth with CU traits have been found to be less physiologically responsive to peer provocation (Muñoz, Frick, Kimonis, & Aucoin, 2008), and to sad (de Wied, van Boxtel, Matthys, & Meeus, 2012) and violent video clips (Fanti, Panayiotou, Lombardo, & Kyranides, 2015). It is this low autonomic reactivity that has been suggested to be a cardinal feature of highly delinquent youth (Raine, 1993), and a distinguishing feature of CU traits (Fanti et al., 2016). However, rather than fearless, this may suggest that youth with CU traits may be hypoaroused to aversive stimuli.

Unfortunately, the hypoarousal fear theory has not been tested properly because of several limitations. Low resting heart rate has been widely used for identifying children who display severe forms of aggression and psychopathic traits (Kavish et al., 2016; Lorber, 2004; Portnoy & Farrington, 2015), and is important to the fearless theory of antisocial behavior (see Raine, 1993). However, prior findings have been inconsistent, with some research not finding the association (Calkins & Dedmon, 2000; de Wied et al., 2012; Pine et al., 1998; Scarpa, Haden, & Tanaka, 2010). Further, fear induction studies have also been inconsistent, finding low heart rate and high heart rate are both associated with response to fear (Aue, Flykt, & Scherer, 2007; Baldaro et al., 1996; Codispoti & De Cesarei, 2007; Dimberg, 1986). An explanation may be that at any given moment heart rate is affected by three neural influences: the intrinsic pacemaker cells in the sinoatrial node, parasympathetic nervous system (PNS) fibers, and parasympathetic nervous system (SNS) fibers (Levenson, 2014). Thus, resting heart rate could indicate parasympathetic or sympathetic arousal at any given time. Therefore, heart rate may not be an accurate indicator of fearlessness.

The SNS and PNS typically have opposing function but are always active. Reciprocal sympathetic activation (high SNS and low PNS) is suited and is the most common physiological response to dealing with stressful or challenging situations (El-Sheikh et al., 2009), whereas reciprocal parasympathetic activation (high PNS and low SNS) is appropriate for circumstances where a calm physiological state is important (Berntson, Cacioppo, & Quigley, 1991). Reciprocal autonomic activity is not the only mode in which the ANS functions. Instead, more complex interactions exist between both branches of the ANS (Levy, 1971). Nonreciprocal modes of ANS functioning include coactivation (increased PNS and SNS reactivity) and coinhibition (reduced PNS and SNS reactivity; Berntson et al., 1991). Nonreciprocal ANS functioning may indicate that the situation is unclear to the adolescent (Berntson et al., 1991). Coinhibition (Beauchaine, Gatzke-Kopp, & Mead, 2007) and coactivation have been associated with greater levels of externalizing in young children (El-Sheikh et al., 2009). Nonreciprocal ANS functioning can have unique effects on heart rate.

For instance, when anticipating aversive stimuli, sympathetic activity (e.g., symptoms may include pupil dilation, and increase in sweat secretion, blood pressure, and heart rate), and parasympathetic activity may increase. The increase in parasympathetic activity withholds cardiac acceleration (from sympathetic activity), allowing the individual to remain attentive and in control while waiting for the aversive stimuli (Carrive, 2006). Therefore, lower heart rate may not be indicative of low arousal as a marker of fearlessness.

Del Giudice, Ellis, and Shirtcliff (2011) have suggested "unemotional” individuals may show low autonomic profiles when at rest or when the stimuli is nonthreatening, which is consistent with findings from research using measures of SNS reactivity to social provocation, fearful faces, or emotionally evocative films (de Wied et al., 2012; Fanti, Panayiotou, Lombardo, et al., 2015; Muñoz et al., 2008). However, when the stimulus is an immediate threat or a non agnostic stressor the “unemotional” individual may display an increase in sympathetic and parasympathetic activity (Del Giudice et al., 2011; Del Giudice, Hinnant, Ellis, & El-Sheikh, 2012). Coactivation has been proposed to be an optimal response to facilitate behavioral and cognitive functioning in high-intensity situations (e.g., parachuting; Allison et al., 2012). When faced with high intensity situations the individual may be alert and attentive (facilitated by the higher SNS) whilst still able to remain calm and in control of the situation (facilitated by the increase in PNS; Allison et al., 2012; Del Giudice et al., 2011, 2012). However, if the situation escalates and requires a more active response, the parasympathetic “brake” on the heart is withdrawn, allowing for an immediate and full expression of sympathetic activity – resulting in an explosive reaction (Carrive, 2006). Therefore, it may be that youth high in CU traits display the same “unemotional” autonomic profile to fear, which could explain their ability to remain in control when manipulating others, appear calm and attentive in stressful situations, but quickly capable to respond to provocation. A coactivated autonomic state during fearful or high-risk conditions may give others the impression that adolescents high in CU traits are fearless.

Another challenge in prior research is the inconsistency in measures. Studies that include parasympathetic and sympathetic measures often use indices to different organs (de Wied et al., 2012; Muñoz et al., 2008; Scarpa et al., 2010). For instance, respiratory sinus arrhythmia (RSA) is an index of PNS to the heart, while skin conductance response (SCR) is an index of SNS to the skin. RSA and SCR are commonly used together within the same study (see Wagner et al., 2015; Wang, Baker, Gao, Raine, & Lozano, 2012). However, sympathetic measures from the skin and heart may reflect different aspects of sympathetic activity (de Geus, Gerssen-Goedhart, & Willemsen, 2014). Therefore, the use of psychophysiological indices of sympathetic (e.g., pre-ejection period [PEP]) and parasympathetic nervous system (RSA) activity to the same organ, such as the heart, greatly enhances the understanding of autonomic responses (Schaaf, Benevides, Leiby, & Sendecki, 2015). Without such, interpretation and replication may be inconsistent (Del Giudice et al., 2012).

There is not a consensus on the definition of fear, and the term is often confused with anxiety. The clearest definition is that fear is an intense physiological response to danger where the person is spurred to manage the threat either by facing the situation or fleeing (or freezing; Grillon, 2008). Fear can be dichotomized as conscious and automatic (Hoppenbrouwers, Bulten, & Brazil, 2016), which have been referred to as the “high road” and the “low road” of fear neural circuitry (LeDoux, 1996). Conscious fear, the high road, is more cognitive and relies on the conscious evaluation of circumstances. Whereas automatic fear, the low road, involves immediate fear processing to necessitate dealing with imminent danger by readying the body physiologically via neurobiological mechanisms (such as increased sympathetic nervous system activity - increasing heart rate and sweat secretion).

It is important to note, LeDoux (2013) argues that automatic response to danger does not require the individual to consciously experience fear. Nevertheless, the experience may have long term effects on conscious fear. Hoppenbrouwers and colleagues (2016) suggest that conscious fear can be further understood by two features, the evaluation of a situation and the emotional identification during the fearful situation. Both require a degree of self-evaluation of emotional experience. In psychopathic adults, deficient responsivity to fear induction have been found at the neurobiological level using startle potentiation (Patrick, Bradley, & Lang, 1993; Rothemund et al., 2012). At the conscious level psychopaths do not differ in their experience of fear (Patrick, Cuthbert, & Lang, 1994; Schmitt & Newman, 1999) and fear as an emotional experience (Herpertz et al., 2001; Hoppenbrouwers et al., 2016). Recent evidence from a study involving children with conduct problems suggest CU traits are associated with less startle responsivity and behavioral fear (Fanti et al., 2016). However, low startle potentiation may not be indicative of fearlessness, and may be due to greater attention to the stimuli (Anthony & Graham, 1985; Bradley, Cuthbert, & Lang, 1990; Patrick et al., 1993). Mapping both branches of the autonomic nervous system, using cardiac indices, may unlock complex interacting biological mechanisms behind CU traits, which could begin to explain why these individuals are characterized as fearless and show low startle potentiation. Based on the limited and mixed findings between child and adult research, it may be expected that adolescents with high CU traits display low physiological responsivity to fear (as found in both adult and child samples), but display no deficits in conscious fear as this may reflect a social-emotional maturation of understanding fear experiences.

The aim of the present paper was to determine if adolescents high in CU traits were in fact fearless, at the automatic (autonomic reactivity) and conscious level (emotional reactivity; self-report). To assess CU traits in youth with high levels of antisocial behavior, Study 1 included adolescents with behavioral problems from Emotional and Behavioral Difficulties (EBD) schools. Consistent with prior research, a median split was used to create a high and low CU group to aid interpretation (see Lawing, Frick, & Cruise, 2010; Sebastian et al., 2015). To validate these groups, teacher-report of aggression subtypes and prosocial behavior were used. As goal-directed aggression (proactive) has been found to distinguish youth high in psychopathic traits it was expected the high CU group would score highest on proactive aggression (Raine et al., 2006). It was expected, based on the EBD school enrollment requirements, that the two groups would not differ on police contacts and would score similarly on reactive aggression. Because this is the first study to date to test PNS and SNS reactivity to fear in adolescents with high and low levels of CU traits, two possible expectations were drawn from prior research and current theory. Based on prior research and Raine's (1993) fearlessness theory, it may be expected low levels of autonomic reactivity would characterize the high CU group. However, based on Del Giudice and colleagues (2011) model, it may be expected that coactivation to fear would characterize the high CU group. Based on the meta-analysis of adult psychopaths (see Hoppenbrouwers et al., 2016), it would be expected both CU groups to report similar levels of conscious fear of emotional reactivity to fear (self-report reactivity of valence, dominance, and arousal to fear induction).

To test if adolescents with less serious conduct problems with and without high levels of CU traits differed in response to fear, Study 2 included typically developing adolescents from community schools. Consistent with prior research, a stratified sampling technique was used to create a high and low CU group (Dadds, El Masry, Wimalaweera, & Guastella, 2008). These groups were compared on parent-report of conduct problems and prosocial behaviors. It was expected the high CU group would score higher in conduct problems and lower in prosocial behaviors. Study 2 included the same measures as Study 1, except self-report measures of fear (situational and physical harm) were chosen to measure conscious fear evaluation of situations. Similar to Study 1 it was expected that either low arousal or coactivation during fear induction would predict being in the high CU group, and self-report of emotional reactivity and self-report of conscious fear were expected to be similar across groups.

Study 1

Method

Participants

Sixty adolescents were recruited from Emotional and Behavioral Difficulties (EBD) schools. Participants were predominantly male (n = 50), White British (96%), and aged between 11 and 16 (M = 13.95, SD = 1.31). Based on school records, 23% had lived in care, 34% had a history of abuse, 52% had a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD), 5% with Autism Spectrum Disorder (ASD), 5% with depression and a history of self-harm, and 2% with Reactive Attachment Disorder. Participants' legal caregivers gave consent for the participant, and the participant assented to be involved in the study.

Procedure

Four EBD schools in the North East of England were included in recruitment process. Each school varied on recruitment success rate (71%, 87%, 60%, 42%), this was due to availability of the pupils and number of pupils on role at each school (from 8 pupils to 78). Information sheets and consent forms were sent home to caregivers, and only those who had returned a signed consent were allowed to participate in the study. The experiment took place in a quiet room within the school. Self-report questionnaires were completed by the participant prior to the experiment to accommodate a stabilization period for the physiological measures. First, participants completed a 3-minute rest period where they were asked to sit still and try to relax. After the rest period participants reported how they felt using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The virtual reality headset was then placed on the participant's head, at which point the child was asked to describe the VR surroundings. This allowed the participant to become familiar with the surroundings (e.g., sitting on a roller coaster) and confirm the participant was able to see the display. The roller coaster lasted for 90 seconds. At which point the participant was asked to report how they felt using the SAM. Next, participants were introduced to a control resting condition, which was a sunny garden set in Tuscany, Italy. Participants were asked to sit still and relax for 3 minutes. Participants wore headphones during the roller coaster and control condition. After the control condition participants reported how they were feeling using the SAM. All participants received a chocolate bar for completing the study.

Measures

Callous-unemotional Traits. The Inventory of Callous and Unemotional Traits (ICU; Frick, 2004) is a 24-item self-report scale designed to measure callous and unemotional traits in youth. Items are scored on a 4-point Likert scale from *Not at all true* (0) to *Definitely true* (3). The ICU is a valid measure of CU traits and has been widely used in community and incarcerated samples of youth (see Pihet, Etter, Schmid, & Kimonis, 2015). In the present study, the ICU yielded good internal consistency ($\alpha = .82$).

Teacher-Report of Reactive and Proactive Aggression. Teachers completed the Proactive/Reactive Aggression Scale (PRA; Dodge & Coie, 1987), which captures proactive and reactive aggressive behavior, and yields a total score of aggression. The full scale consists of 6-items, with responses ranging from 1 (Never true) to 5 (Almost always true). The proactive scale (e.g., “This child uses physical force [or threatens to use force] in order to dominate other kids”) and reactive scale (e.g., “When this child has been teased or threatened, he or she gets angry and easily strikes back”), each scale includes 3-items. The total score ($\alpha = 0.90$), reactive ($\alpha = 0.88$), and proactive ($\alpha = 0.87$) subscales had good internal consistency. The PRA was included for descriptive purposes.

Prosocial Behavior. The Prosocial Scale on the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was completed by the participants’ teacher. The scale includes five items (e.g., “is considerate of other people's feelings”), which are scored from *Not true* (0) to *Certainly True* (2). The prosocial scale was included for group descriptive purposes.

Fear-Inducing Environment. To safely measure emotional and physiological reactivity to fear participants experienced a 90 second virtual reality roller coaster. A roller coaster was selected as it is age and ethically appropriate to administer to children and adolescents for inducing a fearful response. Furthermore, in support of a roller coaster being a marker for fear (or fearlessness), the most widely used self-report measures often include roller coaster items (see the Fear Survey Schedule [Geer, 1965] and the Situated Fear Questionnaire [Campbell et al., 2016]). The virtual reality headset, the Oculus Rift, has an 18 cm 3D screen (allowing for 100 degrees of direct view) with low latency 360 degree head tracking capabilities. The headset is comfortable and lightweight, which makes the headset suitable for ages 7 years and up. While wearing the headset participants wore noise cancelling headphones. The roller coaster video (RiftCoaster; Oculus VR, 2013) lasted for 90 seconds, with steep drops, tunnels, turns, and jumps. The video was designed specifically for the use with the Oculus Rift. As a control condition (virtual reality equivalent of a baseline) participants were "sat" in a virtual reality garden based in Tuscany, Italy (Tuscany Demo; Oculus VR, 2013). Participants experienced the control condition for 3 minutes.

ANS Fear Reactivity. After a stabilization period, participants' physiology (respiratory sinus arrhythmia [RSA] and pre-ejection period [PEP]) was recorded during a three minute rest (baseline condition), and a three minute control condition. To examine emotional arousal and fearlessness, the same physiological indices were measured during the roller coaster. Both PEP and RSA values were averaged across 30 second epochs within each condition (i.e., baseline, control, roller coaster). PEP and RSA reactivity was computed so higher values indicated greater reactivity. PEP reactivity was calculated by *subtracting control condition averages from roller coaster averages*. RSA reactivity was calculated by *subtracting roller coaster averages from control condition averages.* Again, higher values were indicative of shortened PEP (representing greater SNS reactivity), and an increase in RSA reactivity (representing greater PNS reactivity). Conversely, lower values indicated less ANS reactivity.

Physiological Data Acquisition. Two Ag-AgCl electrocardiogram electrodes in a modified Lead II configuration, and eight Ag-AgCl impedance cardiogram paired electrodes on the neck and torso (with at least a 3 cm distance between the paired electrodes as recommended; Sherwood et al., 1990) were placed on the participant. Respiration was recorded using RSPEC-R amplifier with a wireless respiration belt transducer. To ensure the belt was placed at maximum point of sensitivity, the participant was asked to exhale, at full exhalation the respiration belt was fastened around the abdomen of the participant. Data were recorded using Biopac MP150 with BioNomadix module transmitter (MP150-BIOPAC Systems Inc., Goleta, CA), and sampled at 1000 Hz. Data were reduced and analyzed offline, using the Biopac's Acknowledge 4.3 software. Data were visually inspected for motion artifacts and outliers. Electrocardiogram and impedance cardiography were reduced offline and the waves were coded using computer-aided event detection, but modified by visual inspection so that midbeats were created if missing (<.001%) and errors in R-wave detection were adjusted. To compensate for fluctuations due to movement, the electrocardiogram was reduced at 250Hz and respiration was passed through a .5 Hz digital band filter. Pre-ejection period was calculated from the time between the onset of the Q wave of the ECG to the B point of the dZ/dt waveform (i.e., beginning of ejection). RSA was computed using AcqKnowledge automated function for RSA analysis, which applies the validated peak-valley method (Grossman, van Beek, & Wientjes, 1990). RSA values reflect the millisecond difference between the minimum and maximum R-R intervals during each respiration cycle.

Arousal and emotional reactivity. To assess self-report of arousal and valence to the roller coaster participants were asked to report on a nine-point scale how they felt after each condition using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). The SAM is a nonverbal pictographic scale designed to assess feelings across emotional dimensions. The valence scale ranges from a manikin who is smiley and happy (1) to frowning and unhappy (9). The arousal scale ranges from a manikin who looks excited and wide-eyed (1) to relaxed and sleepy (9). The dominance scale ranges from feeling small and out of control (1) to in control (9). Because emotional reactivity was of interest, scores were computed by *subtracting control condition averages from roller coaster averages*. On the arousal scale, positive numbers represented feeling more relaxed and negative values indicated feeling more excited. On the valence scale, a negative value was indicative of *feeling more happy* and *positive numbers represented feeling less happy and more sad*. A negative value on the dominance scale is indicative of feeling *less in control* and *positive value indicated feeling more in control*.

Results

In line with prior research, a median split on total ICU score was used to create high and low CU groups (see Lawing et al., 2010; Sebastian et al., 2015). The EBD sample (M = 27.6, SD = 9.33) cut off score of 28 was consistent with prior research in adolescent samples (see Lawing et al., 2010). To validate if the groups were consistent with prior research on adolescents high in CU traits, independent samples t-tests were conducted to assess if the groups were different on teacher-report of aggression and prosocial behavior, and chi-squared tests with Yates' continuity correction was conducted to test if either group had a greater number of police contact within the past year. Differences in age and gender were assessed using t-test and chi-square, respectively. Overall, groups did not differ in age (t (55) = -.89, p = .476, η_p^2 = .01) or gender (x^2(1) = .00, p = 1). When compared to the low CU group (M = 6.03, SD = 2.63), the high CU group (M = 7.77, SD = 3.20) was higher on proactive aggression (t (57) = -2.31, p = .025, η_p^2 = .08), however the high CU group (M = 9.68, SD = 3.38) was not significantly different on reactive aggression (M = 9.48, SD = 2.77; t (57) = -.24, p = .808, η_p^2 = .00). Although a larger proportion of adolescents in the the high CU group (45%) had police contact within the year when compared to the low CU group (28%), this difference was not significant (x^2 (1) = 1.31, p = .253). Compared to the low CU group (M = 6.52, SD = 2.04), the high CU group were lower on prosocial behaviors (M = 3.86, SD = 2.46; t (39) = 3.89, p = .000, η_p^2 = .27). Thus, the high CU group were perceived by their teachers as displaying more calculated aggression in order to achieve a goal, while the low CU group were considered by their teachers to display more prosocial behaviors.

ANS Reactivity to Fear

To establish if the virtual reality roller coaster was valid at inducing autonomic response, paired sampled t-tests were conducted comparing RSA and PEP at (1) baseline (rest; no video) to the roller coaster, and (2) the control video (virtual reality garden video) to the roller coaster. Table 7 displays the means and standard deviations of each condition. The sample responded with a significant decrease in RSA from baseline to roller coaster (t (59) = 4.19, p = .000), and the control condition to roller coaster (t (59) = 2.25, p = .028). Further, the sample showed shortening in PEP to the roller coaster compared to baseline (t (59) = 3.62, p = .001) and the control condition (t (59) = 6.69, p = .000). Comparing the baseline condition to the control condition, participants had greater RSA in the control condition (t (59) = 3.46, p = .001), and longer PEP (t (59) = -6.23 p = .000). Overall, compared to baseline and control condition, the roller coaster induced reactivity on both PEP and RSA. Based on these results the roller coaster produced sympathetic activation (shortened PEP) and a reduction in parasympathetic activity (RSA), suggesting that the roller coaster induced reciprocal sympathetic activation (high SNS and low PNS), which is considered the most common physiological response to dealing with challenging situations (El-Sheikh et al., 2009).

