

PATHOLOGIC ADAPTATION: EXAMINING AN ECOLOGICAL PATHWAY
MODEL OF CALLOUS-UNEMOTIONAL TRAITS

by

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ABSTRACT OF THE DISSERTATION

Pathologic adaptation: Examining an ecological pathway model of callous-unemotional traits

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Although previous research indicates a robust association between adverse experiences early in life and later externalizing behaviors such as aggression, violence, and delinquency (Anda et al., 2006; Moylan et al., 2010), less is known about the early childhood environmental antecedents of later callous-unemotional traits. In fact, some studies have indicated that callous-unemotional traits are inherited and relatively impervious to environmental influences (Viding, Blair, Moffitt, & Plomin, 2005; Viding, Jones, Frick, Moffitt, & Plomin, 2008). However, a few studies have found conflicting results, in which some youth who exhibit callous-unemotional traits report more experiences with adversity, such as abuse and violence exposure, although these studies are often cross-sectional in nature and typically rely on retrospective self-report (Kimonis, Fanti, Isoma, & Donoghue, 2013; Kimonis, Frick, Munoz, & Aucoin, 2008). The proposed dissertation research examines the impact of environmental influences –

including both risk and promotive factors – on the development of callous-unemotional traits. The research opens with three preliminary studies, two cross-sectional and one longitudinal, and concludes with a project that involves analyzing three large secondary longitudinal datasets.

Data for the dissertation research come from: the serious youth violence and long term use of violent media project, funded by the CDC; the Longitudinal Studies on Child Abuse and Neglect (LONGSCAN), funded by the National Center on Child Abuse and Neglect; the National Institute of Child Health and Development's (NICHD) Study on Early Child Care and Youth Development (SECCYD; The NICHD Early Child Care Research Network, 2005); the Video Game Violence (VGV; Bushman, Huesmann, Boxer, Anderson, & Gentile, 2005) project also funded by NICHD; and the Pathways to Desistance (PTD; Mulvey, 2004; Mulvey, 2011) project initiated by the MacArthur Foundation Research Network on Adolescent Development and Juvenile Justice.

I first use the cross-sectional data in the serious youth violence project to establish that youth with callous-unemotional traits and anxiety retrospectively report greater levels of exposure to aggression and violence, and concurrently report greater symptoms of psychopathology and aggressive and violent behavior. I also provide evidence for construct validity of the Inventory of Callous-Unemotional Traits and how best to integrate information from multiple informants. Then, using the LONGSCAN data, I show that adolescents with conduct disorder who lack guilt, a core component of callous-unemotional traits, are more likely to have substantiated reports of maltreatment in childhood.

For the final set of studies in this project, I incorporate analyses that take advantage of the longitudinal nature of these data to examine the antecedents to callous-unemotional traits. Specifically, I examine risk factors such as parental hostility and exposure to violence, as well as promotive factors such as neighborhood safety, friendship quality, and positive parenting characteristics. I hypothesize that youth exposed to key ecological risk factors will have greater tendencies to develop callous-unemotional traits, whereas youth exposed to theorized ecological promotive factors will be less likely to develop callous-unemotional traits. Finally, analyses will include person-level variables as potential moderators of these relationships, as it is possible that only youth with a fearful or inhibited temperament or who are high in emotional reactivity will be susceptible to these risk and promotive factors.

Preface

This dissertation is original work by the author, M. Docherty. A version of study 1 has been published as Docherty, Boxer, Huesmann, O'Brien, & Bushman (2016), and a version of study 2 is in press as Docherty, Boxer, Huesmann, O'Brien, & Bushman. A version of study 3 is currently in prep for publication. All tables and figures are the author's own work, and all data was used with permission from investigators.

Acknowledgement

This dissertation project would not have been possible without the emotional, social, and instrumental support I received from a number of individuals, and I would like to express my gratitude to them for helping me through this process.

My doctoral advisor, Dr. Paul Boxer, was an invaluable mentor, role model, reviewer, and guide through this journey. Paul encouraged me early on in my doctoral career to pursue research questions that interested me, to be productive and thorough in my work, and to learn new analyses and theories to help improve my research. The advisor is the most crucial piece of a doctoral student's experience, and I am so lucky and grateful that I had Paul with me every step of the way. He provided vital feedback and guidance when I needed it most, allowed me freedom to explore new ideas when I wanted it, and most of all kept encouraging me through difficult moments or areas of self-doubt. His mentoring style has helped to shape me into an independent scholar, and I hope that one day I can be even a fraction as helpful to any future graduate students that I might advise.

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though my publications were in peer-reviewed journals and not tabloid magazines, you still always expressed how proud you were of me and how you knew I would be successful, no matter how difficult it got. I would like to thank my father, Daniel.

Although you passed away while I was in this program, you never doubted me, and you showed me how to work hard, stay curious, and always pursue my goals, no matter how lofty they might seem. I would also like to thank my brothers, Christopher and Cullen, my extended family, and my future in-laws for all of their support and encouragement. Completing a doctoral program often feels like a test of endurance, and I do not know that I would have been able to do it without all of you around me.

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and ever-changing lab décor helped make my time at Rutgers feel more personal and welcoming.

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I am particularly grateful to my committee members, who have always been understanding and helpful through this process, and whose insights and unique perspectives were vital to improving my dissertation and helping me to become a better researcher. I know you are all extremely busy people, and you are amazing teachers and productive scholars, so I am forever grateful that you agreed to dedicate some of your time to being on my committee. Finally, I would like to thank the individuals who participated in the studies I describe throughout this dissertation, as well as the research teams who generously allowed me to use their data. This project would not have been possible without you.

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General Introduction

Adverse experiences in early childhood – such as trauma, exposure to violence, harsh parenting, abuse, and neglect – increase a youth's risk of developing problems later in life, particularly mental health symptoms and behavior problems (Anda et al., 2006; Moylan et al., 2010). Whereas the association between early adverse events and later conduct problems such as aggression and delinquency is well documented (Greenwald, 2002; McCabe, Lucchini, Hough, Yeh, & Hazen, 2005), the research is not as clear when it comes to the development of callous-unemotional traits, or the lack of guilt, empathy, concern, and emotion found in some youth. It is important to study the etiological antecedents to callous-unemotional traits, as these traits are typically exhibited by a subset of youth who engage in more serious and stable aggressive, violent, and antisocial behavior (Frick, 2006; Frick, Cornell, Barry, Bodin, & Dane, 2003; Frick, Cornell, Bodin, et al., 2003; Frick, Ray, Thornton, & Kahn, 2014; Frick & White, 2008). Some studies conceptualize callous-unemotional traits as a stable personality trait that is more heavily influenced by heredity compared to externalizing problems (Viding et al., 2005; Viding, Frick, & Plomin, 2007; Viding et al., 2008), as well as less susceptible to environmental influences, such as parenting and discipline (Chinchilla & Kosson, 2015; Hawes & Dadds, 2005; Oxford, Cavell, & Hughes, 2003; Wootton, Frick, Shelton, & Silverthorn, 1997). However, other research studies have found an association between the presence of early adverse experiences, as well as the absence of early promotive factors, and callous-unemotional traits (Kahn, Frick, et al., 2013; Kimonis, Cross, Howard, & Donoghue, 2013; Kimonis, Fanti, et al., 2013; Kimonis, Frick, Munoz, et al., 2008). Therefore, an important aim of the proposed project is to clarify the nature of the

relationship between ecological risk and promotive factors and the development of callous-unemotional traits.

Pathways to conduct problems

In general, research has found a number of risk factors that are associated with conduct problems in children and adolescents. These include individual risk factors, such as problems with executive function (Giancola, Mezzich, & Tarter, 1998), temperament (Frick & Morris, 2004; Giancola et al., 1998), and genetic predispositions (Button et al., 2007; Goldstein, Prescott, & Kendler, 2001), as well as contextual risk factors, such as ineffective or harsh discipline (Snyder, Cramer, Afrank, & Patterson, 2005; Webster-Stratton & Hammond, 1998), physical abuse (Dodge, Pettit, Bates, & Valente, 1995), and exposure to aggressive or delinquent peers (Barnow, Lucht, & Freyberger, 2005; Snyder, Schrepferman, et al., 2005). Models that predict increased externalizing problems in the presence of such risk factors include the pathologic adaptation model (Boxer et al., 2008; Ng-Mak, Salzinger, Feldman, & Stueve, 2002, 2004) and developmental cascade models (Dodge, Greenberg, Malone, & Conduct Problems Prevention Research Group, 2008; Masten et al., 2005). A number of studies have gone one step further to show that an interaction of personal and contextual risk factors best predicts later conduct problems, in a framework known as the biopsychosocial model (Bates, Pettit, Dodge, & Ridge, 1998; Cadoret, Yates, Ed, Woodworth, & Stewart, 1995; Dadds & Salmon, 2003; Dodge & Pettit, 2003; Jaffee et al., 2005; Kim-Cohen et al., 2006; Moffitt, 2005).

In characterizing the developmental pathways to conduct problems, one widely cited conceptual model focuses on the presence or absence of callous-unemotional traits (Frick, Cornell, Bodin, et al., 2003; Pardini & Frick, 2013). In the fifth edition of the

Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013), these traits are denoted by the “with limited prosocial emotions” (LPE) specifier for the conduct disorder diagnosis. In this dual pathway model of conduct problems, conduct-disordered youth – and particularly those with childhood onset – differ in their etiological trajectories to conduct problems. Youth with callous-unemotional traits are theoretically born with a temperament characterized by low emotional reactivity and decreased behavioral inhibition and fear (Frick, 2004a, 2006, 2012; Frick, Cornell, Bodin, et al., 2003; Pardini & Frick, 2013), and are therefore less responsive to aversive stimuli, such as the negative consequences (e.g., discipline, upsetting others) that often result from aggressive and antisocial behavior (Pardini, Lochman, & Frick, 2003; Sylvers, Brennan, & Lilienfeld, 2011; Viding, Sebastian, et al., 2012). These youth also appear to be less amenable to traditional intervention efforts (Falkenbach, Poythress, & Heide, 2003; O'Neill, Lidz, & Heilbrun, 2003; Spain, Douglas, Poythress, & Epstein, 2004; Waschbusch, Carrey, Willoughby, King, & Andrade, 2007), although they can respond to treatment specifically tailored to their needs (Kimonis & Armstrong, 2012; N. V. Miller et al., 2014).

On the other hand, youth with conduct problems who do not exhibit callous-unemotional traits appear to be highly sensitive to environmental stimuli, such as physical abuse, parenting practices, and violence exposure (Chang, Schwartz, Dodge, & McBride-Chang, 2003; DeKlyen, Speltz, & Greenberg, 1998; Dodge et al., 1995; Edens, Skopp, & Cahill, 2008). To summarize, variable-centered models predict that risk factors such as harsh discipline or abuse universally increase a child's risk of developing conduct problems, whereas person-centered or interaction models predict that these risk factors

operate differentially depending on the characteristics of the individual (Bauer & Shanahan, 2007; Laursen & Hoff, 2006; Murdock & Miller, 2003). Differential susceptibility models such as this one take both variable-level and person-level factors into account by predicting that certain variables may impact subsets of youth differently (Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007; Belsky & Pluess, 2009). The dual-pathway concept of conduct disorder can be thought of as one such differential susceptibility model, as it predicts that both risk and promotive factors would be less effective in predicting conduct problems among youth with callous-unemotional traits compared to youth without these traits.

Pathways to callous-unemotional traits

Much of the work attempting to uncover etiological pathways to callous-unemotional traits has focused on individual characteristics, such as temperament and inhibition (Eriksson, Fanti, Frogner, & Andershed, 2014; Frick, Cornell, Bodin, et al., 2003; Pardini et al., 2003; Roose, Bijttebier, Van der Oord, Claes, & Lilienfeld, 2013), and the degree of heritability for these traits (Henry, Pingault, Boivin, Rijdsdijk, & Viding, 2015; Viding et al., 2005; Viding et al., 2008). In addition, because callous-unemotional traits in youth are often conceptualized as a precursor for adult psychopathy (Johnstone & Cooke, 2004; Skeem & Cauffman, 2003; Vitacco & Vincent, 2006), the heritability and stability of psychopathic traits in adolescence and adulthood (Forsman, Lichtenstein, Andershed, & Larsson, 2008; Larsson, Andershed, & Lichtenstein, 2006; Loney, Taylor, Butler, & Iacono, 2007; Lynam et al., 2009) informs much of this work. However, studies increasingly are illuminating the role of ecological influences above and beyond personal

liabilities in the development of callous-unemotional traits (Rubio, Krieger, Finney, & Coker, 2014).

Ecological risk factors for callous-unemotional traits

Using retrospective report, youth who exhibit callous-unemotional traits in adolescence are more likely to have childhood experiences of abuse and neglect (Carlson, Oshri, & Kwon, 2015; Kimonis, Fanti, et al., 2013; Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012; Krischer & Sevecke, 2008) and less likely to have experienced positive parenting practices (Kimonis, Cross, et al., 2013; Marshall & Cooke, 1999). Using concurrent reports, young children with callous-unemotional traits are more likely to exhibit a disorganized attachment style (Pasalich, Dadds, Hawes, & Brennan, 2012), and among incarcerated adolescents, callous-unemotional traits are positively associated with traumatic experiences and trauma symptoms (Kerig, Bennett, Thompson, & Becker, 2012; Sharf, Kimonis, & Howard, 2014; Tatar, Cauffman, Kimonis, & Skeem, 2012). Other studies have found that certain risk factors, such as low levels of neighborhood collective efficacy and high levels of violence exposure, mediate or moderate the relationship between callous-unemotional traits and externalizing behaviors (Howard, Kimonis, Munoz, & Frick, 2012; Meier, Slutske, Arndt, & Cadoret, 2008), whereas some find that ecological risk factors are only present for youth who are high in both anxiety and callous-unemotional traits (Euler et al., 2015; Kahn, Frick, et al., 2013; Kimonis et al., 2012; Sharf et al., 2014; Tatar et al., 2012), deemed “secondary variants” in comparison to low-anxiety “primary variants” of callous-unemotional traits. Therefore, the development of callous-unemotional traits appears to be influenced by a youth’s environment, and this association may vary depending on person-level factors.

However, more conclusive findings come from prospective longitudinal studies that assess risk factors before callous-unemotional traits, or particularly ones that track callous-unemotional traits over multiple time points across development. One prospective study found that callous-unemotional traits at age thirteen was negatively associated with warm parenting at age four for girls and positively associated with harsh parenting at age four for boys (Barker, Oliver, Viding, Salekin, & Maughan, 2011). Other studies found that later callous-unemotional traits were predicted by earlier parenting characteristics (Lopez-Romero, Romero, & Gomez-Fraguela, 2015; Pardini, Lochman, & Powell, 2007; Waller, Gardner, & Hyde, 2013; Waller et al., 2012), disorganized (Bohlin, Eninger, Brocki, & Thorell, 2012) and avoidant (Conradi, Boertien, Cavus, & Verschuere, 2015) attachment styles, negative life events (Kimonis, Centifanti, L., & Frick, 2014), peer victimization (Barker & Salekin, 2012), chaos in the home (Fontaine, McCrory, Boivin, Moffitt, & Viding, 2011), and exposure to community violence (Davis, Ammons, Dahl, & Kliewer, 2014). There are limitations to some of this research, however, as some of the studies were conducted outside of the United States (Barker et al., 2011; Lopez-Romero et al., 2015) and therefore may not generalize to a U.S. sample, and other studies had relatively small sample sizes (i.e., fewer than 200 participants; Bohlin et al., 2012; Lopez-Romero et al., 2015; Pardini et al., 2007). In addition, none of these studies examined the impact of more severe experiences, such as abuse or trauma, on the development of callous-unemotional traits, and none used person-centered analyses to account for different pathways to callous-unemotional traits, although some did assess interaction effects.

Promotive factors for callous-unemotional traits

Research indicates that externalizing problems are more impervious to positive environmental influences, such as parenting or treatment efforts, among youth with high levels of callous-unemotional traits (Chinchilla & Kosson, 2015; Hawes, Price, & Dadds, 2014; Oxford et al., 2003; Wootton et al., 1997). However, some studies have found that youth high in callous-unemotional traits may have conduct problems that are more strongly influenced by parental warmth than youth low in callous-unemotional traits (Kroneman, Hipwell, Loeber, Koot, & Pardini, 2011; Pasalich, Dadds, Hawes, & Brennan, 2011). In addition, other studies have found that appropriate treatment of youth with callous-unemotional traits can result in improved empathy and emotion recognition (Dadds, Cauchi, Wimalaweera, Hawes, & Brennan, 2012; Datyner, Kimonis, Hunt, & Armstrong, in press), as well as decreased callous-unemotional traits (Butler, Baruch, Hickey, & Fonagy, 2011; Hawes & Dadds, 2007; Kolko et al., 2009; Lochman et al., 2014; McDonald, Dodson, Rosenfield, & Jouriles, 2011; Norlander, 2008; Salekin, Tippey, & Allen, 2012; Somech & Elizur, 2012; Wilkinson, Waller, & Viding, 2015).

There is also evidence that warm parenting practices are associated with later reductions in callousness (Barker et al., 2011; Davis et al., 2014; Pardini et al., 2007), which makes sense given that parental harshness is a risk factor for callous-unemotional traits, as described above. However, many of these studies were limited by small sample sizes (i.e., 108 or fewer subjects; Butler et al., 2011; Hawes & Dadds, 2007; McDonald et al., 2011; Norlander, 2008), brief follow-up periods (i.e., six months or shorter; Hawes & Dadds, 2007; Norlander, 2008), and the use of only parent (McDonald et al., 2011;

Somech & Elizur, 2012) or teacher (Kolko et al., 2009; Lochman et al., 2014) report in assessing callous-unemotional traits.

The proposed differential susceptibility model would explain a variety of previous results and theories, including: primary and secondary variants of psychopathy (Fanti, Demetriou, & Kimonis, 2013; Kimonis et al., 2012; Tatar et al., 2012); conflicting findings regarding temperamental (Barker et al., 2011; Mills-Koonce et al., 2015) and environmental risk factors (Waller et al., 2013; Wootton et al., 1997) for callous-unemotional traits; the distinction between inherent and acquired callousness (Kerig & Becker, 2010; Porter, 1996); and the finding that youth with callous-unemotional traits do not always exhibit conduct problems (Kumsta, Sonuga-Barke, & Rutter, 2012). This model would also be in line with other theories regarding the development of internalizing symptoms and externalizing behaviors, such as pathologic adaptation (youth exposed to high levels of violence exposure protect themselves through moral disengagement and subsequently commit more aggressive and violent behaviors while displaying fewer symptoms of psychological distress; Boxer et al., 2008; Ng-Mak et al., 2002, 2004) and the biopsychosocial model (Dodge & Pettit, 2003). Because the associations between fearlessness or low reactivity and callousness have been researched more extensively than the associations between fearfulness or high reactivity and callousness, the current dissertation will focus on this latter pathway to callousness, here deemed the ecological pathway model of callous-unemotional traits.

This dual-pathways model encompasses the concepts of both equifinality and multifinality (Cicchetti, 2014; Cicchetti & Rogosch, 1996): equifinality because there are multiple pathways (e.g., genetic and ecological) to callous-unemotional traits, and

multifinality because there are multiple outcomes (e.g., callous-unemotional traits, other psychopathology) of ecological risk depending on individual disposition or temperament. It is possible that only youth with a reactive temperament who are exposed to ecological risk might develop callous-unemotional traits as a maladaptive coping mechanism. Although callousness might be maladaptive in terms of increased externalizing behaviors and decreased social skills, it could act as an adaptive strategy to protect the youth from further psychological or emotional harm, consistent with the desensitization (Carnagey, Anderson, & Bushman, 2007; Fanti, Vanman, Henrich, & Avraamides, 2009) and pathologic adaptation (Ng-Mak et al., 2002, 2004) models.

Exposure to ecological risk would not impact emotionally unreactive or fearless youths' callous-unemotional traits, because theoretically they are genetically predisposed to developing callous-unemotional traits, and adverse experiences likely would not change this tendency. However, for some youth with poor emotion regulation or greater emotional reactivity or fearfulness, ecological risk could explain the development of callous-unemotional traits. Although the proposed dissertation project will be the first to directly test this model, the suggested framework is in line with previous findings suggesting that difficult temperament can lead to callous-unemotional traits (Waller, Shaw, Forbes, & Hyde, 2015) and that emotional numbing after trauma is associated with callous-unemotional traits (Kerig et al., 2012).

Goals and hypotheses

In the first three studies, I examine associations between callous-unemotional traits and other variables in two different datasets. Studies one and two examine callous-unemotional traits in a case control sample of adolescents, some of whom are adjudicated

for a juvenile offense and some of whom are high school students. Study one aims to identify variants of callous-unemotional traits that differ in their levels of comorbid anxiety, and hypothesizes that youth with elevated levels of both callous-unemotional traits and anxiety will report greater exposure to violence and aggression, more psychopathology symptoms, and more aggressive and violent behaviors compared to youth with high levels of callous-unemotional traits but low levels of anxiety.

Study two aims to identify the best way to assess callous-unemotional traits using a well-established measure (the Inventory of Callous-Unemotional Traits, or ICU); for this study, I hypothesize that parent report will outperform teacher or youth reports of callous-unemotional traits, that multi-informant composites will outperform any single informant report, and that I will be able to identify a valid cut-off score for the ICU based on the informant report or composite being used. Study three uses a longitudinal sample of youth at high risk of having a child protective services (CPS) report to test whether substantiated CPS reports in childhood and early adolescence are associated with conduct disorder and lack of guilt in adolescence. For study three, I hypothesize the presence, frequency, and variety of earlier CPS reports will be associated with greater risk of having conduct disorder and lacking guilt in adolescence.

The final dissertation study tests the dual-pathways model of callous-unemotional traits using three longitudinal data sets and various statistical analyses in a stepwise fashion. The project is guided by three general research questions: 1) Does earlier ecological risk predict later increased callous-unemotional traits? 2) Do earlier promotive factors predict later decreased callous-unemotional traits? And 3) Does regulation or reactivity moderate the previous two relationships, such that they are stronger for youth

with poorer emotion regulation or greater emotional reactivity, and weaker for youth with better emotion regulation or decreased emotional reactivity?

I hypothesize that there are two likely outcomes to these research questions. In the first outcome, support is found for all three research questions; in other words, risk and promotive factors do influence the development of callous-unemotional traits, and reactivity moderates these associations. However, it is also possible that I may find no support for the first two research questions, but still find support for the third research question; in other words, risk and promotive factors do not influence the development of callous-unemotional traits in the overall sample, but emotional reactivity or regulation acts as a moderator such that these associations do exist for youth with greater emotional reactivity or poorer regulation. The obtained pattern of results will depend on the numbers of youth on the two different pathways to callous-unemotional traits, as well as the strength of associations for youth on the ecological pathway. Although the conclusions regarding the first two research questions differ, the findings for the third research question are assumed to be the same, as this is the most direct test of the differential susceptibility model and would be able to detect between-subject differences in association.

Study 1: Variants of Callous-Unemotional Traits

Although psychopathy was long theorized as a unified construct, many recent studies have begun to examine the heterogeneity of psychopathic or callous-unemotional traits. One line of work with youth focuses on the presence or absence of anxiety, and the difference between low-anxiety “primary variants” and high-anxiety “secondary variants” of psychopathy or callous-unemotional traits (Euler et al., 2015; Kahn, Frick, et al., 2013;

Kimonis et al., 2012; Sharf et al., 2014). Compared to primary variants, secondary variants are more likely to report experiences of abuse, neglect, trauma, and violence exposure (Kimonis et al., 2012; Sharf et al., 2014; Tatar et al., 2012). They are also more aggressive (Kahn, Frick, et al., 2013), delinquent (Euler et al., 2015), and violent (Kimonis, Fanti, et al., 2013), and may be more likely to engage in different types of aggression, such as reactive rather than proactive (Flexon, 2015; Kimonis, Skeem, Cauffman, & Dmitrieva, 2011). However, most of the above studies used samples of detained male adolescents. There has been very little investigation into whether these findings would extend to females and community samples as well. Therefore, the current study employs a mixed sample of both community and detained youth of both genders to investigate whether youth who have high levels of both anxiety and callous-unemotional traits report more adverse experiences, mental health symptoms, and problem behaviors compared to youth with high callous-unemotional traits and low anxiety.

Goals and hypotheses

The current study uses data from the *Serious Youth Violence and Exposure to Violent Media Project* (see Boxer, Huesmann, Bushman, O'Brien, & Mocerri, 2009), funded by the Centers for Disease Control (CDC), to better understand the person-level relationships between anxiety, callous-unemotional traits, and adverse experiences, mental health symptoms, and problem behaviors. I hypothesize that a model-based cluster analysis will reveal at least three clusters in the data based on callous-unemotional traits and anxiety: one cluster with moderate anxiety and low callous-unemotional traits (*non-variants*), one cluster with low anxiety and high callous-unemotional traits (*primary variants*), and one cluster with high anxiety and high callous-unemotional traits

(*secondary variants*). Based on previous research, I hypothesize that the secondary variants will differ from both the non-variants and primary variants in a number of ways, including: higher levels of exposure to aggression and violence; greater symptoms of depression and psychoticism; and more aggressive and violent behavior.

Methods

Participants

Although data were originally collected on 820 youth for a larger project, 21 (2.56%) cases were excluded for this project due to missing data on the anxiety measure. The combined sample included 419 high school students (52.5% female; 46.3% non-white; M age = 16.84 years, SD = 0.71) and 380 youth in juvenile detention facilities (26.3% female; 45.3% non-white; M age = 15.57 years, SD = 1.511. Youth completed self-report measures, and their parents/guardians and teachers (or staff members for the detained sample) completed questionnaires. All 799 youth had valid self-report data and data from either a parent or a teacher; 622 youth had valid data from all three sources. Compared to the detained sample, the student sample was older, had a greater proportion of females, had parents with greater levels of education, had a greater proportion of youth with married parents, and had higher household incomes; however, the two samples did not differ in racial/ethnic composition. In subsequent analyses, the high school and delinquent samples will be collapsed into one sample to understand what variant membership will look like overall, as well as for each separate sample. Collapsing both samples into one allows for the measurement of a broader range of the variables of interest (e.g., callous-unemotional traits) simultaneously.

Measures

Callous-unemotional traits. Youth, their parents/guardians, and their teachers/staff members completed informant-specific versions of the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004b). The ICU was developed from the Antisocial Process Screening Device (APSD; Frick & Hare, 2001), a 20-item measure originally designed to assess the full range of psychopathic traits among children and adolescents. However, the APSD only included six items that captured callous-unemotional traits. In developing the ICU, Frick (2004b) began with four reliable items from the APSD, and used these as the basis for a callous-unemotional measure with four subscales (careless, callous, unemotional, uncaring). An additional five items was written for each of the original APSD items, so that the ICU became a 24-item measure with four subscales of six items each, and each subscale had an equal number of positively and negatively worded items.

Despite the ICU's initial theorized factor structure, follow-up studies have indicated that two of the 24 items are unreliable, and that a total scale score is more reliable than subscale scores (Boxer et al., 2009; Kimonis et al., 2008). Therefore, I computed each informant-specific score as the mean across the remaining 22 items. Each informant rated "how well" each of 24 statements described the target youth along a four-point scale from 0 (not at all true) to 3 (definitely true). To form a composite across all informants, I computed the mean of all available scores. Internal reliability was high for youth self-report ($\alpha = .83$), parent ($\alpha = .93$), and teacher/staff ($\alpha = .92$) versions. Recent studies have established the basic reliability and construct validity properties of the self-report version of the ICU in detained and community samples of adolescents similar to

the current sample (Essau, Sasagawa, & Frick, 2006; Kimonis, Frick, Skeem, et al., 2008).

Psychopathology. Youth completed the six-item Anxiety (e.g., “suddenly scared for no reason”), six-item Depression (e.g., “feeling hopeless about the future”) and five-item Psychoticism (e.g., “the idea that something is wrong with your mind”) subscales of the Brief Symptom Inventory (BSI; Derogatis, 1992). Youth rated the extent to which they have experienced various symptoms of each form of psychopathology during the seven days prior to assessment on a 5-point scale from 0 (not at all) to 4 (extremely). Composite scores are the mean of the raw item scores for each scale multiplied by the number of items on the scale (Anxiety $\alpha = .84$; Depression $\alpha = .96$; Psychoticism $\alpha = .76$). Prior research has found this measure to be valid and reliable among adult and adolescent samples (Canetti, Shalev, & De-Nour, 1994; Derogatis & Melisaratos, 1983).

