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Neuroanatomical and Environmental Correlates of Psychopathy Subtypes in Incarcerated Youth and Implications for Recidivism

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NEUROANATOMICAL AND ENVIRONMENTAL CORRELATES OF PSYCHOPATHY SUBTYPES IN INCARCERATED YOUTH AND IMPLICATIONS FOR RECIDIVISM

by

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DISSERTATION

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DEDICATION

To my sons, Oliver and Owen.

Being successful is not about the money you make. It's not about the degrees you earn or having particular letters behind your name. It's about following your dreams, doing what you love, and giving it your all.

I love you more than the end of the numbers. Always.

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ABSTRACT

Researchers have described subtypes of psychopathy including a primary "constitutional" variant influenced largely by biological factors, and a secondary variant "acquired" through environmental factors (e.g., trauma) and associated with elevated internalizing symptoms. This study used latent profile analysis (LPA) in a sample of 297 juvenile male offenders to identify subgroups of incarcerated youth, based on level of psychopathic traits and anxiety, as measured by the Psychopathy Checklist: Youth Version (PCL:YV) and Multidimensional Anxiety Scale for Children (MASC), respectively, and explore environmental and neural correlates of resulting groups. Two groups were identified that differed in psychopathic trait level, experience of trauma, temporal pole gray matter volume, and reoffending. This study extends work exploring environmental and neural correlates of psychopathic traits in youth and provides additional support for psychopathic traits as an important predictor of outcomes for justice-involved youth with the hope of informing prevention and intervention efforts.

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CHAPTER 1

Introduction

Individuals with psychopathic traits exhibit interpersonal and affective deficits including callousness, shallow affect, manipulation of others, and lack of empathy and remorse, as well as persistent impulsive and antisocial behavior. Despite making up less than one percent of the general population, individuals who meet diagnostic criteria for psychopathy make up 15-30% of the prison population (N. E. Anderson & Kiehl, 2012; Kiehl & Hoffman, 2011). They also place a large burden on our society, both emotionally and economically. These individuals commit more crimes, commit a greater variety of crimes, begin engaging in criminal behavior earlier, and are more violent than individuals with low psychopathy scores (Kiehl & Hoffman, 2011). Empirical evidence suggests they are also three times more likely to recidivate than individuals who do not meet criteria for psychopathy and four times more likely to violently recidivate (Hemphill, Hare, & Wong, 1998; Serin, 1991). Thus, the presence of psychopathic traits has been identified as an important predictor of risk for future violence among justice-involved individuals (Douglas et al., 2018; Harris et al., 1991; Hemphill et al., 1998; Salekin et al., 1996), and, as a result there is a need for a standardized measure to assess psychopathic traits. The Hare Psychopathy Checklist – Revised (PCL-R) has emerged as one of the most widely used risk assessment tools (Fazel et al., 2012).

In addition to being important for the assessment of risk, the presence of psychopathic traits also has been identified as an important factor to consider in making treatment decisions. Some literature suggests that traditional methods of therapeutic intervention are unsuccessful and, in rare cases, iatrogenic for individuals high in psychopathic traits (Rice et al., 1992); however, recent reviews indicate that individuals high in psychopathic traits may be more

treatable than originally thought (Bailey et al., 2015; Harris & Rice, 2006; Polaschek, 2014, 2014; Polaschek & Skeem, 2018; Reidy et al., 2013). Taken together, this suggests that accurately conceptualizing psychopathy has important prevention and treatment implications.

Not only are psychopathic traits, as conceptualized by the PCL-R, an important and predictive construct for adults, but evidence has consistently shown that the core interpersonal and affective traits characteristic of individuals with psychopathic personality, also termed callous-unemotional (CU) traits, can be seen in a subset of youth with conduct problems. These traits have important predictive utility for the trajectory and severity of criminal behavior over the life course (Corrado et al., 2004; Douglas et al., 2008; Edens & Cahill, 2007; Vincent et al., 2008).

Conceptualization of Psychopathy

As far back as the original conceptualizations of psychopathy as a personality disorder, researchers have described subtypes of psychopathy. Most commonly, these are described as a primary "constitutional" variant, hypothesized to be more heavily influenced by biological factors, and a secondary variant, hypothesized to be acquired through environmental factors (Karpman, 1948a; Mealey, 1995a; Porter, 1996). Although many researchers in the field are in agreement regarding the existence of primary and secondary subgroups of individuals high in psychopathic traits, there has been considerable debate regarding the most appropriate way to characterize them.

Early Conceptualizations of Psychopathy

Descriptions of psychopathic individuals exist in Greek and Roman mythology, in the Old Testament of the Bible, in literature across cultures, and throughout popular culture. Theophrastus, one of Aristotle's students, is thought to be one of the first to write about

individuals with psychopathic traits from an academic perspective, referring to them as *the unscrupulous*. The existence of psychopathic individuals across time and cultures suggests psychopathic traits have existed since our emergence as a species rather than having developed as a response to cultural factors or the increasing demands of advancing civilization (Kiehl & Hoffman, 2011).

Philippe Pinel, a French physician, was one of the first medical professionals to describe individuals with psychopathic traits, coining the term *manie sans délire* to describe patients who engaged in profound antisocial behavior but did not exhibit symptoms of psychosis. About 100 years later, Cesare Lombroso proposed the concept of a *born criminal* whose antisocial behavior might be associated with or stem from neurobiological dysfunction (See Kiehl & Hoffman, 2011 for thorough historical review).