Table 7. Means and Standard Deviations of Conditions; EBD Sample

	Baseline	Roller Coaster	Control
RSA	4.55 (.68)	4.19 (.74)	4.34 (.63)
PEP	.141 (.01)	.137 (.02)	.144 (.01)
Arousal	6.33 (2.22)	3.73 (2.74)	7.46 (2.28)
Valence	2.16 (1.60)	1.75 (1.13)	2.00 (1.71)
Dominance	6.63 (2.21)	6.67 (2.34)	7.54 (1.74)

Note. RSA = Respiratory sinus arrhythmia; PEP = pre-ejection period; Arousal = 1 (excited) to 10 (relaxed); Valence = 1 (happy) to 10 (unhappy); Dominance = 1 (out of control) to 10 (in control).

CU Groups and ANS Reactivity to Fear

To test if the high CU group and low CU group differed on ANS reactivity, hierarchical logistic regressions were performed with R (R Core Team, 2016) using psych package (Revelle, 2015). Because of differences in scaling of PEP and RSA, these scores were normalized by transforming values to *z*-scores, which is consistent with prior research (Berntson, Norman, Hawkley, & Cacioppo, 2008; Bylsma et al., 2015; Crowell et al., 2006). Higher values indicate greater reactivity, and low values indicate less reactivity for RSA and PEP. Model 1 included change scores in ANS activity from the control condition and the roller coaster condition. Step 1 included age and gender as covariates, Step 2 added RSA and PEP, and Step 3 included the interaction term between RSA and PEP. Results are displayed in Table 8.

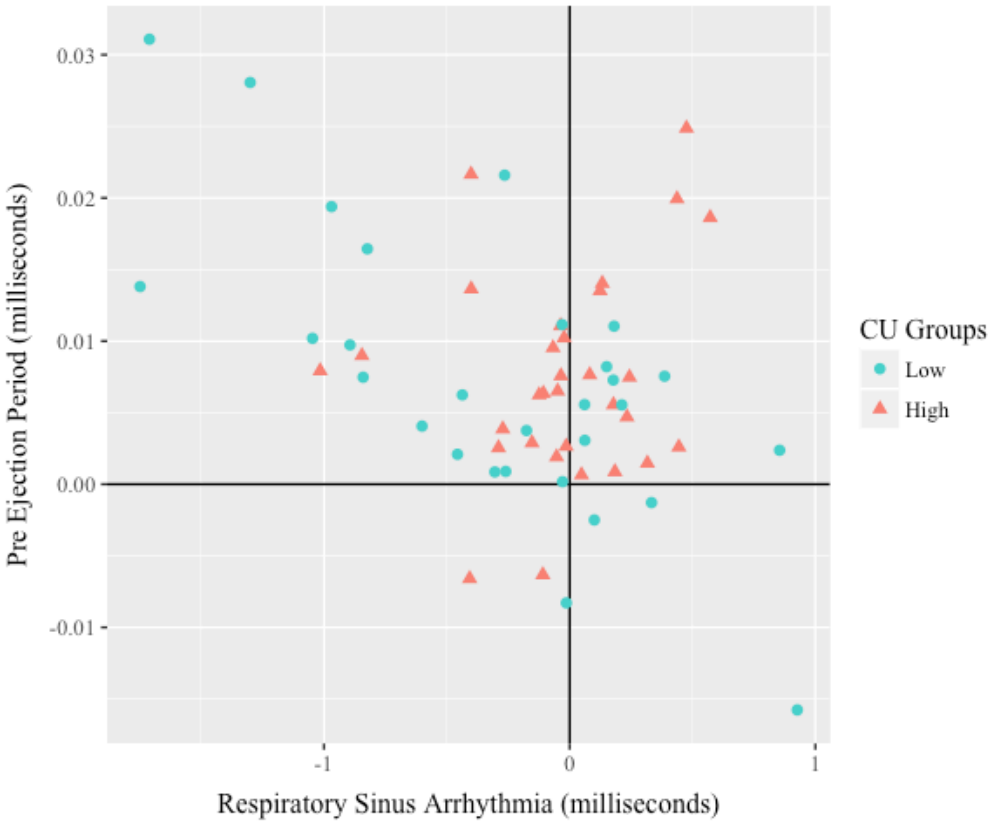
Table 8. ANS Indices Predicting CU Groups (1 = High) in EBD Sample

	Model 1							
	B	*SE*	*z* value	OR	95% CI			2LL
Step 1								41.12
Age	0.19	0.20	0.92	1.20	0.81	-	1.82	
Sex	-0.14	0.70	-0.20	0.87	0.21	-	3.54	
Step 2								39.17
Age	0.04	0.23	0.16	1.04	0.65	-	1.65	
Sex	0.00	0.73	0.01	1.00	0.23	-	4.36	
ΔRSA	0.64	0.35	1.83	1.90	0.99	-	4.01	
ΔPEP	0.31	0.31	1.00	1.37	0.75	-	2.60	
Step 3								34.23*
Age	0.24	0.26	0.93	1.27	0.77	-	2.14	
Sex	0.74	0.85	0.88	2.10	0.42	-	12.74	
ΔRSA	0.23	0.46	0.50	1.26	0.51	-	3.23	
ΔPEP	0.34	0.42	0.81	1.40	0.62	-	3.32	
ΔRSA*ΔPEP	1.42*	0.69	2.07	4.13	1.44	-	20.16	

Note. Model 1 = ANS reactivity (Control - Roller coaster); Sex (0= male, 1 = female); ΔRSA = respiratory sinus arrhythmia reactivity; ΔPEP = pre-ejection period reactivity; CI = 95% confidence interval. **p*<.05

Model 1, Steps 1 (AIC = 88.25; -2LL = 41.12; χ^2 (2) = .86, *p* = .649) and 2 (AIC = 88.34; -2LL = 39.17; χ^2 (4) = 4.77, *p* = .312) were not significantly better than the null model, and Step 2 was not significantly better fitting than Step 1 (*p* = .142). Step 3 was significantly better than both the null model (AIC = 80.47; -2LL = 34.23; χ^2 (5) = 14.65, *p* = .011) and Step 2 (*p* = .001). The interaction term between RSA and PEP was positive and significant (OR = 4.13, CI = 1.44-20.16, *p* =.038). Figure 3 illustrates the high CU group had proportionally more members within the coactivation quadrant. Figure 4 demonstrates high PEP (+1*SD*) and high RSA (+1*SD*) reactivity increased the probability of being in the high CU group.

Figure 3. ANS Reactivity by CU groups

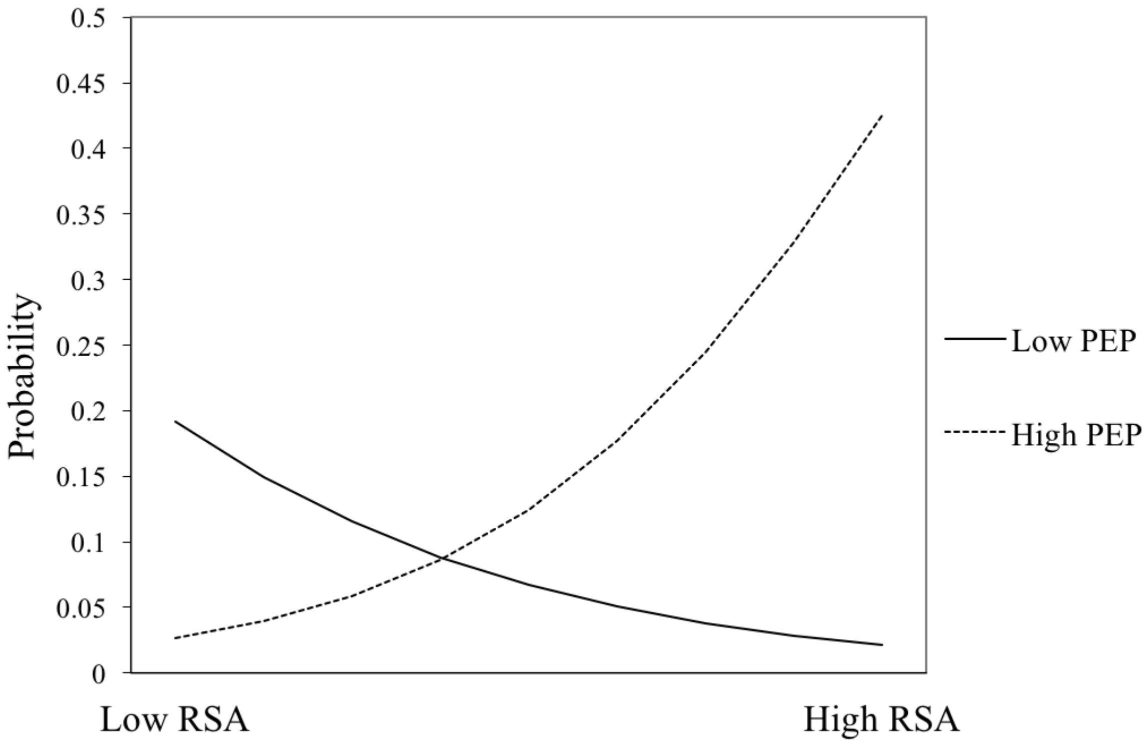


Note. Higher scores indicate greater reactivity

Figures 3 and 4 suggest the positive interaction term in the regression model represents coactivation. However, the high CU group were close to zero-lines in

Figure 3, which may suggest little change in reactivity, to test this post hoc *t*-tests were conducted using absolute change scores in RSA and PEP. Less change may indicate less reactivity from the high CU group. Post-hoc *t*-test showed no significant differences between the high CU group in RSA (M = -.03, SD = .35; t (42) = -1.88, p = .07, η_p^2 = .06) or PEP (M = .007, SD = .01; t (52) = -.12, p = .91, η_p^2 = .00) reactivity compared to the low group (M = -.29, SD = .67; M = .007, SD = .01, respectively). Thus, the high CU group did not significantly differ in magnitude of response when compared to the low CU group, and the significant interaction suggests that adolescents with coactivation during fear induction were over four times more likely to be in the high CU group.

Figure 4. ANS Reactivity: Probability of Belonging to High CU group



Note. Higher scores indicate greater reactivity; Low RSA = -1 *SD*; High RSA = +1 *SD*; Low PEP = -1 *SD*; High PEP = +1 *SD*

Emotional Reactivity to Fear

To establish if the virtual reality roller coaster was valid at inducing emotional feelings, such as arousal (feeling excited or relaxed), valence (happy or unhappy), or dominance (in control or out of control), paired sampled *t*-tests were conducted on the entire sample comparing self-report from the SAM at baseline to the roller coaster, and the control video to the roller coaster. And finally, the baseline condition was compared to the control condition. Arousal levels increased from baseline (t (50) = 6.65, p = .000) and control condition (t (49) = 8.69, p = .000) to the roller coaster, with participants reporting feeling more excited after the roller coaster. There was no significant difference in valence between the baseline (t (50) = 1.87, p = .068) or control condition (t (49) = 1.02, p = .315) and the roller coaster, therefore the rollercoaster did not make the participant feel more or less happy. Compared to the control condition participants felt less in control on the dominance scale after the roller coaster (t (49) = 2.36, p = .022), however, no significant difference was found when compared to the baseline condition (t (50) = -.12, p = .903). Compared to the baseline condition, the control condition made the participants feel more relaxed (t (49) = -2.46, p = .017) and in control (t (49) = -2.55, p = .014). There are two possible explanations for this. First, the calming environment may be effective in making the participants feel more relaxed and in control, or second, the participants may have adjusted over time to the testing environment. There was no significant difference in valence between baseline and control condition (t (49) = .41 p = .684). Table 7 displays the raw means and standard deviations of arousal, valence, and dominance to each condition. Overall, the roller coaster did not affect adolescents' feeling happy or sad, but did make them feel more excited and less in control.

CU Groups and Conscious Fear Reactivity

To test if conscious fear reactivity (self-report reactivity of valence, dominance, and arousal to fear induction) predicted being in the high CU group a series of logistic regressions were conducted. Consistent with the ANS analyses, Model 1 included scores between control condition and the roller coaster. Arousal was the only significant predictor to emerge; those adolescents who reported feeling less excited after the rollercoaster (compared to the control video) were more likely to be in the high CU group (OR = 1.25, *SE* = .11, *CI* = 1.03-1.57, p = .034). However, the overall model was not significantly better than the null model (AIC = 72.17; -2LL = 32.08; χ^2 (3) = 5.15 p = .161). Valence (p = .781) or dominance (p = .144) did not significantly increase or decrease the likelihood of being in either CU group. In sum, there were few significant predictors of self-report emotional reactivity to the roller coaster. However, adolescents who reported feeling less excited after the roller coaster were more likely to be in the high CU group.

Discussion

For the first time to date, the results show adolescents high in CU traits display coactivation of SNS and PNS when experiencing fear. Those adolescents who displayed coactivation were more than four times more likely to be in the high CU group. Coactivation occurs in a minority of people and has been said to characterize those individuals who are unemotional to situations (Alkon et al., 2003; Del Giudice et al., 2011). The present findings support this assertion, and extends it to adolescents who are callous and unemotional. Thus, adolescents who are high in CU traits biologically respond to fear however, it is in a way that enables them to maintain "tight self-control" (Del Giudice et al., 2011 p.19). The only significant finding for conscious fear was arousal, which suggests adolescents who were less excited after the roller coaster were more likely to be in the high CU group. Therefore, coactivation of the ANS and feeling less excited to fear distinguished those in the high CU group from the low CU group. The results demonstrate adolescents with CU traits are biologically different in their autonomic response to fear.

Study 2

Study 2 was designed to assess the link between CU traits and fear reactivity in typically developing adolescents. The community sample was selected to represent adolescents without serious antisocial behavior problems. Consistent with prior research, a stratified sampling method was used to compare adolescents who displayed the highest (within the top 20%) and lowest (within the bottom 20%) levels of CU traits within the community (see Dadds, El Masry, Wimalaweera, & Guastella, 2008). As with Study 1, the aim was to assess if adolescents high in CU traits were fearless at the physiological and emotional level. In addition, self-report measures of conscious fear (fear of physical harm and situational fear) were included to predict the likelihood of being in the high CU group.

Method

Procedure

Six hundred and ninety-six adolescents aged between 12 to 14 years from community schools in the North East of England were screened on the Inventory of Callous-Unemotional Traits (ICU). Participants completed the questionnaire at school. A stratified sampling technique was used to recruit adolescents who were high (top 20%) and low in CU traits (lowest 20%). Based on these scores, participants' parents/carers were invited to bring their child to complete the laboratory-based part of the study. From the 278 participants who were invited, 62 participants accepted the invitation (30% recruitment rate).

Both parent/caregiver and participants completed questionnaires before the experiment. This accommodated a stabilization period for the physiological measures. Next, participants were asked to sit and relax for a 3-minute rest period (baseline condition). Participants wore 3D glasses for the 90 second roller coaster, and the 6-

minute control video (control condition). After each condition participants reported their emotional state using the SAM. Participants received a gift voucher for completing the study, and parents/caregivers were compensated for travel expenses.

Participants

Sixty-two adolescents were included in the final experiment (low CU group n = 35, high CU group n = 27). Participants were predominantly male (n = 53), White British (89%), and aged between 12 and 14 years old (M = 12.54, SD = .57). Minority ethnicities included White other (n = 3), mixed (n = 1), African (n = 1), and Bangladeshi (n = 1). Seventy-nine percent of the sample was raised by both biological parents, 6.5% by biological mother and step father, 6.5% by biological mother alone, 3.2% biological father alone, and the remaining 4.8% included participants who were raised in a shared parental custody (3.2%) or by a guardian (1.6%).

Measures

Callous-unemotional Traits. Consistent with Study 1, CU traits was measured using the Inventory of Callous and Unemotional Traits (ICU; Frick, 2004). In the present study, the parent- (α = .88) and self-report (α = .90) yielded good internal consistency.

Conduct Problems and Prosocial Behavior. Parent report of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was administered to assess group differences in conduct problems and prosocial behavior. The SDQ items are scored from *Not true* (0) to *Certainly true* (2). The conduct problems and prosocial scales include 5 items. In the present sample, the internal consistency was poor for the conduct problems (α = .45) and acceptable for the prosocial scale (α = .75).

Self-Report of Fear. Two questionnaires were selected to measure fear, the fear of physical injury scale on the Spence Children's Anxiety Scale (SCAS; Spence,

1997) and the situated fear questionnaire (SFQ; Campbell et al., 2016). The SCAS fear of physical injury scale is reported as how often she/he experiences the scenarios (e.g., "I am afraid of dogs", "I am afraid of being in high places") from a scale of *Never* (0) to *Always* (3). Reliability for the 5-item physical injury scale was poor (α = .56). The SFQ consists of 27-items, reported on 5-point Likert scale from *Not at all afraid* to *Extremely afraid.* The SFQ includes items of fear across a range of situations including: fear of physical trauma, illness or death; situations of heightened personal vulnerability; fear of public humiliation; fear of harm to loved ones. Items included situations that had been freely entered into (e.g., bungee jumping) or had occurred unexpectedly (e.g., being alone and someone breaking in). Three items were removed from the the SFQ as they were not age appropriate. The internal consistency for the FSQ was very good (α = .94).

Fear-Inducing Environment. To safely measure emotional and physiological reactivity to fear, participants experienced a 90 second 3D roller coaster. The three-dimensional (3D) roller coaster simulation video traverses mountains with steep drops and turns. One of the dips/valleys was determined by the computer scientists to be physiologically impossible for a human to withstand since the positive forces of gravity would be extreme at the lowest point. The control condition was the award-winning six-minute "Our Cosmic Origins" (Holliman, 2010) space documentary. All films were produced at the Durham Visualization Laboratory. The 3D videos were viewed on a 2.4m rear projected PASCAD low-crosstalk screen (using a BARCO Gemini stereoscopic projection display). Participants wore lightweight glasses during the videos. The BARCO display is linked to wireless devices, which allows 3D interaction and head tracking.

ANS Fear Reactivity and Physiological Data Acquisition. The same method (and equipment) was employed from Study 1 to the present study for ANS data acquisition, reduction, and measure of ANS reactivity. Electrocardiogram and impedance cardiography were visually inspected so that midbeats were created if missing (<.001%) and errors in R-wave detection were adjusted. PEP and RSA reactivity was computed so higher values indicated greater reactivity from the control condition. See Study 1 for full details.

Arousal and emotional reactivity. As with Study 1, the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) was used after each condition to measure valence, arousal, and dominance. Emotional reactivity scores were computed by *subtracting control condition averages from roller coaster averages*. Positive numbers on the arousal scale indicated participants feeling more relaxed and negative values represented feeling more excited. Negative values on the valence scale was indicative of *feeling more happy* and positive numbers represented feeling *less happy and more sad*. A negative value on the dominance scale represented participants feeling *less in control* and positive values represented feeling *more in control*.