Externalizing behavior. I measured aggressive and violent behavior using reliable multi-informant composite scores indicating “Violence” (youth, parent/guardian, and teacher/staff reports of serious physical aggression; parent/guardian report of injurious behavior; Boxer et al., 2009; Lefkowitz, Eron, & Walder, 1977) and “General Aggression” not specifically violent in nature (youth report of delinquent behavior and trait aggressiveness; parent/guardian report of conduct problems; teacher/staff report of conduct problems and general aggression; Buss & Perry, 1992; Elliott & Huizinga, 1983; Goodman, 2001; Huesmann, Eron, Guerra, & Crawshaw, 1994). These scores were estimated on the full sample of 820 youth via latent variable modeling using full information maximum likelihood in the AMOS 7.0 program (Arbuckle, 2006). AMOS applies full information maximum likelihood to analyze the model fit in the presence of

missing data, and subsequently can generate latent factor scores via regression imputation. Full measurement details including sample items, scale composition, fit statistics, and known-groups validity of factor scores have been described extensively (Boxer et al., 2009).

Exposure to low-level aggression. Youth completed an 11-item measure to assess experiences with witnessing and being victimized by “low-level” aggressive acts of direct and indirect verbal aggression and mild physical aggression (e.g., “How often have you seen another person get hit or pushed?” “How often have you had rumors spread about you?”; Boxer, Edwards-Leeper, Goldstein, Musher-Eizenman, & Dubow, 2003). Responses were made on a 4-point scale from 0 (never) to 3 (a lot of times). For the purposes of the present investigation, I used the internally reliable total score, computed as the mean of all items ($\alpha = .81$). This measure is validated for use in community samples slightly younger than the current sample (Boxer et al., 2003; Musher-Eizenman et al., 2004).

Exposure to neighborhood violence. Youth completed the four-item Neighborhood Violence subscale of the Stressful Urban Life Events Scale (Attar, Guerra, & Tolan, 1994; see also Guerra, Huesmann, & Spindler, 2003) regarding both concurrent recent exposure and retrospective childhood exposure. Youth indicated (0 = no, 1 = yes) whether they had been exposed to specific indicators of neighborhood violence (e.g., “Have you seen anyone beaten, shot, or really hurt by someone?”). Composite scores are the sum of the four indicators for childhood and recent periods (KR20 [childhood] = .58, KR20 [recent] = .56). Although these internal reliability estimates are less than optimal, it is neither unusual nor problematic for event history checklists to produce low internal

reliability coefficients, as functionally they operate as indexes rather than scales (Streiner, 2003).

Procedures

All procedures were approved by the Institutional Review Board of the University of Michigan, the state agency overseeing the state detention facilities, the federal Office of Human Research Protections, the Institutional Review Board of the Centers for Disease Control, and the directors or principals of all schools and detention facilities involved in the project. Youth were recruited from public high schools (rural, suburban, and urban) and juvenile detention centers (county and state) selected to yield a sample representing a range of risk for aggressive and violent behavior. Youth completed pencil-and-paper Scantron surveys that typically took about one hour to complete, and the research staff provided survey booklets for parents/guardians and teachers/staff members to complete. High school students received \$20 in compensation for their participation, and delinquents received \$10 due to agency restrictions. Parents/guardians of high school students received \$25, and parents/guardians of detained youth received \$50. Teachers and staff members received \$5 per completed survey, although this was distributed differently by site due to school or agency policies.

Plan of analysis

Because the primary/secondary variant model of callous-unemotional traits implies a person-centered analysis, and because a number of previous studies in this area have used model-based cluster (MBC) analysis, I decided to use MBC for the current study. Compared to other cluster procedures, MBC examines the data for a cluster model that provides the best fit to the data, while varying the number, shape, distribution,

volume, and orientation of clusters (Fraley & Raftery, 1998). Thus, it does not require any hypotheses a priori about the quantity or quality of clusters, other than which variables should determine cluster membership; however, based on previous studies, I hypothesized that there would at least be three different clusters based on callous-unemotional traits and anxiety; a low callous-unemotional traits and moderate anxiety cluster (non-variants), a high callous-unemotional traits and low anxiety cluster (primary variants), and a high callous-unemotional traits and high anxiety cluster (secondary variants).

Results

Descriptive statistics

With the exception of the MBC analysis, I used Stata (StataCorp, 2015) to conduct all analyses. Descriptive statistics of study variables and bivariate correlations between study variables can be seen in Table 1. Most of the study variables appear to be strongly correlated, and the only nonsignificant correlations appear to be between age and exposure to low-level aggression, and age and exposure to current neighborhood violence.

Cluster analysis

I conducted the MBC analysis with the mclust package (Fraley, Raftery, Murphy, & Scrucca, 2012) in R (R Core Team, 2013). The MBC analysis used standardized scores (z-scores) of the mean composite of callous-unemotional traits across all available informants and the mean self-reported anxiety scores to determine cluster membership. Results indicated that the best-fitting model to the data included four clusters with diagonal distributions that have variable volume and shape and are oriented along

coordinate axes. Using Bayesian Information Criterion (BIC), this model provided a better fit to the data (BIC = -4165.46) than the second-best-fitting model (BIC = -4182.82) because the difference in BIC between the two models was 17.36, and a difference greater than 10 provides evidence in favor of the model with the largest BIC value¹ (Jeffreys, 1961; Kass & Raftery, 1995). The average posterior probability that observations were correctly assigned to a cluster was 80.18%.

Description of clusters

Table 2 displays sample sizes and descriptive statistics for all four clusters. The MBC analysis indicated that there was a cluster with low callous-unemotional traits and moderate anxiety (*non-variants*), a cluster high in callous-unemotional traits and low in anxiety (*primary variants*), and a cluster high in callous-unemotional traits and high in anxiety (*secondary variants*), as I hypothesized. Surprisingly, the fourth cluster exhibited moderately high levels of callous-unemotional traits and anxiety. Because I had no a priori hypotheses about this cluster, and because previous studies that found a similar group deemed it the fearful cluster, I decided to call this the *fearful* cluster to be consistent with prior work. Perhaps the most surprising aspect of this cluster is its size; 39.05% of the sample is part of this fearful cluster. *F*-tests with post hoc comparisons using Tukey's honest significant difference (HSD) indicated that the clusters differed significantly on callous-unemotional traits, $F(3, 795) = 6.77, p < .001$, such that the other three clusters had significantly higher callous-unemotional traits than the non-variant cluster ($p < .001$), but that they did not differ from one another. The clusters also all

¹ The equation for BIC in mclust is as follows: $BIC = 2 \loglik_M(x, \theta_k^*) - (\# \text{ params})_M \log(n)$, where $\loglik_M(x, \theta_k^*)$ is the maximum loglikelihood for the model and data, $(\# \text{ params})_M$ is the number of independent parameters to be estimated in the model M , and n is the number of observations in the data (Fraley et al., 2012).

significantly differed from each other on anxiety, $F(3, 795) = 1,707.52, p < .001$, such that the secondary cluster had the highest anxiety score, followed by the fearful cluster, the non-variant cluster, and the primary cluster (all comparisons significant at $p < .001$).

Differences among clusters

Demographics. Analyses of demographic differences among the cluster groups indicated no differences in proportion of non-white youth or in household income, but significant variation by gender and adjudicated status, such that the secondary callous-unemotional cluster had a significantly greater proportion of females than the primary callous-unemotional cluster ($p < 0.001$), the non-variant cluster had a greater proportion of high school students than the primary ($p < 0.001$), secondary ($p < 0.001$), and fearful ($p = 0.002$) clusters, and the secondary cluster had a greater proportion of adjudicated participants than the primary and fearful clusters ($p < 0.001$). An F-test indicated that the clusters differed significantly on age, $F(3, 795) = 11.26, p < 0.001$, such that the primary and secondary clusters are younger than the non-variant cluster ($p < 0.001$), and the secondary cluster is younger than the fearful cluster ($p = 0.002$), according to Tukey's HSD tests.

Psychopathology. Next, I assessed group differences by cluster on two different mental health variables, depression and psychoticism. To test for group differences, I ran two different analyses of covariance (ANCOVAs), one for depression and one for psychoticism. Each ANCOVA included adjudicated status (adjudicated vs. high school) and gender (male vs. female) as dummy-coded categorical covariates, and age as a continuous covariate, because these variables differ significantly across the clusters.

ANCOVA results for mental health, aggressive and violent behavior, and exposure to aggression and violence are depicted in Figure 1.

The ANCOVA for depression indicated that the clusters significantly differed in depression, $F(3, 791) = 261.53, p < 0.001$, partial $\eta^2 = 0.50$, and post hoc Tukey's HSD comparisons for the adjusted means indicated that each of the pairwise comparisons was significant ($p < 0.001$ for all comparisons). Specifically, the secondary group was highest in depression, followed by the fearful group, the non-variant group, and the primary group. The ANCOVA for psychoticism suggested similar results, $F(3, 791) = 213.16, p < 0.001$, partial $\eta^2 = 0.45$, again with all post hoc pairwise comparisons significant at $p < 0.001$, and the order of clusters remaining the same.

Aggressive and violent behavior. To assess differences in aggressive and violent behavior by cluster, I ran the post hoc comparisons and found that the fearful and secondary clusters were more exposed to low level aggression than both the non-variant and primary clusters, $p < 0.001$, and that the secondary cluster was more exposed to low level aggression than the fearful cluster, $p = 0.005$.

The ANCOVA for exposure to past neighborhood violence was also significant, $F(3, 792) = 8.09, p < 0.001$, partial $\eta^2 = 0.03$, and significant group differences indicated that the secondary cluster had greater exposure to past neighborhood violence than both the non-variant cluster, $p = 0.005$, and the primary cluster, $p < 0.001$, and the fearful cluster had greater exposure than the primary cluster, $p = 0.003$. Finally, the ANCOVA for exposure to current neighborhood violence was significant, $F(3, 786) = 11.24, p < 0.001$, partial $\eta^2 = 0.03$, such that the secondary and fearful clusters had greater exposure

than the primary cluster, $p < 0.001$ and $p = 0.001$, respectively, and the non-variant cluster, $p = 0.009$ and $p = 0.039$, respectively.

Supplementary analyses

One limitation of using cluster analysis is that each member of a cluster is treated equally, although they vary in their posterior probabilities of cluster membership.

Therefore, I also ran analyses to test whether the outcomes of interest were correlated with probabilities of cluster membership. For each analysis, I regressed the outcome on the posterior probability of being in each cluster, with the non-variant cluster as the base outcome, and included the same covariates (age, gender, and adjudicated status) as the previous models. I then tested whether the three probability coefficients were significantly different from each other as well. Results for each analysis are described below, with unstandardized coefficients reported, and generally confirm the findings from treating the clusters as a grouping variable.

Psychopathology. Compared to the non-variant cluster, probability of being in the primary cluster was significantly associated with fewer depression symptoms, $b = -1.14$, $p = .004$; however, probability of secondary, $b = 12.69$, $p < .001$, and fearful, $b = 3.65$, $p < .001$, cluster membership was significantly associated with greater depression symptoms. The secondary coefficient was stronger than the fearful coefficient, $F(1, 7) = 157.79$, $p < .001$. For psychoticism symptoms, probability of primary cluster membership was significantly associated with fewer symptoms, $b = -1.31$, $p < .001$, while probability of secondary, $b = 8.97$, $p < .001$, and fearful, $b = 2.29$, $p < .001$, cluster membership was significantly associated with more symptoms. All three coefficients significantly differed from each other ($p < .001$).

Aggressive and violent behavior. Probabilities of being in the primary, $b = 2.85$, $p = .003$, secondary, $b = 6.06$, $p < .001$, and fearful, $b = 4.32$, $p < .001$, clusters were each significantly associated with greater aggressive behavior than the non-variant cluster, although the only difference between coefficients was for the primary and secondary probabilities, $F(1, 7) = 9.74$, $p = .002$. Similarly, probabilities of being in the primary, $b = 0.02$, $p = .002$, secondary, $b = 0.04$, $p < .001$, and fearful, $b = 0.03$, $p < .001$, clusters were each significantly associated with greater violent behavior than the non-variant cluster, although the only difference between coefficients was for the primary and secondary probabilities, $F(1, 792) = 6.89$, $p = .009$.

Exposure to aggression and violence. Probability of being in the primary cluster was not significantly associated with exposure to low level aggression, $b = -1.17$, $p = .214$; however, probability of being in the secondary, $b = 6.34$, $p < .001$, and fearful, $b = 3.79$, $p < .001$, clusters was significantly associated with greater exposure to low level aggression. Further, all three coefficients were significantly different from each other at the $p < .01$ level. Although probability of being in the primary, $b = -0.13$, $p = .455$, and fearful, $b = 0.24$, $p = .128$, clusters was not associated with exposure to past neighborhood violence, probability of secondary cluster membership was significantly associated with greater exposure to past neighborhood violence, $b = 0.61$, $p < .001$, and all three coefficients were significantly different from each other at the $p < .05$ level. Probability of being in the primary cluster was not associated with exposure to current neighborhood violence, $b = -0.10$, $p = .561$, but probability of fearful, $b = .31$, $p = .042$, and secondary, $b = 0.58$, $p < .001$, cluster membership was significantly associated with greater exposure to current neighborhood violence. The coefficients for fearful and

secondary cluster probability did not differ from each other, but both differed significantly from the primary coefficient at $p < .01$.

Discussion

In this study, I analyzed extensive data collected from adolescents in the community as well as in detention facilities, including both self-report and multi-informant data obtained through questionnaires and interviews. I examined the relationship between different types of callous-unemotional variants and mental health, exposure to violence and aggression, and violent and aggressive behavior. These analyses used multi-informant data among a sample of adolescents from both high schools ($n = 419$) and juvenile detention facilities ($n = 380$). These findings contribute to the ongoing refinement of identifiable variants of psychopathy. I found that, consistent with my hypotheses, youth with high levels of both callous-unemotional traits and anxiety reported significantly greater levels of psychopathology, exposure to violence and aggression, and violent and aggressive behavior, compared to youth with high levels of callous-unemotional traits and low levels of anxiety.

The results of this study have important implications for theories on development of antisocial behavior and psychopathy. Unlike many studies that have focused on samples that are either incarcerated or at very high risk, this study included a large, blended sample of youth drawn from the community as well as detention centers, relatively high in minority representation (~45% racial/ethnic minority), and included a wide range of parent education backgrounds (i.e., about 7% did not graduate high school, about 21% graduated college).

Similar to previous research, I found two subgroups of adolescents with callous-unemotional traits differing in levels of anxiety. *Primary callous-unemotional variants* presented with low anxiety, while *secondary callous-unemotional variants* reported higher anxiety. I found many expected differences between the groups: secondary variants had more risk factors and worse outcomes than did primary variants. These findings are in line with previous research that secondary variants seem more influenced by contextual factors, and exhibit more psychopathology and aggression (Kimonis et al., 2012; Kimonis et al., 2011). This is in line with theories and research suggesting that youth exposed to aggression and violence may cope negatively with this exposure, and that negative coping may include both internalized coping (e.g., anxiety, depression) and externalized coping (e.g., aggression) (Boxer & Sloan-Power, 2013). I also found demographic differences between the clusters; secondary variants were younger and more likely to be female and adjudicated. However, differences in outcomes remained even when controlling for these demographic characteristics.

A third group of adolescents emerged with high callous-unemotional traits, but with higher anxiety than the primary variants and lower anxiety than the secondary variants. I labeled this group the “*fearful*” cluster, in line with previous research that has found a similar group using the same analysis (Cox et al., 2013; Magyar, Edens, Lilienfeld, Douglas, & Poythress, 2011; Poythress et al., 2010). It is worth noting that this fearful cluster reported many of the same risk factors and outcomes as distressed variants, although not always to the same extent, and that it was the largest cluster in the sample. Although the rate of classification into this cluster was surprisingly high, at least one other study has also found a high classification rate into the fearful cluster (Cox et al.,

2013). Poythress and colleagues (2010) have hypothesized that this fearful cluster may represent a “disadvantaged” secondary psychopath (Mealey, 1995), in that it may represent a cluster of youth who are at risk because of social and economic disadvantage (i.e., family structure, socioeconomic status, etc.). However, my results do not bear this out, as the fearful cluster did differ significantly in household income from the other clusters. This fearful cluster might represent a *transitional* cluster, in which adolescents are experiencing the adverse events and exposure to violence and aggression characteristic of the secondary variant, but are still in the early stages of dealing with these events. Adolescents in this transitional cluster might become secondary variants later on, as their anxiety levels rise due to the stressors in their environment. To my knowledge, this unexpected result represents the first independent replication of Poythress and colleagues’ (2010) findings, and the first identification of a fearful cluster in a mixed sample of adolescents. It is possible that I found this fourth cluster because I used a callous-unemotional trait total score, rather than a full psychopathic trait measure or callous-unemotional subscale scores; or because I did not select for high callous-unemotional traits prior to entering cases into the analysis. Previous studies using model-based clustering have done one or both (Hicks, Markon, Patrick, Krueger, & Newman, 2004; Kimonis et al., 2011; Skeem, Johansson, Andershed, Kerr, & Louden, 2007). Although I also had an unexpected finding with the age differences, it is difficult to draw any conclusions regarding these differences given the cross-sectional design of the study.

My findings suggest that secondary variants, compared to primary variants and non-variants, are experiencing more negative life events and exhibiting more symptoms of psychopathology, including externalizing behaviors. These differences highlight the

importance of recognizing the heterogeneous nature and potential etiological variations of psychopathy. It has long been thought that psychopathy is a genetically predetermined personality disorder (Blonigen, Carlson, Krueger, & Patrick, 2003; Viding et al., 2005), and studies have shown that the two variants are equally influenced genetically in community samples with subclinical levels of psychopathy (Blonigen, Hicks, Krueger, Patrick, & Iacono, 2005; Humayun, Kahn, Frick, & Viding, 2014; Larsson et al., 2006; Taylor, Loney, Bobadilla, Iacono, & McGue, 2003). It might be that a refined understanding of pathways to primary and secondary variants will accrue from a dialectic perspective on genes and environment: genetic and environmental influences interacting differently to produce the risk factors and outcomes associated separately with primary and secondary variants (Porter, 1996; Sameroff, 2000, 2010). For example, studies have found that the associations between parenting behavior and adolescents' antisocial behavior is moderated by the two different factors of psychopathy (Edens et al., 2008), suggesting that the interaction of genetic and environmental risk might be very different for primary and secondary variants. Future research, especially longitudinal designs, will help uncover these developmental pathways.

This study was limited in a few ways. Some indicators relied on self-report data from target youth, and the measure of psychopathology (the BSI) relied on a one-week assessment frame. However, event histories can be difficult to obtain outside of self-report, and the BSI has shown excellent validity and test-retest stability (Maruish, 1994). Also, the cross-sectional design of this study limited my ability to draw inferences about causality. This is a key limitation that should be addressed in future studies given broader developmental theory regarding the origins of callous-unemotional traits, which might be

innate and thus present from a very early age or shaped gradually over time through highly adverse experiences (Frick, Cornell, Barry, et al., 2003; Frick & Morris, 2004; Frick & White, 2008). Further, although I was able to find a number of significant differences between different variant groups, some effect sizes were small. Of course, small effect sizes are not uncommon in social research, and still can reflect findings of great practical importance (McCartney & Rosenthal, 2000).

Despite these limitations, there are key contributions of this investigation. Adolescents who present with callous-unemotional traits are not a homogeneous group. If anxiety is a key distinguishing factor between primary and secondary variants of callous-unemotional traits, then assessments of callous-unemotional traits for adolescents in both scientific and clinical uses may benefit from including a measure of anxiety. Bolstering assessments of callous-unemotional traits by including measures of anxiety can be particularly important for clinicians and corrections staff members, who need to make accurate assessments about their clients in order to treat them most effectively. Beyond assessment, practitioners should bear in mind these callous-unemotional variants as they decide on treatment plans for adolescents. Whether in the community or in a detention center, youth who exhibit high callous-unemotional traits and high anxiety clearly have different experiences and treatment needs than do youth who exhibit high callous-unemotional traits and low anxiety. The former may benefit more from cognitive-behavioral therapies that alleviate symptoms of anxiety and trauma, given their exposure to violence and their high levels of psychopathology. Although some prior research has found that children who exhibit callous-unemotional traits are less responsive to treatment (Hawes & Dadds, 2005), no study has examined whether primary and

secondary callous-unemotional variants differ in treatment process and outcomes.

Moreover, theorizing about secondary psychopathy variants indicates that they might be more responsive to treatment in general (Karpman, 1946). This dovetails with more recent literature that has found evidence of greater trauma among secondary variants (Kimonis et al., 2012; Vaughn, Edens, Howard, & Smith, 2009). Further research is needed to determine how this treatment will be best implemented and most effective with this population.

Study 2: Using Callous-Unemotional Traits to Differentiate Delinquent Youth

Although there is an increased interest among clinicians and forensic staff in determining which youth are presenting with callous-unemotional traits, given the addition of the limited prosocial emotions (LPE) specifier to the DSM-5 (American Psychiatric Association, 2013), there are a limited number of measures for callous-unemotional traits, and none with a specific cut-off score. The Inventory of Callous-Unemotional Traits (ICU; Frick, 2004b) is one such measure of callous-unemotional traits, and prior studies have established its validity and reliability (Essau et al., 2006; Ezpeleta, de la Osa, Granero, Penelo, & Domènech, 2013; Feilhauer, Cima, & Arntz, 2012; Kimonis, Frick, Skeem, et al., 2008). However, with the exception of two studies (Feilhauer et al., 2012; Kimonis, Fanti, & Singh, 2014), prior studies have failed to determine an appropriate cut-off score for the ICU that might help clinicians in their decision making processes. One of these studies used a case-control design similar to the present study, but only used the parent-reported ICU score and failed to establish a valid and reliable cut-off score (Feilhauer et al., 2012). The second study uses parent-reported ICU to predict latent trajectories of parent-reported callous-unemotional traits and

conduct problems, but fails to establish criterion validity of the ICU with external criteria (e.g., arrests, delinquent status; Kimonis, Fanti, et al., 2014). Therefore, even though the DSM-5 urges clinicians to consider multiple sources of information in their determination of the LPE specifier (American Psychiatric Association, 2013), no previous study has used multiple informants and valid external criteria to establish cut-off scores for the ICU.

Goals and hypotheses

The current study uses a mixed sample of youth in the community and in detention centers to determine whether single informant reports and composites of the ICU can predict concurrent detained status. I also examine whether ICU scores predict aggression and violence, numbers of charges and adjudicated offenses, and crime seriousness and violence levels among detained youth. This study also aims to determine how to best integrate and use information from multiple informants, as well as which scores on the ICU might denote a “clinical” level of callous-unemotional traits. I hypothesize that ICU scores will reliably predict externalizing measures, and that composites integrating information from multiple informants will outperform single informant reports; however, I make no hypotheses a priori regarding specific cut-off scores or which informant report is most valid.

Methods

Participants

The sample for this study is the same as the sample used in Preliminary Study 1, except that for this second study, I further narrowed the analyses to the 634 youth with valid data on the ICU across all three informants (youth, parent/guardian, and

teacher/staff). Each informant report on the ICU did not vary as a function of missing data on the other reports; that is, those with missing data on one report did not have significantly higher or lower ICU scores on the other reports. There were no effects of youth sex on the likelihood of reports to be missing from any of the three sources.

However, white youth were more likely than were non-white youth to have data available from parents/guardians ($\chi^2 [1, 820] = 4.57, p < .05$) and from teachers/staff ($\chi^2 [1, 820] = 13.05, p < .001$). Further, all missing self-reports ($\chi^2 [1, 820] = 4.43, p < .05$) and more missing parent/guardian reports ($\chi^2 [1, 820] = 5.64, p < .05$) emanated from the adjudicated sample.

Of the 634 youth retained for analysis (M age = 16.18 years, $SD = 1.31$), 343 (54%) were students and 291 (46%) were detained youth; overall the full sample included 376 males (59%) and 258 females (41%) and a majority of white youth (58% white, 29% black/African-American, 3% Hispanic/Latino/a, 8% multi-racial, 2% other). By sample, the student group ($M = 16.83, SD = .72$) was significantly older ($p < .001$) than the detained group ($M = 15.40, SD = 1.42$). Females were significantly under-represented ($p < .001$) in the detained group (28%) relative to the student group (51%); non-whites were represented about equally across the two groups (39% students, 46% detained youth; $p = .08$).

Measures

Callous-unemotional traits. Just as described in the first study, I used the ICU to assess callous-unemotional traits in the present study. In addition to the three separate ICU scores generated by summing all 22 items for each report, I computed four cross-informant composite scores: 1) the mean composite of all three reports, which was

calculated by averaging all three ICU scores; 2) the mean composite of parent and teacher reports; 3) the max composite of all three reports, which was calculated by taking the highest reported value for each item across all three reports and then summing all items (Frick, Cornell, Barry, et al., 2003; Piacentini, Cohen, & Cohen, 1992); and 4) the max composite of parent and teacher reports. The max composite has been used in several previous studies, and although it has been theorized as a better method to aggregate multiple scores from different informers than simply taking the mean, the current study will be the first paper to directly test this idea using the ICU. I will also look at differences between composites of all three reports and composites of parent and teacher reports because youth reports may be more susceptible to social desirability effects (Laajasalo et al., 2014; J. D. Miller & Lynam, 2015), especially given the content of the measure.

Detained status. Detained status was assessed simply as a dichotomous variable noting whether the youth were interviewed at a detention facility (=1) or in the community (=0).

Violence and aggression. The violence and aggression composites described above for Preliminary Study 1 are also included in the current study.

Offense data. Data on the offense histories of adjudicated participants were obtained via direct extraction from records held by the partner detention facilities. Trained research assistants copied participants' records by hand, verbatim, from facility files. For each participant, research assistants recorded histories of arrests and associated charges as well as any adjudications and associated charges emanating from arrests. Each charge was coded for seriousness and violence levels (Huesmann, Eron, & Dubow, 2002;

Rossi, Waite, Bose, & Berk, 1974), and then average seriousness and violence levels were computed by averaging across all available data for each participant.

Procedures

The procedures for this study are identical to those described above in Preliminary Study 1.

Plan of analysis

First, I will examine criterion validity of the ICU by using a set of logistic regression models to predict adjudicated status, a set of linear regressions predicting aggression and violence, a set of truncated regressions predicting crime seriousness and violence levels, and a set of count regressions predicting numbers of charges and adjudicated offenses. For all models cluster-robust standard errors are computed with data collection site as the cluster variable. I will then use receiver operating characteristic (ROC) curve analyses to predict adjudicated status and examine area under the curve (AUC) and marginal effects from logistic regressions to determine valid cut-off scores for the ICU. Each set of models will rotate the ICU predictor of interest: self-report; parent report; teacher/staff report; all three individual reports; the mean composite across all three informants; the mean composite from parents and teachers; the max composite across all three informants; and the max composite from parents and teachers. Each model will include age, sex, and race (white/non-white) as covariates, and models will be compared using BIC and Akaike's Information Criterion (AIC), as they are able to distinguish between non-nested models (Bozdogan, 1987; Vrieze, 2012).

Results

Descriptive statistics

Table 3 shows descriptive statistics for study variables, separately by sample. I computed a series of two-way analyses of variance (ANOVA) to examine differences by sex and sample (students vs. detained youth) on ICU scores from youths, parents/guardians, and teachers/staff. These analyses showed generally that detained youth received significantly higher scores than did students, across all informants (all $ps < .001$; partial η^2 estimates = .07 [youth], .23 [parents/guardians], .12 [teachers/staff]). For youth and teachers/staff, these main effects were qualified somewhat by modest sex by sample interactions; high school students were rated lower than detained youth and females were rated lower than males, with a larger gender difference for students than detained youth (both $ps < .05$; both partial η^2 estimates = .01). Exploratory t-test analyses indicated no difference in youth and parent/guardian ICU scores as the function of race (white vs. non-white); teachers/staff rated non-white youth higher on the ICU compared to white youth ($p < .001$). Youth age was modestly to moderately negatively correlated with ICU scores (r values $-.17$ to $-.34$, $p < .001$).

Paired samples t-tests indicated that youth underreported ICU scores compared to parents ($p < .001$) and teachers ($p < .001$), but parents and teachers reported relatively similar mean ICU scores ($p = .116$). Separate paired t-tests by sample indicated that informer agreement differed by sample; although youth and parents agreed more for the high school sample ($p = .649$), youth in the adjudicated sample underreported traits compared to their parents ($p < .001$). Youth underreported traits compared to teachers in both samples ($p < .001$). For the high school sample, teachers reported more callous-unemotional traits than parents ($p < .001$), but the reverse was true for the adjudicated sample ($p = .024$).