Although the concept of individuals who are amoral or lack empathy has been described throughout history, use of the term psychopath to describe these individuals is more recent. In fact, the term psychopath initially came from *psychopastiche*, or "suffering soul," a term used by German psychiatrist Julius Koch to describe individuals with personality disorders broadly (Herve, 2007, as cited by Kiehl & Hoffman, 2011). One of the earliest descriptions of individuals with psychopathic traits using the term "psychopathy" was put forward by Emil Kraepelin in 1904, in which he used the term to describe individuals who were impulsive, aggressive, and manipulative and engaged in antisocial behavior (Kiehl & Hoffman, 2011).

The Mask of Sanity (Cleckley, 1941, 1976) is undoubtedly one of the most influential descriptions of psychopathy referenced in the field across its history. Based on his work with hospital inpatients, Cleckley initially outlined twenty-one core traits of psychopathy – eventually reduced to sixteen – describing the individual with psychopathic personality as superficially

charming and intelligent; unreliable, insincere; having significant interpersonal and affective deficits, lacking remorse or shame; and being engaged in "inadequately motivated" antisocial behavior (Cleckley, 1976, p. 343), among other traits. Cleckley differentiated the psychopathic individual from an ordinary criminal stating that though psychopathic individuals will indiscriminately commit crimes without an apparent goal, they rarely commit crimes severe enough to result in a prison sentence, such as murder. He considered violence and aggression to be the exception rather than the rule in psychopathic individuals, stating that when psychopathic individuals "occasionally [commit] a major deed of violence it is usually a casual act done not from tremendous passion or as a result of plans persistently followed with earnest compelling fervor… The psychopath is not volcanically explosive, at the mercy of irresistible drives and overwhelming rages of temper" (Cleckley, 1976, p.263). Importantly, in Cleckley's original description of psychopathy, he noted the absence of "nervousness" and neurotic symptoms in the psychopathic individual stating "within himself he appears almost as incapable of anxiety as of profound remorse" (Cleckley, 1976, p.340). Though Cleckley was not the first to describe a psychopathic personality, his work has been, arguably, the most influential. Current conceptualizations of psychopathy, described below, have been largely based on Cleckley's work, and current assessments of psychopathy are often judged by the degree to which they align with Cleckley's original description (Hare & Neumann, 2008).

Early Theories of Heterogeneity in Psychopathy

Karpman (1941, 1948a, 1948b) who, like Cleckley, based his theory on clinical observation, proposed that subtypes of psychopathic individuals exist who appear phenotypically similar may have differing etiological pathways; one he referred to as primary or "idiopathic," (Karpman, 1948b, p. 458) and a second he referred to as secondary or "symptomatically

psychopathic" (p.458). He characterized both subtypes as antisocial, callous, irresponsible, and hostile but as having differing etiologies and motivations for the behaviors they engage in. He stated that primary psychopathic individuals suffer from an innate or constitutional affective *deficit* and amorality, whereas secondary individuals are "immoral" (p. 458) and suffer from an affective *disturbance,* which is acquired as a result of parental rejection, childhood neglect, or harsh parenting. Specifically, Karpman was referring to a core difference in levels of internalizing symptoms broadly such as anxiety, depression, and general neuroticism. Karpman further distinguished primary and secondary individuals on the basis of the motivation behind their aggressive acts. He suggested primary individuals engage in more instrumental and deliberately planned acts of aggression for their own benefit, while the secondary individual engages in more impulsive behavior spurred by hatred, revenge, and internalizing distress (Karpman, 1948b).

In 1964, McCord and McCord presented case studies in which they described individuals who were deficient in anxiety and emotional reactivity; disinhibited, especially as it related to aggressive behavior; and lacking a social conscience. They described psychopathic criminals as cold, vicious, and predatory. Regarding etiology, they suggest that psychopathic individuals typically have histories of adverse childhood experiences, including maltreatment and neglect.

Porter (1996) also proposed a distinction between primary and secondary subtypes of psychopathic individuals on the basis of etiology. He described primary individuals as being born with interpersonal and affective deficits characteristic of psychopathic individuals, whereas secondary individuals develop similar interpersonal and affective deficits as a way of shutting off their conscience and emotionality after experiencing significant trauma, such as physical or

sexual abuse. This characterization of secondary psychopathy has also been described as dissociative (Skeem et al., 2003).

In contrast, Lykken (1995) put forward a low-fear hypothesis of psychopathy, suggesting that fearlessness underpins primary psychopathy and is its core mechanism. He further posited that the apparent absence of anxiety is a function of their insensitivity to punishment and potential danger. In support of this hypothesis, Lykken proposed a model of subtypes based on Gray's (1982) reinforcement sensitivity theory. This model proposed two orthogonal systems: (a) the behavioral approach (or activation) system (BAS), which mediates reward sensitivity and initiates approach behavior towards biological reinforcements (e.g., food and sexual partners) and is associated with impulsivity, and (b) the behavioral inhibition system (BIS), which regulates responses to conditioned stimuli associated with punishment and omission of an expected reward, as well as novelty, fear stimuli, and high-intensity stimuli, by increasing arousal and inhibition and is associated with anxiety. According to this model, primary individuals can be described as having a weak BIS and average BAS, and secondary individuals can be described as having an average BIS and a strong BAS; however, he suggested that both primary and secondary psychopathy individuals reflect constitutional (or innate) abnormalities, while the term sociopathy should be used for individuals who *appear* psychopathic as a result of environmental stressors. One study in partial support of Lykken's BIS and BAS theory demonstrated that primary psychopathy, characterized by high PCL-R scores and low anxiety, was associated with a weak BIS and a normal BAS; however, results for secondary psychopathy, characterized by high PCL-R scores and high anxiety, supported the idea that these individuals have a strong BAS, but were inconclusive regarding the normal BIS hypothesis (Newman et al., 2005).