Results

To test if the stratified groups were different on behavioral and emotional symptoms, independent samples *t*-tests were conducted on parent-report of CU traits, conduct problems and prosocial behavior. Group differences on gender and age were assessed using chi-square and a *t*-test, respectively. The high CU group (n = 27) was significantly higher on parent-reports of CU traits (M = 24.46, SD = 9.61; t (36) = -4.75, p = .000, η_p^2 = .32), conduct problems (M = 2.00, SD = 1.39; t (54) = -2.08, p = .042, η_p^2 = .07), and lower on prosocial behaviors (M = 7.00, SD = 2.42; t (34) = 3.76, p = .000, η_p^2 = .22) when compared to the low CU group (n = 35; M = 13.78, SD = 5.63; M = 1.29, SD = 1.27; M = 8.89, SD = 1.11;

respectively). The CU groups did not significantly differ on age (*t* (55) = -.18, *p* = .859, η_p^2 = .00) or gender (x^2 (1) = 1.07, *p* = .302). Overall, when compared to the low CU group, the high CU group were perceived by their parents as being high in CU traits, having a greater level of conduct problems and lower level of prosocial behaviors.

ANS Reactivity to Fear

To establish if the 3D roller coaster was valid at inducing autonomic response, paired sampled *t*-tests were conducted comparing RSA and PEP at (1) baseline (rest; no video) to the roller coaster, and (2) the control video (space documentary) to the roller coaster. Table 9 displays the means and standard deviations of each condition.

Table 9. Means and Standard Deviations of Conditions; Stratified Community Sample

	Baseline	Roller Coaster	Control
RSA	4.75 (.59)	4.69 (.58)	4.55 (.59)
PEP	.133 (.02)	.130 (.02)	.136 (.02)
Arousal	6.46 (1.76)	4.20 (2.46)	6.17 (2.37)
Valence	2.69 (1.31)	2.40 (1.51)	2.55 (1.33)
Dominance	5.84 (1.66)	5.75 (1.86)	6.33 (1.62)

Note. RSA = Respiratory sinus arrhythmia; PEP = pre-ejection period; Arousal = 1 (excited) to 10 (relaxed); Valence = 1 (happy) to 10 (unhappy); Dominance = 1 (out of control) to 10 (in control).

From baseline to the roller coaster participants responded with significantly shorter PEP (*t* (63) = 2.91, *p* = .005), but not significantly different RSA (*t* (63) = 1.25, *p* = .218). From the control condition, which featured a space documentary, to the roller coaster, participants responded with shortened PEP (*t* (63) = 4.12, *p* = .000), and a significant increase in RSA (*t* (63) = -3.32, *p* = .002). In comparison to the baseline condition, the control condition decreased PEP (longer intervals; *t* (63) = -2.40, *p* = .019), and RSA activity (*t* (63) = 4.99, *p* = .000). A possible explanation for this decrease in RSA may be that the participants were cognitively engaged with the documentary. Overall, compared to baseline and control condition, the roller coaster was effective at inducing PEP reactivity, and RSA withdrawal (when compared to the baseline [but not significantly]).

CU Groups and ANS Reactivity to Fear

To asses if ANS reactivity predicted CU group membership, hierarchical logistic regressions was performed. Because of differences in scaling of PEP and RSA, these scores were normalized by transforming values to *z*-scores, which is consistent with prior research and study 1. Higher values indicate greater reactivity, and low values indicate less reactivity for RSA and PEP.

Table 10. ANS Indices Predicting CU Groups (1 = High) in Community Sample

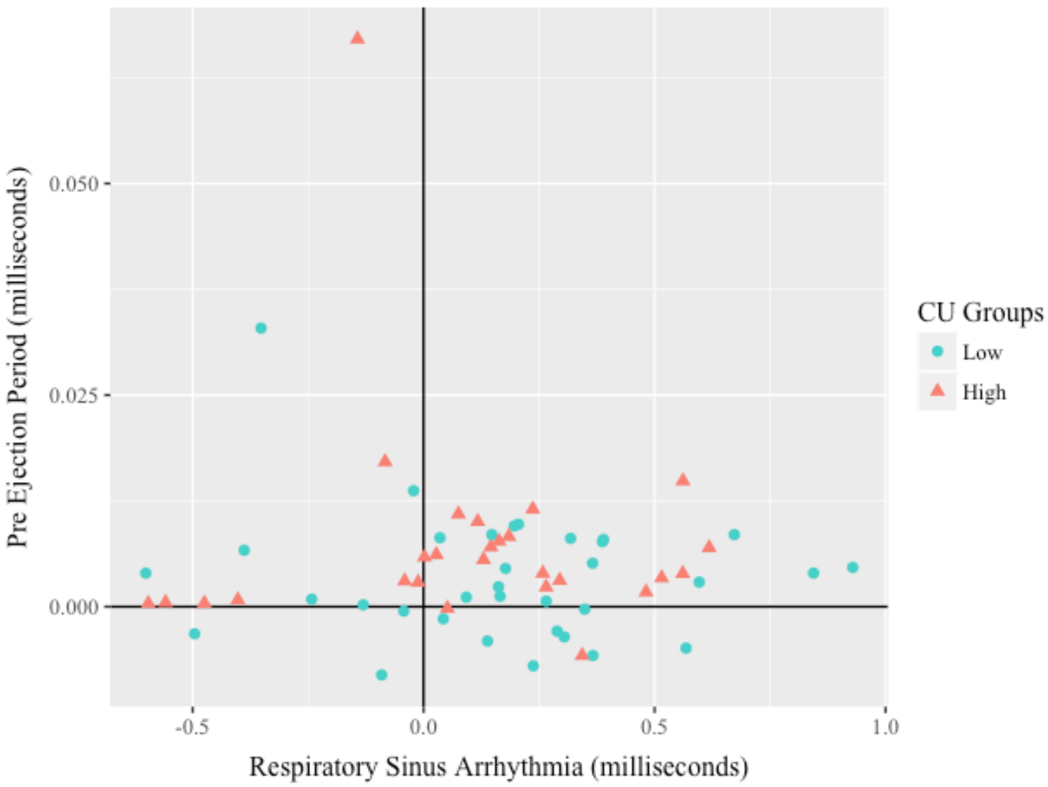
	Model 1					
	B	*SE*	*z* value	OR	95% CI	2LL
Step 1						40.76
Age	-0.08	0.48	-0.17	0.92	0.36 - 2.37	
Sex	-1.21	0.87	-1.39	0.29	0.04 - 1.44	
Step 2						38.17
Age	-0.00	0.50	-0.00	0.99	0.37 - 2.65	
Sex	-1.44	0.90	-1.60	0.24	0.03 - 1.20	
ΔRSA	-0.21	0.27	-0.77	0.81	0.47 - 1.38	
ΔPEP	0.67	0.47	1.42	1.95	0.94 - 5.63	
Step 3						35.57*
Age	0.20	0.54	0.38	1.23	0.43 - 3.58	
Sex	-1.84*	0.92	-1.99	0.16	0.02 - 0.84	
ΔRSA	-0.03	0.29	-0.11	0.97	0.55 - 1.71	
ΔPEP	1.41*	0.58	2.42	4.09	1.50 - 15.35	
ΔRSA*ΔPEP	1.19*	0.57	2.09	3.30	1.17 - 11.77	

Note. Model 1 = ANS reactivity (Control - Roller coaster); Sex (0 = male, 1 = female); ΔRSA = respiratory sinus arrhythmia reactivity; ΔPEP = pre-ejection period reactivity; CI = 95% confidence interval. *p<.05

Model 1 included ANS reactivity scores derived from the control condition and the roller coaster condition. Step 1 included age and gender, Step 2 added RSA and PEP, and Step 3 included the interaction term between RSA and PEP. Results are displayed in Table 10.

Steps 1 (AIC = 87.52; -2LL = 40.76; χ^2 (2) = 2.24, p = .326) and 2 (AIC = 86.33; -2LL = 38.17; χ^2 (4) = 6.25, p = .181) were not significantly better fitting than the null model. RSA (p = .440) and PEP (p = .155) were not significant predictors. Step 3 was significantly better than both the null model (AIC = 83.14; -2LL = 35.57; χ^2 (5) = 11.43, p = .043) and Step 2 (p = .022). The interaction term between RSA and PEP was positive and significant (OR = 3.30, CI = 1.17-11.77, p =.036). Figure 5 and 6 illustrate the interaction between PEP and RSA. Adolescents high in CU traits were proportionally more represented in the co-activation quadrant of Figure 5.

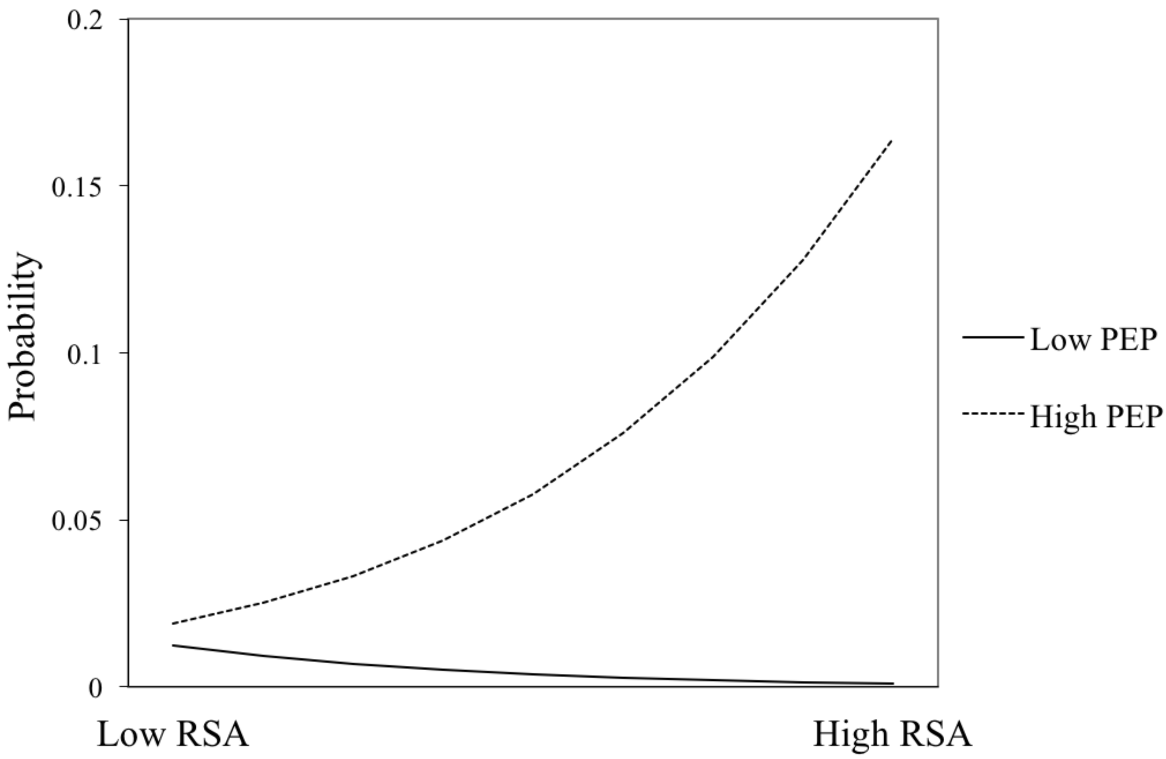
Figure 5. ANS Reactivity by CU groups



Note. Higher scores indicate greater reactivity

Further, Figure 6 shows high PEP (+1 *SD*) and high RSA (+1 *SD*) reactivity increased the probability of being in the high CU group. Thus, coactivation of the SNS and PNS on the roller coaster increases the likelihood by three times of being in the high CU group. To assess if the high CU group were low in reactivity (close to the zero lines; see Figure 5), post hoc *t*-tests were conducted to test for differences in absolute change scores. The high CU group showed did not significantly differ in RSA (M = .10, SD = .33; t (57) = .83, p = .41, η_p^2 = .01) or PEP reactivity (M = .007, SD = .01; t (40) = -1.47, p = .15, η_p^2 = .04) than the low CU group (M = .17, SD = .35; M = .003, SD = .01, respectively). Thus, the high CU group did not significantly differ in level of response when compared to the low CU group, which indicates the high CU group were not characterized by low reactivity.

Figure 6. ANS Reactivity: Probability of Belonging to High CU group



Note. Higher scores indicate greater reactivity; Low RSA = -1 *SD*; High RSA = +1 *SD*; Low PEP = -1 *SD*; High PEP = +1 *SD*

Conscious Fear Reactivity

To assess if the roller coaster was valid at influencing emotional feelings on the arousal (feeling excited or relaxed), valence (happy or unhappy), and dominance (in control or out of control) scale of the self-assessment manikin, paired sampled *t*-tests were conducted on the complete sample. Reactivity was measured from the self-assessment at baseline to the roller coaster, and the control condition to the roller coaster. Self-assessment was then compared from the baseline condition to the control condition to see if the groups differed when experiencing the control condition. Table 9 displays the means and standard deviations for each condition. Participants reported feeling more excited after the roller coaster when compared to the baseline (t (64) = 8.93, p = .000) and control condition (t (64) = 7.79, p = .000). Levels of valence did not significantly change from baseline (t (64) = 1.74, p = .086) or control condition (t (64) = .72, p = .472) to the roller coaster. Participants felt less in control after the roller coaster but this was only significant when compared to the control condition (t (63) = 2.73, p = .008) and not the baseline condition (t (63) = .47, p = .641). In sum, participants found the roller coaster to increase the feeling of excitement, and a loss of control. However, the roller coaster did not have a significant effect on feeling happy or sad. The baseline condition was not significantly different from the control condition on making the participants feel more excited or relaxed (t (64) = 1.04, p = .303), or happy or sad (t (64) = .78, p = .439). However, the control condition significantly increased self-report feelings of being in control (t (63) = -2.39, p = .019) when compared to baseline.

CU Groups and Conscious Fear Reactivity

To determine if self-report of emotional reactivity to the roller coaster increased the likelihood of being in the high CU group a series of logistic regressions were conducted. In all analyses age and gender were included. Model 1 included reactivity scores between control condition and the roller coaster. Model 1 showed arousal (B = .09, SE = .13, OR =

1.02, CI = .86-1.43, p = .452), dominance (B = .24, SE = .17, OR = 1.27, CI = .93-1.81, p = .153), and valence (B = -.26, SE = .16, OR = .77, CI = .54-1.04, p = .108) to be nonsignificant at predicting group membership. These findings suggest adolescents who are high in CU traits do not differentially respond in self-report of emotional reactivity in response to a fearful event when compared to adolescents' low on CU traits.

CU Groups and Self-Report of Fearlessness

To determine if self-report of fear increased the likelihood of group membership two logistic regressions were conducted with age and gender included as covariates. The first regression, which included the situated fear questionnaire, was not a significantly better fitting model than the null model (AIC = 84.69; -2LL = 38.35; χ^2 (3) = 5.88, p = .117). Although the high CU group (M = 53.19, SD = 21.47) reported being less fearful compared to the low CU group (M = 64.06, SD = 18.71), fear was not a significant predictor of being in one group over the other (B = -.03, SE = .05, OR = .97, CI = .95-1.00, p = .074). The same finding was true for the fear of physical injury scale, whereby the high CU group (M = 2.85, SD = 2.57) reported having less fear of physical injury than the low CU group (M = 3.80, SD = 2.39), but this was not significant (B = -.14, SE = .12, OR = .87, CI = .68-1.09, p = .243). In sum, neither fear scales predicted belonging to either the high or low CU group.

Discussion

Consistent with the EBD adolescent sample from Study 1, coactivation of the ANS distinguished the high CU group from the low CU group of community adolescents. Thus, high CU adolescents responded to fear with greater sympathetic and parasympathetic activity, which may be indicative of maintaining alertness and control (Del Giudice et al., 2012). Conscious fear, both emotion identification and evaluation of a situation, did not differentiate those in the high or low CU groups. This is consistent with prior research on psychopathy in adult samples, whereby psychopaths did not differ in conscious fear. In sum, community adolescents high in CU traits did not demonstrate fearlessness on self-report measures, but did display a biological profile suggesting they are able to remain calm and alert while experiencing fear, which may give them the appearance of being fearless.

General Discussion

Children with CU traits are described as being fearless (Fanti et al., 2016; Frick & Morris, 2004; Pardini, 2006), and to some degree the present findings support this assertion for adolescents. By employing cardiac measures of SNS and PNS reactivity a consistent autonomic pattern of fear reactivity was established for adolescents high in CU traits from two different samples. That is, adolescents high in CU traits, regardless of their severity of emotional and behavioral problems, displayed coactivation of sympathetic and parasympathetic nervous system while experiencing fear. Therefore, the high CU groups were physiologically responsive to fear, but not in a manner that is considered typical (e.g., reciprocal sympathetic activity; El-Sheikh et al., 2009). Coactivation of the PNS and SNS during frightening or high-risk situations may give the individual the appearance of being less afraid (see Del Giudice et al., 2011), which may explain why youth with CU traits are characterized as fearless (Fanti et al., 2016; Frick & Viding, 2009).

Coactivation is considered an optimal response during high-intensity situations, allowing for increased behavioral and cognitive functioning (Allison et al., 2012). For example, during high intensity situations the individual may be alert and attentive (facilitated by higher sympathetic activity) whilst being able to remain calm and in control of the situation (facilitated by increase in parasympathetic activity; Allison et al., 2012; Del Giudice et al., 2011, 2012). Coactivation may help the individual remain in control during frightening situations. If however, the situation escalates and requires an immediate response, the parasympathetic “brake” on the heart is withdrawn, allowing for full expression of sympathetic activity, resulting in an explosive response to deal with the situation (Carrive, 2006). Coactivation also has functional benefits (Paton, Boscan, Pickering, & Nalivaiko, 2005), such that the myocardial contractility increases without increasing heart rate, which allows for more efficient cardiac output (i.e., longer ventricular filling times and higher contractility; Koizumi, Terui, Kollai, & Brooks, 1982). Cardiac efficiency would suggest youth with CU traits are “better” able to respond to fearful events. Coactivation may have adaptive qualities for youth with CU traits. During aggressive confrontation parasympathetic upregulation enables the individual to remain calm, and an increase in sympathetic activity heightens vigilance and attentiveness (Del Giudice et al., 2011). Maintaining a physiological state of self-control in high intensity situations may be why youth with CU traits are able to successfully manipulate, intimidate, and carry out goal-directed aggression (Fanti, Frick, & Georgiou, 2009). Further, coactivation is thought to augment the rush from high-risk activities (Allison et al., 2012), which may explain why youth with CU traits engage in risky behaviors (White & Frick, 2010).

It is important to highlight that this is the first study to assess fear induction while measuring cardiac PNS and SNS reactivity in adolescents with CU traits. While the main findings of this paper are novel, there may be an overlap with startle potentiation research in children and adults. Prior research has found *low* fear startle in children (Fanti et al., 2016) and young adults with CU traits (Fanti, Panayiotou, Kyranides, & Avraamides, 2015), and adults high in psychopathy (see Patrick et al., 1993; Rothemund et al., 2012). Therefore, youth with CU traits are not physiologically unresponsive, but just display diminished reactivity (Fanti, Panayiotou, Kyranides, et al., 2015). Lower startle may be an indication that youth with CU traits are paying greater attention to the fear stimuli (orienting response; Anthony & Graham, 1985; Bradley et al., 1990; Lang, Bradley, & Cuthbert, 1997; Patrick et al., 1993). Increased sympathetic activity, greater cardiac vagal control (deceleration of heart rate), and reduced startle response all indicate that the individual is allocating and orienting attention to the fear stimuli (Öhman & Wiens, 2003). Therefore, during fear inducing events, youth with CU traits may not typically respond to fear by losing physiological self-control in order to escape the situation. Instead, and based on startle research and the present findings, they display a physiological profile that maintains calmness, vigilance, and attentiveness to the situation (Del Giudice et al., 2011).

Because of the recent literature review conducted by Hoppenbrouwers et al. (2013) in adult psychopaths showing psychopathy is not associated with low conscious fear, and evidence suggesting children with CU traits are lower conscious fear (Fanti et al., 2016), it was proposed that conscious fear differences between adults and children may be a marker of social maturity. Thus, children with CU traits are less afraid than other children, but as they mature their evaluation of situations, conscious fear, may gravitate towards social norms. However, there is little evidence to support this assertion. With that said, the findings were most similar with adult psychopaths, in that there was not a significant difference in self-report of conscious fear. The only significant finding to emerge was from the EBD sample, with those feeling less excited after fear induction more likely to be in the high CU group. In sum, the high CU group did not show deficits in fear to physical harm, fear inducing situations, or emotional arousal. This suggests adolescents with CU traits are able to recognize frightening events as fearful at a similar level as adolescents low in CU traits.