Logistic regressions predicting adjudicated status

Because of two cases that were missing data on race/ethnicity, the number of cases drops from 634 to 632 for these models. The results of these logistic regression models are shown in Table 4. All of the logistic regression models significantly predict detained status. According to BIC, the model that best maximizes fit without compromising parsimony is the mean composite of parent and teacher reports, as it has the smallest BIC value by 3.93, which provides positive support. However, AIC indicates that the model with all three reports as separate predictors performs the best, with a difference from the next best model of 4.84, which again provides support for this model as the best-fitting model. Further, Akaike weights, calculated by taking the difference of each model's AIC and the minimum AIC, indicate that the probability for the model with all three reports as separate predictors has a probability of .91, while the other models have a probability of .08 or less. It is not surprising that AIC prefers the model with all three reports and the BIC does not, as this model appeared to perform relatively well compared to the others, and BIC has a greater penalty for model complexity (e.g., more regressors in the model).

To further examine which ICU scores and composites provide a greater advantage in predicting detained status, I conducted ROC analyses that plot sensitivity against the inverse specificity ($1 - \text{specificity}$), and calculated the AUC for each ROC plot. A significantly greater AUC suggests a measure with a better trade-off between specificity, or the ability to identify positive cases, and sensitivity, or the ability to not identify negative cases. The AUCs are included in Table 4, and Figure 2 shows the ROC curves plotted from each model, except for the covariates-only model (not shown). The

covariates-only model had the smallest AUC, followed by the models with only self- or teacher-report ICU scores, followed by the models with only parent-report ICU scores or any of the mean or max ICU composites. Finally, the model with all three reports entered separately outperformed all other models, except for the max composite of all three scores, from which it was not significantly different (although most models rounded to .90, the standard errors were very small [<0.013]). Thus, while BIC values indicate that the mean composite model provides the best balance between fit and parsimony, and AIC values indicate that the model with all three reports provides the most information, the AUC values suggest that the model with the max composite and the model with all three reports strike the best balance between sensitivity and specificity.

Linear regressions predicting violence and aggression

The following regression models have the same predictor variables and covariates as in the previous logistic regression models, but are now predicting normally distributed continuous measures of violence and aggression. The number of possible observations for these models drops to 289; out of the 291 detained youth with full ICU information across all informants, two were missing data on race/ethnicity. For these models, raw coefficients are reported because standardized coefficients cannot be computed for the later count models; however, it should still be easy to compare coefficients across models, as all ICU scores and composites are measured on the same scale. The results of these models are reported in Table 5.

In all eight models predicting aggressive behavior, each of the ICU predictors was significant at the $p < .05$ level. According to the BIC values, the three equally best models are the one with all three reports as separate predictors, and the mean and max

composites of all three reports. The BIC values cannot distinguish among these three, as the difference between any two of them is less than two; however, they are preferred to the other models, as the next best model has a larger BIC by at least 27.52. According to the Akaike weights, the model with the max composite of all three models is most likely, with a probability of .51, followed by the model with all three reports at .29 and the mean composite model at .20. In all eight models predicting violent behavior, each of the ICU predictors was significant at the $p < .01$ level. According to both BIC and AIC, the best model is the max composite of all three reports. The max composite has the lowest BIC by at least 13.50, and has an Akaike weight probability that rounds to 1.

Censored regressions predicting crime seriousness and violence

These models are similar to the linear models described above, except the dependent variables are now left- and right-censored. The seriousness variable is left-censored at 3.53 and right-censored at 7.77, while the violence coding variable is left-censored at 0 and right-censored at 2.32. (see Rossi et al., 1974). Because our observed data did not reach the right-censored values, I ran tobit regression models that were only censored on the left values. The number of valid cases for these models drops to $n = 245$, and results are included in Table 5. Twelve observations were left-censored for seriousness, and 84 were left-censored for violence. ICU scores and composites were not associated with crime seriousness and violence; the only significant coefficient was negative for the mean parent/teacher composite predicting crime seriousness. BIC values could not reliably distinguish among models, and pseudo R^2 values were very small. Although Akaike weights indicated that the model with all three informant reports provided the most information regarding crime seriousness and the model with the max

composite of all three reports best predicted crime violence, each had a relatively low probability of being the correct model (18%).

Count regressions predicting numbers of charges and adjudicated offenses

For the number of charges and adjudicated offenses, I used negative binomial regression models to account for the overdispersion in the distributions (all likelihood ratio tests of $\alpha = 0$ were significant at the $p < .001$ level). A zero-truncated negative binomial model is used to predict charges, because each of the adjudicated youth necessarily had to have a charge, but this was not the case for adjudicated offenses, for which a regular negative binomial model is used. The number of valid cases for these models drops to $n = 245$, and results are included in Table 5. In the models predicting charges, none of the individual ICU scores was significant at the $p < .05$ level; however, all four ICU composites were significant at the $p < .001$ level. The BIC values could only differentiate the max composite of all three reports as performing worse than the other composites and the model with all three reports, while Akaike weights indicated that model with all three reports was most probable (29%), followed by the mean of all three reports (23%) and the mean of parent and teacher reports (21%). In the models predicting adjudicated offenses, the only individual ICU score to be significant at the $p < .05$ level was parent report; however, all four composites were significant at the $p < .001$ level. BIC values could not differentiate among the model with all three reports and the composite models, while Akaike weights indicated that the max report of all three informants was most probable (22%), followed closely by the model with all three reports (21%).

Determining cutoff scores for the ICU

Finally, two different methods were used to determine the optimal cut-off scores for each measure of ICU, and the results of both are displayed in Table 6. The first method uses predicted probabilities of detained status from each of the models; the predicted probabilities from each model are plotted in Figure 3. Predicted probabilities below .5 indicate a prediction of non-detained status, while predicted probabilities above .5 indicate a prediction of detained status. Therefore, the point at which each measure's predicted margin exceeds .5 can be used as the optimal cut-off score for that measure, above which the likelihood of detained status increases. Based on these measures, the optimal cut-off scores are as follows: for youth report ICU, 28; for parent report ICU, 30; for teacher report ICU, 33; for the model with all three reports, youth is 40, parent is 30, and teacher is 36; for the mean composite, of all three reports 26.97; for the max composite of all three reports, 42; for the mean composite of parent and teacher reports, 28.84; and for the max composite of parent and teacher reports, 39. Scores are reported to two decimal places for the mean composites, as they are the only scores that have non-integer values. If a more stringent cut-off score is desired to reduce the false positive rate, the probability cut-off can be increased. Therefore, I have also calculated the cut-off scores for a predicted probability of detained status of .75 as follows: for youth report ICU, 58; for parent report ICU, 48; for teacher report ICU, 61; for the model with all three reports, there is no score available for youth and teacher report, as these reports did not produce predicted probabilities beyond .57 and .66, respectively, while the cut-off for parent report ICU is 51; for the mean composite of all three reports, 36.88; for the max composite of all three reports, 56; for the mean composite of parent and teacher reports, 40.64; and for the max composite of parent and teacher reports, 54.

The other method used to determine appropriate cut-off scores for the ICU was Youden's index, or the sum of each cutoff score's sensitivity and specificity minus one, in which I identified cutoff scores that maximized Youden's index (Raftery, 1995). Based on this index, the optimal cutoff scores were as follows: 37 for youth report ICU; 41 for parent report ICU; 21 for teacher report ICU; for the model with all three scores, the cutoffs are 11 for youth report, 21 for parent report, and 25 for teacher report; 26 for the mean composite of all three reports; 46 for the max composite of all three reports; 29.5 for the mean composite of parent and teacher reports; and 44 for the max composite of parent and teacher reports. I then classified youth based on these cutoffs and compared AUC values to determine whether there was a difference in using the score from the predicted probabilities or from the Youden's index for each report. Using the cutoff scores generated from the predicted probabilities resulted in more stable and valid results, as indicated by generally greater AUC values, particularly for youth and parent report, the two max composites, and the mean composite of parent and teacher reports. When comparing different scores and composites for the probability cutoffs, parent report outperformed both youth and teacher report, and both mean composites outperformed both max composites. Parent report and mean composites performed relatively similarly.

Discussion

In this study, I analyzed extensive data collected through interviews with adolescents in the community as well as in detention facilities, including their own self-report data as well as information from people who knew them well (parents/guardians; teachers/staff members). I used logistic, linear, censored, and count regression models to examine the criterion validity of the ICU among this diverse sample of 634 adolescents to

predict detained status, as well as its construct validity in predicting aggressive and violent behavior, crime seriousness and violence, and number of charges and adjudicated offenses. As expected, the ICU was significantly associated with concurrent detained status, across all three informants and four different composites, as well as aggressive and violent behavior among detained youth. However, unexpectedly, ICU scores were generally not associated with crime seriousness and violence among detained youth. Further, only composites were associated with charges and adjudicated offenses, except for parent report, which was also associated with adjudicated offenses. Thus, this study makes a significant contribution to the literature by providing this critical evidence of criterion validity for the ICU in its association with detained status and number of charges or offenses, while suggesting that the ICU may not be associated with measures of offending seriousness and violence.

Although I found that scores on the ICU significantly distinguished detained adolescents from high school students, and were associated with greater aggressive and violent behavior among detained youth, I found no associations with offense seriousness or violence, and limited evidence for associations with the number of charges and adjudicated offenses. Therefore, I found some mixed evidence for the criterion validity of the ICU.

Regarding the first aim of this study, I was able to establish cutoff scores for the ICU based on logistic regression models and receiver operating characteristic curves regressing delinquent status on ICU scores and composites. These cutoff scores significantly distinguished between detained adolescents and high school students. Although using such cutoffs would not result in perfect classification, youth with scores

above the cutoff are more likely to be similar to detained adolescents, and would therefore be more likely to have higher levels of antisocial, aggressive, and violent behavior. I was able to find evidence to inform the second aim, although again the results depend on the outcome of interest. For example, the max composite (calculating the highest score per item across informants) was preferable when examining violence or the number of adjudicated offenses, but the mean composite (calculating the mathematical average of all reports) was preferable when examining detained status or the number of charges. Regarding individual informant reports, parent report tended to consistently outperform both self and teacher report; the only exceptions were the number of charges and crime seriousness and violence, in which all three informant reports performed relatively similarly and poorly.

These results are important in identifying where the ICU has criterion and construct validity and where it does not. For example, the ICU may be reliably associated with the number of charges and offenses, but not the seriousness or violence level of those offenses. These findings are also important in identifying which informant reports may be more strongly associated with behavioral outcomes, as parent report seems to consistently outperform both youth and teacher report. These findings also are essential in establishing cutoff scores for the ICU that can be used for empirical purposes and practical applications. Of course, as with any diagnostic classification system, there can be a possible negative impact of labeling youth as being high on a measure of callous-unemotional traits, but there may be positive impact if high-risk youth can be identified and provided the appropriate services to prevent or mitigate the development of these traits and other problem behaviors.

Although it is perhaps not surprising that parent report of ICU is a better predictor of detained status than is youth report – because youth might be even less forthcoming to indicate their callous and unemotional personality traits than are their parents – it is somewhat surprising that parent report scores performed better than did teacher report scores. Ostensibly, teachers and staff members should be able to provide the most unbiased view of youths' CU traits, since they have nothing to lose or gain from their reporting; they would not feel the same level of shame or social desirability to which youth and parents may be more susceptible. However, this lessened bias comes with a trade-off, as teachers and staff members also might be less knowledgeable about youths' true feelings and cognitions. It may be that the report of parents on their children's CU traits may provide the best balance between bias and knowledge, as parents are typically knowledgeable about their children, but not as biased against reporting their children's socially undesirable traits as the youths themselves might be.

Results from this study offer some insight about the relative contributions of different informants to the assessment of CU traits, and how to best integrate this information from multiple sources, but not without limitations. First, the data are cross-sectional in nature; therefore, I can only provide evidence of *concurrent*, not *temporal*, predictive validity. It is possible that administering the ICU to youth, parents/guardians, and teachers/staff members *before* the youth were incarcerated would have led to weaker predictions, presumably because the knowledge of a youth as a “delinquent” would shape perceptions of that youth and interpretations of their behavior, leading to inflated ICU scores for the detained youth and an overstated relationship between the two variables. The cross-sectional design also limits inferences of causality. For example, is it the case

that youth high in CU traits are more aggressive and antisocial, and therefore end up in detention facilities at higher rates? Or is it instead the case that youth who have been detained in a facility develop higher CU traits as a response to their environment, compared to youth in the community? Prospective designs following youth over time would lend better insight into this critical issue. Low response rate for the surveys was also an issue, and could potentially bias some of the results. Finally, although the ICU captures the four different types of symptoms included in the “with limited prosocial emotions” specifier in the DSM-5, I did not attempt to look at each type of symptom specifically to ensure that youth met two or more of the criteria. Future studies would benefit from doing this type of in-depth analysis to aid in approximating the diagnostic criteria, or could alternatively employ traditional diagnostic assessments and examine their association with “real-world” criteria, such as adjudication status or number or type of offenses.

Despite these limitations, this study has the advantages of a relatively large sample size of 634 youth, a diverse mixed sample of community and detained adolescents, both males and females and from different racial/ethnic backgrounds. Therefore, the results of this study should be able to generalize to similar populations. This study also importantly addresses the question of which informant reports may be more useful than others, and how to most effectively combine information from multiple informants. This information may be helpful to researchers, clinicians, and judicial decision makers who must assess youths’ levels of CU traits, for example, for diagnosis, treatment, investigation, or observation, especially considering the difficulties associated

with assessing CU traits (e.g., youth who are callous and unemotional are not necessarily honest in reporting their personality traits).

These findings might be especially relevant to the ongoing integration of the newest edition of the DSM into routine clinical practice with respect to determining whether a youth manifesting conduct disorder symptoms also meets criteria for the “limited prosocial emotions” specifier. Clinicians might fruitfully incorporate the ICU into assessments with the youth, the parent or guardian, and a teacher or other adult who might know the youth well. Having all three reports would provide the clinician with a stronger basis for making the diagnosis. However, if budgetary or time constraints prevent the clinician from administering the ICU to all three informants, and only one informant can be approached instead, the clinician should secure an ICU report from the youth’s parent or guardian. Once the clinician has obtained the completed ICU from all informants, he or she can determine the likelihood that the youth has CU traits based on the cutoff scores described in this article, and this information can aid in the decision making process of diagnosing the youth. Further research should expand on the temporal predictive validity of the ICU, as well as provide definitive cutoff scores to guide judgments about which youth are experiencing truly clinical or dysfunctional levels of CU traits. Altogether, the results of this investigation support the criterion validity of the ICU for differentiating between detained and non-detained youth, but question its construct validity in predicting serious and violent crimes among detained adolescents, while providing relevant information on how to integrate across informants and which scores might be deemed clinically significant.

Study 3: History of Substantiated Maltreatment and Callous-Unemotional Traits

Previous research indicates a robust link between experiences of maltreatment and abuse and conduct problems (Famularo, Kinscherff, & Fenton, 1992; Flisher et al., 1997; Jaffee et al., 2005; Jaffee, Caspi, Moffitt, Polo-Tomas, & Taylor, 2007; Jaffee, Caspi, Moffitt, & Taylor, 2004), although this association differs somewhat depending on the presence of environmental (Jaffee et al., 2007) or genetic (Jaffee et al., 2005) risk factors. However, the association between abuse and callous-unemotional traits is less clear. For example, one study of adult male sex offenders found a negative association between psychological abuse and callousness, and no relationship between callousness and physical or sexual abuse (Krstic, Knight, & Robertson, 2015). However, in a sample of 132 children, 14% of nonmaltreated children had high callous-unemotional traits, compared to 35% of maltreated children (Dackis, Rogosch, & Cicchetti, 2015), and in a retrospective study of incarcerated male adolescents, youth high in callous-unemotional traits were more likely to report experiences of emotional or physical abuse or physical neglect in childhood than youth low in callous-unemotional traits (Kimonis, Fanti, et al., 2013). Although these studies indicate a possible association between maltreatment and callous-unemotional traits, most studies did not use substantiated maltreatment reports, and it is unclear how maltreatment might be associated with specific characteristics (i.e., lack of remorse/guilt, callousness, lack of concern about performance, shallow affect) under the broader umbrella of callous-unemotional traits.

It is also unclear whether the timing of maltreatment events matters for the particular outcome of callous-unemotional traits. Some studies have found that earlier maltreatment is more detrimental to youth's well-being (Fantuzzo, Perlman, & Dobbins,

2011; Keiley, Howe, Dodge, Bates, & Pettit, 2001; Manly, Kim, Rogosch, & Cicchetti, 2001), while other studies have found that maltreatment in adolescence is a stronger predictor of adolescent outcomes than childhood maltreatment (Stewart, Livingston, & Dennison, 2008; Thornberry, Ireland, & Smith, 2001). Additionally, no previous study has specifically examined the timing of maltreatment events and callous-unemotional traits, or lack of guilt in particular. Therefore, I offer no a priori hypothesis about the timing of maltreatment events. However, previous studies do indicate that chronic maltreatment is robustly associated with poor outcomes (Jaffee & Kohn, 2011; Manly et al., 2001; Thornberry et al., 2001), so I predict that experiencing maltreatment across multiple developmental periods will have a greater influence on conduct disorder and lack of guilt in adolescence.

Goals and hypotheses

In this study, I aim to determine whether substantiated maltreatment events in childhood and early adolescence predict later parent- or youth-reported conduct disorder diagnosis and mother-reported callous-unemotional tendencies (i.e., lack of guilt, a key component of callous-unemotional traits). I hypothesize that youth with a conduct disorder diagnosis and callous-unemotional tendencies at age 14 are more likely to have experienced maltreatment, experienced more frequent maltreatment, experienced a greater variety of maltreatment types, and experienced maltreatment during a greater number of developmental periods than the three alternate groups: youth without a conduct disorder diagnosis with or without callous-unemotional tendencies, and youth with a conduct disorder diagnosis without callous-unemotional tendencies.

Methods

Participants

Data come from the Longitudinal Studies on Child Abuse and Neglect (LONGSCAN) consortium of research studies (Runyan et al., 1998). The original investigators include Runyan, D. K., Dubowitz, H., English, D. J., Kotch, J., Litrownik, A., and Thompson, R. This collaborative includes smaller projects with data collected from five separate sites, with procedures and assessments coordinated across sites to allow for integrative analysis, and the data are published through the National Data Archive on Child Abuse and Neglect (NDACAN). Each site included samples that differed by risk level. The total sample pooled across all five sites includes 1,354 youth (51.48% female; 73.85% non-white). The East site included 282 youth from urban pediatric clinics; 103 had failure to thrive, 68 were exposed to prenatal drug use of an HIV-infected mother, and the remaining 111 coming from the same clinics without these risk factors. At the Midwest site, 245 youth came from an urban area, with 149 youth referred to Child Protective Services (CPS) and 96 non-CPS controls. At the Northwest site, 254 youth came from an urban area and were involved in reports to CPS and judged to be at moderate risk (60% of these reports were later substantiated). The South site included 243 youth who were identified as at risk at birth, but only 34% were reported to CPS. The Southwest site included 330 youth from a suburban area who had confirmed maltreatment and were placed outside of the home (at age 4, 41% were still in foster care, 34% had returned home, and 21% were adopted).

In general, participants were born between February 1986 and October 1995. The proportion of females at each site varied between 47.87% and 54.73%, and none of these

differences was statistically significant, $\chi^2(4) = 3.47, p = .482$. The proportion of non-white youth at each site varied between 4.98% for the East site and 50.00% for the Northwest site, and these differences were significant, $\chi^2(4) = 174.34, p < .001$. The mean actual age at the age 14 interview ranged from 14.07 at the Midwest site to 14.65 at the South site, and these differences were significant, $F(4, 956) = 92.82, p < .001$. The proportions of youth who completed the age 14 interview ranged from 59% at the Southwest site to 69% at the Northwest and South sites, and these differences were significant, $\chi^2(4) = 11.42, p = .022$. However, the proportions of caregivers who completed the age 14 interview ranged from 63% at the Southwest site to 72% at the Midwest and Northwest sites, and these differences were not significant, $\chi^2(4) = 9.32, p = .053$.

Measures

Maltreatment. For the current study, I will analyze maltreatment events coded according to the NIS-2 classification system, originally developed for the Second National Incidence Study (National Center on Child Abuse & Neglect, 1988; Sedlak, 2001). Based on official CPS narratives, research staff coded each report as either having no maltreatment event, or having up to six of the following seven types of maltreatment events: physical abuse; sexual abuse; emotional abuse; physical neglect; educational neglect; emotional neglect; and other maltreatment. Multiple reports could be compiled per year, so that a youth could have more than six events reported in the same year. Raters trained on the coding scheme until they achieved at least 90% agreement with the correct classification codes on a set of training vignettes. In addition to the type of maltreatment reported in the narrative, research staff coded each event for its

investigation status. This is where coders noted that a case was still under investigation, substantiated, unsubstantiated, etc. Inter-rater reliability for classifications and conclusions was generally good, although raters were somewhat less reliable in coding emotional abuse and neglect. Because I use outcomes assessed at age 14, only maltreatment events prior to age 14 are included in this analysis.

Conduct disorder diagnosis. Youth and caregivers completed the Diagnostic Interview Schedule for Children version IV (DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), which includes a 15-item module for conduct disorder, at the age 14 interview. Respondents reported whether youth had engaged in a number of antisocial behaviors (e.g., bullying, stealing) in the past year. Although there was some variability in age, youth were generally around 14 (M age = 14.36, SD = 0.46) at the time of the interview. The items appeared to be internally reliable in the current sample (Cronbach's α = .71 for parent report and .73 for youth report), and previous studies have established the factor structure (Gelhorn et al., 2009), test-retest reliability (Bravo et al., 2001; Shaffer et al., 2000), and validity (Shaffer et al., 2000) of the measure. Out of the 810 youth who completed the DISC, 7% of youth self-reported clinical levels of conduct symptoms in the past year that would warrant a conduct disorder diagnosis, compared to 6% of the 827 parents who completed the measure. There was very little overlap between youth and parent report of conduct disorder diagnosis; about 1% of 755 youth with valid data on both measures met diagnostic criteria for both. However, youth- and parent-reported symptom counts were strongly correlated (Pearson's r = .43), similar to other studies: r = .31 for the Children's Symptom Inventory-4 (Frick, Cornell, Barry, et al., 2003), r = .36 for the Strengths and Difficulties Questionnaire (Goodman, Meltzer, &

Bailey, 1998), and $r = .26-.53$ for the Diagnostic Interview Schedule for Children (Edelbrock, Costello, Dulcan, Conover, & Kala, 1986). I then collapsed both youth and parent report and considered a youth to have a conduct disorder diagnosis at age 14 if either the youth or the parent reported clinical levels of symptoms in the past year, consistent with previous studies combining scores from multiple informants by using the highest score available (Frick, Cornell, Bodin, et al., 2003; Garland et al., 2001; Piacentini et al., 1992). This strategy yielded a conduct disorder diagnosis rate of 11% out of the 887 youth with valid data on either measure.

Callous-unemotional tendencies. Caregivers (78% mothers) completed the Child Behavior Checklist (CBC; Achenbach, 1991) at the age 14 interview. One of the items on the CBC asks how well the following statement applies to their child: “Doesn’t seem to feel guilty after misbehaving.” Caregivers then responded with “Not true” (0), “Somewhat or sometimes true” (1), or “Very true or often true” (2). Of the 929 youth with valid data on this item, 32% of their caregivers responded that they sometimes lacked appropriate guilt, and 8% said that they very often lacked appropriate guilt. I collapsed these two categories to create a dichotomous variable representing the presence (=0) or absence (=1) of appropriate guilt, as a marker for callous-unemotional tendencies. Although a full scale would be preferable to a single item, previous research indicates that the lack of guilt is a key component of callous-unemotional traits in youth, more so than lack of emotion or concern (Byrd, Kahn, & Pardini, 2013; Ciucci, Baroncelli, Franchi, Golmaryami, & Frick, 2014; Kahn, Byrd, & Pardini, 2013).

Procedures

Individual site consent, assent, and related human subjects protocols were approved by the local Institutional Review Board (IRB) for that site. Procedures were relatively similar across sites, such that children and their primary caregivers were interviewed separately at ages 4, 6, 8, 12, 14, 16, and 18. The earliest interviews (4, 6, and 8) were interviewer-administered, and subsequent interviews used the Audio Computer-Assisted Self-Interview (ACASI) system (Caspar, 2008). Annual contact interviews on off-years were conducted by phone. Teachers responded to mailed paper forms from age 6 onward, and researchers abstracted and coded maltreatment data from official CPS records. However, recruitment procedures and inclusion criteria varied by sample. Previous publications have discussed these procedures (Runyan et al., 1998; Runyan & Litrownik, 2003), and more information about procedures and samples can be found at www.unc.edu/depts/sph/longscan.

Plan of analysis

To determine whether substantiated maltreatment events influence the likelihood of having a conduct disorder diagnosis and lacking appropriate guilt, I ran a series of multinomial logistic regression models predicting whether youth were in four categories based on the presence or absence of a conduct disorder diagnosis and the presence or absence of guilt. I chose multinomial logistic regression because the dependent variable was a categorical outcome with four nominal categories. My predictors of interest were whether or not the youth had a substantiated maltreatment event, how many substantiated maltreatment events the youth experienced, how many different categories of substantiated maltreatment type (e.g., physical abuse, emotional neglect, etc.) the youth experienced, and during how many developmental periods the youth experienced

maltreatment. For each predictor, I separated models by age of maltreatment, such that I used maltreatment events from ages 0 to 3 (infancy/toddlerhood), ages 4 to 8 (childhood), and ages 9 to 13 (early adolescence), to assess whether the influence of maltreatment varied by age. The models each use cluster-robust standard errors with data collection site as the cluster. I also ran another set of models where predictors from each age period were entered simultaneously, so that each coefficient represented only the unique association of maltreatment during that age period, while controlling for maltreatment at other ages.

Results

Descriptive statistics

Table 7 depicts demographic characteristics by data collection site. Of the full sample of 1,354 youth, 3% were missing data on conduct disorder diagnosis only, 1% were missing data on callous-unemotional tendencies only, 22% were missing data on maltreatment only, and 32% were missing data on multiple variables. Although this reduces the analysis sample to 557 and results in a high rate (59%) of missing data, I decided to continue with complete case analysis rather than resorting to imputation methods because the data are potentially missing at random (MAR), though not missing completely at random (MCAR), and I was interested in the influence of substantiated maltreatment allegations. Additionally, I was able to confirm that missingness was not related to youth gender (58% for males compared to 60% for females, $\chi^2[1] = 0.40, p = .527$), age (M age = 14.32 for youth with missing data, 14.36 for youth with valid data, $t[959] = 1.50, p = .135$), or socioeconomic status ($\chi^2[10] = 11.96, p = .288$); however, race was a significant predictor of missingness, $\chi^2(3) = 14.51, p = .002$, such that Black

youth (63%) were more likely to have missing data than White youth (52%), $z = 3.58, p < .001$. Data collection site was also a predictor of missingness $\chi^2(4) = 217.47, p < .001$, such that the Northwest and Southwest sites were more likely than the other sites to contribute valid data.

The probability of missing data on either the outcome (conduct disorder and lack of guilt) or the predictor (maltreatment status) is associated with the value of the outcome, such that youth without conduct disorder who feel guilt (CD-/CU-) are more likely to have missing data (41%) than youth from the other categories (23-29%), $\chi^2(3) = 17.75, p < .001$. However, the probability of missing data on the outcome or predictor is not dependent on values of the predictors; the probability of missing data did not vary as a function of whether or not youth were maltreated, $\chi^2(1) = 0.06, p = .803$, or the count of maltreatment types youth experienced, $\chi^2(6) = 8.89, p = .180$, or the count of maltreatment events youth experienced, $\chi^2(18) = 17.79, p = .469$. Logistic regression with listwise deletion is only problematic when the probability of missingness is dependent on values of both the independent and dependent variables, and is more robust to violations of the MAR assumption than maximum likelihood or multiple imputation (Allison, 2001).

Validation of conduct disorder diagnosis and lack of guilt

T-tests confirmed that youth with a self- or parent-reported conduct disorder diagnosis at age 14 scored significantly higher on parent-reported externalizing problems at ages 4, 6, 8, 12, 14, and 16, $p < .01$, as well as significantly higher on teacher-reported externalizing problems at ages 6, 8, 12, 14, and 16, $p < .01$. Moreover, youth with a conduct disorder diagnosis at age 14 were significantly more likely to self-report an arrest

by age 18, $p < .001$. Further, the proportion of youth with callous-unemotional tendencies differed significantly by conduct disorder diagnosis; 37% of youth without a conduct disorder diagnosis lacked guilt, compared to 68% of youth with a conduct disorder diagnosis, $z = 5.85$, $p < .001$.