Mealey (1995a, 1995b) proposed an evolutionary model of the development of subtypes of psychopathic offenders. Specifically, she referred to these subtypes as primary sociopathy (now psychopathy), and *disadvantaged* secondary sociopathy. This model posits that primary sociopathy/psychopathy develops as an evolutionarily favored cheater strategy[1], while secondary sociopathy/psychopathy develops in the context of unpredictable environments (e.g., low socioeconomic status, domestic violence) as a competition strategy. Mealey noted that primary individuals are likely to be higher in PCL-R factor 1 scores (i.e., affective and interpersonal deficits; see "The Hare Psychopathy Checklist" below) and high or low on factor 2 (i.e., impulsive and antisocial behavior), and that secondary individuals would likely receive high scores only on factor 2. Though investigators have identified clusters of individuals that mirror these groups, critics of this model highlight that these secondary individuals do not possess the so-called "core" traits of psychopathy due to the absence of interpersonal and affective traits and should not be termed psychopathic (Verschuere et al., 2018; Verschuere, 2020)

Finally, Blackburn proposed many theories regarding personality traits as measured by the Minnesota Multiphasic Personality Inventory (MMPI) and the five factor model (FFM) of personality and their respective associations with psychopathic traits among forensic psychiatric patients. Specifically, he identified primary and secondary individuals in a forensic sample who differed in levels of extraversion and neuroticism (Blackburn, 1975). Individuals with primary

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[1] A strategy used by organisms to derive benefit at the cost of other organisms. That is, a cheater is an individual who engaging in little to no cooperation with the group, but can benefit from others cooperating. It is a generally favorable strategy in terms of natural selection, as it improves mating success with low costs, but there are mechanisms to regulate it. (Ferriere et al., 2002; Lyons, 2015)

psychopathy were characterized as high in extraversion but not neuroticism, and individuals with secondary psychopathy were high in neuroticism but not extraversion.

Assessment and Modern Conceptualizations of Psychopathy

Diagnostic and Statistical Manual (DSM)

The description of sociopathic personality disturbance included in the first edition of the *Diagnostic and Statistical Manual* (DSM-I*;* American Psychiatric Association, 1952) had a sizeable amount of overlap with Cleckley's formulation of psychopathic personality traits. These individuals were described as chronically antisocial, irresponsible, insensitive to punishment, and callous and hedonistic. *DSM-II* (American Psychiatric Association, 1968) included an antisocial personality disorder that expanded on the conceptualization from *DSM-I* and was slightly closer to Cleckley's definition of psychopathic personality. This disorder was characterized by individuals who were "grossly selfish, callous, irresponsible, impulsive, and unable to feel guilt or to learn from experience and punishment," (American Psychiatric Association, 1968, p.43) and who violated societal norms. Beginning in *DSM-III* (American Psychiatric Association, 1980), however, there was a shift in the way antisocial personality disorder (ASPD) was conceptualized, which initiated the divergence between the concepts of psychopathy and antisocial personality disorder. Specifically, this version of the DSM focused primarily on behavioral characteristics in order to improve reliability between clinicians (at the cost of validity; see criticisms by Hart & Hare, 1996). According to *DSM-III* (American Psychiatric Association, 1980), the presence of conduct disorder was required during childhood in order to receive ASPD diagnosis as an adult. Additional criteria included unlawful behavior, relationship infidelity or instability, aggression, poor work history, financial irresponsibility, irresponsible parenting, recklessness, and a disregard for the truth. Criteria capturing the interpersonal and

affective deficits in individuals with high psychopathic traits were not included in this conceptualization of the DSM. Subsequent versions of the *DSM* have each made modifications to the description of ASPD, but have maintained a heavy reliance on antisocial behavior, as opposed to the core interpersonal and affective deficits. *DSM-5* (American Psychiatric Association, 2013. p. 765*)*, however, has included the specifier "with psychopathic features" to describe "a distinct variant termed… 'primary' psychopathy… characterized by low levels of anxiousness (Negative Affectivity domain) and withdrawal (Detachment domain) and high levels of attention seeking (Antagonism domain)." Although some consider this a step towards the prototypical "Cleckley psychopathy," others have criticized the description of psychopathic features in DSM-5 as lacking empirical support (Crego & Widiger, 2015).

Lykken's (1995) depiction of psychopathy subtypes is particularly relevant to the diagnosis of antisocial personality disorder, as defined by the DSM. Lykken proposed that ASPD is made up of two groups of individuals: psychopaths and sociopaths. Individuals with psychopathy who, according to this model, fail to develop empathy due to an inherent psychological abnormality that limits their ability to learn to function in a prosocial manner. So-called sociopathic individuals lack empathy and concern for others due to a lack of socialization and "training" as a result of maltreatment, neglect, and poor parenting. Although ASPD overlaps to some degree with psychopathy, and was described in the Diagnostic and Statistical Manual, 4th Edition, Text Revision (DSM-IV-TR*; American Psychiatric Association, 2000)* as being synonymous with psychopathy, they are distinct conditions (Hare, 1996; Ogloff, 2006). Thus, while Lykken's theory of ASPD provides a useful conceptualization that is consistent with other theories of primary and secondary psychopathy, the current study will focus on psychopathy as

originally conceptualized by Cleckley and others (e.g., McCord and McCord, 1964; Karpman, 1941, 1948; Porter, 1996).