In light of the findings, the present study was unable to assess gender differences because of the disproportionate number of boys in both samples. Prior research has found aggressive males to exhibit lower baseline PEP, whereas no significant differences were found between aggressive and nonaggressive females (Beauchaine, Hong, & Marsh, 2008). Thus, future research is urged to test for gender differences in autonomic profiles of adolescents with CU traits while experiencing fear. Further, it would have been beneficial to include supplementary physiological indices to measure valence during the rollercoaster, such as electromyography, which would have provided information on the participants experience of the roller coaster as negative or positive at the physiological level, and if this was different for those high in CU traits. Nevertheless, there are many strengths to the findings. To date, this is the first study to assess PEP and RSA reactivity to fear induction in adolescent CU groups, from community and EBD schools. Using community and EBD adolescent samples provided support that the autonomic profile of CU traits while experiencing fear may not be explained by high levels of conduct problems, and suggests coactivation of PNS and SNS is specific to CU traits. This methodology has, for the first time, offered a more complete understanding of the autonomic operations in adolescents high in CU traits in response to fear, and supported the replicability of this finding in two adolescent populations.

Prior research has suggested that youth with CU traits are characteristically unemotional and fearless (Fanti et al., 2016; Frick & Morris, 2004). At the biological level the present findings may be interpreted to support this assertion, however it is proposed here that a shift in thinking from being fearless to being better able to manage fearful situations may be more appropriate. To be fearless, an individual must not experience fear. However, youth high in CU traits do not seem to be unresponsive to fear, as indexed by low arousal, as much as they display greater autonomic control. Further, youth with CU traits reported being as consciously afraid as other youth. Therefore, adolescents with CU traits acknowledge fearful events for what they are, but are able to respond in a way that may be considered as more optimal dealing with and maintaining control of a fearful situation, which may give them the appearance as being fearless. Having the psychophysiological disposition to better manage high intensity and fearful situations, coupled with an unemotional and callous lack of concern for others, there is no surprise that adolescents with CU traits are able to predatorily aggress and commit more severe forms of violence.

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CHAPTER FOUR

The Habitual Female Offender Inside: How Psychopathic Traits Predict Chronic Prison Violence

Published article:

Thomson, N. D., Towl, G. J., & Centifanti, L. C. (2016). The habitual female offender inside: How psychopathic traits predict chronic prison violence. *Law and human behavior*, *40*(3), 257. doi: 10.1037/lhb0000178

Abstract

Psychopathy is considered one of the best predictors of violence and prison misconducts and is arguably an important clinical construct in the correctional setting. However, the present study tested whether psychopathy can be used to predict misconducts in prison environments for women as has been done for men. To date, few studies exist that examine and validate this association in female offender samples. The present study included 182 ethnically diverse female offenders. The aim was to prospectively predict violent and nonviolent misconducts over a 9-month period using official records of prior violent criminal history (e.g., homicide, manslaughter, assault), and self-report measures of psychopathy, impulsivity, and empathy. Using negative binomial regression, the results showed past violent criminal history, and callous and antisocial psychopathic traits were predictors of violent misconducts, while antisocial psychopathic traits and impulsivity best predicted nonviolent misconducts. Although empathy was negatively associated with psychopathy it was not a significant predictor of violent or nonviolent misconducts. Statistical models thats included impulsivity were considered the most parsimonious at predicting misconducts. The findings demonstrate how risk factors found to be reliable in male offender samples, such as psychopathic traits, impulsivity, and past violent criminal history, generalize to female offenders for predicting nonviolent and violent misconducts. One notable difference is the importance of callous psychopathic traits when predicting chronic violent misconducts by female offenders. In sum, there are more similarities in psychopathy and impulsivity than differences in the prediction of misconducts among men and women.

Keywords: psychopathy, impulsivity, institutional misconduct, violence, female offender.

Introduction

Rates of incarceration have been consistently higher for men than for women, but recent statistics released by the U.S. Department of Justice show a generational increase of female probation (16.5%), jail (30%), and prison (21%) populations (Glaze & Kaeble, 2014). While adult male imprisonment rates fell during 2013, for females there was a 2% increase (Carson, 2014). With the correctional population surpassing 1.5 million in the US, keeping order and safety in prisons has become an operational challenge. Prior research has suggested that incarceration was a period of criminal inactivity (Blumstein & Cohen, 1979). However, research has identified a small population who continue their habitual criminal careers behind bars (DeLisi, 2003), even when opportunities to engage in criminal behaviors are limited (King, 1999). For correctional administrators, maintaining safety is the most important priority (Cullen, Latessa, Burton, & Lombardo, 1993), hence identifying predictors of prison misconducts has become a valuable tool for correctional staff (Steiner & Wooldredge, 2014). The majority of measurement tools and empirical knowledge about predicting prison misconducts has been developed from male samples (McKeown, 2010; van der Knaap, Alberda, Oosterveld, & Born, 2012). This is in part due to the disproportion, severity, and chronicity of male offenders (Drury & DeLisi, 2010; Warren et al., 2005). Male-dominated research has yielded useful results but it still remains unclear how these commonly employed predictive factors generalize to female offenders (Davidson & Chesney-Lind, 2009; Kruttschnitt & Gartner, 2003; Pollock, 2002; Steiner & Wooldredge, 2014; Wright, Salisbury, & Van Voorhis, 2007), and whether these predictors work as well for women as for men (Andrews et al., 2012; Wright, Van Voorhis, Salisbury, & Bauman, 2012).

Predicting Misconducts

Chronic offenders (i.e., those who continually break laws over time) make up a small proportion of the correctional population. Although small in number, these habitual offenders are responsible for the majority and the most severe forms of violent and nonviolent offenses (DeLisi & Gatling, 2003; Piquero, Farrington, & Blumstein, 2007). These individuals continue their criminal careers while in prison, making them the most difficult to manage group given the high levels of prison misconducts (DeLisi, Berg, & Hochstetler, 2004). Some of the best predictors of nonviolent and violent misconducts are age, criminal history, and personality characteristics (Cunningham & Sorensen, 2007; DeLisi, 2003; Gendreau, Goggin, & Law, 1997; Vitacco, Gonsalves, Tomony, Smith, & Lishner, 2012), including impulsivity, psychopathic and antisocial traits, and aggressiveness (L. C. Gonçalves, Gonçalves, Martins, & Dirkzwager, 2014). Although these demographic and personality characteristics are being used in prisons as part of risk assessments for both male and female offenders, limited research studies exist to validate this potential link to violent and nonviolent misconducts committed, specifically, by female offenders (e.g., Houser, Belenko, & Brennan, 2012; Kruttschnitt & Gartner, 2005; Steiner & Wooldredge, 2009a; Steiner & Wooldredge, 2014; Wright et al., 2007). Further, it is important to include personality characteristics, demographics, and criminal history within the same study to determine which of the previously identified predictors for male offenders relate most strongly with violent or nonviolent misconducts for incarcerated women.

Psychopathy

Psychopathy has been proposed to be one of the most reliable constructs in the criminal justice system, both in and out of prison (Hare, 1996; Hare, Clark, Grann, & Thornton, 2000; Hemphill & Hare, 2004; Jackson, Rogers, Neumann, & Lambert, 2002). Hare (1993) estimates psychopaths are responsible for committing over 50% of the most violent crimes. High levels of psychopathic traits have been shown to predict chronic offending, antisocial behavior (Baskin-Sommers, Baskin, Sommers, & Newman, 2013; Blais, Solodukhin, & Forth, 2014), and increase recidivistic risk (DeMatteo, Edens, & Hart, 2010; Kosson, Smith,

& Newman, 1990; Serin, Peters, & Barbaree, 1990). Propensity to criminality is not curtailed while in prison. Psychopaths emerge as inmate leaders and habitual criminal offenders (Schrag, 1954), and exhibit the most aggressive types of behavior (Campbell, French, & Gendreau, 2009; McDermott, Edens, Quanbeck, Busse, & Scott, 2008). Even statistically controlling for other well-known predictors of misconducts (e.g., sentence length, previous convictions, age; Hare et al., 2000), psychopathy has still been shown to predict violent and nonviolent misconducts (Edens, Poythress, Lilienfeld, Patrick, & Test, 2008; Guy, Edens, Anthony, & Douglas, 2005; Walters, 2003a, 2003b).

There has been a recent growing body of literature looking to support psychopathy as a risk factor in women. Thus far, the findings have yielded mixed results. Indeed, psychopathy in women has been related to criminal behavior (Beaver, Boutwell, Barnes, Vaughn, & DeLisi, 2015; Coid et al., 2009; Geraghty & Woodhams, 2015; Rutherford, Cacciola, Alterman, & McKay, 1996; Weiler & Widom, 1996), violent and nonviolent crime (Vitale, Smith, Brinkley, & Newman, 2002), goal-directed aggression (Lehmann & Ittel, 2012; Marsee & Frick, 2007), and delinquency (Beaver et al., 2015). However, in female forensic samples, psychopathy has not been shown to correlate significantly with staff reports of violent and disruptive behavior (Salekin, Rogers, & Sewell, 1997). Further, in a sample of 132 maximum security female offenders, high psychopathy scores were unrelated to institutional violence (Warren et al., 2005). Antithetical to the understanding of psychopathy in male samples, women incarcerated for murder have been shown to score significantly lower on psychopathy than those not convicted for murder (Warren et al., 2005). These mixed findings may suggest that manifestations of psychopathic traits do not always run parallel for males and females, and rather, it could be that male and female offenders differ in how psychopathic traits are expressed and how they are associated with antisocial behavior (Verona, Bresin, & Patrick, 2013; Warren et al., 2005). It may be that for female offenders, psychopathic traits, when compared to other personality characteristics, are a less robust predictor of violent and antisocial behavior (Warren et al., 2005).

There are important issues surrounding the expression of psychopathy in female offenders. In general, women and men are biologically, psychologically, and socially different (Logan & Weizmann-Henelius, 2012). Therefore, it is logical to expect the expression of psychopathy to be different in women than men (Sprague et al., 2012). For instance, women higher in psychopathic traits are more likely than men to show emotional instability, while a lack of anxiety may be more apparent in males than females high on psychopathic traits (Logan & Weizmann-Henelius, 2012). Sprague and colleagues (2012) argue that the phenotypic equivalent to psychopathy in women may be borderline personality disorder traits due to the relatively strong features of impulsivity in females. As a result, it may be that the psychopathic traits females show are misdiagnosed as borderline personality disorder, which may explain the over diagnosis of borderline personality disorder in women (Morey & Benson, 2015) and lower prevalence of psychopathy in women (Rogers, Jordan, & Harrison, 2007). Regarding gender differences of victim perpetration, women high in psychopathic traits are more likely to dominate and exploit sexual partners, dependents, and colleagues and friends, while males high in psychopathic traits are less constrained in victim selection and perpetrate more frequently (Logan & Weizmann-Henelius, 2012).

There are challenges to understanding psychopathy in women. A significant difficulty is because measures of psychopathy have been developed and validated in male populations, and are focused on male behavior as a presence of psychopathic traits (Fourouzan & Cook, 2005). Therefore, current measures of psychopathy may conceal any gender differences unless women have very high levels of psychopathic traits (Logan & Weizmann-Henelius, 2012). In which case, women with moderate levels of psychopathic traits or antisocial behavior may be less represented in the construct of female psychopathy. A gender-biased measure will fail to capture any gender differences of the manifestation of psychopathy and any outcomes (e.g., predictive ability, treatment efficacy; Logan & 2012). Nevertheless, there is increasing evidence that psychopathic traits, at the dimensional level, in women may be important for assessing risk of antisocial behavior (Beaver et al., 2015).

Dimensional Construct of Psychopathy

Examining the dimensions of psychopathy (affective, interpersonal, and behavioral) rather than considering it as a single construct has been useful in understanding violence, and there has been strong support for the three-factor model in men and women (White, 2014). The behavioral (antisocial) dimension of psychopathy has been associated with impulsivity, disinhibition, anger, and externalizing behaviors (Brinkley, Diamond, Magaletta, & Heigel, 2008; Camp, Skeem, Barchard, Lilienfeld, & Poythress, 2013; Sellbom, 2011), and is most associated with violent misconducts in male offenders (Chakhssi, Bernstein, & de Ruiter, 2014; Edens, Poythress, Lilienfeld, & Patrick, 2008; Kennealy, Skeem, Walters, & Camp, 2010; Walters & Heilbrun, 2010; Walters 2003a, 2003b). The interpersonal (egocentric) dimension is marked by social dominance and selfishness (Sellbom, 2011). Egocentric traits in women have been shown to be a predictor of recidivism (Salekin, Rogers, Ustad, & Sewell, 1998), as well as the strongest of the three psychopathy dimensions to predict premeditated and goal-directed violence (Blais et al., 2014). The affective (callous) dimension of psychopathy is characterized by a callous lack of empathy, coldheartedness, and complete disregard for others (Brinkley et al., 2008; Sellbom, 2011). In male offender populations, the affective dimension has been associated with past violent and nonviolent crime, and having a history of severe violence (e.g., murder, assault, kidnapping; Hall, Benning, & Patrick, 2004).

The construct of psychopathy is not without criticism, and there is evidence that suggests psychopathy is not a good predictor of violence (see Cooke & Michie, 2010; Edens et al., 2008). Cooke and Michie (2010) argue that predicting violent offending at the individual level cannot be achieved "with any degree of confidence" (p. 272), because at any given moment or place a person could be violent for any different reason. In male samples the affective dimension of psychopathy has neither been shown to predict institutional violence (Chakhssi et al., 2014; Edens et al., 2008; Walters & Heilbrun, 2010) nor to be associated with frequent physical fights in adulthood (Hall et al., 2004). Further, Yang, Wong, and Coid (2010) found in a meta-analysis of violent risk assessment measures, the affective dimension of the PCL-R had little predictive ability of violence (effect size = .22, AUC = .56). Similar to Walters, Knight, Grann, and Dahle (2008), Yang and colleagues (2010) suggest the predictive validity of psychopathy seems to be largely drawn from the antisocial dimension of psychopathy (effect size = .61, AUC = .67). Therefore, it has been proposed that rather than the personality-based dimensions of psychopathy (e.g., affective and interpersonal) being catalytic for violent behavior, it is the behavioral-antisocial component of psychopathy that is more consistently related to violence (Camp et al., 2013; Edens et al., 2008; Walters et al., 2008; Yang et al., 2010). This not suprising as antisocial psychopathic traits incorporates past antisocial behavior (Cooke, Michie, Hart, & Clark, 2004; Skeem & Cooke, 2010), and consistent with Meehl's maxim (1954), past behavior is a strong predictor of future behavior (Camp et al., 2013; Gendreau, Goggin, & Smith, 2002). Further, antisocial psychopathic traits incorporate anger and impulsivity, which are not unique to psychopathy, and are associated with greater risk of violent behavior (Skeem, Miller, Mulvey, Tiemann, & Monahan, 2005).

It is important to note that these studies have only included male samples (e.g., Morrissey et al., 2007; Edens et al., 2008), and where women were available they were excluded from analysis (see Camp et al., 2013). Within the meta-analysis conducted by Yang et al (2010) only two studies specifically focused on females (compared to 17 male-only studies and nine mixed-gender studies). Yang and colleagues (2010) concluded that the PCL-R total score was as predictive of violence in male samples as it was in the female samples, which was comparable to other violent risk assessments (e.g., Violence Risk Scale; Wong & Gordon, 2006). Within these female sampled studies, the affective dimension, which was not a predictor of violence in men, was found to be predictor of violence in women (Yang et al., 2010). Further, in a large sample (*N* = 367) of inpatient women, the PCL-R total score and both the affective and antisocial dimensions predicted post-release violent recidivism. Given the mixed findings, concerns of gender-bias in measurement, and scarcity of research in female offenders it is important that more research be conducted in female samples to fully understand the importance of psychopathic traits as a risk factor for prison violence (Yang et al., 2010).

Impulsivity as a Predictor of Misconducts

Impulsivity is a prominent feature of psychopathy (Hare, 2003; Hart & Dempster, 1997), and is central to the antisocial dimension (Neumann, Hare, & Pardini, 2014). The link between impulsivity and antisocial behavior has been well documented in men and women (Barratt, Stanford, Kent, & Felthous, 1997; Komarovskaya et al., 2007; Moffitt, Caspi, Harrington, & Milne, 2002; White et al., 1994). Typically, males report higher levels of impulsivity than females, but prior research has suggested that violent offending committed by women is more often unplanned and impulsive (Sommers & Baskin, 1993; Warren et al., 2005). When examining motives and post-offense behavior in 182 male and female offenders, females showed more extreme emotional reactivity (self-destructive behavior and jealousy) and regret when compared to male offenders (Häkkänen-Nyholm et al., 2009). Häkkänen-Nyholm et al. (2009) suggest that the homicides perpetrated by females result from situational contexts involving “in-the-moment” conflict. Further, experimental and self-report measures of impulsivity have been shown to differentiate violent female parolees, who score higher in impulsivity, from nonviolent female parolees (Cherek & Lane, 1999). However, prior research has found that the relation between impulsivity and antisocial behavior for females is complex, hence the mixed findings (Komarovskaya et al., 2007; Malouf et al., 2014). For instance, within the same study of females housed in maximum-custody, impulsivity predicted nonviolent and violent misconducts, but women with high levels of impulsivity did not necessarily have a record of a prior violent offense (Komarovskaya et al., 2007). Komarovskaya and colleagues (2007) propose that although impulsivity predicted violent misconducts the effect size was small (Komarovskaya et al., 2007). The inconsistencies of prior research may be explained by a failure to account for the overlap between psychopathy and impulsivity, as impulsivity is considered a cardinal feature of the antisocial dimension of psychopathy (Brinkley et al., 2008).

Empathy as a Predictor of Misconducts

Perpetrators of violent crimes are often described as being coldblooded and having a lack of empathy (Vachon, Lynam, & Johnson, 2014; Woodworth & Porter, 2002). Further, a lack of empathy is considered a hallmark of psychopathy (Decety, Lewis, & Cowell, 2015), and has been suggested to play an integral role in criminal behavior (see Farrington, 1998; Jolliffe & Farrington, 2007). That is, those with low empathy fail to consider or recognize how their actions impact other people (Decety et al., 2015). Without this awareness or concern for others, the perpetrator acts uninhibited by the distress of others (Blackburn, 2007). Due to the strong link between low empathy and high levels of antisociality (see Feshbach, 1975; Jolliffe & Farrington, 2007; Miller & Eisenberg, 1988; Vachon et al., 2014; Vachon & Lynam, 2015; Van Langen, Wissink, Van Vugt, Van der Stouwe, & Stams, 2014), there has been substantial intervention research and programs aiming to reduce antisocial behavior and aggression by increasing the offender's empathy level (e.g., Marshall, 1999; Ross & Ross, 1995; Serin & Kuriychuk, 1994). However, in female offenders, empathy has not been shown to predict aggression, and similar nonsignificant findings were found for violent or nonviolent recidivism in young adults (Bock & Hosser, 2014). Further, a recent meta analysis by Van Langen et al. (2014) found that female offenders did not differ in empathy levels when compared to female non-offenders, but those who had committed a violent crime were lower in empathy (Bock & Hosser, 2014). It is proposed here that one explanation for the inconsistent findings may be the close association between low empathy and psychopathy (e.g., the callous features of psychopathy). Although they are closely linked theoretically, to date, no studies have included empathy and the three dimensions of psychopathy to predict official records of misconducts in female offenders.