Multinomial regression models predicting conduct disorder diagnosis and lack of guilt from maltreatment histories

Table 8 provides descriptive statistics of the proportion of youth who experienced maltreatment, the numbers of maltreatment events that youth experienced, and the number of different types of maltreatment events that youth experienced by age, conduct disorder diagnosis, and lack of guilt. In order to determine the influence of experiencing substantiated maltreatment events on both conduct disorder diagnosis and lack of guilt at age 14, I conducted a series of multinomial logistic regression models where the dependent variable is a four-level nominal variable with the following categories: no conduct disorder, no callous-unemotional tendency (CD-/CU-; 56%); no conduct disorder, callous-unemotional tendency (CD-/CU+; 33%); conduct disorder, no callous-unemotional tendency (CD+/CU-; 3%); conduct disorder, callous-unemotional tendency (CD+/CU+; 8%). Because I was interested in comparing the CD+/CU+ youth to all other youth in the sample, I conducted a series of regression models where I rotated the base outcome among the other three groups of youth, so that the coefficients displayed provide a contrast from the group of interest (CD+/CU+) to the other three groups. Table 9 presents the results of these models with relative risk ratios.

The first set of models determines whether experiencing maltreatment compared to no maltreatment has any influence on conduct disorder and callous-unemotional

tendencies. These models indicate that prior to age 4, the only significant difference is from CD-/CU- youth ($p < .001$), such that experiencing a substantiated maltreatment event at this age increases a youth's expected risk of being in the CD+/CU+ group (from 7% to 10%), compared the CD-/CU- group (from 53% to 49%). There are no significant differences between maltreated and non-maltreated youth ages 4-8 for any of the base outcomes. Experiencing maltreatment between the ages of 9 and 13 significantly increased youth's risk of being in the CD+/CU+ group (from 8% to 17%), compared to the CD-/CU- group (from 51% to 49%, $p = .001$) and the CD-/CU+ group (from 37% to 31%, $p = .012$). The Wald χ^2 test of joint significance indicated that experiencing substantiated maltreatment was significantly associated overall with membership in the different groups, for ages 0 to 3 ($p < .001$), ages 4 to 8 ($p = .006$), and ages 9 to 13 ($p < .001$).

The second set of models included the count of maltreatment events experienced at different age periods as a predictor. Because these models represent contrasts in more than two different predicted probabilities, the marginal effect (*ME*) of maltreatment events, or the change in probability of group membership attributable to the additional events, at the mean number of events is reported. The first three models indicated that each maltreatment event experienced from ages 0 to 3 was associated with a significantly higher risk for being in the CD+/CU+ group ($ME = 0.01$), relative only to the CD+/CU- group ($ME = 0.00$, $p = .019$), although relative risk ratios were significant for comparisons between CD+/CU+ and the two non-conduct disorder categories (CD-/CU+ and CPD/CU-). For ages 4 to 8, each maltreatment event experienced was associated with a significantly higher risk for being in the CD+/CU+ group ($ME = 0.01$), relative only to

being in the CD+/CU- group ($ME = -0.01, p = .002$). Finally, each maltreatment event experienced from ages 9 to 13 was associated with a significantly higher risk for being in the CD+/CU+ group ($ME = 0.01$), relative only to the CD-/CU- group ($ME = -0.02, p = 0.14$). Figure 4 plots these probabilities by count of maltreatment events. Although no relative risk ratios were significant for the count of substantiated maltreatment events experienced from ages 9 to 13, the Wald χ^2 tests were significant at the $p < .01$ level for all three models.

The third set of models included the count of different types of substantiated maltreatment events (e.g., physical abuse, emotional abuse) experienced at different ages as a predictor. Again, the marginal effect of event types at the mean number of types is reported. The first three models indicated that each additional type of maltreatment experienced from ages 0 to 3 was associated with a significantly higher risk for being in the CD+/CU+ group ($ME = 0.02$), relative to the CD-/CU- ($ME = -0.03, p = .033$) and CD+/CU- ($ME = -0.01, p = .012$) groups. Each additional type of maltreatment experienced from ages 4 to 8 was associated with a significantly higher risk for being in the CD+/CU+ group ($ME = 0.00$) relative to the CD+/CU- group ($ME = -0.02, p = .006$). Finally, each additional type of maltreatment experienced from ages 9 to 13 was associated with a significantly higher risk for being in the CD+/CU+ group ($ME = 0.02$) relative to the CD-/CU- group ($ME = -0.02, p < .001$). Again, Figure 4 plots these probabilities by count of maltreatment types. Wald χ^2 tests were significant for all three models at $p < .001$.

As a final note, I ran another set of models to determine how robust my findings would be. I conducted models with maltreatment at all three ages as predictors, so that

each predictor characterized the unique influence of maltreatment experienced at that age period while controlling for maltreatment experienced at other ages. The results from these models did not differ substantially from results obtained in the earlier models presented in Table 9, although number of different maltreatment types at ages 0 to 3 no longer distinguished the CD+/CU+ group from the CD+/CU- group.

Discussion

In this study, I analyzed longitudinal questionnaire data collected from 557 youth to determine the influence of experiencing substantiated maltreatment prior to age 14 on the likelihood of having a conduct disorder diagnosis and lacking appropriate guilt at age 14. I found that overall, experiencing maltreatment appeared to increase the risk of having conduct disorder and lacking guilt, and that this association was most marked for the count of substantiated maltreatment events experienced prior to age 4. These findings are important because they examine how maltreatment events in childhood are associated with later risk for conduct disorder and lack of guilt.

The results of this study clearly point to differential impact of maltreatment on child development conditional on age, and this is supported by earlier developmental work on child maltreatment (Kaplow & Widom, 2007; Manly et al., 2001; Perry, 2006; Stewart et al., 2008), including work from the organizational perspective of development (Rieder & Cicchetti, 1989) and developmental cascade models (Rogosch, Oshri, & Cicchetti, 2010). They also point to additive effects of experiencing multiple maltreatment events; in other words, I did not find a ceiling effect in this study where the count of maltreatment events no longer had an impact past any particular number. Instead, I found that each additional event was associated with increased risk of being in

the group of youth with a conduct disorder diagnosis and callous-unemotional tendencies, assessed as mother-reported lack of guilt. Again, this is in line with work on chronic maltreatment (English, Graham, Litrownik, Everson, & Bangdiwala, 2005; Jonson-Reid, Kohl, & Drake, 2012; Manly et al., 2001) and polyvictimization (Anderson, Tiro, Price, Bender, & Kaslow, 2002; Clemmons, Walsh, DiLillo, & Messman-Moore, 2007; Finkelhor, Ormrod, & Turner, 2009), which indicates that greater numbers of maltreatment events and types are associated with increasingly negative outcomes.

These findings are important because they examine how maltreatment events in childhood are associated with later risk for conduct disorder and callousness in adolescence. Previous research indicated that youth with conduct disorder and callous-unemotional traits, such as the lack of guilt, are less likely to be susceptible to environmental influence than youth with conduct disorder without callous-unemotional traits (Chinchilla & Kosson, 2015; Frick, 2004a, 2006, 2012; Oxford et al., 2003), but the current study provides evidence to the contrary. Experiencing maltreatment, particularly a greater number of maltreatment types at earlier ages, significantly differentiated the CD+/CU+ group from the CD+/CU- group. In no model did the CD+/CU- group experience more maltreatment than the CD+/CU+ group.

The current study was limited in a few ways, including the use of a single caregiver-reported item to assess lack of guilt, in place of a more global measure of callous-unemotional traits that would account for other dimensions (e.g., unemotional, callous, uncaring) of these traits. Although this is a limitation of the current study, it is worth noting that single indicators have found to be valid substitutes for multi-item measures in other areas (Abdel-Khalek, 2006; Elo, Leppanen, & Jahkola, 2003; Robins,

Hendin, & Trzesniewski, 2001). It is also worth noting that there was a high rate of missing data in the current study, and that conducting complete case analysis rather than using imputations can sometimes produce biased results (Knol et al., 2010; White & Carlin, 2010); however, I decided to analyze only non-missing data because I was interested in the influence of substantiated maltreatment events. I also treated all maltreatment events the same, although there are many characteristics of maltreatment (e.g., the context, perpetrator, severity, etc.) that can alter its impact (Belsky, 1980, 1993; Boxer & Sloan-Power, 2013; Clemmons et al., 2007; Manly, Cicchetti, & Barnett, 1994). Finally, although using substantiated maltreatment events allowed me to ensure the validity of these analyses, it is worth noting that restricting maltreatment to only substantiated events may not accurately capture all experiences of maltreatment (Leiter, Myers, & Zingraff, 1994; Smith, Ireland, Thornberry, & Elwyn, 2008). Therefore, the relationships identified in this paper may be underestimated compared to associations between lived maltreatment and conduct disorder with lack of guilt.

However, even with these limitations, this study is the first to examine how substantiated maltreatment in childhood influences conduct disorder and callous-unemotional tendencies in adolescence. These findings point to lack of guilt, and potentially the broader construct of callous-unemotional traits by extension, as a possible coping mechanism or adaptation for dealing with stressful events early in life. This interpretation is supported by work finding that negative life experiences are associated with increases in callous-unemotional traits (Kimonis, Centifanti, et al., 2014) and decreased conscientiousness (McElroy & Hevey, 2014), and that emotional numbing mediates the association between trauma and increased callousness (Kerig et al., 2012).

Further research is needed on this issue to determine the processes by which maltreatment in early and late childhood can lead to greater conduct problems and callousness in adolescence. Understanding these processes can aid not only in the treatment of children who experience maltreatment, but also in uncovering how children and adolescents might acquire callousness from exposure to ecological risk.

Study 4: Developmental Pathways to Callous-Unemotional Traits

Although callous-unemotional traits are often conceptualized as a genetic predisposition that is less susceptible to environmental influences (Henry et al., 2015; Oxford et al., 2003; Viding et al., 2005; Viding et al., 2008), several studies have begun to implicate ecological factors that are likely to increase or decrease a youth's callousness (Barker et al., 2011; Davis et al., 2014; Kimonis, Centifanti, et al., 2014), particularly for emotionally reactive, fearful, or inhibited youth (Allwood, Bell, & Horan, 2011; Euler et al., 2015; Kimonis et al., 2012). Unfortunately, these studies are limited in a number of ways, and none directly examines the interaction between ecological factors and individual dispositions in predicting prospective callous-unemotional traits. The proposed dissertation project aims to better establish the relationships among ecological risk and promotive factors, fearful/inhibited temperament or emotional reactivity/regulation, and callous-unemotional traits by analyzing three large longitudinal datasets.

Youth who exhibit callous-unemotional traits tend to engage in more serious antisocial behavior and sustain their antisocial activity for longer periods of time (Frick, 2006; Frick, Cornell, Barry, et al., 2003). Additionally, they can be very difficult to treat because they are typically less responsive to intervention efforts than youth without callous-unemotional traits (Falkenbach et al., 2003; O'Neill et al., 2003; Spain et al.,

2004; Waschbusch et al., 2007). A better understanding of the etiology of these traits might help inform treatment efforts to make them more effective for use with these youth.

Although many studies have concluded that callous-unemotional traits are highly heritable (Henry et al., 2015; Larsson et al., 2006; Viding et al., 2005), and that antisocial behavior among youth with callous-unemotional traits is more genetically influenced (Viding, Fontaine, & McCrory, 2012; Viding et al., 2008), genes do not entirely explain the variability in callous-unemotional traits. Several research studies have examined how environmental influences, such as parenting characteristics (Kimonis, Cross, et al., 2013; Marshall & Cooke, 1999) or abuse and neglect (Carlson et al., 2015; Kimonis, Fanti, et al., 2013; Kimonis et al., 2012; Krischer & Sevecke, 2008), are associated with the later development of callous-unemotional traits. Further, ecological promotive factors, such as warm parenting (Barker et al., 2011; Davis et al., 2014; Pardini et al., 2007) or appropriate interventions (Butler et al., 2011; Hawes & Dadds, 2007; Kolko et al., 2009; Lochman et al., 2014; McDonald et al., 2011; Norlander, 2008; Salekin et al., 2012; Somech & Elizur, 2012; Wilkinson et al., 2015), are associated with reduced callous-unemotional traits. Therefore, it appears possible that youth may develop callous-unemotional traits through genetic or ecological vulnerabilities, but some questions remain unanswered. For example, it is unclear whether ecological risk for callous-unemotional traits is relegated to a particular developmental period, or if it is only relevant for youth at a particular level of risk. The current dissertation project aims to answer some of these questions through the analysis of multiple datasets that include youth of various ages and risk levels.

Goals and hypotheses

In the proposed study, I will determine how ecological risk and promotive factors, as well as individual factors such as temperament and emotional reactivity, predict callous-unemotional traits in the following three samples: a longitudinal sample of 1,354 low-risk youth followed from birth to 15 years of age; a cohort-sequential sample of 1,421 medium-risk youth followed from 2nd to 11th grade, and a longitudinal sample of 1,354 high-risk youth followed from adolescence (ages 14 to 19) to early adulthood. Table 10 provides a list of the measures available at each age for each of these samples. I have three objectives:

Objective 1: To examine the association between ecological risk (e.g., abuse) and later callous-unemotional traits.

I predict that presence of ecological risk will be associated with higher levels of callous-unemotional traits.

Objective 2: To examine the association between ecological promotive factors (e.g., warm parenting) and later callous-unemotional traits.

I predict that the presence of promotive factors will be associated with lower levels of callous-unemotional traits.

Objective 3: To determine whether dispositional factors (e.g., temperament, emotional reactivity) moderate the associations between ecological risk and promotive factors and callous-unemotional traits.

I predict that the relationships between ecological factors and callous-unemotional traits will be stronger among youth high in emotional reactivity, fear, or inhibition, compared to youth low in emotional reactivity, fear, or inhibition. I will test two two-way

interactions – risk and regulation/reactivity, promotive factors and regulation/reactivity – in order to establish temperament and regulation/reactivity as moderators.

Study 4a: Study of Early Child Care and Youth Development

For the first in this series of studies, I examined predictors of callous-unemotional traits at age 15 in a normative, relatively low-risk sample of youth followed from birth through adolescence. Although this study is able to inform an ecological model of callous-unemotional traits for low-risk youth through rich data obtained from multiple sources at various time points, it cannot assess change in callous-unemotional traits over time, or whether these associations might be different for youth at greater risk of psychopathology and problem behavior.

Methods

Participants

The Study of Early Child Care and Youth Development (SECCYD; United States Department of Health and Human Services. National Institutes of Health. Eunice Kennedy Shriver National Institute of Child Health and Human Development, 2014a, 2014b, 2014c, 2014d), funded by the National Institute for Child Health and Development (NICHD), recruited 1,364 youth from 10 research sites across the country in 1991. These sites (with sample proportions in parentheses) included: University of North Carolina, Chapel Hill (17.8%); University of Arkansas at Little Rock (17.1%); University of Virginia (13.2%); Temple University (11.2%); University of Kansas (9.9%); Harvard University and Wellesley College (8.6%); University of Washington, Seattle (8.6%); University of California, Irvine (6.6%); University of Wisconsin,

Madison (6.6%); and University of Pittsburgh (0.7%). The research team recruited participants from hospitals near these sites.

Of these youth, 52% were female, and 80% were White/Caucasian, 13% were Black/African American, 2% were Asian, and 5% listed their race/ethnicity as other. In addition to these categories, 6% of youth identified as Hispanic. At the one-month interview, youth's mothers were 28 years old on average ($SD = 5.63$), and 85% of youth's fathers were living in the same household as the mother and youth. Only 10% of mothers were currently employed at the one-month interview, and mothers' median annual income was between \$20,001 and \$25,000 before having the baby. In contrast, their husbands'/partners' median annual income was between \$30,001 and \$35,000. About 88% of mothers had completed high school, and 30% completed a bachelor's degree.

Measures

Callous-unemotional traits. To assess callous-unemotional traits, the SECCYD used the 15-item callous-unemotional dimension of the self-reported Youth Psychopathic Traits Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002). The YPI was developed as a self-report measure for psychopathy in adolescents, and is largely based on more structured interview and file review assessments, such as the Psychopathy Checklist: Youth Version (PCL:YV; Forth, Kosson, & Hare, 2003). The full YPI includes scales to assess the interpersonal, affective, and lifestyle facets of psychopathy, and previous studies provide evidence of the full measure's validity and reliability (Andershed, Hodgins, & Tengström, 2007; Campbell, Doucette, & French, 2009; Poythress, Dembo, Wareham, & Greenbaum, 2006; Skeem & Cauffman, 2003). Importantly, the full YPI score correlated highly with both youth- ($r = .47$) and parent-

reported ($r = .35$) ICU scores in a previous study (Fink, Tant, Tremba, & Kiehl, 2012), and the callous-unemotional YPI dimension was highly correlated with self-reported ICU score ($r = .62$) in a mixed sample of community and detained youth (Pihet, Etter, Schmid, & Kimonis, 2015). When examining the measures by subscales, all three ICU scales (callous, uncaring, unemotional) were correlated with the YPI callousness scale ($r = .20-.36$), the callous ($r = .35$) and uncaring ($r = .18$) ICU scales were correlated with the YPI remorselessness scale, and the callous ICU scale was correlated with the YPI unemotionality ($r = .21$) scale (Ansel, Barry, Gillen, & Herrington, 2015). Participants indicated how well each statement applied to them on a 4-point Likert scale from “Does not apply at all” to “Applies very well.” The dimension can further be broken down into three five-item subscales; remorselessness (e.g., “To feel guilt and regret when you have done something wrong is a waste of time”); unemotionality (e.g., “I usually feel calm when other people are scared”); and callousness (e.g., “I think that crying is a sign of weakness, even if no one sees you”). The callous-unemotional dimension of the YPI was administered at the age 15 interview and demonstrates high internal reliability (Cronbach’s $\alpha = .82$). The 15 items were summed to produce an overall scale score.

Temperament. For temperament, mothers completed an 80-item version of the Children’s Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001) at the 54-month interview, including the 10-item fear ($\alpha = .64$; “Is very frightened by nightmares”) and inhibitory control ($\alpha = .75$; “Can lower his/her voice when asked to do so”) subscales. Mothers rated each item on a 7-point Likert scale from “Extremely untrue” to “Extremely true.”

Ecological risk factors. To assess ecological risk in the normative SECCYD sample, I chose to adapt the Adverse Child Experiences (ACE) framework (Sacks, Murphey, & Moore, 2014), which focuses on the following eight risk factors for children: living with a parent/guardian who got divorced/separated, died, or served time in jail or prison; living with someone who is mentally ill or suicidal, or severely depressed for more than a couple of weeks; living with anyone with a substance abuse problem; witnessing adult violence in the household; exposure, through victimization or witnessing, to violence in his or her neighborhood; and experiencing economic hardship. To best assess these risk factors, I used nine items from the Life Experiences Survey (Sarason, Johnson, & Siegel, 1978), completed by mothers at the 54-month and 3rd and 5th grade interviews: husband/partner detained in jail for law violation; marital separation (due to conflict); divorce; death of husband/partner; family violence or abuse; gunshots or violence in neighborhood; took non-prescription drugs monthly to help with mental problems; took prescription drugs monthly to help with mental problems; had psychological counseling or therapy. Mothers indicated whether they had experienced each item in the past year. In addition, to measure economic hardship, I used reported data on household size and household income to determine whether participants were living below the federal poverty level at the 54-month and 3rd and 5th grade interviews. Each participant's risk score is the sum of these risk factors at each interview time point.

Ecological promotive factors. To assess promotive factors, I used available data on support from peers, teachers, and parents at the third and fifth grade interviews. Study children completed a 20-item version of the Friendship Quality Questionnaire (Parker & Asher, 1993) at the 3rd and 5th grade interviews, and internal reliability was high for the

measure ($\alpha = .87$ for 3rd grade, $.89$ for 5th grade). Children rated each item on a 5-point Likert scale from “not at all true” to “really true.” Sample items include “___ and I make each other feel important and special,” and “___ and I tell each other private things a lot.” Mothers and teachers also provided information about friendship quality by completing a 20-item measure adapted from the Quality of Classroom Friends measure (Clark & Ladd, 2000) at the 3rd and 5th grade interviews. Twelve items assess positive relationship with friends (e.g., “Work well together,” “Take turns effectively,”), and informants rated each item on a 4-point Likert scale from “Strongly disagree” to “Strongly agree.” Internal reliability was high for both mother ($\alpha = .88$ for 3rd grade, $.89$ for 5th grade) and teacher report ($\alpha = .88$ for 3rd grade, $.85$ for 5th grade).

To assess support from the child’s teacher, teachers completed the 15-item Student-Teacher Relationship scale (Pianta, 2001) at the 3rd and 5th grade interviews. Teachers rated each item (e.g., “This child values his/her relationship with me”) on a 5-point Likert scale from “Definitely does not apply” to “Definitely applies.” Internal reliability was high for both the 3rd ($\alpha = .89$) and 5th grade ($\alpha = .88$) versions. In addition, children completed measures regarding their relationship with their teacher at the 5th grade interview, including 7 items that measure proximity seeking from the Relatedness Questionnaire (Lynch & Cicchetti, 2002; e.g., “I wish my teacher knew me better”), 8 items that measure security from the Security Questionnaire (Kerns, Klepac, & Cole, 1996; e.g., “It’s easy to trust my teacher”), and 10 items that assess the emotional quality of the child’s relationship with his or her teacher (e.g., “When I’m with my teacher, I feel safe”). All items were rated on a 4-point Likert scale, from “Not at all true” to “Very true” for the proximity and security items, and from “Almost never” to “Almost always”

for the emotional quality items. Items had moderate internal reliability for the proximity seeking ($\alpha = .75$) and security ($\alpha = .73$) measures, and high reliability for the emotional quality ($\alpha = .87$) measure.

To assess youth's relationship with their parents, youth completed measures of proximity seeking and emotional quality regarding their relationship with both parents at the 3rd and 5th grade interviews. Proximity seeking was measured with 7 items (except for relationship with mother at 3rd grade, which was assessed with 6 items) from the Relatedness Questionnaire (Lynch & Cicchetti, 2002; e.g., "I wish my mother/father knew me better"), and emotional quality was measured with 11 items (e.g., "When I'm with my mother/father, I feel safe"). Proximity seeking had acceptable internal reliability at the 3rd ($\alpha = .78$ for mother, .82 for father) and 5th grade ($\alpha = .81$ for mother, .86 for father) interviews. Emotional quality also had acceptable internal reliability at the 3rd ($\alpha = .80$ for mother, .85 for father) and 5th grade ($\alpha = .82$ for mother, .87 for father) interviews. Additionally, youth completed an 11-item measure of relationship security (Kerns et al., 1996; e.g., "It's easy to trust my mom/dad") at the 5th grade interview regarding their relationship with both their mother ($\alpha = .77$) and their father ($\alpha = .81$).

Mothers also completed a 19-item of parental monitoring and supervision (Stattin & Kerr, 2000) at the 5th grade interview, including 9 items to measure parental monitoring (e.g., "Do you know what your child does during his or her free time?"; $\alpha = .63$), 5 items to measure child disclosure (e.g., "Does your child talk about how he or she is doing in the different subjects in school?"; $\alpha = .61$), and 5 items to measure parental solicitation (e.g., "Do you ask your child about things that happened during a normal day at school?"; $\alpha = .69$).

Procedures

This study was conducted by the NICHD Early Child Care Research Network supported by NICHD through a cooperative agreement that calls for scientific collaboration between the grantees and the NICHD staff. The SECCYD employed a longitudinal research design incorporating multiple sources of information. The families of study participants were recruited at the participants' birth and followed for the first fifteen years of life at regular intervals: at 1, 6, 15, 24, 36, and 54 months of age, and then annual interviews from kindergarten through 8th grade, and a final data collection point at age 15. Data sources include the child, the mother and/or father, teacher, caregiver(s) if any, teachers, principals, child care center directors, clinicians, friends, and friends' parents, as well as observations conducted by the research team. Of the original 1,364 youth who began the study, 90% continued their participation through the 1st grade, 78% continued through the 6th grade, and 74% continued through the age 15 interview. These retention rates are relatively high (de Graaf, Bijl, Smit, Ravelli, & Vollebergh, 2000; Ribisl et al., 1996), especially for such an involved study that required intensive data collection.

Plan of Analysis

Before testing hypotheses, I inspected the data for missingness and used multiple imputation to address missing data concerns. To test the first hypothesis, I used linear regression to assess whether exposure to risk factors prior to 54 months of age predicts callous-unemotional traits at age 15. To test the second hypothesis, I used linear regression to assess whether exposure to promotive factors prior to 54 months of age predicts callous-unemotional traits at age 15. Finally, to test the third hypothesis, I tested

mother-reported temperament at 54 months of age as a moderator of the associations between risk and promotive factors and callous-unemotional traits.

I also conducted supplementary analyses using linear regression to gain a better understanding of the associations between the predictors and the outcome of interest. Specifically, I tested whether three-way interactions between gender and temperament and ecological risk or promotive factors significantly predict callous-unemotional traits. Similarly, I tested whether three-way interactions between ethnicity and temperament and ecological risk or promotive factors significantly predict callous-unemotional traits. Finally, I tested whether mother-reported anxiety or social problems, rather than temperament, moderate associations between ecological risk or promotive factors and callous-unemotional traits.

Results

Missing Data

First, I examined the data for missingness. I found that the rate of missing data was roughly 38% in models with main effects only and 53% in models with interaction effects. Therefore, because the rate of missing data is so high, I proceeded to use multiple imputation by chained equations (Royston, 2004; Royston & White, 2011) to impute missing data before running subsequent analyses. Multiple imputation and all subsequent analyses are conducted in Stata 14 (StataCorp, 2015). All variables to be included in the models were included in the multiple imputation equations, as well as additional auxiliary variables that are not part of the models (e.g., mother's and father's race/ethnicity, mother's employment status at 1 month post-birth, etc.). Variables were modeled appropriately based on their measurement and distribution; for example, Poisson models

were used for count data, ordered logit models for ordinal data, etc. Using this method, I created 50 imputed data sets, which I used in all subsequent analyses. I examined imputed values and found no issues with the imputations (e.g., out-of-range predictions). Although values of the dependent variable were imputed in order to impute accurate values for independent variables and covariates, I only included cases that had complete data on the dependent variable ($n = 954$) in subsequent analyses.

Hypothesis 1

To test my first hypothesis that ecological risk factors would be positively associated with callous-unemotional traits, I first created a risk index based on my measures of risk at 54 months, 3rd grade, and 5th grade. I created a sum score of the number of risk factors to which youth were exposed at each age, and then imputed the summed index. Creating a summed measure of risk factors is in line with previous research assessing exposure to risk across various domains and contexts (Appleyard, Egeland, van Dulmen, & Sroufe, 2005; Boxer et al., 2009; Rutter, 1979; Sameroff, 2000). Initially I attempted to impute the individual index items, but doing so for three separate time points created issues with multicollinearity and perfect prediction; thus, I imputed the index score at each age instead.

Many participants did not experience ecological risk according to my measure; 33% had an index score greater than 0 at 54 months, compared to 30% at 3rd grade and 33% at 5th grade. Overall, out of the 1,158 youth with valid ecological risk data for at least one time point, 36% did not experience any risk (e.g., death of a parent, father jailed, parents' divorce or separation) according to my measure. For youth who did experience some form of risk, out of a possible 10 different experiences, most reported

only one, but some reported as many as five (at 54 months and 5th grade) or six (at 3rd grade); see Figure 5 for frequencies of each risk factor by time point in the original complete case data.

The initial linear regression model with robust standard errors predicting callous-unemotional traits at age 15 from risk indices at 54 months, grade 3, and grade 5 indicated that exposure to risk factors was not significantly associated with callous-unemotional traits. Including mother-reported temperament at 1 and 6 months of age and dummy-coded ethnicity (1 = white) and gender (1 = female) as covariates resulted in one significant and negative coefficient, for risk exposure at grade 3 ($b = -0.58, p = 0.022$). Table 11 displays 95% confidence intervals of the coefficients from both models. Overall, it appears that there is not a main effect of risk exposure predicting increased callous-unemotional traits; therefore, I am unable to reject the null hypothesis that there is no association between ecological risk exposure in childhood and callous-unemotional traits in adolescence.