The Hare Psychopathy Checklist (PCL)

Around the time the DSM-III introduced the diagnostic category of ASPD, Hare developed the Psychopathy Checklist (Hare, 1980), an expert-rater clinician rating scale consisting of 22 items[2] that aimed to more closely parallel traditional clinical conceptualizations of psychopathy by focusing on core personality features rather than solely on antisocial behavior, as is the case with the DSM ASPD diagnosis (Hare et al., 1990). Later, a revised version was developed (PCL-R), which dropped two of the original items[3] due to their low correlations with the total score.

For clinical purposes, PCL-R total score is most commonly used. However, the academic literature has extensively examined the underlying factor structure of the PCL-R and the meaning and interpretability of identified factors as they relate to the overall construct of psychopathy and its neural, behavioral, and clinical correlates. Item response theory (IRT) and factor analyses have supported the use of two-, three-, and four-factor models of psychopathic traits as measured by the PCL and PCL-R (Bolt et al., 2004; Cooke & Michie, 1997; Vitacco, Rogers, et al., 2005). For nearly three decades, the two-factor model of psychopathy consisting

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[2] These items include: (1) glibness/superficial charm, (2) previous diagnosis as a psychopath (or similar, (3) egocentricity/grandiose sense of self-worth, (4) proneness to boredom/low frustration tolerance, (5) pathological lying, (6) conning/lack of sincerity, (7) a lack of remorse or guilt, (8) shallow affect, (9) callousness and/or a lack of empathy, (10) a parasitic lifestyle, (11) poor behavioral controls, (12) promiscuous sexual behavior, (13) early behavioral problems, (14) lack of realistic long-term goals, (15) impulsivity, (16) irresponsibility, (17) frequent marital relationships, (18) juvenile delinquency, (19) poor probation or parole risk, (20) a failure to accept responsibility for their actions, (21) criminal versatility, (22), drug or alcohol abuse not direct cause of antisocial behavior

[3] Dropped items between the PCL and PCL-R included previous diagnosis as psychopath (or similar) and drug or alcohol abuse not direct cause of antisocial behavior

of interpersonal-affective traits (factor 1) and impulsive-antisocial traits (factor 2) has been accepted among investigators in the field. Cooke and Michie (2001), however, proposed a model that suggested psychopathy be defined by personality deviation alone rather than by antisocial behavior. As such, they presented a hierarchical three-factor model that they demonstrated, using 13 of the 20 PCL-R items[4], was a good fit across forensic and psychiatric samples in North America and Europe. This model divided the original factor 1 into an interpersonal factor defined as Arrogant and Deceitful Interpersonal Style, and an affective factor defined as Deficient Affective Experience. The antisocial items were eliminated, and the original factor 2 became the Impulsive and Irresponsible Behavior Style factor. Proponents of this conceptualization suggest that criminal behavior and antisocial behavior, more broadly, is better viewed as a consequence of psychopathic traits, and should not be included as core traits. However, the proposal of this three-factor model was controversial, with many researchers suggesting that dropping the items capturing antisocial behavior (e.g., revocation of conditional release, criminal versatility, poor behavioral controls) and developmental course (e.g., early behavior problems, juvenile delinquency) diminishes its utility in predicting future outcomes, such as recidivism and violence (Vitacco, Neumann, et al., 2005) and mischaracterizes "antisocial behavior" as equivalent to criminal behavior (Hare & Neumann, 2010). Thus, a four-factor model has also been validated in youth and adults. This model included three factors similar to those proposed by Cooke and Michie (2001) but included a fourth "antisocial behaviors" factor which captures antisocial behavior and developmental course (Forth et al., 1990; Hare, 2003).

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[4] Dropped items included: promiscuous sexual behavior, many short-term marital relationships, revocation of conditional release, criminal versatility, poor behavioral controls, early behavioral problems, and juvenile delinquency.

Extension of Psychopathic Traits to Youth

The construct of psychopathic traits in youth has been well-established, though concerns have been raised around the ramifications of using the stigmatizing and pejorative diagnostic label of psychopathy with children and adolescents, given the poor treatment outcomes and higher recidivism rates associated with psychopathy in adult offenders (Edens & Vincent, 2008; Hemphill et al., 1998). Thus, much of the work to date in youth demonstrating these traits has conceptualized youth with psychopathic traits as a subtype of antisocial and aggressive youth with conduct problems (CP) or conduct disorder (CD) and high levels of "callous-unemotional traits" (CU), which can be conceptualized as the downward extension of interpersonal-affective psychopathic traits.

For a large proportion of youth with low to moderate levels of psychopathic traits and conduct problems, psychopathic traits have been found to reduce over time (Frick, 2009; Lee et al., 2009; Lynam et al., 2007); however, for a subset of youth with severe antisocial behavior and high CU traits, psychopathic traits and antisocial behavior remain stable into adulthood (Blonigen et al., 2006; Frick et al., 2003; Hemphälä et al., 2015; Lynam, 1997; Lynam et al., 2007; Neumann et al., 2011; Obradović et al., 2007).

Assessment of Psychopathic Traits in Youth

Several tools have been used to assess callous-unemotional and psychopathic traits in children and adolescents. The Hare Psychopathy Checklist: Youth Version (PCL:YV) (Forth, Hart, & Hare, 1990; Forth, Kosson, & Hare, 2003), a downward extension of the PCL-R,

contains twenty items modified from the PCL-R for age appropriateness[5]. Scoring of the PCL:YV largely mimics that of the PCL-R and results in factor and facet structures similar to what has been reported previously in adult samples (Neumann et al., 2006).