Violent Criminal History and Future Misconducts

Past behavior is considered one of the best predictors of future behavior (Gendreau et al., 2002; Meehl, 1954), and in the forensic setting, violent criminal history is considered a reliable predictor of violent misconducts in males (DeLisi et al., 2004; Diamond, Morris, & Barnes, 2012; Flanagan, 1983; Hanks, 1940; Nachshon & Rotenberg, 1977; Steiner & Wooldredge, 2009b; Wolfgang, 1961). Further, recent evidence suggests this may generalize to female offenders (Celinska & Sung, 2014). However, not all people who commit violent crimes are habitually violent (Cunningham & Sorenson, 2007). Habitual offending may be dependent on stable personality traits such as psychopathy (Hemphill & Hart, 2002; Neumann, Wampler, Taylor, Blonigen, & Iacono, 2011).

The Present Study

Despite the growing body of literature on female psychopathy (Verona et al., 2013), prior studies have neglected to include measures of impulsivity and empathy, which are known to closely relate to psychopathy. Indeed, these factors have been shown to independently predict violent and nonviolent prison misconducts. Therefore, by including valid and widely used self-report measures, the present study aimed to differentiate the role of empathy, impulsivity, and the three dimensions of psychopathy for predicting misconducts over time in an ethnically diverse female offender sample.

Prior research has found that antisocial traits (Wright et al., 2007) and impulsivity (Gordon & Egan, 2011; Kerley, Hochstetler, & Copes, 2009) are reliable predictors of nonviolent misconducts in men (Gonçalves et al., 2014). Therefore, it is expected that when impulsivity and psychopathy were entered into separate predictive models, nonviolent misconducts would be predicted by high levels of impulsivity and antisocial psychopathic traits. However, when all predictors were included in the same model it is expected that antisocial psychopathic traits would be the remaining predictor of nonviolent misconducts. This is due to the broader coverage of antisocial characteristics captured by antisocial psychopathic traits (e.g., impulsivity, anger, frustration, and externalizing behavior; Brinkley et al., 2008), which have been shown to predict offending behavior in women (Wright et al., 2007). Further, when violent criminal history, psychopathy, and empathy and impulsivity were entered into separate models, it was expected that violent misconducts would be predicted by having a violent criminal history, high levels of antisocial, egocentric, and callous psychopathic traits, and low levels of empathy. In addition, it was hypothesized that when all predictors were entered into the same model, having a prior violent criminal history, high levels of callous and antisocial psychopathic traits would predict violent misconducts. Because the age of an offender is a well-substantiated predictor of violent and nonviolent misconducts in women (Steiner & Wooldredge, 2014) it was included it as a covariate.

Method

Participants

Participants (N=182, M_{age} = 38.8 years, SD = 10.3, age range: 20-72 years) were recruited from a women's correctional facility that houses maximum, medium, and minimum custody-level female offenders. Pretrial offenders and offenders receiving treatment in the mental health or medical facility were not included. Participants self-identified as Pacific Islander (52%), Caucasian (28%), Asian-American (9%), and other minority ethnicities (11% [Native American, Native Alaskan, African American, Hispanic American, Mexican, and Middle Eastern]). Participants reported their highest levels of education completed, with 59% having graduated high school, 34% leaving high school before 11th grade, and 7% completed college degrees (5% associates and 2% bachelors). Twenty-five percent of the participants had been convicted of a violent criminal offense (33% assault, 22% robbery, 20% threatening, 11% manslaughter, 11% kidnapping, 9% homicide, 2% attempted manslaughter, 2% negligent homicide, 2% sexual assault). Participants received no incentive or compensation for participation in the study, and were informed that the questionnaires were being used for research and would not form part of the correctional institutional files. The present study was approved by the institutional review board at the University of Hawai'i.

Measures

Psychopathic traits. The Levenson Self-Report of Psychopathy Scale (LSRP; Levenson, Kiehl, & Fitzpatrick, 1995) was administered to measure psychopathic traits. The LSRP captures three factors; callous, egocentric, and antisocial psychopathic traits (Brinkley et al., 2008; Sellbom, 2011). Sellbom (2011) examined three separate populations (male offenders, and male and female college students) and found that the egocentric factor showed the largest correlation with narcissistic traits. Callous was found to be the strongest predictor of cold-heartedness and low empathy, and the antisocial factor correlated most strongly with impulsivity, disinhibition, and emotional distress; in male prisoners rebelliousness and nonconformity were most strongly related (Sellbom, 2011). Validity for the three factors (egocentricity, callous, and antisocial) was shown with expected correlations with antisocial behavior, sensation-seeking, and aggression (Brinkley et al., 2008). The LSRP consists of 26 items reported in a Likert-scale self-report format, with ratings from 1 (disagree strongly) to 4 (agree strongly). In the present study, the LSRP total score (*M* = 51.78, *SD* = 12.61) had a Cronbach's alpha coefficient of .88. The egocentric dimension (*M* = 18.08, *SD* = 6.07) included 10 items (e.g., "In today's world, I feel justified in doing anything I can get away with to succeed"). The callous dimension (*M* = 7.18, *SD* = 2.74) consisted of 4 items (e.g., "I make a point of trying not to hurt others in pursuit of my goals"). The antisocial dimension (*M* = 11.23, *SD* = 3.63) was derived from 6 items (e.g., "I have been in a lot of shouting matches with other people"). The psychopathy subscales showed low to adequate internal consistency (Cronbach's alpha = .85, .54, and .76, respectively). The average correlations ranged from .20 to .61, which were above acceptable ranges (Clark & Watson, 1995), and similar to Sellbom (2011).

Impulsivity. The Barratt Impulsiveness Scale (BIS-II; Patton, Stanford, & Barratt, 1995) was used to measure impulsivity. The BIS-II consists of 30 items reported in a Likert-scale self-report format. Ratings are on a scale from 1 (Rarely/Never) to 4 (Almost Always). Total scores integrate measures of non-planning, cognitive, and motor impulsivity (Stanford et al., 2009). The BIS-II has been used extensively in forensic research (Stanford et al., 2009), such that those with violent criminal convictions score higher than those with nonviolent criminal offenses (Smith, Waterman, & Ward, 2006). In female offenders, the BIS-II has been shown to differentiate those with psychopathy and those meeting diagnostic criteria for antisocial personality disorder (ASPD), with higher levels of impulsivity associated with ASPD, whereas lower levels of impulsivity was associated with psychopathy (Warren & South, 2006). Further, the BIS-II has been used to postdict nonviolent criminal convictions (Gordon & Egan, 2011), and is associated with poorer adaption to institutional life (Mahmood, Tripodi, Vaughn, & Bender, & Schwartz, 2012). In the present study, the BIS-II had a Cronbach's alpha coefficient of .88, suggesting a reliable self-assessment measurement, and was consistent with prior studies (see Gordon & Egan, 2011).

Empathy. The Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004) consists of 40 items, which capture social skills and cognitive and affective empathy (Thomson, Wurtzburg, & Centifanti, 2015). Items are scored from 1 (Strongly Agree) to 4 (Strongly Disagree) and are summed for a total empathy score. The EQ is considered the most comprehensible, reliable, and valid empathy scale to date. With a 12-month test-retest reliability of $r = .97$, and a Cronbach's alpha measured validity of .92, it scores well, and is ranked highly by other researchers in the field (Baron-Cohen & Wheelwright, 2004). Furthermore, the use of the Rasch model for analysis provides an excellent level of construct validity, with an item reliability of .99, and person reliability of .92 (Allison, Baron-Cohen, Wheelwright, Stone, & Muncer, 2011). The convergent validity has also been assessed and confirmed in correlation to the 'Reading the Mind in the Eyes' Test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). In the present study, the EQ had a Cronbach's alpha coefficient of .85, suggesting a reliable self-assessment measurement, and is consistent with prior research (Thomson et al., 2015).

Violent criminal history. Institutional files were used to assess the current criminal conviction as a violent or nonviolent offense. Consistent with Baskin-Sommers and colleagues (2013), violent crimes included murder, assault, weapons possession, and kidnapping. Violent criminal history was measured as a dichotomous variable (1 = committed a violent crime, 0 = not committed a violent crime).

Misconducts. Official reports of misconducts were collected 9-months post questionnaire administration. Misconducts were coded using the Hawai'i Department of Public Safety Corrections Administration Policy and Procedures Manual. Consistent with Steiner and Wooldredge (2014), misconducts were coded as a violent misconduct if the offense included threatening, causing physical harm, or attempting to cause physical harm to an offender or staff member. Nonviolent misconducts were coded for all other offenses

(Steiner & Wooldredge, 2014). The prevalence of violent (*M* = .30, *SD* = .83, count proportion of zero = .85, range 0 to 5) and nonviolent (*M* = .48, *SD* = 1.14, count proportion of zero = .81, range 0 to 6) misconducts over the course of 9-months is consistent with prior research including male and female samples (see Edens, Kelley, Lilienfeld, Skeem, & Douglas, 2015).

Data analytic plan

First, a confirmatory factor analysis was conducted to test the three-factor model (see Brinkley et al., 2008; Sellbom, 2011) of the Levenson Self-Report Psychopathy scale (LSRP; Levenson et al., 1995). Next, to examine psychopathy as a predictor of misconducts, violent and nonviolent misconducts were summed for the 9-month period following administration of the questionnaires. To determine which statistical technique was most suitable for the data, the model fit of a negative binomial regression and Poisson regression were compared. The selected method was chosen based on best fitting and parsimonious model using Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC) as suggested by Muthén and Muthén (2008-2012). Because there were a large number of zeroes for violent (count proportion of zero = .85) and nonviolent misconducts (count proportion of zero = .81) the selected negative binomial regression was compared to a zero-inflated model to test if there was an improvement in model fit, taking parsimony into account. Unstandardized estimates and standard errors were reported for the models. Confidence intervals were included to provide an index of effect size, with intervals farther away from zero indicating stronger effects. In addition to confidence intervals, incident rate ratio (IRR) were used to aid in the comparison of significant predictor variables. IRR is derived from the exponentiated regression coefficients as a measure of effect size. IRR is interpreted similar to odds ratio, only the outcome is the rate of incidents rather than the odds of an incident occurring.

Results

Confirmatory Factor Analysis on the LSRP

Since the data were ordinal, Mplus 7.3 (Muthén & Muthén, 2008-2012) with weighted least squares means and variance adjusted (WLSMV) estimation was used to perform a confirmatory factor analysis – the aim was to confirm that a three-factor model fit the data. Confirmatory methods are preferable over exploratory methods, particularly when prior research directs a specific structure with specific items being associated with each factor. Thus, the fit of the model identified by Brinkley et al. (2008) that included 19 items was tested. There were no missing data in the present study, so the full data set was analyzed. To examine whether the model fit the data well, a chi-square was used: A nonsignificant chi-square suggests a good fit. Yet, chi-square with sample sizes as large as that used in the present study ($N = 182$) is often significant with even trivial deviations from a perfect model. Hence, the three indices of practical fit were used as suggested by prior research (TLI, Tucker & Lewis, 1973; CFI, Bentler, 1990; and RMSEA, Browne & Cudeck, 1993). A comparative fit index (CFI) and TLI> .90 suggests an acceptable model fit (Bentler & Bonett, 1980) and > .95 suggests a good model fit (Hu & Bentler, 1999). A root mean square error of approximation (RMSEA) < .08, suggests an acceptable fit; an RMSEA < .06 suggests a good fit (Browne & Cudeck, 1993). Although chi-square was significant, the indices of practical fit suggest that the model tested had an acceptable fit, $\chi2$ ($df = 149$) =216.069, $p = .0003$; TLI = .95, CFI = .95, RMSEA = .051, 90% CI = .035, .065. Item 7 was the only item at .3 and all the other items were above .5, suggesting a strong relationship between items and their respective factors. The factors were correlated with each other, since they all comprise different facets of psychopathy. The strongest factor correlations were between antisocial and egocentric ($r = .62$, $p < .001$), and egocentric and callous ($r = .30$, $p < .001$), while the correlation between callous and antisocial was low ($r = .20$, $p < .05$).

Correlations Among Main Study Variables

Table 11 shows the zero-order correlations that were provided by Mplus. Violent misconducts were positively and significantly related to antisocial psychopathic traits, having a past violent crime, and being younger in age, but was non-significant for empathy, impulsivity, egocentric or callous psychopathic traits. A greater number of nonviolent misconducts was significantly related to higher levels of antisocial psychopathic traits, and impulsivity. Empathy was not significantly related to age, but significantly and negatively related to all psychopathy dimensions and impulsivity. High impulsivity was associated with higher levels on all three dimensions of psychopathic traits.

Table 11. Summary of Correlations, Means, and Standard Deviations for the Main Study Variables

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. Nonviolent Count	-								
2. Violent Count	.46***	-							
3. Violent Crime	.05	.20*	-						
4. Age	-.16	-.22**	.03	-					
5. Egocentric	.00	.14	.02	-.27***	-				
6. Callous	-.05	.09	.11	-.09	.30***	-			
7. Antisocial	.29***	.23**	.02	-.37***	.62***	.20*	-		
8. Impulsivity	.35***	.15	-.08	-.30***	.57***	.30***	.66***	-	
9. Empathy	-.03	.00	.05	.08	-.37***	-.30***	-.37***	-.32***	-
M				38.83	18.08	7.18	11.23	67.87	44.58
SD				10.28	6.07	2.74	3.63	13.04	11.52

Note. Nonviolent Count = Nonviolent misconducts count; Violent Count = Violent misconducts count; Violent Crime = Violent criminal history (1=Yes). **p*<.05, ***p*<.01, ****p*<.001.

Age and Violent Criminal History and Misconducts

First, the best fitting model to the count data was tested. There were a large number of zeroes, and the standard deviation for violent (M =.30, SD = .83) and nonviolent (M = .48, SD = 1.14) misconducts was larger than the mean, which suggests overdispersion. Therefore, an inflation factor was included in model comparison. Compared to the Poisson regression model (AIC = 654.47, BIC = 673.70, -2 log-likelihood = -321.24), the negative binomial model (AIC = 533.89, BIC = 559.52, -2 log-likelihood = -258.94) was a better fitting model with the lowest AIC, BIC, and -2 log-likelihood. The negative binomial dispersion parameters for nonviolent misconducts (α = 5.32, $p < .001$) and violent misconducts (α = 7.34, $p < .001$) were significantly greater than zero, suggesting the data were overdispersed. Negative binomial regression corrects for overdispersion, therefore producing more reliable estimates (Cameron & Trivedi 1998; Hilbe, 2011). A zero inflated negative binomial regression was conducted to compare the model fit with the negative binomial model. Compared to the zero-inflated model (AIC=513.61, BIC=558.47, -2 log likelihood= -242.81, parameters = 14), the negative binomial model had a marginally higher BIC and a lower number (8) of parameters, suggesting the negative binomial model without the inflation factor was the most parsimonious model. Further, prior research confirms that a zero-inflated model accurately estimates observed frequencies in violent count data. However, when considering model fit, parsimony, and previous research findings and theory, the negative binomial is a better model for violent count data, as it accurately estimates observed frequencies while maintaining parsimony (Swartout, Thompson, Koss, & Su, 2015).

Given that age and violent criminal history were both related to misconducts these were included as a baseline model (Model 1) to allow subsequent testing of the contribution of psychopathy factors, impulsivity, and empathy in separate models (see Table 12 for fit indices). Both age (estimate = -.06, SE = .03, CI = -.11, -.00, IRR = .94) and violent criminal history (estimate = .82, *SE* = .39, CI = .05, 1.58, IRR = 2.26) were significant in predicting total violent misconducts. Younger female offenders and those with a prior violent criminal history were more likely to have a greater number of violent misconducts. Age and violent history did not significantly predict nonviolent misconducts.

Table 12. Comparison of Model Fit

Model	Number of free parameters	AIC	BIC	Average standardized residuals violent	Average standardized residuals nonviolent
1	8	533.89	559.52	0.42	0.72
1.1	14	506.31	550.61	0.42	0.55
1.2	12	501.53	539.51	0.39	0.50
2	18	492.20	548.85	0.42	0.40

Note. Model 1 = Violent criminal history and age; Model 1.1 = Violent criminal history, age, antisocial, callous, and egocentric psychopathic traits; Model 1.2 = Violent criminal history, age, empathy, and impulsivity; Model 2 = Violent criminal history, age, empathy, impulsivity, antisocial, callous, and egocentric psychopathic traits.

Psychopathy and Misconducts

Model 1.1 added the three factors of psychopathy to Model 1. Comparing Model 1.1 to Model 1, the AIC and BIC for violent and nonviolent misconducts decreased. The average standardized residuals reduced only for nonviolent misconducts, while for violent misconducts the average standardized residuals remained the same. Satora-Bentler scaled chi-square difference test for MLR was significant (x^2 ($df = 6$) = 68.24, p<.001*)*. Overall, adding psychopathy to Model 1 provided a significantly better fitting model, but only explained more variance when predicting nonviolent misconducts, given the change in residual variance was higher for nonviolent misconducts. For nonviolent misconducts, egocentric (estimate = -.10, *SE* = .04, CI = -.17, -.03) and antisocial psychopathic traits (estimate = .36, *SE* = .07, CI = .22, -.49) were significant predictors. Egocentric showed a small effect size given the closeness of the confidence interval to zero, and the negative sign seems to suggest a suppression effect (see Table 13). Suppression can occur as a consequence of fitting a statistical model using multiple predictors that are highly correlated (Baguley, 2012). In the present study, the suppression effect is likely due to the close relationship between egocentric psychopathic traits and antisocial and callous psychopathic traits (see Table 11).

Table 13. Psychopathy Predicting Violent and Nonviolent Misconducts

	Nonviolent Misconducts				Violent Misconducts			
	Estimate	SE	95% CI	IRR	Estimate	SE	95% CI	IRR
Age	-0.00	.02	-.05,.04	.99	-0.03	0.03	-.08,.02	.97
V Crime	-0.37	0.37	-1.10,.37	.69	0.80*	0.37	.08,1.52	2.24
Callous	0.00	0.06	-.12,.12	1.00	0.15*	0.08	.00,.30	1.16
Antisocial	0.35***	0.07	.22,.49	1.42	0.18*	0.08	.02,.35	1.20
Egocentric	-0.10**	0.04	-.17,-.03	.91	-0.03	0.04	-.11,.05	.97

Note. V crime = Violent criminal history; CI = Confidence intervals; IRR = Incident risk ratio. **p*<.05, ***p*<.01, ****p*<.001

For violent misconducts, violent criminal history (estimate = .80, *SE* = .37, CI = .08, 1.52), callousness (estimate=.15, *SE*= .08, CI= .00, .30), and antisocial psychopathic traits (estimate = .18, *SE* = .08, CI = .02, .35) were positive predictors. In sum, for every one-unit increase (1 *SD*) the frequency rate of committing a violent misconduct increase by a factor of 2.24 for violent criminal history, 1.16 for callous psychopathic traits, and 1.2 for antisocial psychopathic traits predicted. For every unit increase, the frequency rate of committing a nonviolent misconduct increase by a factor of 1.42 for antisocial psychopathic traits. Thus, having a violent criminal history had the largest effect on predicting violent misconducts.

Impulsivity and Empathy and Misconducts

Model 1.2 added impulsivity and empathy to model 1. Comparing Model 1.2 to Model 1 (see Table 12), there was a decrease in AIC, BIC, and the average standardized residuals for violent and nonviolent misconducts. Satora-Bentler scaled chi-square difference test for

MLR was significant (x^2 ($df = 4$) = 73.09, $p < .001$), which suggests the model including impulsivity and empathy is a significantly better fit when compared to model 1. As with Model 1.1, this suggests that including impulsivity and empathy to the baseline model resulted in a better fitting model. The results of this model are presented in Table 14.