Hypothesis 2

To test my second hypothesis that ecological promotive factors would be negatively associated with callous-unemotional traits, I first created indices of promotive factors based on measures at 3rd and 5th grade. I first imputed the individual promotive variables, and then created a sum score of the number of promotive factors to which youth were exposed at each age. I considered a youth to be exposed to a particular promotive factor if a youth was in the upper quartile (75th percentile and above) for that factor. Most youth in the data had exposure to some promotive factors; out of the 1,100 youth for whom I had ecological promotive factor data for at least one time point, less

than 2% had no observed exposure to any of the promotive factors I examined. On average, youth were exposed to 2.01 promotive factors ($SD = 1.51$) in grade 3 and 4.46 ($SD = 2.72$) in grade 5; however, I included a greater number of promotive factors at grade 5 (16) compared to grade 3 (8) because of the variables that were available. Figure 6 plots the frequencies of each promotive factor by time point in the original complete case data.

In a model with promotive indices at grades 3 and 5 predicting callous-unemotional traits at age 15, both coefficients were negative and significant; $b = -0.53$, $p = .001$ for grade 3, and $b = -0.50$, $p < .001$ for grade 5. The coefficients remained negative and significant when I included temperament at 1 and 6 months and gender and ethnicity in the model; $b = -0.30$, $p = .044$ for grade 3, and $b = -0.26$, $p = .001$ for grade 5. Again, Table 11 displays 95% confidence intervals for the coefficients in both models. Overall, the results support my hypothesis; it appears that there is a main effect for exposure to ecological promotive factors predicting decreased callous-unemotional traits.

Hypothesis 3

To test my third hypothesis that temperament would moderate the associations between ecological risk and promotive factors and callous-unemotional traits, I included interaction terms with mother-reported temperament at 54 months to the models I had tested for hypotheses 1 and 2. I tested both fear and inhibitory control measures as moderators and included all risk factors and the relevant temperament measure as main effects. I ran two sets of models, one with the covariates (temperament at 1 and 6 months, ethnicity, and gender) that were included in the main effects models, and one without these covariates. Table 11 also includes the 95% confidence intervals for the interaction

coefficients from these models. None of the two-way interaction coefficients was significant; therefore, temperament and ecological risk or promotive factors do not appear to interact to predict callous-unemotional traits.

Supplementary Analyses

In addition to the analyses listed above, I also examined additional models to gain a better understanding of the relationships among variables in this data set. Specifically, I tested whether race or gender interacted with the interactions tested in hypothesis 3. In other words, I included three-way interactions of race, ecological factors, and temperament, as well as gender, ecological factors, and temperament, in models predicting callous-unemotional traits. I tested models both with and without covariates. For the three-way interactions with gender, none of the p -values for the coefficients fell below .05.

One interaction came close, however; there was a three-way interaction between gender, fear, and promotive factors at 5th grade when covariates were included in the model ($p = .055$). To probe this interaction, I plotted marginal effects using complete case data ($n = 662$; see Figure 7). It appears that for males, the association between promotive factors and callous-unemotional traits becomes increasingly negative at higher levels of fear, while the reverse is true for females. Therefore, promotive factors appear to protect against increased callous-unemotional traits at high levels of fear for males and low levels of fear for females, although the relationship was not quite significant. None of the three-way interactions with ethnicity was significant. I also tested moderation models with mother-reported anxiety and social problems in place of mother-reported fear and

inhibitory control, to probe whether these interactions provided a better fit to the data. Again, none of these interactions was significant.

Discussion

In this study, I tested three hypotheses among a sample of 1,364 youth from 10 different research sites across the U.S. Specifically, I tested whether exposure to ecological risk factors was positively associated with callous-unemotional traits, whether exposure to ecological promotive factors was negatively associated with callous-unemotional traits, and whether temperament moderated these associations. I only found support for my second hypothesis. That is, exposure to promotive factors at grades 3 and 5 appears to be associated with lower callous-unemotional traits at age 15. However, there was no main effect of exposure to ecological risk factors, and mother-reported fear and inhibitory control at 54 months did not moderate these associations.

The results from this study indicate that early to middle childhood exposure to promotive factors – such as emotionally close relationships with parents, friends, and teachers – is associated with lower levels of callous-unemotional traits in adolescence. However, it does not appear that exposure to risk factors is associated with increased callous-unemotional traits, and temperament did not moderate these associations. It is possible that youth who are on a trajectory towards greater callous-unemotional traits can be protected from poor outcomes by exposure to promotive factors, while youth who are not prone to develop callousness are not influenced by exposure to risk factors. It could also be the nature of these data; most of these youth were not exposed to significant risk factors, such as trauma or exposure to aggression or violence. Finally, it is possible that the conceptualization of risk in the current study could be better refined. For example, I

included the youth's parent attending therapy or taking medication (prescription or non-prescription) to cope with a mental health issue as risk factors, because according to the ACE model, living with someone with mental illness or severe depression can be a risk factor for youth. However, if the parent is attending therapy or taking prescription medication, it is more likely that the parent is effectively managing any mental health diagnoses, and therefore the inclusion of this item in the measure of risk might require re-evaluation.

Interestingly, I found an interaction (at $p = .055$) between gender, fear at 54 months, and promotive factors measured in 5th grade. The results indicated that fearful males have a stronger negative association between promotive factors and callous-unemotional traits, while the reverse was true for females; promotive factors only predicted lower callous-unemotional traits among females low in fear. The association among males is what I had originally hypothesized I would find in the data, and indicates that the relationship between ecological factors and callous-unemotional traits is stronger at higher levels of fear. However, the association among females was not predicted, and is more difficult to interpret. It is possible that different levels of fear are normative for males and females, such that females are typically more fearful than males. In this case, it might be that individuals who are farther from the norm (i.e., fearful males and fearless females) are more susceptible to environmental influences. However, it is not clear whether this is the case, or if there is a better alternative explanation. Future research in this area might more closely examine these associations by gender, to better determine whether the etiological mechanisms responsible for callous-unemotional traits differ for males and females.

It should be noted that the nature of these data limit the possibility to test for causal or even directional relationships. For example, it is unclear whether exposure to promotive factors actually causes a reduction in callous-unemotional traits, or whether youth who are less prone to develop callousness are more likely to have positive factors in their environment (i.e., their warmer personality elicits a more positive response from those around them). In this sample, it does appear that temperament at 54 months predicted risk and promotive factor exposure at 54 months, 3rd grade, and 5th grade, such that fearfulness was associated with greater exposure to risk, and inhibitory control was associated with decreased exposure to risk factors and increased exposure to promotive factors. This analysis, however, is still inconclusive; therefore, results should be interpreted with caution. Future research with developmental samples should strive to obtain similar measures across interview waves, to examine change in variables over time; for example, having measures of callousness, empathy, or guilt at earlier ages would improve this analysis.

Study 4b: Video Game Violence Project

For this next study, I was able to test associations of ecological factors with time-varying trajectories of callous-unemotional traits, which allowed me to gain valuable information above and beyond what I had found in the previous study. Importantly, I was also able to test these associations among a sample of youth in the community at various levels of risk.

Methods

Participants

Participants for the Video Game Violence (VGV) project, funded by NICHD, spanned three separate cohorts, including the 2nd, 4th, and 9th grades, and came from seven different schools (four in Michigan and three in Iowa). Proportionally, 68% of the sample came from Michigan schools, with 30% of the sample specifically coming from a school in Flint, and 32% of the sample was recruited from schools in Iowa. Of the 1,354 youth in the study, 447 were in the 2nd grade cohort, 517 were in the 4th grade cohort, and 457 were in the 9th grade cohort. Baseline interviews were conducted in 2006 and 2007, and youth, their parents, and their teachers were interviewed annually for another two years.

Across the cohorts, about 53% of the sample was female; 58% was White/Caucasian, 18% was Black/African American, 7% were biracial or multiracial, 2% identified with another racial/ethnic category, and 14% were missing data on race/ethnicity. The interviewed parents (88% of whom were mothers) were, on average, 36 years old ($SD = 6.21$) at baseline for the 2nd grade cohort, 38 years old ($SD = 6.93$) at baseline for the 4th grade cohort, and 42 years old ($SD = 6.88$) at baseline for the 9th grade cohort. Of the interviewed parents, 98% had completed high school, and 39% completed their college education; at baseline, 53% were working full-time, 23% were working part-time, and 25% were not employed; at baseline, 65% were married, 31% were unmarried, and 5% were separated; and the median yearly household income was \$41,000 to \$50,000 at baseline.

Measures

Callous-unemotional traits. Parents completed the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004b) for youth in all cohorts. In addition, the 9th grade

cohort completed the self-report version of the ICU. Mothers and youth rated how well each of 24 items (e.g., “I do not show my emotions to others”) applied to the study youth on a 4-point Likert scale from “Not at all true” to “Definitely true.” The psychometric properties and factor structure of the ICU have been established in prior studies (Essau et al., 2006; Feilhauer et al., 2012; Kimonis, Frick, Skeem, et al., 2008). In the VGV data, after removing two items (“What I think is right and wrong is different from what other people think” and “I do not let my feelings control me”) found to be unreliable in prior studies, the 22-item measure was internally reliable for maternal report across all waves for the 2nd ($\alpha = .88, .90, \text{ and } .88$), 4th ($\alpha = .89, .90, \text{ and } .90$), and 9th ($\alpha = .89, .90, \text{ and } .90$) grade cohorts. Self-report was also internally reliable across all three waves for the 9th grade cohort; $\alpha = .84, .85, \text{ and } .86$, respectively. For each report, scale items were averaged to produce a scale score.

Emotion regulation. To assess emotion regulation, I used eight items from the aggression subscale of the Child Behavior Checklist (CBC; Achenbach, 1991). Using principal component factor analysis with varimax rotation, I found that these eight items formed their own cohesive dimension separate from other more behavioral items. Sample items include “sudden changes in mood or feelings” and “temper tantrums or hot temper.” Mothers rated how well each item described their child on a 3-point Likert scale from “Not true” to “Very true or often true.” This eight-item scale demonstrated good internal reliability ($\alpha = .84\text{--}.86$), and in the SECCYD data, within-informant correlations between this measure and a measure of emotion reactivity (Parent’s Report of Children’s Reactions) ranged from .41 to .49, all significant at the $p < .001$ level. Items were reverse coded and summed to produce an emotion regulation scale score.

Ecological risk factors. To assess risk factors, teachers completed six items of the Social Experience Questionnaire (SEQ-T; Cullerton-Sen & Crick, 2005); three items assessed indirect or relational aggression (e.g., “This child is the target of rumors or gossip in the playgroup”), and three items assessed direct or physical aggression (e.g., “This child gets hit or kicked by peers”). Teachers rated how well each item applied to the study youth on a 5-point Likert scale from “Never true” to “Almost always true.” Even with the small number of items, these scales appeared to be highly reliable; Cronbach’s α ranged from .81 to .91 for the relational aggression measure and from .83 to .95 for the physical aggression measure, across all cohorts and waves. Scale items were averaged into a total score.

Teachers also completed the two-item victimization and rejection subscales of the Teacher/Staff Predictions of Peer Nominations measure (Huesmann et al., 1994). For victimization, teachers indicated how many students would say that the study youth “gets picked on by other kids/others” and “gets hit and pushed by other kids/others” ($\alpha = .68-.77$). For rejection, teachers indicated how many students would say that the study youth “is a kid they really do not like” and “is someone they wish were not in their class at all” ($\alpha = .87-.89$). Response options for all items were 0% (0), 1-5% (3), 6-10% (8), 11-25% (18), 26-50% (38), 51-75% (62.5), and over 75% (87.5). Scale items were averaged into a total score.

Youth in the 2nd and 4th grade cohorts completed a two-item measure of exposure to low-level aggression, and the 9th grade cohort completed a four-item measure (Boxer et al., 2003). Youth indicated how often they had witnessed different kinds of aggression (e.g., “How often have you heard students threatening to beat someone up after school?”)

on a 3-point Likert scale from “Never” to “Lots of times.” This scale has been used in previous studies (Boxer et al., 2003; Boxer et al., 2009; Docherty, Boxer, Huesmann, O'Brien, & Bushman, in press), and had low to moderate internal reliability (Cronbach's α ranged from .53 to .73 across cohorts and waves), likely due to the wide difference in base rates among items (e.g., 98% of youth across all grades saw someone get hit or pushed at school, but only 63% of high school students heard kids talk about bringing a weapon to school). Items were averaged to produce a scale score. Youth also completed a four-item measure of exposure to neighborhood violence (Attar et al., 1994) by indicating whether or not a particular item applied to them (e.g., “Had to hide someplace because of shootings in the neighborhood”). A scale score was computed by summing items, and the measure demonstrated acceptable to good internal reliability ($\alpha = .69-.80$).

Parents completed a 14-item measure of rejection toward their child, and responded yes or no to each item (e.g., “Has this child been too forgetful?”). Ten scale items were averaged to compute a scale score, after excising four items with high rates (61-85%) of missing data; the remaining 10 items demonstrated acceptable internal reliability ($\alpha = .74-.75$). Parents also completed measures of parental aggression and violence. Parents completed nine items that measure physical aggression from the Buss-Perry Aggression Questionnaire (Buss & Perry, 1992). They rated each item (e.g., “I have threatened people I know”) on a 5-point Likert scale from “Not at all true of me” to “Definitely true of me” (α ranged from .73 to .77). Parents also completed the four-item Severe Physical Aggression Scale (Huesmann, Eron, Lefkowitz, & Walder, 1984; Lefkowitz et al., 1977). They indicated how often they had engaged in a number of violent acts (e.g., “How often have you slapped or kicked someone?”) using a 4-point

Likert scale from “Never” to “A lot.” This scale had low internal reliability (α was between .43 and .59) and the averaged scale scores produced a highly negatively skewed distribution. Therefore, a dummy variable was created to indicate whether each parent had (1) or had never (0) engaged in any violent acts. Finally, parents completed nine items from the Conflict Tactics Scale (Straus, 1979), which specifically measures aggression and violence targeted at the respondent’s spouse. Parents indicated how often they had engaged in aggressive behaviors (e.g., “threatened to hit or throw something at your spouse?”) in the past year using a 10-point Likert scale from 0 (“never”) to 9 “nine or more times”). Although the measure demonstrated acceptable to good internal reliability ($\alpha = .75-.88$), the computed average was highly skewed, as most parents did not admit to engaging in domestic violence. Therefore, a dummy variable was created to indicate whether each parent had (1) or had never (0) engaged in domestic violence.

Ecological promotive factors. To assess promotive factors, parents completed a two-item measure of parental monitoring for elementary school students and a five-item measure for high school students. They rated each item (e.g., “How often does your child check in with you after school?”) on a 5-point Likert scale from “Never or almost never” to “Always or almost always.” The five-item measure achieved Cronbach’s α between .64 and .71. Items were averaged to produce a scale score. Parents also completed a nine-item measure of parental nurturing, for which responses to open-ended questions (e.g., “What makes your child unhappy?”) were coded dichotomously as either nurturing or non-nurturing. However, because internal reliability was so low as to be unacceptable for this scale ($\alpha = .29-.33$), the scale items were first summed, and then a categorical variable was created to denote very low (<7), moderate (7), high (8), or very high (9) nurturing.

The resulting groups were not quite quartiles, with category sizes ranging from 13% to 34%.

Procedures

Each participant was interviewed individually or in small groups for about one hour at three one-year intervals. One of the child's parents and the child's teacher were both interviewed each year by mail and/or phone for the parent, or in person for the teacher. The interviewers were trained staff and graduate students overseen by a masters-level supervisor. The overall retention rate by the third wave of interviews was 84%, and this was relatively consistent across the cohorts; 86% for the 2nd grade cohort, 85% for the 4th grade cohort, and 81% for the 9th grade cohort.

Plan of Analysis

I first assessed the data for missingness and used multiple imputation to address any missing data concerns. I then conducted a group-based trajectory model with these data to examine latent trajectories within the data. Subsequent analyses were conducted based on these results; because trajectory models show that there is little change over time in callous-unemotional traits for this sample, I examined ecological predictors of trajectory membership assessed at wave 1. I again tested the following three hypotheses: that exposure to ecological risk factors is associated with increased callous-unemotional traits; that exposure to ecological promotive factors is associated with decreased callous-unemotional traits; and that self-regulation will moderate these associations, such that the associations are stronger among youth with poor self-regulation. I used ordered logistic and multinomial logistic regression models with robust standard errors to test these hypotheses, and included age at baseline, sex, ethnicity, and cohort as covariates.

Additionally, I ran supplementary analyses to identify whether the associations among variables varied as a function of demographic characteristics. Specifically, I tested three-way interactions of gender, regulation, and ecological factors, as well as ethnicity, regulation, and ecological risk factors, to see whether they significantly predict callous-unemotional traits.

Results

Missing Data

Most of the sample had valid data for parent-reported callous-unemotional traits, and 68% of the sample had valid data at all three time points. Group-based trajectory modeling is able to overcome missing data limitations to produce group membership and posterior probabilities for youth who are missing some callous-unemotional traits data; therefore, 1,372 youth (97% of the sample) were included in the trajectory model. However, while missing data was not a problem for the dependent variable, including all variables in the models resulted in high rates of missing data; for example, the model with all ecological risk factors as predictors reduced the sample size to 1,069 (75%).

Therefore, I proceeded to use multiple imputation by chained equations (Royston, 2004; Royston & White, 2011) to impute missing data before running subsequent analyses. Multiple imputation and all subsequent analyses are conducted in Stata 14 (StataCorp, 2015). All variables to be included in the models were included in the multiple imputation equations, and variables were modeled appropriately based on their measurement and distribution; for example, logit models were used for binary data, ordered logit models for ordinal data, etc. Using this method, I created 50 imputed data sets, which I used in all subsequent analyses. I examined imputed values and found no

issues with the imputations (e.g., out-of-range predictions). Although I included parent-reported callous-unemotional traits at all time points in the equations to impute accurate values for independent variables and covariates, the trajectory analysis was still completed with youth who had valid data for callous-unemotional traits ($n = 1,372$).

Group-Based Trajectory Model Results

I conducted a group-based trajectory model analysis of parent-reported ICU scores in Stata 14 (StataCorp, 2015) using the traj package, and all subsequent analyses are conducted in Stata as well. I used the entire sample and varied the number of groups from 1 to 6, varied the polynomial order of each group from zero to three, and included cohort, age at the first wave, gender, and ethnicity as time-table covariates. My goal was to identify a solution that minimized Aikake's information criterion (AIC) and Bayesian information criterion (BIC), while producing meaningful results and group sizes of at least 3% of the total sample size. According to these criteria, the best-fitting trajectory model was a four-group solution, with a low-stable group, a low-increasing group, a moderate-increasing group, and a high-stable group. These trajectories are plotted in Figure 8, along with a line that corresponds to the cut-off score (30) for the parent version of the ICU that I had determined in Study 2. The two low groups are well below this cut-off, but the moderate group starts just under it and approaches closer at each wave, while the high group is well above it.

Hypothesis 1

To examine whether ecological risk factors predict membership in the trajectory of high, stable callous-unemotional traits, I first conducted an ordered logistic regression model with standardized measures of ecological risk factors as predictors and trajectory

group as the outcome. I also included cohort, ethnicity, gender, school, age at baseline, and parent-reported youth aggression as covariates in this and all subsequent models. For the measure of parent-reported youth aggression, I summed all items on the CBCL that were not used to compute the emotion regulation measure. The results of this and other regression models in this study are depicted in Table 12. According to the results, parental rejection ($OR = 2.38, p < .001$) and parental aggression ($OR = 1.13, p = .047$) were both associated with significantly greater odds of being in a higher trajectory group.

I then used multinomial logistic regression to examine which ecological risk factors differentiated the high-stable trajectory group from the other groups. Parental rejection was consistently associated with greater relative risk of being in the high-stable trajectory compared to the low-stable and low-increasing groups ($p < .001$), but the other risk factors were not significantly associated with risk of membership in the high-stable trajectory. Overall, the results appear to indicate that parental rejection is strongly associated with high and stable levels of parent-reported callous-unemotional traits; therefore, I reject the null hypothesis that there is no association between ecological risk exposure and callous-unemotional traits.

Although it is important to determine which specific risk factors are associated with high and stable trajectories of callous-unemotional traits, it is also important to examine how cumulative risk exposure is associated with trajectory membership. Therefore, I created a count of risk factor exposure at baseline by summing the number of ecological risk factors for which youth fell into the upper quartile. According to this count, youth's risk exposure ranged from 0 to 7 ($M = 1.98, SD = 1.46$). I also included this variable in multiple imputation models. This risk count was significantly associated

with higher trajectory membership in an ordered logistic regression model ($OR = 1.30, p < .001$), and was significantly associated with greater relative risk of being in the high-stable trajectory compared to being in the low-stable ($RRR = 1.80, p < .001$) or low-increasing ($RRR = 1.48, p = .001$) trajectory groups, but did not significantly differentiate the high-stable group from the moderate-increasing group ($RRR = 1.19, p = .123$). Overall, cumulative ecological risk exposure is associated with greater likelihood of having high and stable levels of callous-unemotional traits; again, I reject the null hypothesis that there is no association between ecological risk exposure and callous-unemotional traits.

Hypothesis 2

To examine whether ecological promotive factors are associated with membership in latent trajectories of callous-unemotional traits, I conducted an ordered logistic regression model with promotive factors (parental monitoring and nurturing) as predictors and trajectory membership as the outcome. According to this model, the standardized measure of parental monitoring was associated with lower odds of being in a higher trajectory ($OR = 0.62, p < .001$), but there was no significant association with parental nurturing. Multinomial logistic regression models indicated that parental monitoring was significantly associated with decreased relative risk of being in the high-stable trajectory group compared to the low-stable ($RRR = 0.38, p < .001$) and low-increasing ($RRR = 0.54, p < .001$) trajectories, but was not significant in differentiating the high-stable group from the moderate-increasing group ($RRR = 0.81, p = .095$). Based on these results, I reject the null hypothesis that exposure to ecological promotive factors is not associated with trajectories of callous-unemotional traits.

Hypothesis 3

To test whether emotion regulation moderated the associations between ecological risk and promotive factors and trajectories of callous-unemotional traits, I re-ran the above models for hypotheses 1 and 2, but included interaction terms for the regulation by risk factors and regulation by promotive factors interactions. For risk factors, parental rejection did not significantly interact with emotion regulation to predict trajectory membership. However, regulation appeared to moderate the association between cumulative risk exposure and relative risk for being in the high-stable trajectory compared to the low-stable ($p = .034$), low-increasing ($p = .015$), and moderate-increasing ($p = .052$) trajectories. This interaction is plotted for the unimputed, complete case data ($n = 1,191$) in Figure 9.

When probing this interaction, I tested marginal effects of risk exposure at the mean and one standard deviation above and below the mean of emotion regulation in the complete case data. These tests indicated that risk exposure is negatively associated with relative risk of being in the low-stable trajectory group and positively associated with relative risk of being in the moderate-increasing trajectory group at all levels of emotion regulation. Further, risk exposure is not associated with the relative risk of being in the low-increasing trajectory at any level of emotion regulation. Risk exposure is associated with membership in the high-stable trajectory only at lower levels (the mean and below) of emotion regulation. In other words, the association between risk and trajectory membership does not depend on emotion regulation for the three lower trajectories, but does for the highest trajectory. Therefore, I am able to reject the null hypothesis that

emotion regulation does not moderate the association between ecological risk exposure and trajectories of callous-unemotional traits.

I again tested interaction terms of emotion regulation with both parental monitoring and nurturing, to detect whether emotion regulation moderates the association between ecological promotive factors and callous-unemotional trajectories. The only interaction to reach significance was a parental monitoring by youth emotion regulation interaction differentiating the high-stable trajectory from the moderate-increasing trajectory ($p = .034$). This interaction is plotted in Figure 10 using quadratic linear plots of linear predictions from the multinomial logistic regression model using the imputed data, and it appears to indicate that parental monitoring is associated with a steeper decrease in probability of being in the high stable trajectory compared to the moderate-increasing trajectory, particularly at lower levels of emotion regulation. Overall, I reject the null hypothesis that emotion regulation does not moderate the association between ecological promotive factors and trajectories of callous-unemotional traits.

Supplementary Analyses

I ran additional analyses with gender and ethnicity as moderator variables to see whether there were significant two-way interactions between demographic characteristics and ecological exposure – as well as three-way interactions between demographic characteristics, ecological exposure, and emotion regulation – in predicting callous-unemotional trajectory membership. The only significant association was a gender by rejection interaction differentiating the high-stable trajectory from the moderate-increasing trajectory. This interaction is plotted using complete case data in Figure 11.

From the figure, it is clear that the association between parental rejection and risk of being in the high-stable trajectory is similar for males and females; however, at high levels of rejection, males have a greater probability of being in the moderate-increasing trajectory compared to females. There is also a significant difference in the marginal effect on moderate-increasing trajectory membership for females with high (1 *SD* above *M*) parental rejection ($ME = 0.26$) compared to males with high parental rejection ($ME = 0.40$). Therefore, although there is no gender difference in parental rejection predicting a high and stable trajectory of callous-unemotional traits, males who are exposed to parental rejection are at a greater risk than females exposed to parental rejection of being in a moderate and increasing trajectory of callous-unemotional traits.

Discussion

In this study, I examined latent trajectories of parent-reported callous-unemotional traits in a cohort-sequential sample that included youth in early and middle childhood, as well as adolescence (ages 8, 10, and 15 at baseline). First, I used group-based trajectory modeling and found that the trajectory model that provided the best balance between fit and parsimony included four trajectories: a low-stable group; a low-increasing group; a moderate-increasing group; and a high-stable group. I then tested my hypotheses using ordered logistic regression models, to predict membership in a higher trajectory, and multinomial logistic regression models, to see which factors predicted membership in the high-stable trajectory compared to the other trajectories. The results of these analyses indicated that cumulative risk exposure, parental rejection, and parental monitoring were each significantly associated with membership in the high-stable trajectory, such that

youth in this group were more likely to experience risk exposure and parental rejection and less likely to experience parental monitoring.

I also found that parental monitoring was not as predictive of lower callous-unemotional traits for youth who are able to regulate their emotions, but that it can serve as a promotive factor for youth with lower levels of emotion regulation. This result is in line with my proposed ecological model of callous-unemotional traits, as it indicates that youth are differentially susceptible to environmental influences in their development of callous-unemotional traits, and that youth with both low regulation and low promotive factors might be at increased risk for developing callous-unemotional traits. Importantly, this result remained significant when I included other parent-reported covariates in the model. Similarly, exposure to risk was more strongly associated with high, stable callous-unemotional traits at lower levels of emotion regulation, indicating that youth who are unable to regulate their emotions may be particularly susceptible to environmental influences in their development of callous-unemotional traits.

These findings are in line with the proposed differential susceptibility model of callous-unemotional traits, and highlight a possible ecological pathway for youth to develop these traits. These results are also a departure from the findings in the low-risk child care data (study 4a), as temperament did not moderate risk-callousness or promotive-callousness associations in those data. There are a number of potential reasons for this difference; it could be that the present study has more valid measures of risk and promotive factors, or that the differential susceptibility model is not as applicable to youth at lower levels of risk for developing callousness, psychopathology, or problem behavior.

It should be noted that although some of the youth in this study came from a high-risk urban area and may have been exposed to some risk factors such as parental aggression and violence, it is still a community sample that included youth from rural areas as well. The trajectory analysis confirmed that only some of the youth in this sample might be at greater risk of developmental psychopathology and problem behavior, as only 3% of the sample was included in the high-stable trajectory. Therefore, it is possible that the results of this study would not replicate in higher-risk samples, such as youth involved in child protective services or youth who have already been arrested for a serious offense. However, the relatively diverse nature of this sample lends credibility to the generalizability of these results, and the results indicate that the proposed differential susceptibility model can explain the development of callousness among youth in the community who are at elevated levels of risk.

This study had a number of strengths, including a relatively large sample size, collection of data from multiple informants, collection of similar data across time points to be able to track longitudinal changes, and the use of valid and reliable measures. However, there were a number of limitations as well. For example, although this was a multi-informant study, only a few measures of ecological factors were reported by either the youth or the youth's teacher. Further, only the parent-reported measures of ecological factors were significantly associated with trajectories of parent-reported callous-unemotional traits. While I attempted to account for common method variance by including other parent-reported measures in these models, I cannot verify that common method variance was completely accounted for in these data. Future research should attempt to examine these associations among multiple informant composites, the research

team's observations if applicable, and official or archival data (e.g., neighborhood crime exposure, arrest records) where available in order to better identify the true nature of relationships among variables.