In addition to expert-rater and self-report measures of psychopathic/CU traits in youth, CU traits were added to the DSM-V in the form of the specifier "*with limited prosocial emotions"* for the diagnosis of conduct disorder (CD; American Psychiatric Association, 2013, p.670). The key features of the specifier are lack of remorse/guilt, callous lack of empathy, lack of concern about performance in school or other activities, and shallow/deficient affect. Conduct disorder, like antisocial personality disorder, is characterized by persistent rule-breaking behavior (e.g., destruction of property, theft, truancy) and aggression and has an estimated total prevalence of 8% (Mohammadi et al., 2021). Callous-unemotional traits, on the other hand, are estimated to occur in fewer than half of youth who meet diagnostic criteria for conduct disorder but identify those who may be at risk for poorer treatment outcomes and more severe, persistent antisocial behavior (Blair et al., 2014).

Other measures to assess psychopathic traits in youth include the Antisocial Process Screening Device (APSD) and the Childhood Psychopathy Scale (CPS), which were both modeled after the PCL-R, and the Inventory of Callous-Unemotional (ICU) and Youth Psychopathic traits Inventory (YPI), which assess the presence of interpersonal-affective

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[5] These items include: (1) impression management, (2) grandiose sense of self-worth, (3) stimulation seeking, (4) pathological lying, (5) manipulation for personal gain, (6) lack of remorse, (7) shallow affect, (8) callousness and/or lack of empathy, (9) parasitic lifestyle, (10) poor anger controls, (11) impersonal sexual behavior, (12) early behavioral problems, (13) lacking goals, (14) impulsivity, (15) irresponsibility, (16) failure to accept responsibility for their actions, (17) unstable interpersonal relationships, (18) serious criminal behavior, (19) serious violations of conditional release, and (20) criminal versatility (Forth et al., 2003).

psychopathic traits in the absence of externalizing symptoms. However, evidence suggests the PCL:YV and self-report measures of callous-unemotional and psychopathic traits show relatively low agreement and, thus, should not be used interchangeably (Cauffman et al., 2009; Fink et al., 2012; Lee et al., 2003; Skeem & Cauffman, 2003). Self-report measures of youth psychopathic traits have also demonstrated poor prediction of outcomes such as delinquency as compared to the PCL:YV (Boccaccini et al., 2007; Cauffman et al., 2009; Douglas et al., 2008; Fink et al., 2012; Sharp & Kine, 2008; Spain et al., 2004) and have been found to be highly susceptible to underreporting and/or positive impression management (Kelsey et al., 2015).

Although the PCL:YV is time-intensive to administer and requires specialized training, its relatively low susceptibility to positive impression management and its predictive utility for clinical outcomes (e.g., treatment responsiveness) and recidivism make it a useful tool for making important clinical (e.g., treatment selection) and legal decisions (e.g., risk assessment, amenability to treatment, sentencing/placement). Therefore, it is currently considered the gold standard for assessment of psychopathic traits in youth in clinical settings.

Correlates of Psychopathy and Its Subtypes

Conceptualization and Assessment of Anxiety and Trauma

Just as a range of measures of psychopathic traits have been used in the literature, conceptualization and measurement of anxiety and trauma have also differed, which has led to disagreement across studies seeking to identify possible subtypes of psychopathic individuals.

Anxiety

Cleckley (1976) describes anxiety as “remorse, uneasy anticipation, apprehensive scrupulousness, the sense of being under stress or strain” (p. 257) and also used the term “psychoneurotic,” meaning “anxious, restless, unhappy, and obsessed with thoughts they

themselves recognize as absurd" (p256), interchangeably with anxiety. Regarding psychopathy and anxiety, Cleckley stated "It is doubtful if in the whole of medicine any other two reactions stand out in clearer contrast" (Cleckley, 1976, p.259) and that "many [psychopaths], as a matter of fact, show less evidence of anxiety, uneasiness, and other reactions implied by emotional instability than the average person" (Cleckley, 1976, p.240.). In contrast, Karpman (1948b) described symptomatic (i.e., secondary) psychopathic individuals has emotionally reactive and high in general neuroticism and internalizing distress more broadly.

Though many researchers tend to consider fear, anxiety, and neuroticism interchangeably, there is support for conceptual differences between these constructs. Conceptually, fear and anxiety are both adaptive emotional states experienced in response to danger or threat that can become pathological when experienced in excess. It is argued that fear is best conceptualized as a primitive, context-specific response following the presentation of a threatening stimulus that triggers a physical cascade (i.e., activation of the hypothalamic-pituitary-adrenal axis) and manifests itself in avoidance or escape behaviors (i.e., fight-fight-flee response) (Grillon, 2008; Hoppenbrouwers et al., 2016; Rosen & Schulkin, 1998). It is a state, rather than a trait. Consistent with this definition of fear as a short-lived response to a particular threatening stimulus, studies have utilized psychophysiological tools including startle potentiation and fear conditioning paradigms (Baskin-Sommers et al., 2013; Birbaumer et al., 2005; Hoppenbrouwers et al., 2016) demonstrating that those high in psychopathic traits demonstrate reduced startle potentiation and impairments in fear conditioning compared with control samples (with low psychopathic traits). Lykken, however, compared psychopathic individuals to individuals in heroic and/or dangerous professions like being test pilot and described fearlessness as harm avoidance and sensation-seeking resulting from a lack of sensitivity to consequences.