Table 14. Impulsivity and Empathy Predicting Violent and Nonviolent Misconducts

	Nonviolent Misconducts				Violent Misconducts			
	Estimate	SE	95% CI	IRR	Estimate	SE	95% CI	IRR
Age	-0.04*	0.02	-.08,-.01	.96	-0.05	0.03	-.10,.00	.95
V crime	0.25	0.43	-.60,1.09	1.28	0.76*	0.38	.02,1.49	2.13
Impulsivity	0.06***	0.02	.03,.10	1.02	0.03	0.02	-.01,.06	1.02
Empathy	0.02	0.01	-.01,.05	1.06	0.02	0.02	-.02,.06	1.03

Note. V crime = Violent criminal history; CI = Confidence intervals; IRR = Incident risk ratio. *p<.05, **p<.01, ***p<.001

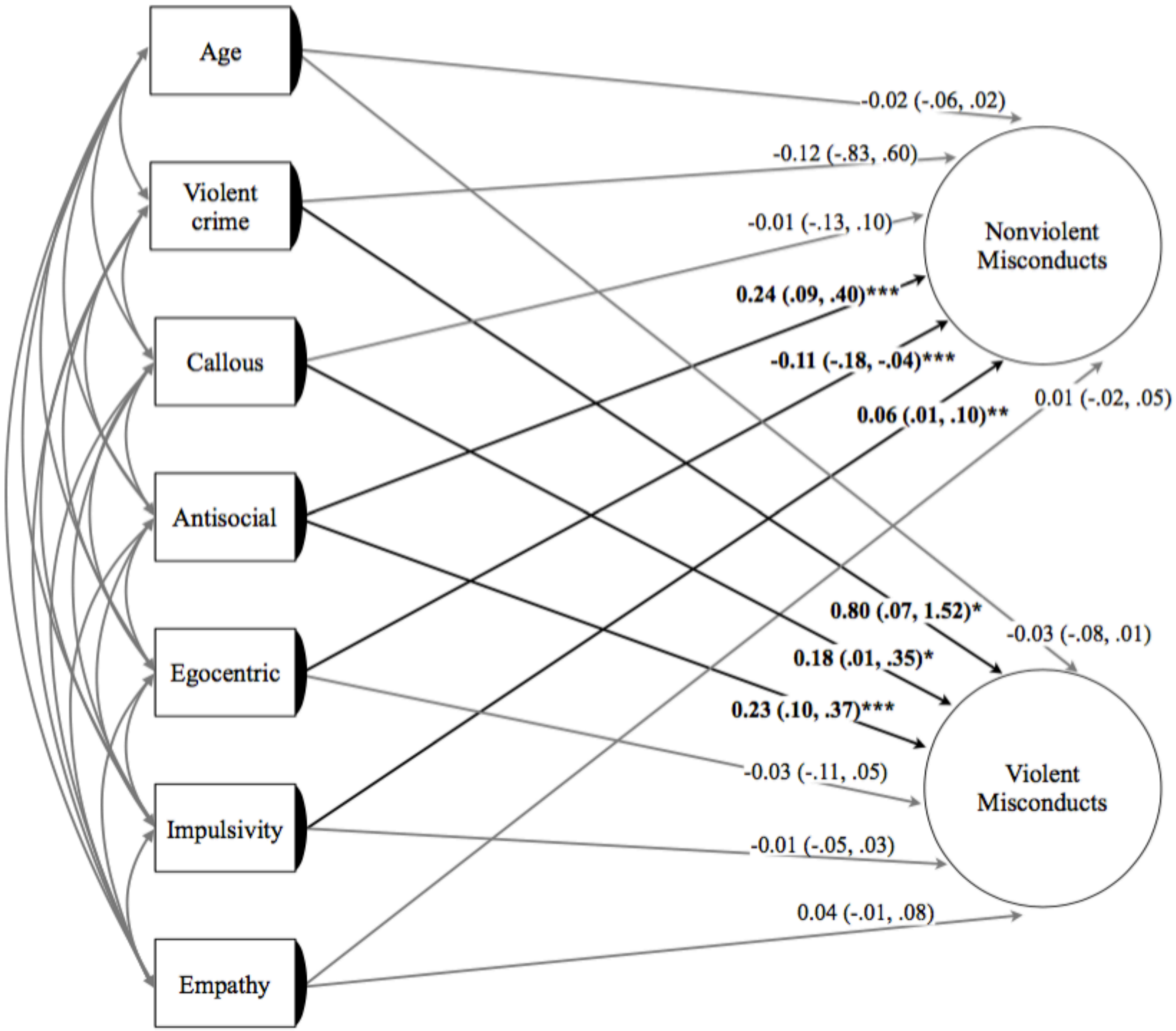
Impulsivity (estimate = .06, *SE* = .02, CI = .03, .10) and age (estimate = -.04, *SE* = .02, CI = -.08, -.01) were significant in predicting nonviolent misconducts. Violent criminal history was a significant predictor for violent misconducts (estimate = .76, *SE* = .38, CI = .02, 1.49). Thus, for every unit increase the frequency rate of violent misconduct increased by 1.49. Further, being impulsive may serve as an indicator for risk of committing nonviolent misconducts over time. For every 1 *SD* increase in impulsivity the frequency rate of nonviolent misconducts increase by 1.02.

Psychopathy, Empathy, and Impulsivity

Model 2 included psychopathy, impulsivity, and empathy to model 1. Models were compared using the AIC, number of free parameters, and average standardized residuals. Although the lowest AIC suggests a balance between goodness-of-fit and parsimony of the model (Symonds & Moussalli, 2011), it is important to take into account model simplicity. Based on the lowest AIC and average standardized residuals Models 1.2 and 2 were most similar. A log-likelihood ratio was conducted to compare Model 1.2 to Model 2, and it was found that the two models were not significantly different (p = .16). Therefore, including the psychopathy dimensions to the models did not add to a better fitting model. Consequently, the simplified model with less complexity (e.g., number of free parameters) is considered the most parsimonious model. Although Model 2 has the smallest AIC there is a risk of over fitting and a lack of generalization beyond these data. As a result, model 1.2 which includes impulsivity, empathy, violent criminal history, and age can be considered the best fitting model for predicting violent and nonviolent misconducts in female offenders.

For Model 2, the best predictors for violent misconducts were violent criminal history (estimate = .80, *SE* = .37, CI = .07, 1.52, IRR = 2.22), callous (estimate = .18, *SE* = .09, CI = .01, .35, IRR = 1.20) and antisocial psychopathic traits (estimate = .23, *SE* = .07, CI = .10, .37, IRR = 1.26). For nonviolent misconducts, impulsivity (estimate = .06, *SE* = .02, CI = .01, .10, IRR = 1.01), egocentric (estimate= -.11, *SE* = .04, CI = -.18, -.04, IRR = .89), and antisocial (estimate = .24, *SE* = .08, CI = .09, .40, IRR = 1.27) psychopathic traits were significant predictors. As with Model 1.2, the negative sign for egocentric psychopathic traits seems to suggest a suppression effect as a result of the close relation with callous and antisocial psychopathic traits when predicting nonviolent misconducts (see Table 1). Overall, having a violent criminal history, higher levels of callous or antisocial psychopathic traits was associated with more violent misconducts over the 9-month period. In comparison, violent criminal history had a larger effect (IRR = 2.22) than callous (IRR = 1.20) or antisocial psychopathic traits (IRR = 1.26). However, antisocial psychopathic traits (IRR = 1.27) and impulsivity (IRR = 1.01) remained the best predictors for nonviolent misconducts. Figure 7 presents the results of Model 2.

Figure 7. Predictors of Violent and Nonviolent Misconducts



Note. Violent crime = Violent criminal history. **p*<.05, ***p*<.01, ****p*<.005

Discussion

Psychopathy has been considered a consistent predictor of misconduct in men (Edens et al., 2008; Guy et al., 2005; Walters, 2003a, 2003b), and the present findings show that this is generalizable to female offenders. Since there has been a rise in female incarceration rates (Carson, 2014; Glaze & Kaeble, 2014) identifying valid risk assessment measures is critical to the treatment of female offenders (McKeown, 2010; Steiner & Wooldredge, 2014). As has been found in prior research with men, psychopathy was a predictor of misconducts while women were in prison, even after controlling for age and violent criminal history. Although there were similarities between the present study and the existing literature on male offender samples, the findings draw notable gender specific differences.

Prior research has found that the antisocial dimension of psychopathy and having a prior violent criminal history predict institutional violence in male samples (Chakhssi et al., 2014; Diamond et al., 2012; Kennealy et al., 2010). The present study indicates that this is is also the case for female offenders. One notable gender difference was the importance of callous psychopathic traits. Even while controlling for age, impulsivity, empathy, and a history of violent offense, callous psychopathic traits predicted violent misconducts. Of note, recent research has found that incarcerated women scoring high on the affective dimension of psychopathy (callousness) have diminished physiological responses to victim distress (Verona et al., 2013). Therefore, when perpetrating violent acts, women with high callous psychopathic traits may not emotionally respond to others' distress, which may explain why specifically in female offenders, callous psychopathic traits predicted chronic levels of violent prison misconducts.

Impulsivity is considered a cardinal feature of psychopathy (Hart & Dempster, 1997). In male offender samples, antisocial psychopathic traits and impulsivity have been shown to predict nonviolent misconducts (Edens et al., 2008; Poythress et al., 2010). The present study confirms that antisocial psychopathic traits and impulsivity were both significant predictors of nonviolent misconducts. When all predictors were entered into the final model, it was expected that antisocial psychopathic traits would be the best predictor. However, both impulsivity and antisocial psychopathic traits remained significant. Not only do the findings support the close association between antisocial psychopathic traits and impulsivity (Hart & Dempster, 1997), but also illustrates the independent contribution that both impulsivity and antisocial psychopathic traits have when predicting prison misconducts for female offenders. For an offender to continually perpetrate misconducts over a 9-month period in an environment where the odds of being caught are high suggests that individuals who engage in misconducts compulsively break the rules, either because they cannot regulate their behavior or because they are motivated to be antisocial.

There has been debate on the generalizability of psychopathy for men and women, with an emphasis that females may present these traits differently (see Sprague et al., 2012; Salekin et al., 1998; Sutton et al., 2002; Vitale et al., 2002). Nevertheless, research has found that psychopathy is generalizable to women as a reliable risk factor for antisocial behavior in the community (e.g., arrests, incarceration; Beaver et al., 2015). By including the dimensional construct of psychopathy, the present study provides evidence that males and females show similarities in how psychopathy predicts official reports of misconduct within the prison setting. Consistent with male offender research (see Kennealy et al., 2010; Walters, 2003b), it was found that female offenders with high antisocial psychopathic traits pose the greatest risk for both violent and nonviolent misconducts. In male offender samples, callous psychopathic traits have been associated with more brutal forms of violence (Hall et al., 2004), yet callousness has been shown to not be a significant predictor of violent misconducts (Chakhssi et al., 2014; Edens et al., 2008; Walters & Heilbrun, 2010). However, the findings suggest that callousness may be important to female offenders' level of risk in the perpetration of violence over an extensive period of time. Therefore, female offenders who perpetually commit violent misconducts are not just more likely to be characteristically impulsive, disinhibited, or antisocial like male offenders, but are dominant, remorseless, and cruel. These findings demonstrate how psychopathy in men and women converge when predicting nonviolent misconducts, but may also highlight gender differences when predicting violent misconducts.

The link between empathy and misconducts was not confirmed, even when the zero-order correlations between empathy and misconducts were tested. Prior findings regarding the relation between empathy and delinquency have been mixed. Some research finds that empathy predicts antisocial behavior (see Jolliffe & Farrington, 2007) while others find no significant association (see Lee & Egan, 2013). There are possible explanations for the divergent findings. Psychopathy has a strong link with antisocial behavior, and prior research has found that individuals with psychopathy have an intact ability to understand others' emotional states (cognitive empathy), but are deficient in being able to experience others' emotions (affective empathy; Pfabigan et al., 2015). Therefore, people without an emotional connection with others may find it easy to continually violate the rules while in prison, yet their skill in cognitively understanding emotions may play a smaller role. Since empathy was measured as a single construct, the present study may have missed potentially important associations with aspects of empathy and misconducts.

Another explanation of the inconsistent findings for empathy and antisocial behavior may be that the current model of empathy is "censored and fails to capture the full range of the [empathy] construct" (Vachon et al., 2014, p.17). Traditional measures of empathy focus on how peoples' feelings resonate with other people. However, research has suggested that empathy extends beyond a person's ability to emotionally respond to others' feelings, and includes a dissonant and lack of response (e.g., callousness, unemotional, contemptuous and cynical of others; Vachon & Lynam, 2015). Indeed, it was found that female offenders with high levels of callous traits showed higher levels of continual violent misconducts over the duration of the study.

There were limitations to the present study that must be considered when interpreting the findings. The present study neglected to include the length of time that each offender had been incarcerated for, which is known to be a reliable predictor of misconducts for female offenders (Drury & DeLisi, 2010). Even with this limitation there are some substantial strengths. Prior research has called for studies to test alternative measures of psychopathy (besides the Psychopathy Checklist Revised; Hare, 2003) to determine the predictive value in criminal justice outcomes (see Walters, 2012). Compared to the PCL-R, self-report measures of psychopathy are time and resource efficient (Camp et al., 2013), so the inclusion of the LSRP was a valuable addition. However, since this was for research and anonymity was assured, offenders may have felt more comfortable being truthful and forthcoming than if they had been asked to report to staff making sentencing, classification, or release decisions. In this ethnically diverse population, the three-factor model of the LSRP was confirmed (Brinkley et al., 2008; Sellbom, 2011). By doing so, meaningful associations were found between the dimensions of psychopathy and violent and nonviolent misconducts, which has yielded similarities and disparities with prior research including male samples.

Incarceration was once considered to be a period of criminal inactivity (Blumstein & Cohen, 1979). However, the present study has identified a subgroup of female offenders who, as described by DeLisi (2003), are particularly difficult to manage and who habitually offend even when behind bars. The present findings dovetail with prior research, which shows that habitual nonviolent antisocial behavior is often a result of impulsivity and antisocial personality traits, whereas those who are "free of remorse, as unperturbed, and as secure in a callous equanimity" (Cleckley, 1976, p. 266) are the most chronic violent female offenders.

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CHAPTER FIVE

General Discussion

Discussion

The general aim of this thesis was to explore factors that may predict antisocial behavior. More specifically, the research focused on possible neurobiological mechanisms in children and adolescents to understand groups of youth who were most at risk for aggression. Furthermore, in female offenders, the aim was to understand how personality and behavioral factors contributed to predicting official reports of violence and antisocial behavior.

It is important to recognize that in each study, across middle childhood, adolescence, and adulthood, and across community, forensic, and special school populations, psychopathic traits, particularly the affective dimension, was consistently related to higher aggressive or violent behavior. Specifically, it was found 1) children who perpetrated proactive and reactive aggression were highest on callous, narcissistic, and impulsive psychopathic traits; 2) adolescents from Emotional and Behavioral Difficulties (EBD) schools highest in CU traits were perceived by their teachers as having higher levels of proactive aggression; 3) adolescents from community schools high in CU traits had greater levels of conduct problems based on parent-report; 4) and callous and antisocial psychopathic traits in female offenders predicted chronic levels of institutional violence. Across the present studies, these findings support the idea by extant research that there is a strong interplay between psychopathic traits and aggressive behavior, particularly the more severe forms (e.g., physical harm, and premeditated aggression; Baskin-Sommers & Baskin, 2016; Hawkins et al., 2000; Reidy et al., 2015).

Psychopathy and Aggression: Tautological Beginnings

In Chapter 2, children were grouped based on their proactive and reactive aggressive behavior. It may be that grouping children in this way resulted in a group that is more consistent with the construct of psychopathy. For instance, children in the mixed group, who were behaviorally distinct by their high levels of proactive aggression, showed higher levels of psychopathic traits across all three dimensions when compared to children who displayed low levels of aggression or only reactive aggression. Mixed aggressive children also showed similar neurobiological profiles to adolescents high in CU traits (see de Wied, van Boxtel, Matthys, & Meeus, 2012). Additionally, these children displayed fewer deficits in their cognitive ability, which is consistent with research from noncriminal adult psychopaths and prisoners scoring high in the affective and interpersonal dimension of psychopathy (see Baskin-Sommers et al., 2015; Ishikawa, Raine, Lencz, Bihrle, & Lacasse, 2001). Thus, mixed aggressors may be most distinct from other children by their high levels of psychopathic traits, which is related to a host of biological, personality, and neuropsychological differences. Therefore, classifying children by their behavior, especially proactive aggression, which is behaviorally characteristic of psychopathy (see Blair, 2001), may have grouped together children highest in psychopathic traits as expected. This finding highlights the significant overlap between observed behavior and psychopathology, and the complexities behind the interpretation of one over the other - such that, is it more valid to measure behavior as a function of psychopathology or to measure psychopathology as a function of behavior? In this instance, if proactive aggression is an expression of psychopathic personality is it more relevant to assess the mechanisms of psychopathy or the psychopathic behavior?

It is this author's thoughts that both are relevant to elucidate the construct of psychopathy and to understand risk factors for antisocial behavior. However, it is important that psychopathology and associated behaviors remain distinct in measurement - for example, it is counterintuitive to credit behavior as a function of personality traits, and then apply the same personality traits to understand or predict the behavior (Cooke & Logan, 2015; Skeem & Cooke, 2010). As stated in Chapter 1, it is only logical to expect that a measure of antisocial psychopathic traits is predictive of antisociality and criminality. To address this tautological measurement, the present thesis used the three-factor model (and CU traits in adolescents) to avoid statistically predicting antisocial behaviors from antisocial psychopathic traits, where the overlap may be obvious. However, it is of this author's opinion that researching behaviors known to be theoretically linked to psychopathy may shed light on the development of psychopathic traits. This is especially true for children, as early behaviors may be more emergent and evident early on in a child's development than the entire cluster of characteristics that make up the psychopathology.

Moving Forward with Fear

A compelling volume of research has suggested a link between antisocial behavior and fearlessness (Raine, 2005). Similarly, individuals high in psychopathic traits are also proposed to be fearless (Fanti, Panayiotou, Lazarou, Michael, & Georgiou, 2016; Frick & Morris, 2004). For example, youth with CU traits are proposed to be fearless and therefore fail to learn from punishment or physical harm. Thus, there are no meaningful consequences that deter them from antisocial behavior. Hence, Raine (1993) suggests people who are fearless are most likely to be antisocial. The fearlessness theory and proposal that psychopathic traits are linked to fearlessness are compelling arguments and support one another, and some evidence exists to support this assertion. However, a caveat in the fearlessness association with antisocial behavior or CU traits is the broad generalization from theory to practice, and this seems to have skipped the stage of empirical evaluation to being widely accepted. For instance, Raine (2005) suggested the fearlessness theory is supported by the finding that people who show antisocial behavior also show low arousal; that is, they show low resting autonomic activity. Raine (2005) proposed the condition of resting activity is a mild stressor that evokes emotions such as anxiety or fear. Thus, low autonomic activity at rest has been considered a marker for fearlessness (Raine, Venables, & Mednick, 1997; Raine, 2005). There are several logical and empirical problems with this assumption.

Firstly, Raine (2005) explains resting conditions evoke two possible emotions, fear and anxiety, however, these are distinct emotions - behaviorally, biologically, and neurologically (Grillon, 2008; Sylvers, Lilienfeld, & LaPrairie, 2011). Further, fear and anxiety have conflicting theoretical relevance to the *fearlessness* theory. To understand the conflict, anxiety and fear will be explored separately as a function of resting activity. If resting activity is to be considered an indicator of anxiety, increased autonomic activity would indicate greater anxiety and lower autonomic activity would indicate lower anxiety. Thus, consistent with the fearlessness theory it would be expected low anxiety (and not high anxiety) would be associated with antisocial behavior. However, a great deal of research shows high anxiety (marked by hyperarousal) predicts aggression (Bilgiç et al., 2016; Marsee, Weems, & Taylor, 2008). Further, there are subgroups of youths high in CU traits: a group with high anxiety and a group with low anxiety. Both groups display a high degree of conduct problems (Fanti, Demetriou, & Kimonis, 2013). Thus, the fearlessness theory fails to account for the equifinality of antisocial behavior, that is, the varied pathways (e.g., children with high and low anxiety) leading to antisocial behavior.