The findings of this study generally support my hypotheses and lend support to the proposed differential susceptibility model. They also indicate that research in the area of callous-unemotional trait development might benefit from integrating both person-centered and variable-centered analyses, as relationships among variables can differ across individuals. Understanding how these associations operate at the level of the individual can help inform clinical practice by helping to tailor treatment to meet individuals' specific needs, and can inform future research on the etiology of callousness and the development of empathy and morality in youth.

Study 4c: Pathways to Desistance

In the final test of the differential susceptibility model for callous-unemotional traits, I test my hypotheses in a sample of high-risk juvenile offenders followed for seven years from adolescence (ages 14 to 19) to early adulthood (ages 21 to 26). Because callous-unemotional traits and risk and promotive factors are assessed at each time point, I am able to use more sophisticated analyses to best take advantage of these prospective panel data.

Methods

Participants

Participants in the Pathways to Desistance (PTD; Mulvey, 2016) project were on average 16 years old ($SD = 1.14$) at the time of the baseline interview, which were mostly conducted in 2001 and 2002. The sample was mostly male (86%) and nonwhite (80%);

41% of participants were Black/African American, 34% were Hispanic, and 5% identified with another racial/ethnic category. Participants were diverse in their family structure; 59% lived with their biological mother but not biological father, 8% lived with their biological father but not their biological mother, 15% lived with both biological parents, and 18% did not live with either biological parent. About a quarter of participants had been employed, and the median grade completed was 9th grade. About half (52%) of the sample came from Philadelphia County, Pennsylvania, and the remaining (48%) youth came from Maricopa County (Phoenix), Arizona.

Measures

Callous-unemotional traits. At post-baseline interviews, youth completed the Youth Psychopathic Traits Inventory (YPI; Andershed et al., 2002), including the 15-item callous-unemotional subscale, the same measure used in Study 4a. Youth rated each item's applicability on a 4-point Likert scale from "Does not apply at all" to "Applies very well." Five items each came from the remorselessness (e.g., "To feel guilt and regret when you have done something wrong is a waste of time"), unemotionality (e.g., "I usually feel calm when other people are scared"), and callousness (e.g., "I think that crying is a sign of weakness, even if no one sees you") subscales. The measure demonstrated good internal reliability in this sample ($\alpha = .73-.79$ across waves).

Emotion regulation. To assess emotion regulation, youth completed nine items adapted for this study from the Children's Emotion Regulation Scale (Walden, Harris, Weiss, & Catron, 1995). Youth rated items (e.g., "I can change my feelings by thinking of something else") on a 4-point Likert scale from "Not at all like me" to "Really like me." Scale scores were computed by averaging all items, and were coded as missing if

more than three items were missing. This measure had good internal reliability in this sample ($\alpha = .81-.88$ at first five interviews).

Ecological risk factors. To assess risk factors, participants completed measures of parental hostility, exposure to antisocial family members and friends, exposure to violence, and exposure to neighborhood disorder. To assess parental hostility, participants completed an adapted version of the Quality of Parental Relationships Inventory (Conger, Ge, Elder, Lorenz, & Simons, 1994) at each interview for the first five years of the study (i.e., up to 60 months post-baseline). The scale contained 12 items each to assess maternal (e.g., “How often does your mother get angry at you?”; $\alpha = .79-.85$) and paternal (e.g., “How often does your father throw things at you?”; $\alpha = .78-.88$) hostility separately. Participants coded each item on a 4-point Likert scale from “Always” to “Never”, and items were reverse coded before scale means were computed. Youth needed to have valid data on at least 9 out of the 12 items in order to get a computed scale score.

For exposure to antisocial family members and friends, participants reported at baseline whether their biological mother or father had been arrested or jailed during the recall period. Youth also reported the proportion of their close friends that had been arrested, and whether any family members in their household were involved in crime, at all interviews.

For exposure to violence, participants completed a modified version of the Exposure to Violence Inventory (Selner-O'Hagan, Kindlon, Buka, Raudenbush, & Earls, 1998). Each respondent indicated whether they had experienced (six items; $\alpha = .62$ at baseline) or witnessed (seven items; $\alpha = .78$ at baseline) a variety of violent acts, and

scores were summed to produce a victim scale, a witness scale, and a total score that summed both victim and witness scales.

For exposure to neighborhood disorder, participants completed an adapted version of the Neighborhood Conditions Measure (Sampson & Raudenbush, 1999). They indicated how well each of 21 items described the neighborhood that they spent the most time in during the recall period on a 4-point Likert scale from “Never” to “Often.” Twelve items measured physical disorder (e.g., “graffiti or tags”; $\alpha = .91-.94$ for first five interviews), and nine items measured social disorder (e.g., “adults fighting or arguing loudly”; $\alpha = .87-.92$ for first five interviews). The mean of scale items was computed for social and physical disorder scales, as well as the mean of all 21 items for a total disorder score ($\alpha = .94-.96$ for first five interviews). Participants had to have valid responses on 16 out of 21 items to get a computed total score, 9 out of 12 items to get a computed physical disorder score, and 6 out of 9 to get a computed social disorder score.

Ecological promotive factors. To assess environmental promotive factors, participants completed measures of neighborhood safety, support from caring adults, friendship quality, parental warmth, and parental knowledge and monitoring. The measure of neighborhood safety included seven items from the above Neighborhood Conditions Measure, with two items reverse coded, and participants needed valid data on all seven items in order to get a computed neighborhood safety scale score. Scale scores are the mean of all seven items.

Support from caring adults was measured using an inventory derived for this study from several other sources (Nakkula, Way, Stauber, & London, 1990; Northwestern Juvenile Project, 2000; Phillips & Springer, 1992). Participants were asked

about the type and range of supportive adults in their life across eight domains (e.g., adults you can depend on for help; adults you admire and want to be like). From this measure, the current study uses the number of domains for which the youth is able to name at least one adult.

To assess friendship quality, youth responded to 10 items adapted from the Quality of Relationships Inventory (Pierce, Sarason, Sarason, Solky-Butzel, & Nagle, 1997) at each interview. Youth were asked how much each item (e.g., “How much can you count on these people for help with a problem?”) applied to their five closest friends (averaged across all five), and responded to each item on a 4-point Likert scale from “Not at all” to “Very much.” Youth only responded to these items if they were able to identify at least one close friend, and a mean scale score was only computed if youth had valid data on at least 7 of the 10 items. A scale score of 0 (the lowest possible score) was computed for youth who were unable to identify at least one close friend. The measure demonstrated acceptable inter-item reliability ($\alpha = .74-.82$ for the first five interviews).

To assess parental warmth, participants completed an adapted version of the Quality of Parental Relationships Inventory (Conger et al., 1994) at each interview up to five years post-baseline. The scale contained 9 items each to assess maternal (e.g., “How often does your mother let you know she really cares about you?”; $\alpha = .92-.94$) and paternal (e.g., “How often does your father tell you he loves you?”; $\alpha = .95-.96$) warmth separately. Participants coded each item on a 4-point Likert scale from “Always” to “Never”, and items were reverse coded before scale means were computed. Youth needed to have valid data on at least 7 out of the 9 items in order to get a computed scale score.

To assess parental knowledge and monitoring, participants completed an adapted version of the Parental Monitoring Inventory (Steinberg, Lamborn, Dornbusch, & Darling, 1992). Five items assessed parental knowledge (e.g., “How much does this person know about how you spend your free time?”), are rated on a 4-point Likert scale from “Doesn’t know at all” to “Knows everything,” and were asked whether or not the youth lives with the applicable parent or guardian. Mean scale scores were computed for youth with valid data on four out of five items. An additional four items assessed parental monitoring (e.g., “How often do you have a set time to be home on weekend nights?”), are rated on a 4-point Likert scale from “Never” to “Always,” and were only asked if the youth lived with the applicable parent or guardian.

Psychopathic traits. Trained raters completed the Psychopathy Checklist: Youth Version (PCL:YV; Forth et al., 2003) for each participant. The PCL:YV includes 20 items that measure the interpersonal (4 items; e.g., grandiose self-worth), affective (4 items; e.g., lack of remorse), lifestyle (5 items; e.g., parasitic orientation), and antisocial (5 items; e.g., criminal versatility) aspects of psychopathy. Each item is rated from 0 (consistently absent) to 2 (consistently present), and all 20 items are summed for a scale score.

Time in secure settings. Youth also reported the proportion of time during the recall period that they had spent in secure settings (e.g., jail, detention, prison) without access to the community.

Procedures

The Pathways to Desistance project targeted serious juvenile offenders in Philadelphia County, Pennsylvania, and Maricopa County, Arizona for recruitment.

Youth had to be between the ages of 14 and 17 at the time they committed their offense, and had to be found guilty of a serious offense (mostly felonies). Enrollment occurred from November 2000 to January 2003, with a participation rate of 80%. All participating youth provided informed assent or consent, and parents consented for youth under the age of 18 at the time of enrollment. All females and youth being considered for adult trials who met eligibility criteria were approached, but the research team kept the proportion of male youth found guilty of a drug charge to 15%. From the original 1,354 youth who completed baseline interviews, 84% completed the last interview seven years later. This is a relatively high retention rate, considering the length of time participants were enrolled in the study, the nature of the participants, and the intensity of data collection procedures (Schubert et al., 2004). Baseline interviews were conducted with youth from November, 2000 to March, 2003. Youth then completed interviews biannually for the first three years of study enrollment, and annual interviews for the next four years of study enrollment, for a total of a seven-year follow-up period. Self-report interviews were also supplemented by official records, such as arrest data and child protective services data, as well as collateral informant reports obtained from parents at baseline and from peers at annual follow-ups for three years after baseline.

Plan of Analysis

Before testing hypotheses, I inspected the data for missingness and used multiple imputation to address missing data concerns. Then, because Pathways to Desistance involves longitudinal data collected over multiple periods, and data collection procedures were similar for post-baseline interviews, I built a latent growth curve model to assess how time-varying risk and promotive factors predict change in callous-unemotional traits

over time. I tested various models (e.g., fixed effects, random intercept, random slope) increasing in complexity until I arrived at the most parsimonious model that best accounted for inter- and intra-individual variability in callous-unemotional traits. I then tested whether risk and promotive factors predict significant change in callous-unemotional traits, as well as whether emotional reactivity moderates these associations, such that they are stronger among youth with greater emotional reactivity. Finally, as with the previous studies, I tested whether gender or ethnicity moderates the interaction between emotion regulation and ecological factors to predict callous-unemotional traits.

Results

Missing Data

First, I examined the data for missingness. Each of the variables of interest was missing at least some data. I first ran latent growth curve models for hypotheses 1 and 2 on complete case data, to see what the overall rate of missingness would be. The model with risk factors only included 59% of the original 1,354 participants, and the model with promotive factors only included 37% of the original 1,354 participants. Therefore, because the rate of missing data is so high, I proceeded to use multiple imputation by chained equations (Royston, 2004; Royston & White, 2011) to impute missing data before running subsequent analyses. Multiple imputation and all subsequent analyses are conducted in Stata 14 (StataCorp, 2015). All variables to be included in the models were included in the multiple imputation equations. Because of the number and complexity of these equations, I used predictive mean matching with a kernel size of 10 to impute values based on other observations with similar predicted means. Using this method, I created 50 imputed data sets, which I used in all subsequent analyses. I examined

imputed values and found no issues with the imputations (e.g., out-of-range predictions), and verified that variable distributions across each wave were preserved in the imputed data sets. Although values of the dependent variable (callous-unemotional traits) were imputed in order to impute accurate values for independent variables and covariates, I only included cases that had complete data on the dependent variable ($n = 1,335$ across waves) in subsequent analyses. Further, because values could not be imputed across all waves for each variable (because some variables were missing for valid reasons and could not be imputed; e.g., neighborhood disorder when the youth had spent the recall period in a secure setting), the sample size decreases somewhat in the models.

To get a sense of how this sample differs from the SECCYD sample in study 4a, I have included a bar graph of mean YPI CU subscale scores for the two samples (Figure 12; note that the y-axis does not begin at 0, to more clearly display differences). Although youth in the Pathways to Desistance data are only a few months older than the SECCYD youth at the initial time point, their YPI scores are significantly higher. The YPI scores in the Pathways data decrease somewhat across time, but the confidence intervals never overlap with the confidence interval around the mean for the SECCYD youth. Additionally, the standard errors around the mean for the Pathways sample are about 19% to 26% smaller than the standard error for the SECCYD sample, suggesting that these youth are not just at higher risk levels than the low-risk sample, but that participants in this sample are more similar to each other in their levels of callous-unemotional traits. This graph also shows that there is change over time in the level of callous-unemotional traits for these youth, to help provide justification for using panel data models.

Hypothesis 1

To test my first hypothesis, that time-varying risk factors would be associated with greater callous-unemotional traits over time, I estimated fixed effects and mixed effects models using the xtreg and mixed commands in Stata. Because some of the predictor variables were only assessed for the first five years of the study, and callous-unemotional traits were only measured at post-baseline interviews, these models represent four and a half years, from 6 months post baseline to 60 months post baseline. On average, youth were about 16 years old at the 6-month interview and 21 years old at the 60 month-interview. The model included family members' crime involvement, friends' crime involvement, witnessing violence, violent victimization, neighborhood disorder, maternal hostility, and parental hostility as predictors, and wave, age, site, gender, ethnicity, proportion of time spent in a secure setting, psychopathy score at baseline, and whether the youth's biological mother or father had been arrested or jailed prior to baseline as covariates.

I first compared the consistency of fixed effects estimators to the efficiency of random effects estimators using the Hausman test (Hausman, 1978). Using this test, I found that the number of friends involved in crime ($z = -4.33$), witnessing violence ($z = -3.09$), maternal hostility ($z = -2.63$), and paternal hostility ($z = -6.88$) were each inconsistent under the random effects estimator. Therefore, to provide the best trade-off between consistency and efficiency while still being able to test coefficients of time-stable regressors, I include fixed effects estimators for these variables by including individual-level means as regressors, in addition to the variables in their original time-

varying metric. The estimate of rho indicated that 42% of the variance in callous-unemotional traits was accounted for by differences between individuals.

Next, I examined whether adding a random effect on the slope of the wave variable improved the fit of the model. In order to get obtained log likelihood values to calculate information criteria and likelihood ratio tests for model fit, I ran four mixed effects models (one with no random effect; one with random intercepts; one with random slopes for wave; and one with random slopes for wave and age) on each of the imputed data sets. The predictors in all models were the same, as outlined above: the predictors, covariates, and the means of the four predictors for which fixed effects would be estimated. The results from these models indicated that the random intercept model fit better than the model without a random effect for intercept, and the random slope for wave model fit better than the random intercept only model. However, adding a random effect for the slope of age did not improve model fit.

Therefore, the model with a random effect for the coefficient of the wave variable appeared to provide the best fit for the data; for the sake of comparison, though, Table 13 depicts the results of all four models estimated on the imputed data. Although callous-unemotional traits do not appear to be heteroskedastic over time (see Figure 13), robust standard errors are included in all models to mitigate the possibility of heteroskedasticity with respect to other predictors. The results of a dynamic panel data model with random intercepts and a random effect for growth across waves are also depicted in Table 13. Although it is common for researchers to employ dynamic panel data models to account for heterogeneity bias by including the lagged dependent variable as a predictor in the model, this practice can actually introduce bias in the model by ensuring that the

unobserved errors are correlated with observed variables. I will be interpreting the results of the random coefficient model for growth across waves below, but importantly, the magnitude and significance of time-varying risk factors remained relatively stable across all five models.

There was a significant decrease ($b = -0.03, p = .006$) in callous-unemotional traits at each time point, and this decrease was not accounted for by differences in participants' ages. There was also significant population-level heterogeneity in slopes across individuals, such that the 95% confidence interval of the random effect for time point (measured in months between interviews) is $-0.13, 0.07$. Examining time-stable level 2 regressors, participants from Arizona had higher callous-unemotional traits than participants from Pennsylvania ($b = 1.82, p < .001$); females had lower callous-unemotional traits than males ($b = -3.63, p < .001$); participants with higher PCL scores at baseline had higher callous-unemotional traits on average ($b = 0.12, p < .001$); participants with more friends involved in crime had higher callous-unemotional traits on average ($b = 0.53, p = .027$); and participants who witnessed more violence had higher callous-unemotional traits on average ($b = 0.92, p < .001$). Examining time-varying level 1 regressors, participants had higher callous-unemotional traits on average at time points when they reported witnessing more violence ($b = 0.30, p < .001$), being exposed to more disorder in their neighborhood ($b = 0.37, p = .005$), or experiencing greater hostility from their mother ($b = 1.19, p < .001$).

Hypothesis 2

To test the hypothesis that time-varying promotive factors would be associated with changes in callous-unemotional traits over time, I again built a mixed effects model

with the same covariates as in the risk model, but with diversity of social support from caring adults, friendship quality, neighborhood safety, parental knowledge, parental monitoring, maternal warmth, and paternal warmth as predictors. I first compared the consistency of fixed effects estimators to the efficiency of random effects estimators using the Hausman test (Hausman, 1978). The results of this test indicated that friendship quality ($z = 2.51$), parental knowledge ($z = 7.60$), parental monitoring ($z = 6.97$), and paternal warmth ($z = 2.19$) were each inconsistent under the random effects estimator. Therefore, to provide the best trade-off between consistency and efficiency while still being able to test coefficients of time-stable regressors, I include fixed effects estimators for these variables by including individual-level means as regressors, in addition to the variables in their original time-varying metric. The estimate of rho indicated that 40% of the variance in callous-unemotional traits was accounted for by differences between individuals.

Again, I used AIC, BIC, and likelihood ratio tests to compare four models (fixed effects, random intercept, random slope for wave, random slope for both wave and age) and again found that the model with a random effect for the slope of wave provided the best fit for the data. The results of these models, as well as a dynamic panel data model that included initial and lagged callous-unemotional traits, are depicted in Table 14. Again, the magnitude and significance of key time-varying predictors did not differ considerably across the five models, and I report here the results of the random effects model with a random effect for the slope of the wave variable. There was a significant decrease ($b = -0.03, p = .005$) in callous-unemotional traits at each time point, and this decrease was not accounted for by differences in participants' ages.

There was also significant population-level heterogeneity in slopes across individuals, such that the 95% confidence interval of the random effect for time point (measured in months between interviews) is -0.13, 0.07. Similar to the model for hypothesis 1, a number of level 2 variables were significantly associated with callous-unemotional traits: being at the Arizona site compared to the Pennsylvania site ($b = 0.92$, $p = .010$), being female ($b = -3.63$, $p < .001$), having a father arrested prior to baseline ($b = 0.77$, $p = .006$), baseline PCL score ($b = 0.13$, $p < .001$), and parental monitoring ($b = -1.04$, $p = .006$). However, even controlling for these individual-level characteristics, a number of time-varying level 1 regressors remained significant. Youth reported lower levels of callous-unemotional traits at time points when they reported greater feelings of neighborhood safety ($b = -0.51$, $p < .001$) or more warm behavior from their mother ($b = -0.47$, $p = .002$) or father ($b = -0.46$, $p = .001$).

Hypothesis 3

For my third hypothesis, I tested interactions of emotional reactivity with each of the significant time-varying regressors from the above models. For risk factors, I tested whether reactivity moderated the association between witnessing violence, neighborhood disorder, or maternal hostility and callous-unemotional traits, and found no significant interactions. For promotive factors, I tested whether reactivity moderated the association between neighborhood safety, maternal warmth, or paternal warmth and callous-unemotional traits, and found no significant interactions. Although this measure of emotional reactivity does not appear to moderate associations between ecological factors and callous-unemotional traits, I also tested random effects models with random effect terms for the slope coefficients of each of the significant ecological factors. In these

models, I found that adding these random effects significantly improved model fit for the risk factor model, and indicated that there is significant population-level heterogeneity in the associations between risk factors and callous-unemotional traits.

For example, in the model using ecological risk factors to predict callous-unemotional traits, I included random effects for the coefficients for witnessing violence, neighborhood disorder, and maternal hostility, as well as the random effect for wave. In this model, each of the random effects was significant in that the confidence intervals for the standard deviations excluded 0. For witnessing violence, the estimate of the standard deviation of the random effect was 0.71, meaning that the 95% confidence interval of the random effect for witnessing violence ranges from -1.08 to 1.72. Similarly, the 95% confidence intervals of the random effects were -0.76 to 1.45 for neighborhood disorder and -1.16 to 3.65 for maternal hostility. Therefore, while on average youth who report more exposure to violence, neighborhood disorder, and maternal hostility tend to report greater callous-unemotional traits, there is a high degree of heterogeneity in these associations, and for some youth they may be nonexistent or even negative. I conducted the same analysis with the model using ecological promotive factors to predict callous-unemotional traits by including random effects for the coefficients for neighborhood safety and maternal and paternal warmth, as well as the random effect for wave. However, the results indicated that these random effect terms were not significant, and including them worsened the fit of the model.

Supplementary Analyses

To further investigate whether these associations differed as a function of gender or ethnicity, I ran a series of models with three-way interactions. For the gender models, I

interacted gender and emotional reactivity with witnessing violence, neighborhood disorder, and maternal hostility in the risk factor model and with neighborhood safety and maternal and paternal warmth in the promotive factor model. I ran the risk model twice, once with a random slope for wave only, and once with a random slope term for witnessing violence, neighborhood disorder, and maternal hostility. The promotive factor model only included a random slope for wave. The only interaction term to reach significance for these models was a three-way interaction between gender, emotional reactivity, and neighborhood disorder ($p = .004$) in the model with random effect terms for the slopes of the three significant risk factors. This association is plotted using a linear prediction plot in Figure 14, and seems to indicate that there is a stronger association between neighborhood disorder and callous-unemotional traits at higher levels of reactivity for females, while the reverse is true for males. I then ran an identical set of models that included a three-way interaction term with ethnicity rather than gender. In these models, the only significant interaction terms were a two-way interaction between ethnicity and emotion reactivity ($p = .026$) and a two-way interaction between ethnicity and witnessing violence ($p = .034$), plotted in Figure 15 and Figure 16, respectively. The reactivity interaction indicates that reactivity might be more strongly negatively associated with callous-unemotional traits for youth who identify as White or Other, but less so for youth who identify as Black or Hispanic. The second interaction term indicates that witnessing violence is more strongly associated with callous-unemotional traits for White or Other youth, but less so for Black or Hispanic youth.

Discussion

In this study, I examined predictors of callous-unemotional traits in a high-risk sample ($n = 1,354$) with panel data over about seven years. I found that certain risk factors significantly and robustly predicted greater levels in callous-unemotional traits, or a higher rate of change in callous-unemotional traits, even after controlling for individual characteristics to help attenuate the possibility of heterogeneity bias. In particular, reporting witnessing violent events, neighborhood disorder, and maternal hostility were all associated with greater callous-unemotional traits, across a variety of different models (e.g., fixed effects, random intercept, random slope, and dynamic panel data models). Further, there appears to be a high degree of heterogeneity in these associations in the population, as including random effects for these coefficients improved the fit of the model and the confidence intervals for the standard deviations of the random effects did not include 0. However, this heterogeneity could not be explained by differences in emotional reactivity in this data set.

Similarly, certain promotive factors were consistently associated with decreases in callous-unemotional traits. In particular, feelings of safety in one's neighborhood and maternal and paternal warmth were each associated with lower callous-unemotional traits in a range of different models. However, including random effects for each of these variables worsened the fit of the model and indicated that these associations are relatively homogenous across individuals.

Although I found substantial support for my first two hypotheses in this study, I did not find support for my third hypothesis, because I did not find that emotional reactivity specifically moderated the association between risk or promotive factors and

callous-unemotional traits. However, I did find that there was a substantial degree of variability in these associations for risk factors; therefore, it is still entirely plausible that some youth are more susceptible than others to environmental influences in their development of callous-unemotional traits, thus providing some support for a differential susceptibility model of callous-unemotional traits. Going forward, future research would benefit from investigating which individual-level factors best explain this heterogeneity in associations, to further refine and develop the ecological pathway model proposed in this dissertation.

The interactions between ethnicity and reactivity, and ethnicity and witnessing violence, and callous-unemotional traits were difficult to interpret. These results suggested that the association between reactivity and callousness is stronger among youth who identify as White or Other, compared to youth who identify as Black or Hispanic. Similarly, the association between witnessing violent events and callousness is stronger among youth who identify as White or Other, compared to youth who identify as Black or Hispanic. It's possible that callousness might have different antecedents and correlates for youth depending on their ethnicity, and future research should examine whether this is the case. Unfortunately, because the support for hypothesis 3 was mixed in this study, it's difficult to determine whether the differential susceptibility model of callous-unemotional traits operates differently as a function of youth's ethnicity; again, future work can focus on examining whether this is the case.

The three-way interaction between gender, reactivity, and neighborhood disorder in predicting callous-unemotional traits is also difficult to interpret. For females, the association between neighborhood disorder and callous-unemotional traits becomes

stronger at higher levels of reactivity, which is in line with an ecological pathway model of callous-unemotional traits. However, the reverse was true for males, such that neighborhood disorder is more strongly associated with callous-unemotional traits at lower levels of reactivity. This part of the interaction is not predicted by the current ecological pathway model. This interaction is made even more complex by its direct opposition to the interaction results from study 4a, in which the ecological pathway model fit for males but not females. Given the array of differences between these samples (e.g., age, risk level, different measures of fear/reactivity), it's difficult to point to one potential explanation for this finding. However, one possible explanation could be that the interaction in the low-risk sample (study 4a) was with promotive factors, and the current interaction includes risk factors. Perhaps females are more susceptible to risk factors at higher levels of fear or reactivity, but susceptible to the influence of promotive factors at lower levels of fear or reactivity, and the reverse is true for males. Future research can investigate this possibility and examine gender differences in more depth to determine if the differential susceptibility model is equally valid for both males and females, or if it operates differently as a function of gender and risk and promotive factors.

While this study benefited from a number of strengths, such as a prospective longitudinal design, a large sample size, and relatively high retention rates, it also suffered from a number of limitations. The rate of missing data varied by variable and wave, and for certain variables (e.g., maternal and paternal warmth and hostility) at certain waves (3, 4, or 5 years post-baseline), the rate of missing data was quite high. However, I did use multiple imputation by chained equations to attempt to overcome the

issue of missing data in the current data set. The variables included in the current study are almost entirely self report, and therefore relationships among variables may be inflated due to common method variance. However, there were a number of self-reported predictors included in the models, so some of the shared variance should have been partialled out. Still, future research could replicate and expand on these results by examining associations among variables obtained from a variety of methods (e.g., observation, physiological data) or informants (e.g., parent, teacher).

The results of this study clearly identify risk and promotive factors that are associated with increased or decreased callous-unemotional traits, respectively, and suggest that there is a high degree of variability in risk-callousness associations. Therefore, it is entirely possible that some youth will be impervious to such risk factors, while these environmental influences will have a much greater impact for others. These results call into question previous findings that callous-unemotional traits are relatively stable and unchanging over time, and that they are not influenced by factors in a youth's environment. The results of this study also point to the importance of studies that incorporate person-centered analyses, as there appears to be a high degree of variability across individuals in these variables and their associations, as well as variable-centered analyses to identify individual- and environmental-level risk and promotive factors.

General Discussion

In this dissertation project, I tested an ecological pathway model of callous-unemotional traits in three large panel datasets that represented different levels of risk and different stages of development. According to this model, some youth may be differentially susceptible to factors in their ecology in their etiological pathways to

callous-unemotional traits. For youth with fearless, unreactive tendencies, the associations between risk and promotive factors and callous-unemotional traits might be weak or nonexistent; however, these associations are hypothesized to be stronger for youth who are fearful or reactive, or whose emotion regulation abilities are poorer. I tested this model among three samples: a relatively low-risk sample of normative youth followed from birth to age 15; a medium-risk sample of youth in the community, including youth from disadvantaged urban areas as well as rural areas, followed for three years in a cohort-sequential design beginning in 2nd, 4th, and 9th grades; and a high-risk sample of serious juvenile offenders interviewed over the course of seven years, from ages 14 to 19 at baseline to 21 to 26 at the final wave.