Fearlessness, in this sense, has been primarily measured using scales of harm avoidance (e.g., Multidimensional Personality Questionnaire – Harm Avoidance scale). However this model has been criticized (Newman & Brinkley, 1997) as several studies have found fearlessness and sensation-seeking to be unrelated to psychopathic traits (N. E. Anderson et al., 2021; Schmitt & Newman, 1999).

In contrast to fear, anxiety is conceptualized by some as a prolonged sense of apprehension or hypervigilance due to (1) perceived inability to escape a prolonged feared situation, (2) expectation of a future dangerous or feared situation, or (3) uncertainty (Grillon, 2008). Anxiety can be conceptualized dimensionally as both a state and a trait, and at clinical levels of anxiety, psychopathology (e.g., generalized anxiety disorder, social anxiety disorder, phobias) can develop. Measures of anxiety vary widely in the literature from assessments of physical symptoms of anxiety and panic to social anxiety, generalized anxiety, or specific phobias. Spielberger et al. (1970) developed the State-Trait Anxiety Inventory (STAI) to assess both state and trait levels of physical and generalized anxiety. Additional measures that have been used to assess anxiety in the context of psychopathy include Gray's Anxiety Scale, Welsh Anxiety Scale (WAS), and the Beck Anxiety Inventory (BAI) in adults, and the Revised Child Manifest Anxiety Scale (RCMAS), Multidimensional Anxiety Scale for Children (MASC), Massachusetts Youth Screening Instrument (MAYSI-2) Depressed/Anxious scale, Child Behavior Checklist (CBCL) and Youth Self Report (YSR), and the Brief Symptom Inventory[6] in youth. These measures differ in their conceptualization and measurement of anxiety from

[6] A self-report measure with nine subscales: Somatization, Obsession-Compulsion, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic anxiety, Paranoid ideation, and Psychoticism.

primarily assessing physical symptoms of anxiety (e.g., BAI) to assessing multiple categories of anxiety. For example, the RCMAS assesses five domains including Physiological Anxiety, Defensiveness, Worry, and Social Anxiety, and the MASC assesses four domains including Separation Anxiety/Panic, Harm Avoidance, Physical Symptoms, and Social Anxiety.

Finally, neuroticism is a personality characteristic or temperament marked by a tendency towards negative affect and more frequent experience of negative emotions especially in response to stressors. Neuroticism, by definition is a personality trait rather than a state. Measures of neuroticism include neuroticism subscales of personality measures such as the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975), Multidimensional Personality Questionnaire – Brief Form (MPQ-BF; Patrick et al., 2002), NEO Personality Inventory (NEO-PI/NEO-PI-R/NEO-FFI; Costa & McCrae, 1992).

To date, there has been no consensus on the optimal way to conceptualize anxiety or neuroticism in the context of identifying subtypes of psychopathic individuals. Interestingly and perhaps unsurprisingly, findings in a sample of adult offenders revealed differing associations between the PCL-R and various measures of fear, anxiety, and neuroticism (Schmitt & Newman, 1999), suggesting that using these terms interchangeably, especially in studies examining subtypes of psychopathic personality, may lead to confusion and limited agreement between studies.

Trauma

Studies examining early environmental factors influencing the development of psychopathic/CU traits have also spanned a range of definitions and measures. Some conceptualizations of subtypes of individuals high in psychopathic traits have focused on maltreatment, neglect, and abuse as contributing to the development of psychopathic traits for

secondary (high psychopathy, high anxiety) individuals (e.g., McCord & McCord, 1964; Porter, 1996). Mealey, (1995a, 1995b) on the other hand, described unpredictable environments, low socioeconomic status, and domestic violence alluding to the contribution of generally disadvantaged environment, possibly with exposure to observed family or community trauma, as relevant for the development of psychopathic traits.

In adult and juvenile criminal offenders, prior work has found significant associations between various forms of childhood trauma and psychopathic traits (See Ireland et al., 2020 for systematic review) . Specifically, a number of studies have identified a significant positive correlation between childhood maltreatment and overall PCL-R or PCL:YV score (Campbell et al., 2004; Craparo et al., 2013; Dargis et al., 2016; Gao et al., 2010; Krischer & Sevecke, 2008; O'Neill et al., 2003; Schimmenti et al., 2014), and there appears to be a unique positive correlation between physical abuse, in particular, and PCL-R impulsive-antisocial (factor 2) scores (Borja & Ostrosky, 2013; Dargis et al., 2016; Schimmenti et al., 2015). Experience of sexual abuse has also been positively associated with PCL-R impulsive antisocial (factor 2) scores in a sample of violent offenders (Schimmenti et al., 2015), and PCL-R scores in adult offenders have been positively associated with earlier age at first relational trauma (Craparo et al., 2013). Though most studies have focused on childhood maltreatment (e.g., abuse and neglect), one study found that more exposure to community violence was associated with higher PCL:YV total scores. Additionally, maltreatment was positively correlated with PCL:YV lifestyle and antisocial facet scores while exposure to community violence was positively associated with interpersonal, lifestyle, and antisocial facet scores (Schraft et al., 2013). Overall, these findings suggest that experience of childhood trauma (both experienced and observed) is

associated with psychopathic traits, but these associations appear to be specific to lifestyle and antisocial (factor 2) traits, rather than interpersonal and affective (factor 1) traits.

Furthermore, research suggests traumatic experiences in childhood, irrespective of psychopathic traits, are also associated with increased risk for recidivism (See Dalsklev et al., 2021 and Yohros, 2022 for systematic reviews and meta-analysis).