The second emotion, which is more accurate to the fearlessness theory, is that resting conditions evoke fear, but this is also a tenuous leap from theory to empirically valid. To begin with, there has been no validation that resting during physiological data acquisition, whether it is in a school, hospital, prison, or a laboratory setting, evokes fear in participants (and if this differs for youth or adults); therefore, it remains unknown if resting during physiological data acquisition induces fear. Putting this rather significant caveat aside, and for a moment this discussion shall similarly assume that resting activity is an autonomic measure of fear, what do the measures explain?

A widely used measure that supports the fearlessness theory is resting heart rate. Some have gone as far to say that low resting heart rate is an “unequivocal risk factor for…violence" (Raine, 2015, p. 962). Thus, low resting heart rate represents being biologically fearless, and being fearless is associated with being antisocial (Raine, 2005). Typically, however, when a person experiences fear reciprocal sympathetic activation occurs; a withdrawal in parasympathetic activity and an increase in sympathetic activity (El-Sheikh et al., 2009). Thus, it seems that the fearlessness theory operates under the assumption that heart rate captures sympathetic activity. However, this is not entirely accurate. Heart rate is under control from both branches of the autonomic nervous system (Berntson, Quigley, & Lozano, 2007). Thus, findings associated with heart rate may reflect either sympathetic and parasympathetic activity, which may explain the mixed findings in research using heart rate. Some research has found fear induction reduces heart rate (Bernat et al., 2006; Codispoti & De Cesarei, 2007; Dimberg, 1986; Fredrickson & Levenson, 1998; Theall-Honey & Schmidt, 2006) while others have shown increases in heart rate (Aue et al., 2007; Baldaro et al., 1996). Furthermore, some research has not been able to replicate the association between low heart rate and antisocial behavior (e.g., Calkins & Dedmon, 2000; Garralda et al., 1991; Pine et al., 1998; Scarpa et al., 2010; van Hulle et al., 2000; Zahn & Kruesi, 1993). This may suggest resting heart rate is not a robust measure of fearlessness, and highlights the importance of specified measures of sympathetic and parasympathetic activity to be used at the same time.

Using parasympathetic and sympathetic measures within the same study is often neglected, but including both measures offers a complete understanding to the underlying autonomic processes. Thus, without a distinct measure of each branch of the autonomic nervous system, low levels of one branch may not be indicative of high levels of the other. Reciprocal autonomic activity is not the only mode in which the autonomic nervous system functions and instead more complicated interactions exist between both branches of the autonomic nervous system (Levy, 1971), as found in Chapter 3.

When an individual experiences fear, they respond emotionally and physiologically. Thus, when a person is fearless, the stimuli should not evoke any emotional or physiological reactivity, as there is nothing to be feared. However, to date, research that tests reactivity (to stress, provocation, and emotionally evoking videos) shows this is not the case in antisocial individuals or youth and adults high in psychopathic traits. Instead, there is a lower magnitude of response to aversive stimuli (Fanti, personal communication, May 24, 2016). Also, self-report measures of emotional reactivity to fear and situational fear did not differentiate those high in CU traits from those low in CU. Therefore, a well-reasoned step would suggest these individuals are not fearless because they are still responding in the same way as others (increase in autonomic activity), but instead their response is smaller. It is important to note before this discussion continues that the majority of research drawing support for the fearlessness theory are associated with dampened response to emotionally evocative videos, peer-provocation, emotional faces, and stress tasks. Therefore, very few studies test the association with stimuli that may be considered as fear inducing, and to date, this is limited to startle potentiation (see Fanti, Panayiotou, Kyranides, & Avraamides, 2015; Patrick, Bradley, & Lang, 1993). Nevertheless, a common finding is the startle response is smaller magnitude, and not absent. Therefore, it is this author's thoughts that a reevaluation of the present fearlessness theory is needed.

Chapter 3 demonstrates the autonomic profiles of fear responsivity from two independent samples of youths high in CU traits. These adolescents also showed high levels of conduct problems and aggression. Combined with the work by Fanti et al. (2015) and Patrick et al. (1993) the findings in Chapter 3 may begin to provide a rich explanation for the reasons youths high in CU traits have been characterized as fearless. The results showed youth with CU traits responded to fear with coactivation of the sympathetic and parasympathetic nervous system. The same pattern of autonomic reactivity was found in both the community adolescent sample and the EBD adolescent sample, which suggests a relatively robust finding. Initially, this was opposite to the expectation based on the fearlessness theory that suggests adolescents with CU traits would display hypoarousal to fear. Del Giudice, Ellis, and Shirtcliff (2011) suggest people who engage in proactive aggression and show high levels of callousness may display a lack of responsivity (physiological hypoactivity) to nonagnostic stressors. This suggestion is consistent with the findings in Chapter 2 whereby children who engaged in proactive aggression, had higher levels of psychopathic traits, and displayed atypically low parasympathetic activity during rest (a nonagnostic stressor). Thus, at rest or when there is little immediate threat "unemotional" individuals may be characterized by low autonomic profiles (Del Giudice et al., 2011). However, when unemotional individuals face an immediate threat or agnostic stressors they may display an increase in sympathetic and parasympathetic activity, thus they may coactivate both branches of the autonomic nervous system (Del Giudice et al., 2011; Del Giudice, Hinnant, Ellis, & El-Sheikh, 2012). This proposal is consistent with the findings from Chapter 3. Adolescents high in CU traits display the unemotional autonomic profiles suggested by Del Giudice et al. (2011), and these same individuals show higher levels of proactive aggression and conduct problems. Combining the present findings with previous research highlights the complex interactions that exist at the biological level, which further emphasizes the need for using multiple biological measures when unpacking possible mechanisms for antisocial behavior and CU traits.

Coactivation has been proposed to be an optimal response to fear or threatening situations, as the person can remain calm yet alert and in control of the situation (Del Giudice et al., 2012). Upregulating parasympathetic activity with sympathetic activity in response to threat may have offered an evolutionary advantage; appearing calm but vigilant may be perceived by antagonists that the individual is unafraid, thus, willing to fight (Del Giudice et al., 2012). Animal studies have shown during conditioned fear response, cardiac coactivation may occur while the animal waits for the aversive stimuli to come (Carrive, 2006). Therefore, it seems that an increase in parasympathetic activity withholds cardiac acceleration (from sympathetic activity), which may allow for attention and control of the situation/stimuli. A coactivated autonomic profile supports startle potentiation research which finds youth high in CU traits have less physiological response to startle. However, instead of dampened startle interpreted as fearlessness, the reduced startle response may be an indication that the individual is more focused and attentive to the situation and less stimulated by the startle potentiation (Anthony & Graham, 1985; Bradley, Cuthbert, & Lang, 1990; Patrick et al., 1993). Therefore, it is systematic to propose youth with CU traits are not absent of fear, and thus not fearless. Instead, the findings suggest youth with CU traits attend to fear in a way that they attentively manage and deal with the situation without losing self-control, which may be perceived by others as being unemotional and unafraid of the situation.

Moving Beyond *His* Disorder

Literature in female offenders has been sparse, and the association between psychopathy and violence has been largely generalized from male samples (Forouzan & Cooke, 2005; McKeown, 2010). Within the present thesis, an aim was to test the predictive ability of personality and behavioral traits known to theoretically relate to each other, and antisocial behavior. These measures included empathy, impulsivity, and psychopathy. While empathy deficits and impulsivity are considered core features of psychopathy and antisocial behavior (Decety, Lewis, & Cowell, 2015; Hart & Dempster, 1997; Jolliffe & Farrington, 2007), they did not predict violence and only impulsivity predicted nonviolent antisocial behavior. Empathy and impulsivity not predicting violence is an important finding for several reasons. A lot of resources have been spent on empathy training in the United States, with estimates of over $500 million spent each year in hopes that empathy training decreases offending (Mcgrath, Cumming, Burchard, Zeoli, & Ellerby, 2010; Ross & Ross, 1995; Serin & Amos, 1995; Vachon, Lynam, & Johnson, 2014). Although this thesis did not investigate the effectiveness of empathy training, it may suggest that for female offenders having a lack of empathy is not a fundamental contributor to being violent in prison. This finding may warrant empirical exploration as to the effectiveness of empathy training to curb antisocial behavior in female offenders. Of note, this finding may be unique to women, as in comparison to research including male offenders lower levels of empathy has been associated with antisocial behaviors (van Langen, Wissink, van Vugt, Van der Stouwe, & Stams, 2014).

Deficient empathy is a characteristic of psychopathy (particularly the affective and interpersonal facets). Based on Chapter 4, it is logical to draw the conclusion that having deficits in empathy will only contribute to the prediction of violence if the individual is equinamonously callous, contemptuous of society, and willing to violate the rights of others for personal gain. Clinical interventions may choose to apply more gender specific approaches to treatment for females posing a greater risk for violence. In relation to the present finding, interventions may require a more person-centered focus to address curbing the callous personality and cynical view and use of others. An example of this is the Primrose Unit in the United Kingdom, a specialist service for high-risk women presenting with severe personality disorder. Inmates are assessed and interventions tailored to the individual’s needs. Treatment may include dialectical behavioral therapy to manage emotions and challenge problematic thinking styles, and interventions designed to directly target violent behavior (e.g., life minus violence). Individualized programs are expensive, but in the long run have been shown to save on long-term costs to society (Farrington & Koegl, 2014), which is why programs such as Primrose service are acclaimed by the world health organization as a high quality service (Ministry of Justice, 2014).

Although impulsivity explains male prison violence (Værøy, Western, & Andersson, 2016), it does not seem to predict prison violence committed by women (see Chapter 4; Komarovskaya, Loper, & Warren, 2007). However, antisocial psychopathic traits, which have features of impulsivity, did predict violence. This result is similar to findings for male samples (see Edens, Poythress, Lilienfeld, Patrick, & Test, 2008; Walters & Heilbrun, 2010), and is not surprising given that a measure of antisocial psychopathic traits predicts prison antisociality. However, because Chapter 4 used the three-factor construct of psychopathy to predict prison violence, it was possible to assess which factors were most important for understanding female violence. This method took into account the criticisms that the current construct of psychopathy weighs too heavily on antisocial and criminal behavior (Skeem & Cooke, 2010). Using the dimensional construct of psychopathy, the findings revealed both psychopathic personality characteristics (e.g., callous dimension) and behavioral factors (e.g., antisocial dimension) predict violent behavior committed by female offenders.

Chapter 4 demonstrates the similarities between men and women high in psychopathic traits. However, there are also distinctions when predicting violent and antisocial behaviors. Past research on gender, violence, and psychopathy has yielded conflicting results. Some suggest measures of psychopathy are sensitive and reliable enough to capture the construct of psychopathy in women (Gray & Snowden, 2016). Yet prior evidence (including Chapter 4) indicates there are disparities in the presentation, etiological pathways, and neuropsychological mechanisms of psychopathy in women (see Jackson, Rogers, Neumann, & Lambert, 2002; McKeown, 2010; Nicholls, Ogloff, Brink, & Spidel, 2005; Vitale & Newman, 2001; Wynn, Høiseth, & Pettersen, 2012). The gender disparities have spurred questions as to how appropriate the current measures represent the construct of psychopathy in women (see Forouzan & Cooke, 2005). The aim of a diagnosis is to conceptualize functional impairments into a common language that is understood by all clinicians and researchers. The common language helps professionals reliably communicate about the disorder, such as treatment needs and efficacy, risk-assessment, and research findings. Therefore, it is paramount that clear criteria and universal language are developed to represent the construct of psychopathy, especially in women. While the aim of a diagnosis is to assist in helping a client, without such clarity and universal validity, measures such as the PCL-R, although self-proclaimed to "save lives", (Cooke & Logan, 2015; Hare, 2003 p.16) may be severely harmful to the client's wellbeing (e.g., treatment bias and legal ramifications; Blais, Solodukhin, & Forth, 2014; Boccaccini, Murrie, Clark, & Cornell, 2008; Polaschek & Daly, 2013). In sum, psychopathic traits seem to play an influential role in identifying women at risk for violent and antisocial behavior while in prison. However, work is needed to understand the complex dynamic between current clinical assessments of psychopathy and the utility of a diagnosis in female offenders.

Limitations

This thesis is not without limitations, and the results should be interpreted with these in mind. Firstly, the aim of this thesis was broad in scope in hopes to understand factors that may predict antisocial behavior during childhood, adolescence, and adulthood. However, this meant that the general aim was not unique to a developmental age group (e.g., only children), which may be seen to dilute the importance of the findings. Secondly, psychopathic traits and callous-unemotional traits were measured using questionnaires, and while a multi-informant questionnaire strategy was employed, the inclusion of clinical measures may have been more sensitive in scoring psychopathic traits. However, given the large sample sizes, diverse age groups and population settings this was not feasible. Thirdly, Chapter 4 was the only study not to include biological measures, which is a shortfall for the consistency between studies. This is especially important as Chapter 2 and 3 demonstrate the importance of including multidisciplinary techniques when predicting antisocial behaviors.

Conclusion

Although the broad aim of this thesis was to understand mechanisms of aggression, it was intended that the findings could be used to understand people. Identifying people who violate the rights of others is important, but understanding the diversity of individuals within this group is paramount to treatment efficacy. Based on the present findings and previous research, a person-centered approach may be more effective at understanding the diverse risk for antisocial behavior. Indeed, individuals who perpetrate aggression and antisocial behavior are a heterogeneous group (Fanti et al., 2016; Moffitt, 1993), as adults and children. The biggest distinction may be at the personality level. Those with low levels of psychopathic traits and high levels of antisocial behavior may be characterized by aggression in response to provocation because of difficulties with behavioral inhibition (Chapter 3 and 4), more global executive functioning deficits (Chapter 2), and greater hostile attributional biases and problems with social information processing (Crick & Dodge, 1996; Dodge et al., 2015; Hubbard, Dodge, Cillessen, Coie, & Schwartz, 2001). While these individuals display antisocial behavior, it may not be as severe as those with psychopathic traits (Chapters 2-4). In contrast, individuals with psychopathic traits may be distinct on a host of biological, behavioral, and personality factors - including, atypicality in prefrontal functioning (Chapter 2), low levels of prosocial behaviors (Chapter 3), propensity for goal-directed aggression (Chapter 2-3), as well as an unemotional biological profile (Chapter 3). Of note, differences were not always deficiencies. Instead, the present thesis may suggest people with psychopathic traits exhibit factors that contribute to their success at carrying out predatory behaviors. Such as the capability to remain physiologically calm and alert when others may lose control, the perseverance and cognitive skills to pursue long-term goal-directed behaviors, the superior motor skills to carry out aggression, and above all else a callous equanimity.

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Appendices

Appendix A: The Antisocial Process Screening Device (APSD; Frick & Hare, 2001)

APSD

Child's name____
Child's Ethnicity______________________________________

Instructions: Read each statement and decide how well it describes the child. Mark your answer by circling the appropriate number (0-2). Do not leave any statement unrated.

	Not at all True	Sometimes True	Definitely True
1. Blames others for his/her mistakes. **[I]**	0	1	2
2. Engages in illegal activities.	0	1	2
3. Is concerned about how well s/he does at school/work. **[C]**	0	1	2
4. Acts without thinking of the consequences. **[I]**	0	1	2
5. His/her emotions seem shallow and not genuine. **[N]**	0	1	2
6. Lies easily and skillfully.	0	1	2
7. Is good at keeping promises. **[C]**	0	1	2
8. Brags excessively about his/her abilities, accomplishments, or possessions. **[N]**	0	1	2
9. Gets bored easily. **[I]**	0	1	2
10. Uses or "cons" other people to get what s/he wants. **[N]**	0	1	2
11. Teases or makes fun of other people. **[N]**	0	1	2
12. Feels bad or guilty when s/he does something wrong. **[C]**	0	1	2
13. Engages in risky or dangerous activities. **[I]**	0	1	2
14. Can be charming at times, but in ways that seem insincere or superficial. **[N]**	0	1	2
15. Becomes angry when corrected or punished. **[N]**	0	1	2
16. Seems to think that s/he is better or more important than other people. **[N]**	0	1	2
17. Does not plan ahead, or leaves things to the "last minute." **[I]**	0	1	2
18. Is concerned about the feelings of others. **[C]**	0	1	2
19. Does not show feelings or emotions. **[C]**	0	1	2
20. Keeps the same friends. **[C]**	0	1	2

Key: **[C]** = Callous item; **[N]** = Narcissism item; **[I]** = Impulsivity item

Appendix B: Reactive–Proactive Aggression Questionnaire (RPQ; Raine et al., 2006)

RPQ

Instructions: There are times when most of us feel angry, or have done things we should not have done. Rate each of the items below by putting a circle around 0, 1, or 2.

0 = Never **1 = Sometimes** **2 = Often**

Do not spend a lot of time thinking about the items—just give your first response.

	Never (0)	Sometimes (1)	Often (2)
1. Yelled at others when they have annoyed you **[R]**	0	1	2
2. Had fights with others to show who was on top **[P]**	0	1	2
3. Reacted angrily when provoked by others **[R]**	0	1	2
4. Taken things from other students **[P]**	0	1	2
5. Gotten angry when frustrated **[R]**	0	1	2
6. Vandalized something for fun **[P]**	0	1	2
7. Had temper tantrums **[R]**	0	1	2
8. Damaged things because you felt mad **[R]**	0	1	2
9. Had a gang fight to be cool **[P]**	0	1	2
10. Hurt others to win a game **[P]**	0	1	2
11. Become angry or mad when you don’t get your way **[R]**	0	1	2
12. Used physical force to get others to do what you want **[P]**	0	1	2
13. Gotten angry or mad when you lost a game **[R]**	0	1	2
14. Gotten angry when others threatened you **[R]**	0	1	2
15. Used force to obtain money or things from others **[P]**	0	1	2
16. Felt better after hitting or yelling at someone **[R]**	0	1	2
17. Threatened and bullied someone **[P]**	0	1	2
18. Made obscene phone calls for fun **[P]**	0	1	2
19. Hit others to defend yourself **[R]**	0	1	2
20. Gotten others to gang up on someone else **[P]**	0	1	2
21. Carried a weapon to use in a fight **[P]**	0	1	2
22. Gotten angry or mad or hit others when teased **[R]**	0	1	2
23. Yelled at others so they would do things for you **[P]**	0	1	2

Key: **[R]** = Reactive aggression item; **[P]** = Proactive aggression item

Appendix C: Proactive/Reactive Aggression Scale (PRA; Dodge & Coie, 1987)

PRA

Instructions: For each of the following statements, please circle the number that best applies to this child. Use the scale below to determine the best applying number.

Never True	Rarely True	Sometimes True	Usually True	Almost Always True
1	2	3	4	5

1. When this child has been teased or threatened, he or she gets angry easily and strikes back. **[R]**	1	2	3	4	5
2. This child always claims that other children are to blame in a fight and feels that they started the trouble. **[R]**	1	2	3	4	5
3. When a peer accidentally hurts this child (such as by bumping into him or her), this child assumes that the peer meant to do it, and then overreacts with anger/fighting. **[R]**	1	2	3	4	5
4. This child gets other kids to gang up on a peer that he or she does not like. **[P]**	1	2	3	4	5
5. This child uses physical force (or threatens to use force) in order to dominate other kids. **[P]**	1	2	3	4	5
6. This child threatens or bullies others in order to get his or her own way. **[P]**	1	2	3	4	5

Key:
[R] = Reactive aggression item
[P] = Proactive aggression item

Appendix D: Inventory of Callous and Unemotional Traits (ICU; Frick, 2004)

ICU (Self Report)

Instructions: Please read each statement and decide how well it describes you. Mark your answer by circling the appropriate number (0-3) for each statement. Do not leave any statement unrated.