My first hypothesis was that ecological risk factors, such as parental rejection and exposure to violence, would be associated with greater callous-unemotional traits. This hypothesis was supported in two out of the three data sets. Associations between risk factors at 4, 8, and 10 years of age and callous-unemotional traits at 15 years were not significant in the low-risk child care data. However, cumulative risk exposure, and particularly parental rejection, were both associated with high, stable trajectories of callous-unemotional traits in the medium-risk sample, and witnessing violence, neighborhood disorder, and maternal hostility were each associated with greater callous-unemotional traits in the high risk sample. Given that risk exposure seemed to be a more robust predictor of callous-unemotional traits in the medium- and high-risk sample compared to the low-risk sample, it might be the case that there is a certain threshold for risk in predicting callous-unemotional traits. In the low-risk normative sample, it was extremely rare for participants to report events like witnessing neighborhood violence or

violence in the home; however, these events were more common in the other two data sets. The measure of risk in the normative sample also included factors such as living in poverty or the youth's parents going through a divorce. While these are factors that can influence youth development, it is entirely possible that they do not have as much of an influence on callous-unemotional traits as more salient negative events, such as exposure to abuse and violence and rejection. The conceptualization of risk in the low-risk child care data may also require refinement.

For my second hypothesis, I tested whether ecological promotive factors predicted decreased callous-unemotional traits, and found this to be the case across all three data sets. In the low-risk normative sample, the count of promotive factors at ages 8 and 10 (3rd and 5th grade) both significantly predicted lower callous-unemotional traits at age 15. However, in these data callous-unemotional traits were only measured at one time point. Therefore, it is possible that youth with a pleasant temperament who do not exhibit high levels of problem behaviors might be more likely to elicit promotive factors (e.g., bonding with parents, peers, and teachers) from their environment, and also less likely to develop callous-unemotional traits. I attempted to account for this possibility by controlling for mother-reported temperament at 1 and 6 months of age, but the direction of associations is still unclear in these data.

In the medium-risk sample, parental monitoring was associated with decreased risk of having a high, stable trajectory of callous-unemotional traits, and in the high-risk sample, neighborhood safety and maternal and paternal warmth were each associated with lower callous-unemotional traits. Interestingly, although parental monitoring was significant in the medium-risk sample, changes in parental monitoring were not

associated with changes in callous-unemotional traits in the high-risk sample, although there was a significant between-subject effect, such that youth who reported higher levels of parental monitoring on average tended to have lower callous-unemotional traits than other youth. Also, it is worth noting that promotive factors remained significant even when including initial and lagged callous-unemotional traits, suggesting that although callous youth might be less likely to elicit promotive factors from their environment, there still appears to be a negative association between the two variables. Therefore, overall I found support for my second hypothesis.

My third hypothesis was that emotional regulation or reactivity would moderate these associations, such that they would be stronger for youth with greater reactivity or lower regulation. I found mixed support for this hypothesis in each data set. For example, in the low-risk child care data, I found this association to be true, but only for males. For males, promotive factors were associated with greater decreases in callous-unemotional traits at high levels of fearfulness, while the opposite was true for females. These results are difficult to interpret, although they might be informed by differences in normative levels of fear for the two genders, and potential differences in responses to demonstrated fearfulness for each gender.

In the medium-risk sample, I found support for regulation as a moderator of risk factors and callous-unemotional traits, as well as promotive factors and callous-unemotional traits. Specifically, I found that parental monitoring was more strongly associated with decreased risk of high and stable callous-unemotional trajectories for youth with lower levels of emotion regulation, and cumulative risk exposure was more strongly associated with increased risk of high and stable callous-unemotional trajectories

for youth with lower levels of emotion regulation. These findings provide strong support for a differential susceptibility model of callous-unemotional traits, such that youth who are unable to regulate their emotions effectively might be more likely to develop callous-unemotional traits in response to adverse experiences, or less likely to develop callous-unemotional traits when exposed to positive relationships with others.

In the high-risk juvenile offender sample, I did not find support for my hypothesis that reactivity would moderate the associations between risk and promotive factors and callous-unemotional traits. However, I did find that there is a high degree of variability in the associations between risk factors and callous-unemotional traits. Therefore, it does appear that youth at high risk for developing callous-unemotional traits and problem behaviors may be differentially susceptible to risk factors in their environment. Future research can further investigate which characteristics best explain this differential susceptibility, as it does not appear to be adequately captured by emotional reactivity. It is possible that general anxiety or social anxiety might be a better moderator of these associations and thus explains who might be at risk for developing callous-unemotional traits in the presence of ecological risk; this would also be in line with findings regarding high-anxiety secondary and low-anxiety primary variants of callous-unemotional traits or psychopathy, although these studies have tended to focus on general anxiety. It is unclear how results might differ if the focus was specifically social anxiety. As many of the risk factors seem social in nature (e.g., parenting characteristics), it is plausible that youth with high levels of social anxiety would be particularly vulnerable.

Many of the risk and promotive factors implicated in these studies involve a youth's relationship to caring others, and particularly parents. In the medium risk sample,

parental rejection was particularly predictive of high and stable callous-unemotional trajectory membership, while parental monitoring was particularly protective against high and stable callous-unemotional traits. In the high risk sample, maternal hostility and maternal and paternal warmth were also important factors in predicting callous-unemotional traits over time. It's possible that callous-unemotional traits may serve not just as a distancing coping mechanism for exposure to violence and abuse and trauma, but also as a way to cope with insecure attachments. This possibility is supported by findings that youth with callous-unemotional traits are more likely to have insecure attachments (Bohlin et al., 2012; Conradi et al., 2015; Pasalich et al., 2012) and their parents are more likely to exhibit negative parenting characteristics such as rejection (Barker et al., 2011; Lopez-Romero et al., 2015; Pardini et al., 2007; Waller et al., 2013; Waller et al., 2012); however, future research can better investigate these associations to determine how youth characteristics and parenting styles might interact to produce attachment styles and later outcomes, such as callous-unemotional traits.

Differences in findings across studies might also be attributed to differences in measures of callous-unemotional traits. Across all studies, I used three different measures of callous-unemotional traits: the ICU in studies 1, 2, and 4b; a single-item measure assessing lack of guilt in study 3; and the YPI callous-unemotional subscale in studies 4a and 4c. Although future research can better investigate how well a single item assessing lack of guilt can capture callous-unemotional traits, previous studies have demonstrated the validity, reliability, and convergence of the ICU and YPI (Andershed et al., 2007; Ansel et al., 2015; Campbell et al., 2009; Essau et al., 2006; Fink et al., 2012; Kimonis, Frick, Skeem, et al., 2008; Pihet et al., 2015; Poythress et al., 2006; Skeem & Cauffman,

2003). Therefore, these measures are potentially similar enough and both well suited to assessing callous-unemotional traits in youth, which lends credibility to drawing conclusions across multiple studies.

It is unclear why youth develop callous-unemotional traits, or what evolutionary purpose they might serve. According to evolutionary psychology, empathy and moral behavior should be selected for because they enhance one's chances for reproduction and survival (de Waal, 2008; Plutchik, 1990), but callousness or psychopathy should not. However, it is possible that callousness or psychopathy is a mutation that does not confer reproductive advantage, but also is not associated with enough reproductive harm in order to be phased out of the population more quickly (Glenn, Kurzban, & Raine, 2011). It is even possible that callousness or psychopathy could serve some reproductive advantage. For example, individuals with callousness or psychopathy tend to favor a fast life history strategy over a slow one, and are therefore more likely to engage in sexually promiscuous behavior, initiate sex at younger ages, and have a larger number of sexual partners (Glenn et al., 2011). Also, according to frequency-dependent selection, it could be that the rare individuals with callousness or psychopathy who employ a manipulative, self-serving strategy at the cost of others might reap benefits they would not otherwise have, as long as the number of these individuals does not become so great that the strategy becomes less effective (Glenn et al., 2011). In addition, developing callousness might help to mitigate psychological distress when youth are in particularly hostile or disadvantageous environments, by acting as a distancing coping mechanism (Boxer et al., 2008; Boxer & Sloan-Power, 2013; Del Giudice, Ellis, & Shirtcliff, 2011; Kerig & Becker, 2010; Kerig et al., 2012), as would be predicted by the pathologic adaptation

framework (Ng-Mak et al., 2002, 2004). This reduced distress could lead to relatively better outcomes regarding survival and reproduction, even though it may also result in increased antisocial and violent behavior. This theorizing is also in line with work examining the profiles of adjustment among youth who have been exposed to violence in the home, as a number of youth may exhibit externalizing problems in the absence of internalizing symptoms (Grych, Jouriles, Swank, McDonald, & Norwood, 2000). Future research can augment this work by investigating characteristics of youth and their violence exposure that contribute to the likelihood of pathologic adaptation or desensitization to violence. Continuing to investigate the antecedents, correlates, and consequences of callous-unemotional traits might help researchers to uncover what role they play in selection and reproduction.

This dissertation project represents a test of a newly proposed differential susceptibility model of callous-unemotional traits, and provides some preliminary support for this model using three different samples of youth varying in risk and developmental stages. This work is important in not only questioning previous studies that have identified associations among variables without accounting for variation among individuals in the strength and even direction of these associations, but also in informing future research and clinical work. According to the results of these studies, youth who present with callous-unemotional traits are likely a heterogeneous group who differ in their etiological pathways to callous-unemotional traits, and therefore likely differ in their treatment needs, response to treatment, event histories, and outcomes as well. For example, youth with callous-unemotional traits who also appear to have histories of trauma and abuse, violence exposure, or hostile relationships with parents might benefit

from trauma-focused therapies and treatment that seeks to improve their emotion regulation and coping skills. Future work might focus on developing screens and assessments that best tap into the heterogeneity of youth with callous-unemotional traits, to differentiate those who may be more susceptible to environmental influences; for example, combining a measure of callous-unemotional traits with a measure of anxiety or emotion regulation might improve screening and subsequent treatment planning and clinical decisions. Further testing and refinement of the differential susceptibility model of callous-unemotional traits will help inform the literature in this area, as well as improve clinical guidelines and practices for working with youth who present with callous-unemotional traits.

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Table 1

<i>Bivariate Correlations and Descriptive Statistics</i>									
	1	2	3	4	5	6	7	8	9
1. Total CU	--								
2. Anxiety	.13***	--							
3. Depression	.18***	.79***	--						
4. Psychoticism	.16***	.73***	.81***	--					
5. Aggression	.67***	.26***	.28***	.25***	--				
6. Violence	.64***	.26***	.28***	.26***	.96***	--			
7. Low level exp.	.18***	.37***	.43***	.42***	.40***	.41***	--		
8. NV past	.21***	.22***	.20***	.23***	.41***	.40***	.35***	--	
9. NV current	.16***	.20***	.16***	.19***	.35***	.35***	.34***	.66***	--
Minimum	0.29	0.00	0.00	0.00	-14.09	-0.10	0.00	0.00	0.00
Maximum	2.18	24.00	24.00	20.00	36.31	0.32	33.00	4.00	4.00
Mean	1.14	5.21	5.98	4.45	0.00	0.00	16.84	1.53	1.66
Standard deviation	0.36	4.96	5.59	4.34	8.98	0.06	6.59	1.20	1.12

Table 2

Description of Clusters

Variable	Overall sample (<i>n</i> = 820)	Non-variant (<i>n</i> = 196)	Fearful (<i>n</i> = 312)	Primary (<i>n</i> = 169)	Secondary (<i>n</i> = 122)	χ^2 or <i>F</i> statistic
% Male**	60.37	62.76 _{a, b}	58.01 _{a, b}	68.64 _b	48.36 _a	13.27
% Adjudicated***	47.56	32.14 _a	45.83 _b	50.89 _b	72.13 _c	49.33
% White	54.48	52.31 _a	56.09 _a	49.40 _a	60.66 _a	4.30
Mean age***	16.22	16.60 _c	16.30 _{b, c}	16.02 _{a, b}	15.80 _a	11.26
Mean total CU***	1.15	1.00 _a	1.16 _b	1.20 _b	1.25 _b	16.77
Mean anxiety***	5.21	2.20 _b	6.05 _c	0.33 _a	14.70 _d	1707.52

Note. Asterisks indicate significant chi-square analyses for percentages or significant F-tests for continuous variables between clusters.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Significant differences between clusters are noted by subscripts.

Table 3

<i>Descriptive Statistics for Study Variables by Sample</i>					
<i>Variable</i>	<i>N</i>	<i>M</i>	<i>(SD)</i>	<i>Minimum</i>	<i>Maximum</i>
<i>High school students</i>					
Youth ICU	343	19.86	(7.58)	1	44
Parent/guardian ICU	343	20.27	(10.38)	0	66
Teacher/staff ICU	343	23.84	(10.37)	2	54
Mean Y/P/T	343	21.32	(6.46)	6.33	40.67
composite					
Max Y/P/T	343	34.51	(9.18)	12	66
composite					
Mean P/T composite	343	22.05	(7.92)	5	44.5
Max P/T composite	343	30.60	(9.86)	10	66
Aggressive behavior	343	-5.89	(5.36)	-14.09	13.83
Violent behavior	343	-.04	(.04)	-.10	.11
<i>Detained youth</i>					
Youth ICU	291	24.88	(9.45)	1	46
Parent/guardian ICU	291	33.24	(12.25)	1	64
Teacher/staff ICU	291	31.26	(9.11)	2	58
Mean Y/P/T	291	29.79	(6.58)	14	46.33
composite					
Max Y/P/T	291	44.96	(8.14)	26	66
composite					
Mean P/T composite	291	32.35	(7.82)	10.5	55.5
Max P/T composite	291	41.64	(8.79)	20	64
Aggressive behavior	247	7.03	(8.36)	-13.13	36.31
Violent behavior	247	0.05	(0.06)	-0.10	0.32
Number of charges	247	6.11	(4.46)	1	29
Number adjudicated	247	3.44	(2.93)	0	16
Crime seriousness	247	5.29	(1.07)	3.53	7.25
Crime violence	247	0.53	(0.55)	0	1.73
<i>Note. N = sample size with valid data; M = mean; SD = standard deviation.</i>					

Table 4

A Comparison of Logistic Regression Models Predicting Detained Status from ICU Scores and Composites

Predictor	Wald χ^2	BIC	AIC	AUC	Correctly classified	Sensitivity	Specificity	PRE	Cutoff score (50% prob.)	Cutoff score (75% prob.)	Youden's <i>J</i> cutoff
Youth ICU	100.91	614.91	592.67	.86	79.59%	73.70%	84.55%	.55	28	58	37
Parent ICU	145.28	540.05	517.81	.90	82.75%	78.55%	86.30%	.62	30	48	41
Teacher ICU	46.56	605.50	583.26	.86	80.85%	74.74%	86.01%	.58	33	61	21
Youth, parent, and teacher ICU	444.91	536.13	504.99	.90	84.18%	79.58%	88.05%	.65	40 (y), 30 (p), 36 (t)	-- (y), 51 (p), -- (t)	11 (y), 21 (p), 25 (t)
Mean Y/P/T composite	176.01	535.99	513.75	.90	84.18%	79.24%	88.34%	.65	26.97	36.88	26.00
Max Y/P/T composite	180.19	541.97	519.72	.90	82.12%	78.55%	85.13%	.61	42	56	46
Mean P/T composite	88.35	532.07	509.83	.90	83.07%	78.89%	86.59%	.63	28.84	40.64	29.50
Max P/T composite	82.87	544.36	522.11	.89	82.59%	78.89%	85.71%	.62	39	54	44

Note. ICU = Inventory of Callous-Unemotional Traits; BIC = Bayesian Information Criterion; AIC = Akaike Information Criterion; AUC = area under the curve; PRE = proportion reduction in error; prob. = probability. All Wald χ^2 tests significant at the $p < .001$ level, and all have $df = 4$, except for the model with youth, parent, and teacher ICU, which has $df = 6$.

Table 5

Using ICU to Predict Aggressive, Violent, and Antisocial Behavior

Predictor	Aggression		Violence		Number of charges		Number adjudicated		Crime seriousness		Crime violence	
	<i>b</i>	BIC	<i>b</i>	BIC	<i>b</i>	BIC	<i>b</i>	BIC	<i>b</i>	BIC	<i>b</i>	BIC
Youth ICU	.31**	2020.24	.00**	-801.47	.00	1305.05	.01	1114.99	.00	758.01	.00	536.68
Parent ICU	.29**	2011.00	.00**	-818.51	.01	1302.75	.01*	1111.96	-.01	757.05	.00	537.04
Teacher ICU	.24*	2039.00	.00**	-784.63	.01	1303.06	.01	1114.59	.00	757.80	.00	537.04
Youth, parent, and teacher ICU	.25*** .24** .19*	1960.03	.00** .00** .00**	-859.97	.00 .00 .01	1299.21	.01 .01 .01	1109.31	.00 -.01 .00	756.63	.00 .00 .00	536.67
Mean Y/P/T composite	.69**	1960.79	.00***	-858.49	.02***	1299.66	.02***	1109.53	-.01	757.51	.00	536.94
Max Y/P/T composite	.56***	1958.87	.00**	-873.47	.01***	1302.01	.02***	1110.19	.00	758.05	.01	536.10
Mean P/T composite	.50**	1989.76	.00**	-834.77	.02***	1299.79	.02***	1109.56	-.01*	756.88	.00	537.04
Max P/T composite	.45**	1988.31	.00**	-841.80	.01***	1301.48	.02***	1109.18	-.01	757.40	.00	536.93

Note. * $p < .05$; ** $p < .01$; *** $p < .001$. ICU = Inventory of Callous-Unemotional Traits; *b* = raw regression coefficients; BIC = Bayesian Information Criterion; Y/P/T = youth, parent, and teacher; P/T = parent and teacher. Sex, age, and binary race are included as controls in all models. All standard errors were adjusted for clustering by data collection site.

Table 6

Using ICU Cutoff Scores to Predict Detained Status

Report	Score	Sensitivity	Specificity	Correctly classified	OR	AUC
Predicted probabilities (>.5)						
Youth ICU	28	40.89%	84.26%	64.35%	3.70	.63***
Parent ICU	30	65.64%	83.97%	75.55%	10.00	.75***
Teacher ICU	33	48.80%	79.59%	65.46%	3.72	.64
Mean composite Y/P/T ICU	26.97	67.35%	78.13%	73.19%	7.37	.73
Max composite Y/P/T ICU	42	62.20%	76.97%	70.19%	5.50	.69**
Mean composite P/T ICU	28.84	68.73%	79.30%	74.45%	8.42	.74*
Max composite P/T ICU	39	60.14%	79.30%	70.50%	5.78	.70***
Youden's index						
Youth ICU	37	10.65%	98.25%	58.04%	6.70	.54
Parent ICU	41	24.74%	95.04%	62.78%	6.30	.60
Teacher ICU	21	89.35%	39.94%	62.62%	5.58	.65
Mean composite Y/P/T ICU	26.00	70.10%	72.89%	71.61%	6.30	.71
Max composite Y/P/T ICU	46	42.27%	87.46%	66.72%	5.12	.65
Mean composite P/T ICU	29.50	65.29%	79.88%	73.19%	7.47	.73
Max composite P/T ICU	44	39.17%	90.09%	66.72%	5.85	.65

Note. OR = Odds Ratio; AUC = area under the curve; ICU = Inventory of Callous-Unemotional Traits. Robust, clustered standard errors were used in computing significance of odds ratios. Significance stars are used for comparisons between AUC for the two types of cutoff scores, with stars denoting the cutoff score with the greater AUC:

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7

Demographic Characteristics by Data Collection Site

	Overall sample	EA	MW	NW	SO	SW	χ^2
<i>N</i>	1,354	282	245	254	243	330	
% female	51.48	47.87	53.06	49.21	54.73	52.73	3.47
% non-white	73.84	95.02 _a	86.94 _b	50.00 _d	64.20 _c	71.52 _c	174.77***
% valid DISC							
Youth	61.74	65.60 _a	50.20 _b	66.93 _a	69.55 _a	57.27 _b	27.54***
Caregiver	63.22	69.50 _a	46.94 _c	69.69 _a	69.55 _a	60.30 _b	42.68***

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. EA = East; MW = Midwest; NW = Northwest; SO = South; SW = Southwest; *N* = sample size. *P*-values are obtained from two-tailed chi-squared tests with four degrees of freedom, and subscripts denote groups for significant chi-squared tests.

Table 8

<i>Maltreatment Events Overall and by Conduct Disorder Diagnosis and Lack of Guilt</i>					
Age category	Proportion	Count of events		Count of types	
		Maximum	<i>M (SD)</i>	Maximum	<i>M (SD)</i>
<u>Overall (<i>n</i> = 557)</u>					
Ages 0-3	62.66%	5	1.05 (1.06)	14	1.52 (1.90)
Ages 4-8	21.54%	5	0.36 (0.81)	16	0.54 (1.56)
Ages 9-13	11.67%	4	0.21 (0.66)	10	0.28 (0.98)
<u>No CD, feels guilt (<i>n</i> = 283)</u>					
Ages 0-3	61.13%	4	0.99 (0.97)	9	1.38 (1.65)
Ages 4-8	22.61%	4	0.37 (0.79)	6	0.47 (1.08)
Ages 9-13	11.31%	4	0.19 (0.60)	10	0.24 (0.91)
<u>No CD, lacks guilt (<i>n</i> = 201)</u>					
Ages 0-3	62.69%	5	1.08 (1.09)	14	1.58 (1.96)
Ages 4-8	19.90%	5	0.37 (0.89)	16	0.64 (1.94)
Ages 9-13	9.95%	4	0.20 (0.69)	7	0.27 (0.98)
<u>CD, feels guilt (<i>n</i> = 23)</u>					
Ages 0-3	65.22%	4	0.87 (0.92)	9	1.22 (1.88)
Ages 4-8	17.39%	1	0.17 (0.39)	2	0.22 (0.52)
Ages 9-13	8.70%	3	0.26 (0.86)	5	0.35 (1.19)
<u>CD, lacks guilt (<i>n</i> = 50)</u>					
Ages 0-3	70.00%	5	1.38 (1.35)	14	2.18 (2.75)
Ages 4-8	24.00%	3	0.36 (0.72)	15	0.70 (2.27)
Ages 9-13	22.00%	4	0.36 (0.80)	6	0.50 (1.18)
<i>Note.</i> <i>M</i> = mean; <i>SD</i> = standard deviation; <i>CD</i> = conduct disorder; <i>n</i> = sample size.					

Note. *M* = mean; *SD* = standard deviation; *CD* = conduct disorder; *n* = sample size.

Table 9

Multinomial Logistic Regression Models Predicting Conduct Disorder and Lack of Guilt from Substantiated Maltreatment

Predictor	No CD, feels guilt	RRR		Wald $\chi^2(3)$
		No CD, lacks guilt	CD, feels guilt	
Dummy variables				
Ages 0-3	1.48***	1.39	1.24	171.35***
Ages 4-8	1.08	1.27	1.50	12.41**
Ages 9-13	2.21**	2.55*	2.96	25.74***
Count of events				
Ages 0-3	1.20**	1.13***	1.27	176.33***
Ages 4-8	1.09	1.02	1.45*	25.28***
Ages 9-13	1.22	1.18	1.10	14.65**
Count of types				
Ages 0-3	1.38***	1.26	1.56*	252.28***
Ages 4-8	0.98	0.98	1.54**	26.98***
Ages 9-13	1.36**	1.32	1.16	48.84***
Count of periods	1.78***	1.47	1.36	

Note. CD = conduct disorder; RRR = relative risk ratio. * $p < .05$, ** $p < .01$, *** $p < .001$. p -values come from multinomial logistic regression models in which the outcome of interest is CD diagnosis and lack of appropriate guilt, and the base outcome is rotated to reflect the three other options in the table. All models use cluster-robust standard errors based on five data collection sites. Types of maltreatment include physical abuse, sexual abuse, physical neglect, educational neglect, emotional neglect, and other maltreatment. $N = 557$ for all models.

Table 10

Measures across Samples in Study 4

Age	Callous-unemotional traits	Risk factors	Promotive factors	Emotional regulation/reactivity
<u>Study 4a</u>				
4		ACE model (e.g., divorce, father jailed, death of a family member, etc.)		CBQ fear and inhibition subscales (mother report)
8			Bonding with parents, teachers, and peers	
10				
15	YPI self report			
<u>Study 4b</u>				
8	ICU parent	Peer rejection	Mother-reported	Mother-reported
9	report	and	reported	emotion regulation
10	available at all	victimization,	parental	available at all ages
11	ages	exposure to	monitoring and	
12		violence, and	nurturing	
15		parental rejection	available at all	
16		and aggression	ages	
17				
<u>Study 4c</u>				
16	YPI self report	Exposure to	Social support,	Self-reported
17	available at all	violence,	friendship	emotional reactivity
18	ages	neighborhood	quality,	available at all ages
19		disorder, family	parental	
		and friend crime	knowledge and	
		involvement, and	monitoring and	
		parental hostility	warmth	

Note. Ages represent average age at time point, though individual youth may have been older or younger. CBQ = Children's Behavior Questionnaire; ACE = Adverse Childhood Experiences; YPI = Youth Psychopathic Traits Inventory; ICU = Inventory of Callous-Unemotional Traits.

Table 11

Using Ecological Risk and Promotive Factors to Predict Callous-Unemotional Traits

Predictor variable	Without covariates		With covariates	
	95% CI		95% CI	
	LL	UL	LL	UL
Risk factors				
54 months	-0.06	1.07	-0.02	1.01
3 rd grade	-1.10	0.01	-1.07	-0.08
5 th grade	-0.53	0.66	-0.47	0.66
Promotive factors				
3 rd grade	-0.83	-0.23	-0.58	-0.01
5 th grade	-0.66	-0.33	-0.42	-0.10
Risk x temperament interactions				
Risk x fear interactions				
54 months	-0.53	0.82	-0.47	0.72
3 rd grade	-0.62	0.43	-0.40	0.51
5 th grade	-0.88	0.28	-0.62	0.84
Risk x inhibition interactions				
54 months	-1.10	0.26	-0.93	0.32
3 rd grade	-0.44	0.81	-0.43	0.64
5 th grade	-0.76	0.47	-0.65	0.49
Promotive x temperament interactions				
Promotive x fear interactions				
3 rd grade	-0.33	0.38	-0.26	0.40
5 th grade	-0.15	0.25	-0.13	0.22
Promotive x inhibition interactions				
3 rd grade	-0.37	0.37	-0.29	0.37
5 th grade	-0.33	0.07	-0.33	0.05

Note. CI = Confidence interval; LL = lower limit; UL = upper limit. Covariates included mother-reported temperament at 1 and 6 months, and dummy-coded ethnicity (1=white) and gender (1=female). Main effects were included in interaction models. Calculated standard errors were robust.

Table 12

Regression Models Predicting Callous-Unemotional Trajectories

	Ordered logit	Multinomial logit regression model		
	<u>model</u>	<u>HS vs. LS</u>	<u>HS vs. LI</u>	<u>HS vs. MI</u>
	<i>OR</i>	<i>RRR</i>	<i>RRR</i>	<i>RRR</i>
Model 1: Risk exposure				
Peer victimization	1.01	1.15	1.11	1.10
Peer rejection	1.08	1.00	1.08	0.89
Low-level exposure	1.02	0.1	1.00	0.82
Neighborhood violence exposure	1.01	0.94	0.94	0.86
Parental rejection	2.38***	8.89***	4.02***	2.39***
Parental aggression	1.13*	1.22	0.98	1.03
Parental violence ^a	1.12	1.69	1.53	1.39
Parental conflict ^a	1.32	1.80	1.50	1.15
Model 2: Cumulative risk exposure				
Count of risk factors	1.30***	1.80***	1.48**	1.19
Model 3: Promotive factors				
Parental nurturing	1.01	1.08	1.10	1.05
Parental monitoring	0.62***	0.38***	0.54***	0.81

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. ^a denotes dichotomous predictor. HS = high-stable trajectory; LS = low-stable trajectory; LI = low-increasing trajectory; MI = moderate-increasing trajectory; OR = odds ratio; RRR = relative risk ratio. All models included cohort, ethnicity, sex, and age at baseline as covariates.