Evidence for Psychopathy Subtypes

Adult Psychopathy Subtypes

Several methods for identifying subtypes of individuals with psychopathic personality have been examined in the literature.

Mokros and colleagues (2015) utilized latent profile analysis (LPA) in a large sample of male offenders with high levels of psychopathic traits (PCL-R total score ≥ 27) to identify subgroups and found that a 3 class solution best fit the data. These groups were termed manipulative, aggressive, and sociopathic, and differed significantly across facets of the PCL-R as well as level of anxiety. A replication analysis was conducted in a second sample of male offenders that produced similar results. Specifically, the sociopathic group demonstrated the highest level of anxiety and lowest level of affective traits, the manipulative group demonstrated the lowest level of antisocial traits and lowest level of anxiety, and the aggressive group demonstrated consistently high scores across interpersonal, affective, lifestyle, and antisocial facets and had only somewhat elevated anxiety when compared with the manipulative group. The authors suggested the manipulative and aggressive groups could best be characterized as subgroups of primary individuals and the sociopathic group could be described as most consistent with the antisocial personality disorder or “sociopathy.”

Using model-based cluster analysis (MBCA) of the PCL-R in a sample of incarcerated offenders with high levels of psychopathic traits (PCL-R total scores ≥ 29), Skeem and colleagues (2007) found two subtypes of psychopathic offenders that are consistent with theoretical descriptions of primary and secondary individuals. Specifically, the secondary group demonstrated higher trait anxiety (as measured by the Karolinska Scales of Personality, anxiety subscales), fewer psychopathic traits, higher social withdrawal, more borderline personality disorder features, and more symptoms of mental illness, but similar levels of antisocial behavior compared to the primary cluster. Poythress and colleagues (2010) used a similar technique in a large sample of offenders without preselecting individuals for clinical levels of psychopathic traits to identify groups that displayed four profiles including two that were consistent with theoretical models of primary and secondary psychopathy. That is, they identified two groups of individuals with high psychopathy scores: one (primary) with lower anxiety (as measured by Personality Assessment Inventory, anxiety subscale), harm avoidance (as measured by Multidimensional Personality Questionnaire, harm avoidance subscale), and childhood maltreatment scores (as measured by the Child Abuse and Trauma Scale) and another (secondary) who scored significantly higher across measures of anxiety, harm avoidance, and childhood maltreatment. They also identified two additional groups: a “fearful” group (high psychopathic traits, high harm avoidance) and a “nonpsychopathic ASPD” group who exhibited low PCL-R interpersonal, affective, and lifestyle traits and mean levels of anxiety and harm avoidance. MBCA in a sample of adult male offenders scoring at or above 30 on the PCL-R, identified two groups of individuals who differed in level of negative affect (as measured by the Multidimensional Personality Questionnaire). Specifically, the secondary group was characterized by higher negative affect and significantly more childhood maltreatment (as

measured by the Childhood Trauma Questionnaire) compared to the "primary" group (Dargis & Koenigs, 2018).

In support of Porter's theory of "dissociative" secondary psychopathy, dissociative symptoms have been shown to partially mediate the relationship between child abuse and PCL-R total score, and more specifically, behavioral traits (e.g., impulsive-irresponsible lifestyle) (Cooke & Michie, 2001).

Although these studies represent only a subset of the research conducted in adult samples to identify subgroups of individuals with high psychopathic traits, taken together, the literature to date supports the existence of primary and secondary subtypes of adults with high levels of psychopathic traits that differ in level of anxiety, fear, negative affect, and/or history of childhood trauma consistent with theoretical models proposed by Karpman (1941, 1948), Porter (1996), Mealey (1995a, 1995b), and others.

Youth Psychopathy Subtypes

A very limited number of studies have attempted to identify subtypes of youth with psychopathic traits using the PCL:YV, with mixed results. Kimonis and colleagues (2011) used model-based cluster analysis (MBCA) in a sample of 116 juvenile offenders with high PCL:YV scores (PCL:YV $\geq$ 27) and identified two groups which differed in anxiety (as measured by the Brief Symptom Inventory) and experience of childhood abuse (as measured by the Childhood Abuse Scale): (a) a primary group characterized by lower anxiety and lower abuse history and (2) secondary group characterized by higher anxiety and abuse history. On the other hand, Lee and colleagues (2010) also used MBCA in a sample of 94 justice-involved youth (mean PCL:YV total score = 17.99) but did not find primary (low anxiety) and secondary (high anxiety) groups. Instead, they identified low (PCL:YV mean = 12.14), moderate (PCL:YV mean = 20.56), and

high (PCL:YV mean = 25.14) psychopathy groups. When comparing groups on level of anxiety (as measured by the Revised Interpersonal Adjective Scales - Big 5, anxiety subscale), the high psychopathy group demonstrated the highest level of anxiety and the moderate group demonstrated the lowest level of anxiety; however, due to the large differences in level of psychopathic traits and relatively low mean PCL:YV scores in the sample overall, these groups do not appear to be consistent with traditional conceptualizations of primary (high psychopathy, low internalizing, lower history of trauma) and secondary (high psychopathy, high internalizing, higher history of trauma) groups. Finally, Waller and Hicks (2019) conducted LPA using the PCL:YV and Brief Symptom Inventory in a large sample of justice-involved youth that identified four groups: low-anxious primary psychopathy, high-anxious secondary psychopathy, anxious-only (low psychopathic traits), and low-risk (low psychopathic traits, low anxiety). The secondary group demonstrated similar levels of substance use, aggression, and psychopathic traits to the primary group but had more depressive, anxious, and post-traumatic stress symptoms.