	Not at all true	Somewhat true	Very true	Definitely True
1. I express my feelings openly.	0	1	2	3
2. What I think is “right” and “wrong” is different from what other people think.	0	1	2	3
3. I care about how well I do at school or work.	0	1	2	3
4. I do not care who I hurt to get what I want.	0	1	2	3
5. I feel bad or guilty when I do something wrong.	0	1	2	3
6. I do not show my emotions to others.	0	1	2	3
7. I do not care about being on time.	0	1	2	3
8. I am concerned about the feelings of others.	0	1	2	3
9. I do not care if I get into trouble.	0	1	2	3
10. I do not let my feelings control me.	0	1	2	3
11. I do not care about doing things well.	0	1	2	3
12. I seem very cold and uncaring to others.	0	1	2	3
13. I easily admit to being wrong.	0	1	2	3
14. It is easy for others to tell how I am feeling.	0	1	2	3
15. I always try my best.	0	1	2	3
16. I apologize (“say I am sorry”) to persons I hurt.	0	1	2	3
17. I try not to hurt others’ feelings.	0	1	2	3
18. I do not feel remorseful when I do something wrong.	0	1	2	3
19. I am very expressive and emotional.	0	1	2	3
20. I do not like to put the time into doing things well.	0	1	2	3
21. The feelings of others are unimportant to me.	0	1	2	3
22. I hide my feelings from others.	0	1	2	3
23. I work hard on everything I do.	0	1	2	3
24. I do things to make others feel good.	0	1	2	3

ICU
(Teacher/Parent Report)

Instructions: Please complete the background information above. Then read each statement and decide how well it describes the child. Mark your answer by circling the appropriate number (0-3) for each statement. Do not leave any statement unrated.

	Not at all true	Somewhat true	Very true	Definitely True
1. Expresses his/her feelings openly.	0	1	2	3
2. Does not seem to know “right” from “wrong”.	0	1	2	3
3. Is concerned about schoolwork.	0	1	2	3
4. Does not care who he/she hurts to get what he/she wants.	0	1	2	3
5. Feels bad or guilty when he/she has done something wrong.	0	1	2	3
6. Does not show emotions.	0	1	2	3
7. Does not care about being on time.	0	1	2	3
8. Is concerned about the feelings of others.	0	1	2	3
9. Does not care if he/she is in trouble.	0	1	2	3
10. Does not let feelings control him/her.	0	1	2	3
11. Does not care about doing things well.	0	1	2	3
12. Seems very cold and uncaring.	0	1	2	3
13. Easily admits to being wrong.	0	1	2	3
14. It is easy to tell how he/she is feeling.	0	1	2	3
15. Always tries his/her best.	0	1	2	3
16. Apologizes (“says he/she is sorry”) to persons he/she has hurt.	0	1	2	3
17. Tries not to hurt others’ feelings.	0	1	2	3
18. Shows no remorse when he/she has done something wrong.	0	1	2	3
19. Is very expressive and emotional.	0	1	2	3
20. Does not like to put the time into doing things well.	0	1	2	3
21. The feelings of others are unimportant to him/her.	0	1	2	3
22. Hides his/her feelings from others.	0	1	2	3
23. Works hard on everything.	0	1	2	3
24. Does things to make others feel good.	0	1	2	3

Appendix E: Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997)

SDQ
(Teacher/Parent Report)

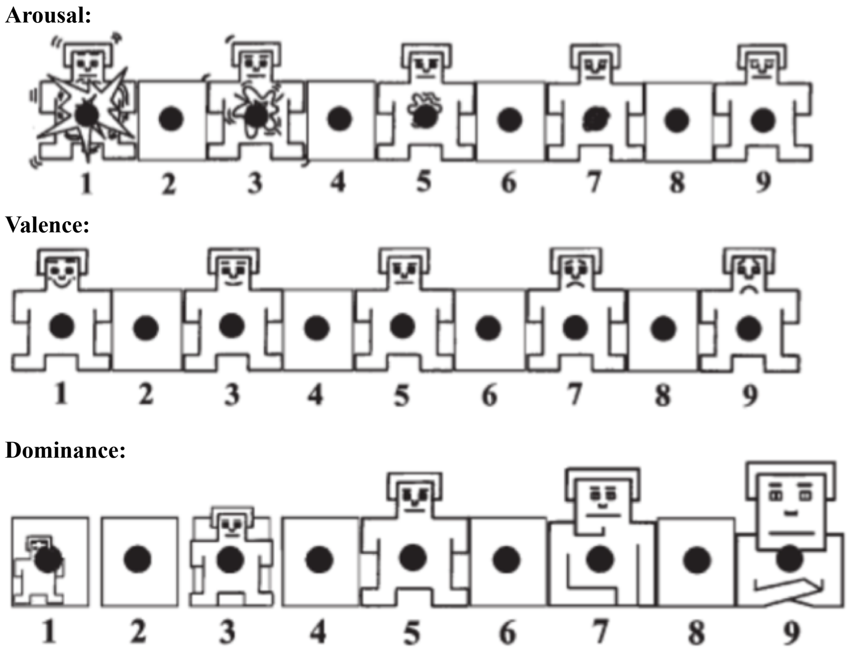
Instructions: For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain or the item seems daft! Please give your answers on the basis of the child's behaviour over the last six months or this school year.

	Not true	Somewhat true	Certainly true
1. Considerate of other people's feelings. **[P]**	[ ]	[ ]	[ ]
2. Restless, overactive, cannot stay still for long.	[ ]	[ ]	[ ]
3. Often complains of headaches, stomach-aches or sickness.	[ ]	[ ]	[ ]
4. Shares readily with other children (treats, toys, pencils etc.). **[P]**	[ ]	[ ]	[ ]
5. Often has temper tantrums or hot tempers. **[C]**	[ ]	[ ]	[ ]
6. Rather solitary, tends to play alone.	[ ]	[ ]	[ ]
7. Generally obedient, usually does what adults request. **[C]**	[ ]	[ ]	[ ]
8. Many worries, often seems worried.	[ ]	[ ]	[ ]
9. Helpful if someone is hurt, upset or feeling ill. **[P]**	[ ]	[ ]	[ ]
10. Constantly fidgeting or squirming.	[ ]	[ ]	[ ]
11. Has at least one good friend.	[ ]	[ ]	[ ]
12. Often fights with other children or bullies them. **[C]**	[ ]	[ ]	[ ]
13. Often unhappy, down-hearted or tearful.	[ ]	[ ]	[ ]
14. Generally liked by other children.	[ ]	[ ]	[ ]
15. Easily distracted, concentration wanders.	[ ]	[ ]	[ ]
16. Nervous or clingy in new situations, easily loses confidence.	[ ]	[ ]	[ ]
17. Kind to younger children. **[P]**	[ ]	[ ]	[ ]
18. Often lies or cheats. **[C]**	[ ]	[ ]	[ ]
19. Picked on or bullied by other children.	[ ]	[ ]	[ ]
20. Often volunteers to help others (parents, teachers, other children). **[P]**	[ ]	[ ]	[ ]
21. Thinks things out before acting.	[ ]	[ ]	[ ]
22. Steals from home, school or elsewhere. **[C]**	[ ]	[ ]	[ ]
23. Gets on better with adults than with other children.	[ ]	[ ]	[ ]
24. Many fears, easily scared.	[ ]	[ ]	[ ]
25. Sees tasks through to the end, good attention span.	[ ]	[ ]	[ ]

Key: [C] = Conduct problems item; **[P]** = Prosocial item

Appendix F: Self-Assessment Manikin
(SAM; Bradley & Lang, 1994)

Self-Assessment Manikin



Appendix G: Spence Children's Anxiety Scale - Physical Injury Scale (SCAS; Spence, 1997)

SCAS: FPIS

Instructions: Please put a circle around the word that shows how often each of these things happen to you. There are no right or wrong answers.

1. I am scared of the dark	Never	Sometimes	Often	Always
2. I am scared of dogs.	Never	Sometimes	Often	Always
3. I am scared of going to the doctors or dentists	Never	Sometimes	Often	Always
4. I am scared of being in high places or lifts (elevators)	Never	Sometimes	Often	Always
5. I am scared of insects or spiders	Never	Sometimes	Often	Always

Appendix H: Situated Fear Questionnaire (SFQ; Campbell et al., 2016)

Situated Fear Questionnaire

Instructions: Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.

1	2	3	4	5
Not at all afraid	A little afraid	Moderately afraid	Very afraid	Extremely afraid

1. You are walking down a poorly lit alleyway at night. You can hear footsteps behind you but you can't see anybody there.	(1)	(2)	(3)	(4)	(5)
2. You are just about to do a bungee jump off the side of a bridge; the initial drop is over 200 m.	(1)	(2)	(3)	(4)	(5)
3. You are alone in your house during the night when you hear what sounds like someone breaking in.	(1)	(2)	(3)	(4)	(5)
4. You are on the top floor of a building when a fire alarm goes off. You reach the staircase and see the fire blocking the stairs down to the ground floor.	(1)	(2)	(3)	(4)	(5)
5. You are swimming in the sea with a few friends. You can feel yourself being rapidly pulled away from the shore by a rip tide.	(1)	(2)	(3)	(4)	(5)
6. You lose your train ticket and realise that the guard will be checking soon. You have no more cash to pay a fine or pay for a new one.	(1)	(2)	(3)	(4)	(5)
7. You are drunk at a party out of town and your friends have gone home without you.	(1)	(2)	(3)	(4)	(5)
8. You realise you have left the iron/gas on when you left for work this morning.	(1)	(2)	(3)	(4)	(5)
9. Sitting on top of the bus, a group of teenagers is in front of you are making threatening comments.	(1)	(2)	(3)	(4)	(5)
10. You check the petrol gauge — your car is running at empty and there is no garage for miles.	(1)	(2)	(3)	(4)	(5)
11. All the electrics fuse in your house, and you are alone and unsure of where the fuse box is.	(1)	(2)	(3)	(4)	(5)
12. You are involved in a car accident on a busy motorway. You have been taken to hospital and you cannot feel any sensation in your legs.	(1)	(2)	(3)	(4)	(5)
13. Your flight has been cancelled due to bad weather conditions. You think you may be stranded abroad with little money.	(1)	(2)	(3)	(4)	(5)
14. A member of your family is on holiday abroad, and you hear that there have been terrorist attacks in the city where they are staying. You cannot get hold of them.	(1)	(2)	(3)	(4)	(5)
15. You hit an icy patch on a busy main road, and lose complete control of the car.	(1)	(2)	(3)	(4)	(5)
16. You stall your car on a busy roundabout. You cannot seem to start it again.	(1)	(2)	(3)	(4)	(5)
17. Your neighbour has hurt herself very badly in the garden — she appears to be unconscious.	(1)	(2)	(3)	(4)	(5)
18. A member of your family should have been home many hours ago you cannot contact them.	(1)	(2)	(3)	(4)	(5)

Appendix I: Levenson Self-Report of Psychopathy Scale (LSRP; Levenson et al., 1995)

LSRP

Instructions: Listed below are a number of statements. Each represents a commonly held opinion and there are no right or wrong answers. Please read each statement carefully and circle the number which best describes the extent to which you agree or disagree with each statement, or the extent to which each statement applies to you.

1	2	3	4
Disagree Strongly	Disagree somewhat	Agree somewhat	Agree strongly

1. I am often bored. **[A]**	1	2	3	4
2. In today's world, I feel justified in doing anything I can get away with to succeed. **[E]**	1	2	3	4
3. Before I do anything, I carefully consider the possible consequences.	1	2	3	4
4. My main purpose in life is getting as many goodies as I can. **[E]**	1	2	3	4
5. I quickly lose interest in tasks I start. **[A]**	1	2	3	4
6. I have been in a lot of shouting matches with other people. **[A]**	1	2	3	4
7. Even if I were trying very hard to sell something, I wouldn't lie about it. **[C]**	1	2	3	4
8. I find myself in the same kinds of trouble, time after time. **[A]**	1	2	3	4
9. I enjoy manipulating other people's feelings. **[E]**	1	2	3	4
10. I find that I am able to pursue one goal for a long time.	1	2	3	4
11. Looking out for myself is my top priority.	1	2	3	4
12. I tell other people what they want to hear so that they will do what I want them to do. **[E]**	1	2	3	4
13. Cheating is not justifiable because it is unfair to others. **[C]**	1	2	3	4
14. Love is overrated.	1	2	3	4
15. I would be upset if my success came at someone else's expense.	1	2	3	4
16. When I get frustrated, I often "let off steam" by blowing my top. **[A]**	1	2	3	4
17. For me, what's right is whatever I can get away with. **[E]**	1	2	3	4
18. Most of my problems are due to the fact that other people just don't understand me.	1	2	3	4
19. Success is based on survival of the fittest; I am not concerned about the losers. **[E]**	1	2	3	4
20. I don't plan anything very far in advance.	1	2	3	4
21. I feel bad if my words or actions causes someone else to feel emotional pain. **[C]**	1	2	3	4
22. Making a lot of money is my most important goal. **[E]**	1	2	3	4
23. I let others worry about higher values; my main concern is with the bottom line. **[E]**	1	2	3	4
24. I often admire a really clever scam. **[E]**	1	2	3	4
25. People who are stupid enough to get ripped off usually deserve it. **[E]**	1	2	3	4
26. I make of point of trying not to hurt others in pursuit of my goals. **[C]**	1	2	3	4

Key: [C] = Callous item; **[E]** = Egocentric item; **[A]** = Antisocial item

Appendix J: Barratt Impulsiveness Scale
(BIS-II; Patton et al., 1995)

BIS
(Self-Report)

Instructions: People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement and put an X on the appropriate circle on the right side of this page. Do not spend too much time on any statement. Answer quickly and honestly.

1 Rarely/Never	2 Occasionally	3 Often	4 Almost Always/Always

1. I plan tasks carefully.	(1)	(2)	(3)	(4)
2. I do things without thinking.	(1)	(2)	(3)	(4)
3. I make-up my mind quickly.	(1)	(2)	(3)	(4)
4. I am happy-go-lucky.	(1)	(2)	(3)	(4)
5. I don't "pay attention."	(1)	(2)	(3)	(4)
6. I have "racing" thoughts.	(1)	(2)	(3)	(4)
7. I plan trips well ahead of time.	(1)	(2)	(3)	(4)
8. I am self controlled.	(1)	(2)	(3)	(4)
9. I concentrate easily.	(1)	(2)	(3)	(4)
10. I save regularly.	(1)	(2)	(3)	(4)
11. I "squirm" at plays or lectures.	(1)	(2)	(3)	(4)
12. I am a careful thinker.	(1)	(2)	(3)	(4)
13. I plan for job security.	(1)	(2)	(3)	(4)
14. I say things without thinking.	(1)	(2)	(3)	(4)
15. I like to think about complex problems.	(1)	(2)	(3)	(4)
16. I change jobs.	(1)	(2)	(3)	(4)
17. I act "on impulse."	(1)	(2)	(3)	(4)
18. I get easily bored when solving thought problems.	(1)	(2)	(3)	(4)
19. I act on the spur of the moment.	(1)	(2)	(3)	(4)
20. I am a steady thinker.	(1)	(2)	(3)	(4)
21. I change residences.	(1)	(2)	(3)	(4)
22. I buy things on impulse.	(1)	(2)	(3)	(4)
23. I can only think about one thing at a time.	(1)	(2)	(3)	(4)
24. I change hobbies.	(1)	(2)	(3)	(4)
25. I spend or charge more than I earn.	(1)	(2)	(3)	(4)
26. I often have extraneous thoughts when thinking.	(1)	(2)	(3)	(4)
27. I am more interested in the present than the future.	(1)	(2)	(3)	(4)
28. I am restless at the theater or lectures.	(1)	(2)	(3)	(4)
29. I like puzzles.	(1)	(2)	(3)	(4)
30. I am future oriented.	(1)	(2)	(3)	(4)

Appendix K: Empathy Quotient
(EQ; Baron-Cohen & Wheelwright, 2004)

EQ
(Self-Report)

Instructions: Below is a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by circling your answer. There are no right or wrong answers, or trick questions.

1	2	3	4
Strongly agree	Slightly agree	Slightly disagree	Strongly disagree

1. I can easily tell if someone else wants to enter a conversation.	(1)	(2)	(3)	(4)
2. I find it difficult to explain to others things that I understand easily, when they don't understand it first time.	(1)	(2)	(3)	(4)
3. I really enjoy caring for other people.	(1)	(2)	(3)	(4)
4. I find it hard to know what to do in a social situation.	(1)	(2)	(3)	(4)
5. People often tell me that I went too far in driving my point home in a discussion.	(1)	(2)	(3)	(4)
6. It doesn't bother me too much if I am late meeting a friend.	(1)	(2)	(3)	(4)
7. Friendships and relationships are just too difficult, so I tend not to bother with them.	(1)	(2)	(3)	(4)
8. I often find it difficult to judge if something is rude or polite.	(1)	(2)	(3)	(4)
9. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.	(1)	(2)	(3)	(4)
10. When I was a child, I enjoyed cutting up worms to see what would happen.	(1)	(2)	(3)	(4)
11. I can pick up quickly if someone says one thing but means another.	(1)	(2)	(3)	(4)
12. It is hard for me to see why some things upset people so much.	(1)	(2)	(3)	(4)
13. I find it easy to put myself in somebody else's shoes.	(1)	(2)	(3)	(4)
14. I am good at predicting how someone will feel.	(1)	(2)	(3)	(4)
15. I am quick to spot when someone in a group is feeling awkward or uncomfortable.	(1)	(2)	(3)	(4)
16. If I say something that someone else is offended by, I think that that's their problem, not mine.	(1)	(2)	(3)	(4)
17. If anyone asked me if I liked their haircut, I would reply truthfully, even if I didn't like it.	(1)	(2)	(3)	(4)
18. I can't always see why someone should have felt offended by a remark.	(1)	(2)	(3)	(4)
19. Seeing people cry doesn't really upset me.	(1)	(2)	(3)	(4)
20. I am very blunt, which some people take to be rudeness, even though this is unintentional.	(1)	(2)	(3)	(4)
21. I don’t tend to find social situations confusing.	(1)	(2)	(3)	(4)
22. Other people tell me I am good at understanding how they are feeling and what they are thinking.	(1)	(2)	(3)	(4)
23. When I talk to people, I tend to talk about their experiences rather than my own.	(1)	(2)	(3)	(4)
24. It upsets me to see an animal in pain.	(1)	(2)	(3)	(4)
25. I am able to make decisions without being influenced by people's feelings.	(1)	(2)	(3)	(4)
26. I can easily tell if someone else is interested or bored with what I am saying.	(1)	(2)	(3)	(4)

EQ
(Self-Report)

27. I get upset if I see people suffering on news programmes.	(1)	(2)	(3)	(4)
28. Friends usually talk to me about their problems as they say that I am very understanding.	(1)	(2)	(3)	(4)
29. I can sense if I am intruding, even if the other person doesn't tell me.	(1)	(2)	(3)	(4)
30. People sometimes tell me that I have gone too far with teasing.	(1)	(2)	(3)	(4)
31. Other people often say that I am insensitive, though I don't always see why.	(1)	(2)	(3)	(4)
32. If I see a stranger in a group, I think that it is up to them to make an effort to join in.	(1)	(2)	(3)	(4)
33. I usually stay emotionally detached when watching a film.	(1)	(2)	(3)	(4)
34. I can tune into how someone else feels rapidly and intuitively.	(1)	(2)	(3)	(4)
35. I can easily work out what another person might want to talk about.	(1)	(2)	(3)	(4)
36. I can tell if someone is masking their true emotion.	(1)	(2)	(3)	(4)
37. I don't consciously work out the rules of social situations.	(1)	(2)	(3)	(4)
38. I am good at predicting what someone will do.	(1)	(2)	(3)	(4)
39. I tend to get emotionally involved with a friend's problems.	(1)	(2)	(3)	(4)
40. I can usually appreciate the other person's viewpoint, even if I don't agree with it.	(1)	(2)	(3)	(4)