Table 13

Growth curve models with risk factors predicting callous-unemotional traits in the Pathways to Desistance data

	Fixed effects model	Random intercept model	Random slope (wave) model	Random slope (wave and age) model	Dynamic model (v_i for wave)
Wave	-0.03	-0.03**	-0.03**	-0.03**	-0.02
Phoenix site		1.78***	1.82***	1.82***	0.95**
Time in secure settings	-0.10	-0.42	-0.49	-0.49	-0.81
Age	-0.03	-0.07	-0.08	-0.08	-0.12
Female		-3.71***	-3.63***	-3.63***	-2.62***
Ethnicity					
Black/African American		0.54	0.58	0.58	0.10
Hispanic		0.29	0.30	0.30	-0.17
Other		0.50	0.59	0.67	0.23
Father arrested		0.19	0.23	0.23	0.02
Mother arrested		0.07	0.13	0.13	0.24
PCL score		0.12***	0.12***	0.12***	0.04*
Family crime involvement	0.13	0.15	0.15	0.15	0.08
Friend crime involvement	0.02	0.05	0.06	0.06	0.10
Witnessing violence	0.33***	0.31***	0.30***	0.30***	0.33***
Violent victimization	0.16	0.16	0.16	0.16	0.19
Neighborhood disorder	0.53***	0.38**	0.37**	0.37**	0.27*
Maternal hostility	1.32***	1.24***	1.19***	1.19***	1.24**
Paternal hostility	0.04	0.11	0.10	0.10	-0.01
Between-subject means					
Friend crime involvement		0.54*	0.53*	0.53*	0.12
Witnessing violence		0.93***	0.92***	0.92***	0.44*
Maternal hostility		1.32	1.45	1.45	-0.38
Paternal hostility		1.91	1.91	1.91	1.85*
σ_u	5.32	3.99	3.75	3.75	2.87
σ_e	4.79	4.78	4.68	4.68	4.77
σ_v			0.05	time: 0.05; age: 0.00	0.01
ρ	0.55	0.41			

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. PCL = psychopathy checklist. White/Caucasian is the reference group for ethnicity.

Table 14

Growth curve models with promotive factors predicting callous-unemotional traits in the Pathways to Desistance data

	Fixed effects model	Random intercept model	Random slope (wave) model	Random slope (wave and age) model	Dynamic model (v_i for wave)
Wave	-0.04*	-0.03**	-0.03**	-0.03**	-0.01
Phoenix site		0.85*	0.92*	0.92*	0.29
Time in secure settings	0.35	0.17	0.10	0.10	0.02
Age	-0.02	-0.27*	-0.24*	-0.24*	-0.36**
Female		-3.76***	-3.63***	-3.63***	-2.72**
Ethnicity					
Black/African American		0.11	0.18	0.18	-0.41
Hispanic		-0.32	-0.32	-0.32	-0.55
Other		0.21	0.29	0.29	0.06
Father arrested		0.72**	0.77**	0.77**	0.44
Mother arrested		0.16	0.22	0.22	0.25
PCL score		0.12***	0.13***	0.13***	0.03
Social support from adults	-0.00	0.01	0.01	0.01	0.07*
Friendship quality	-0.01	-0.01	-0.01	-0.02	0.01
Neighborhood safety	-0.59***	-0.51***	-0.51***	-0.51***	-0.45**
Parental knowledge	-0.26	-0.26	-0.26	-0.26	-0.24
Parental monitoring	-0.23	-0.23	-0.23	-0.23	-0.23
Maternal warmth	-0.45**	-0.48**	-0.47**	-0.47**	-0.50**
Paternal warmth	-0.45**	-0.47**	-0.46**	-0.46**	-0.47**
Between-subject means					
Friendship quality		-0.17	-0.21	-0.21	-0.31
Parental knowledge		-0.95**	-0.85	-0.85	-0.71
Parental monitoring		-1.10**	-1.04**	-1.04**	-0.75
Paternal warmth		-0.60	-0.57	-0.57	0.02
σ_u	5.11	3.94	3.75	3.80	2.86
σ_e	4.83	4.83	4.71	4.73	4.76
σ_v			0.05	time: 0.05; age: 0.00	0.00
ρ	0.53	0.40			

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. PCL = psychopathy checklist. White/Caucasian is the reference group for ethnicity.

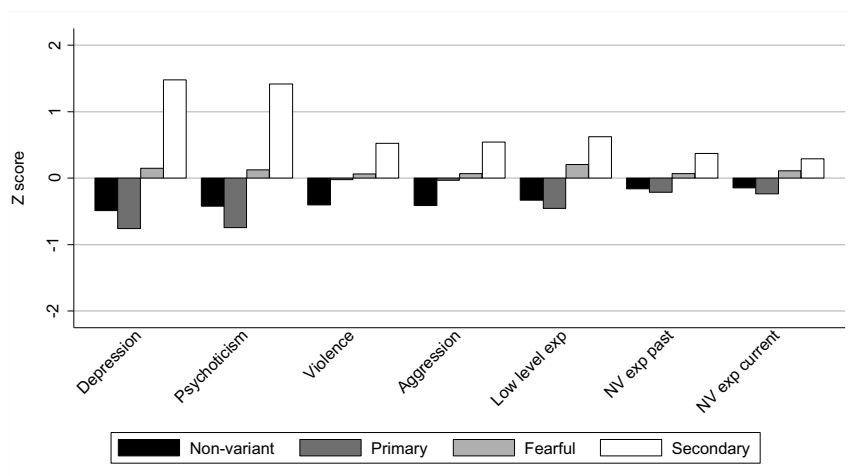


Figure 1. Z-scores of outcome variables by cluster group (study 1).
Note: NV exp = neighborhood violence exposure.

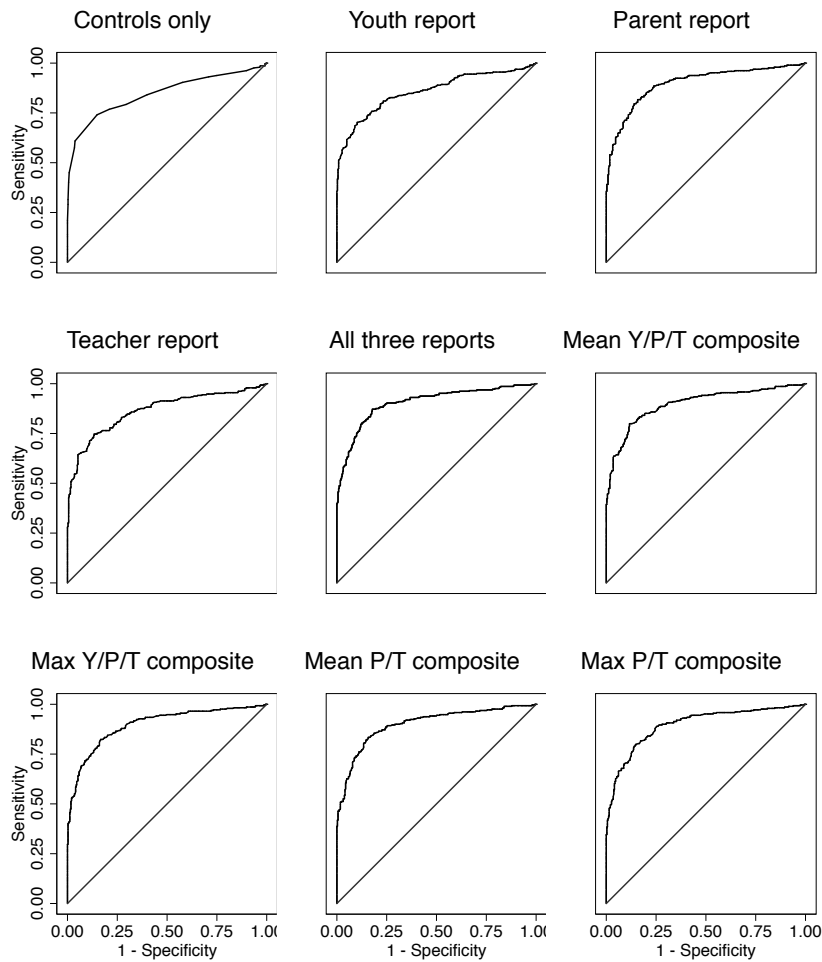


Figure 2. Receiver operating characteristic (ROC) curves for nine different logistic regression models predicting detained status from controls and various reports and composites of callous-unemotional traits (study 2).

Note. Controls include age, binary sex, and binary (white/non-white) race; Y/P/T = youth/parent/teacher; P/T = parent/teacher.

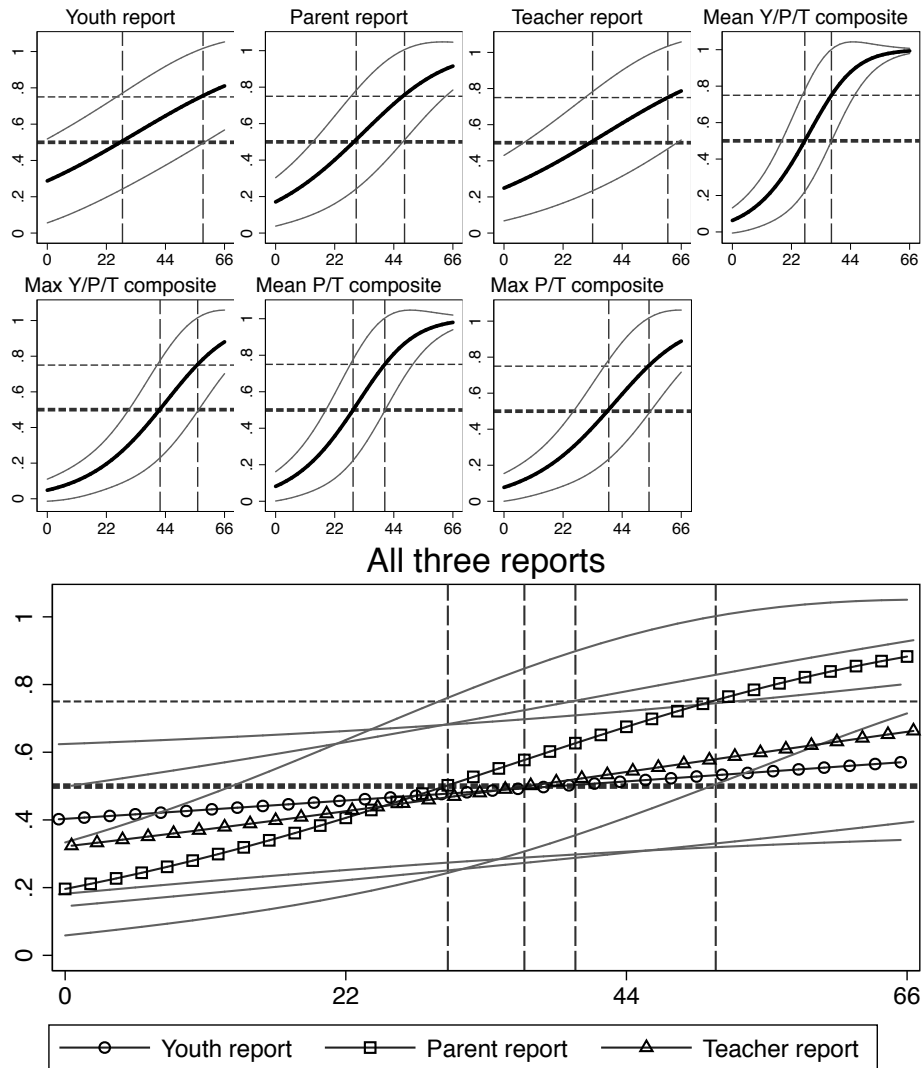


Figure 3. Predicted probabilities of detained status obtained from logistic regression models, with cutoff scores for ICU reports and composites at which the predicted probability exceeds .5 and .75 (study 2).

Note. Y/P/T = youth/parent/teacher; P/T = parent/teacher.

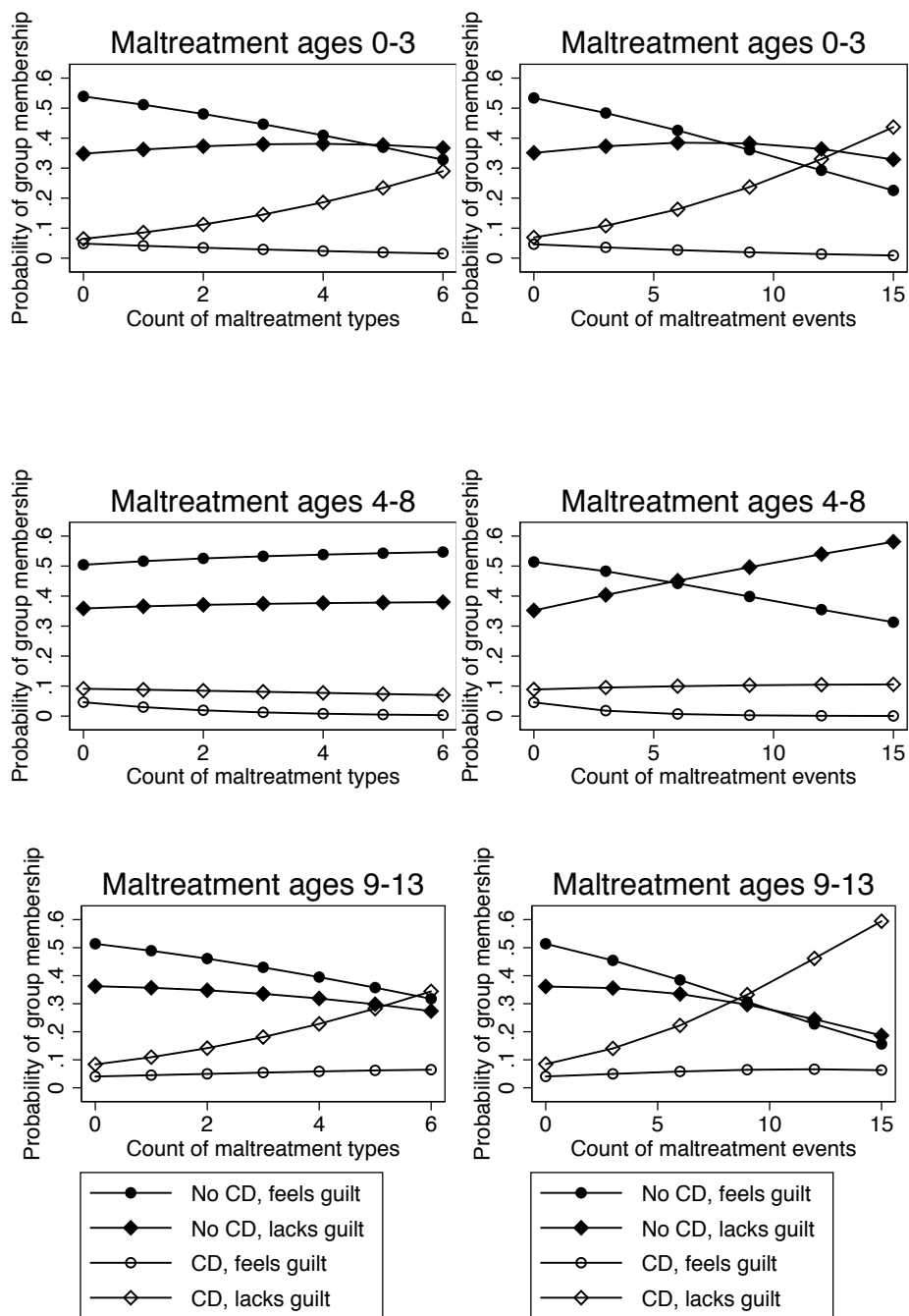


Figure 4. Probabilities of group membership by count of substantiated maltreatment events and types experienced at different ages (study 3).

Note. CD = conduct disorder.

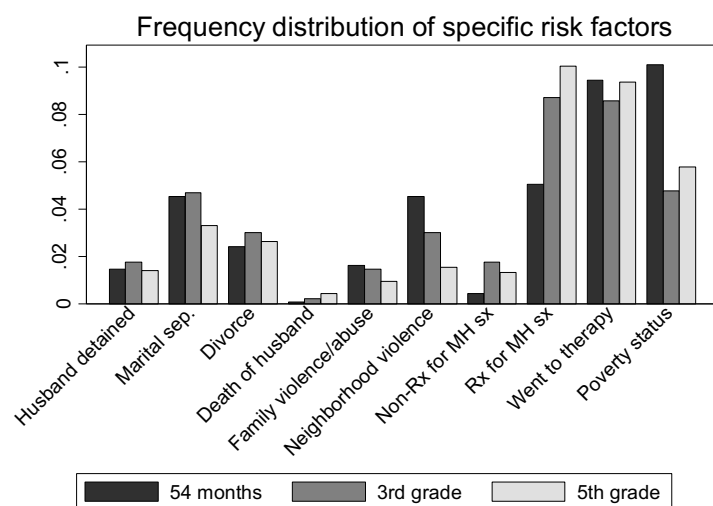


Figure 5. Frequencies of reported ecological risk factors at 54 months, 3rd grade, and 5th grade interviews in the Study of Early Child Care and Youth Development (study 4a).
Note. sep. = separation; Rx = prescription; MH = mental health.

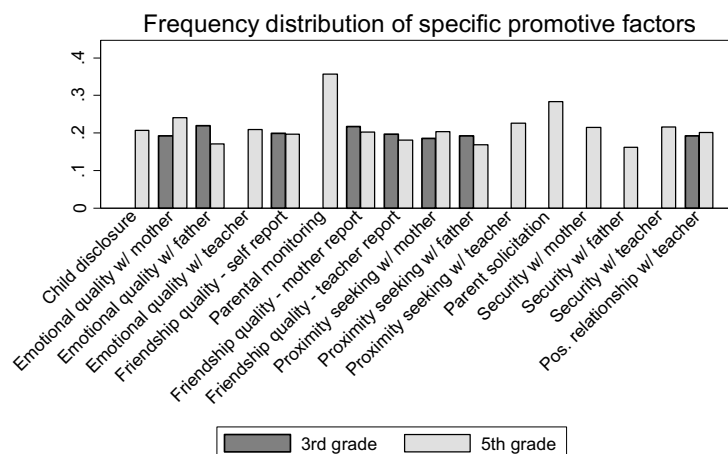


Figure 6. Frequency distribution of reported ecological promotive factors at 3rd and 5th grade interviews in the Study of Early Child Care and Youth Development (study 4a).

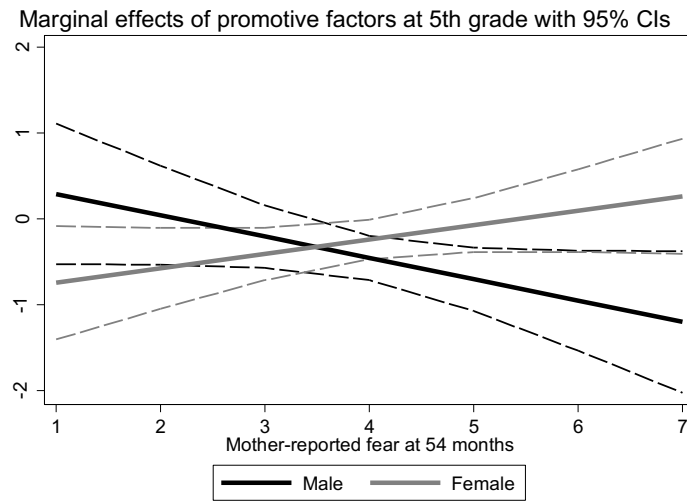


Figure 7. Three-way interaction of gender, temperament, and promotive factors predicting standardized callous-unemotional traits (study 4a).

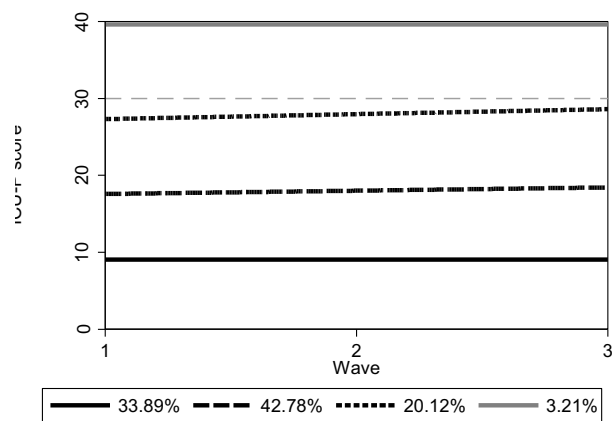


Figure 8. Latent trajectories of parent-reported callous-unemotional traits at one-year intervals (study 4b).

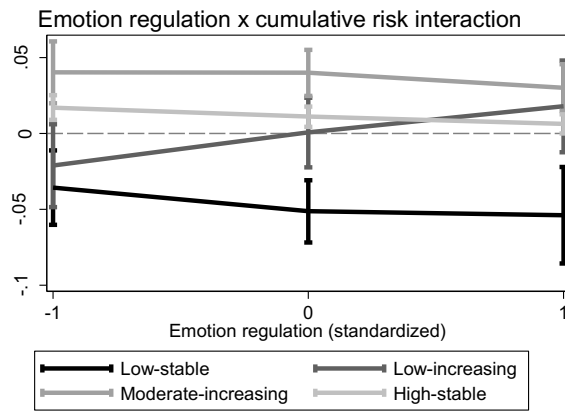


Figure 9. Interaction of emotion regulation and cumulative risk exposure predicting CU trajectories (study 4b).

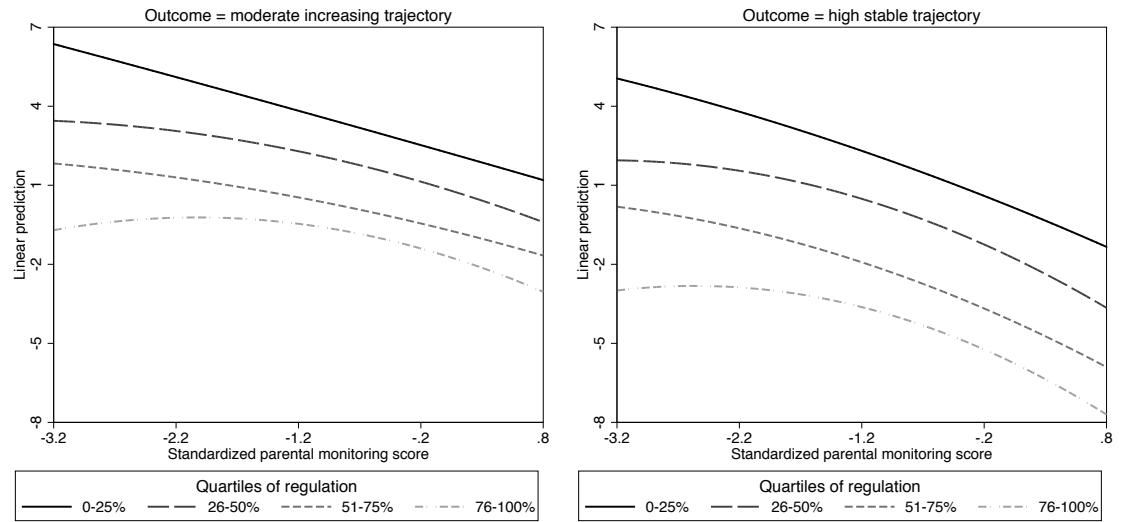


Figure 10. Two-way emotion regulation by parental monitoring interaction predicting callous-unemotional trait trajectories.

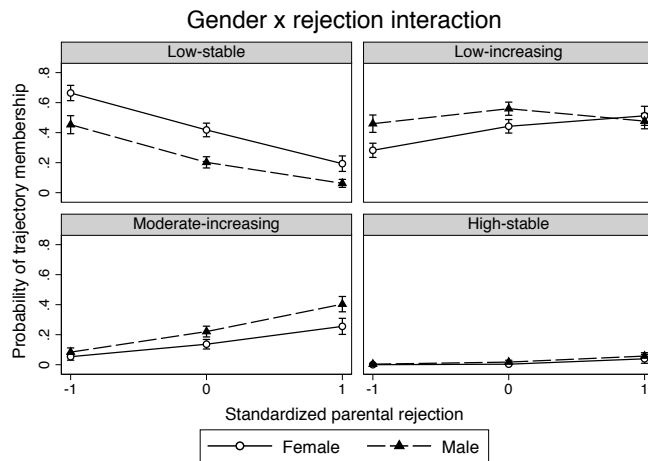


Figure 11. Gender by parental rejection interaction predicting trajectory membership (study 4b).

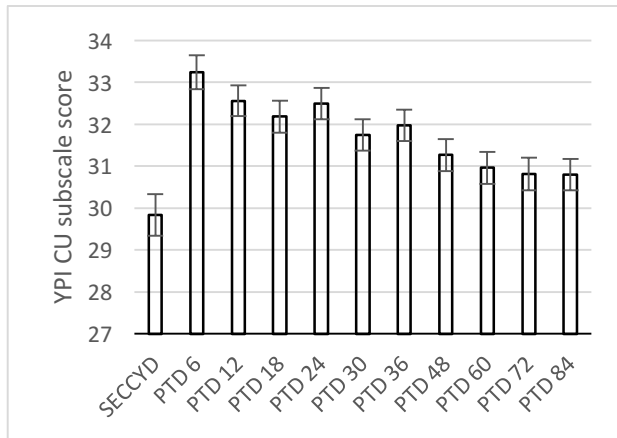


Figure 12. YPI CU subscale mean scores in SECCYD and PTD data sets (study 4).
Note. The y-axis does not start at 0. Error bars denote standard errors.

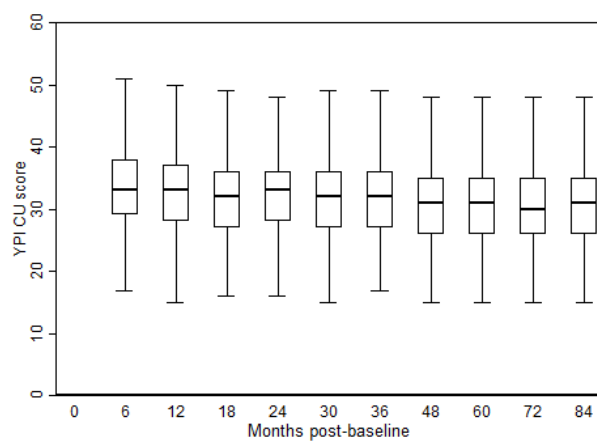


Figure 13. Distribution of callous-unemotional traits over time in complete case data (study 4c).

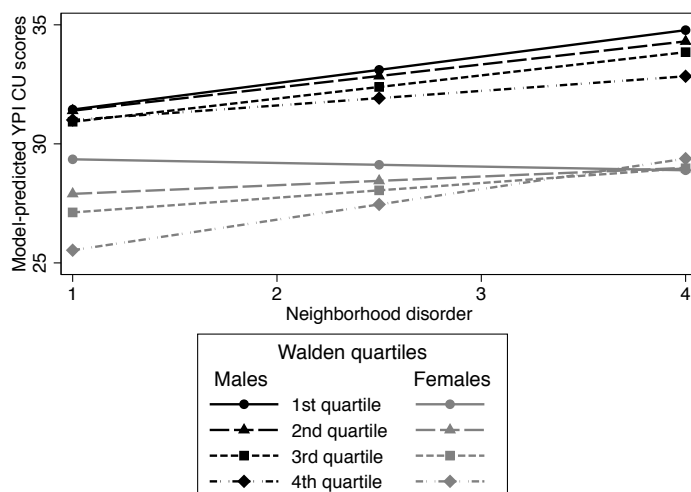


Figure 14. Three-way gender by reactivity by disorder interaction predicting callous-unemotional traits.

Note. The y-axis does not begin at 0.

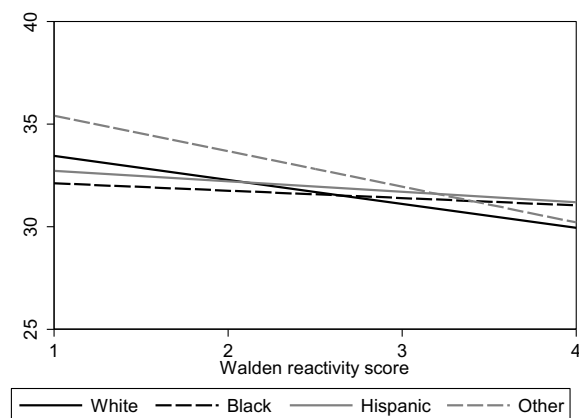


Figure 15. Two-way ethnicity by reactivity interaction predicting callous-unemotional traits (study 4c).

Note. The y-axis does not begin at 0.

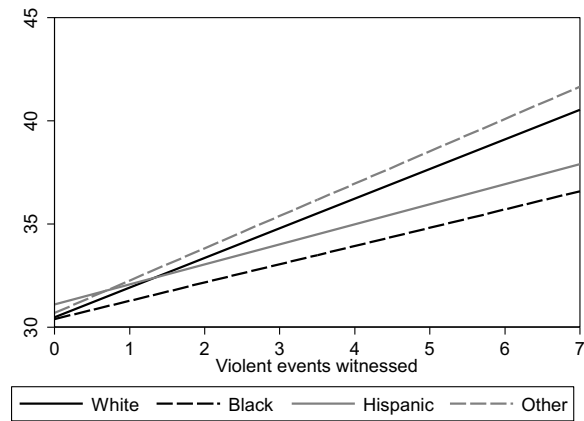


Figure 16. Two-way ethnicity by witnessing violence interaction predicting callous-unemotional traits.

Note. The y-axis does not begin at 0.