A number of studies have utilized latent profile analysis (Craig & Moretti, 2019; Fanti et al., 2013, 2020; Kimonis et al., 2013; Kimonis, Fanti, et al., 2017) and model-based cluster analysis (Docherty et al., 2016; Gill & Stickle, 2016; Kahn et al., 2013; Kimonis, Frick, et al., 2012; Tartar et al., 2012) to identify primary and secondary subtypes of youth with high psychopathic/CU traits, as measured by the YPI and ICU, who differ in level of anxiety or neuroticism. In subsequent validation analyses, researchers have consistently found that secondary individuals report higher levels of childhood abuse/neglect and/or posttraumatic stress disorder (PTSD) symptoms than primary individuals (Craig & Moretti, 2019; Fanti et al., 2020; Kahn et al., 2013; Kimonis et al., 2013; Kimonis, Fanti, et al., 2017; Kimonis, Frick, et al.,

2012). (See Craig et al., 2021 for a systematic review.) Studies using a threshold score in justice-involved youth to preselect individuals with high levels of psychopathic/CU traits (Bennett & Kerig, 2014; Kimonis, Frick, et al., 2012; Kimonis, Tatar, et al., 2012; Tartar et al., 2012; Vaughn et al., 2009; Veen et al., 2011), have consistently found a two-group solution as the best fit, in which a "primary" group demonstrates lower internalizing distress or anxiety and relatively less history of trauma and a "secondary" group demonstrates higher levels of internalizing distress or anxiety and relatively higher history of trauma. Studies in which researchers opted to use the full range of psychopathic traits, have found that three- (Gill & Stickle, 2016; Kahn et al., 2013; Kimonis et al., 2013), four- (Craig & Moretti, 2019; Docherty et al., 2016; Fanti et al., 2013; Fanti & Kimonis, 2017; Huang et al., 2020; Kimonis, Fanti, et al., 2017; Kimonis, Goulter, et al., 2017; Meehan et al., 2017), or five- (Fanti et al., 2020; Zwaanswijk et al., 2018) group solutions provided the best fit. Each of these studies consistently identified two groups high in psychopathic traits who, mirroring hypothesized primary and secondary subtypes, differed in level of internalizing distress/anxiety and history of childhood traumatic experiences. In addition to primary and secondary groups, one, two, or three additional groups were identified in these studies characterized by relatively lower levels of psychopathic traits and varying levels of internalizing distress/anxiety and history of trauma. Most commonly, in studies which found a 4 group solution, in addition to primary and secondary groups with elevated levels of psychopathic traits, two remaining groups, "anxious" and "low," were identified. These groups were characterized by relatively lower levels of psychopathic traits with the "anxious" group demonstrating elevated levels of anxiety and the "low" group demonstrating mean levels of all traits (Craig & Moretti, 2019; Docherty et al., 2016; Fanti et al., 2013; Huang et al., 2020; Meehan et al., 2017). One study, conducted by Fanti and colleagues (2020), in addition to

identifying “primary,” “secondary,” “anxious,” and “low” groups, identified a fifth “maltreatment” group characterized by mean levels of psychopathic traits and anxiety, but significantly more history of abuse.

Two studies utilizing cluster techniques to identify subtypes of youth with psychopathic traits did not find primary and secondary groups and, instead, identified groups which differed on level of psychopathic traits. Specifically, Euler and colleagues (2015) performed two-step cluster analysis in a clinical sample of youth with behavior problems using the YPI – CU subscale and MAYSI-2 and identified four groups: high psychopathy, moderate psychopathy, high anxiety/low psychopathy, and control. Colins (2018) performed LPA in a sample of justice-involved youth using the YPI and MAYSI-2 and identified four similar groups: high psychopathy, moderate psychopathy, high anxiety (low psychopathy), and control (all low).

Relatedly, a number of studies have used posttraumatic stress symptoms rather than anxiety to distinguish between primary and secondary subtypes of youth with callous-unemotional traits and conduct problems. Kerig and colleagues (2012) proposed a theory of emotional numbing leading to the development of “acquired” CU traits in response to trauma, given findings that the association between trauma exposure and CU traits was mediated by numbing of emotions, sadness and, in cases of trauma experiences involving betrayal, numbing of fear. Researchers from the same group also found that youth with “acquired” callous-unemotional traits, characterized by high CU traits and high posttraumatic stress symptoms, reported more traumatic events than the primary (high CU, low posttraumatic stress) and comparison groups. However, it is important to note that the difference in number of traumatic events between the groups may be a product of using level of posttraumatic stress to define the groups at the outset (Bennett & Kerig, 2014).

Biological Models of Psychopathy

Neurobiological Models of Psychopathy

Over the years, several cognitive and neurobiological models of the development of psychopathic traits have emerged identifying structural and functional neural substrates underlying cognitive and affective deficits seen in individuals with psychopathic traits.

In support of Lykken's (1957) "*low fear hypothesis,"* prior work has shown that individuals high in psychopathic traits evidence weak physiological responses in anticipation of aversive stimuli, poor passive avoidance learning, and a lack of startle potentiation. However, more recent work suggests that this may reflect a deficit in detection and responsivity to threat rather than reduced subjective experience of fear, per se (Hoppenbrouwers et al., 2016). In fact, Newman proposed a subsequent *"response modulation hypothesis"* suggesting individuals high in psychopathic traits do not have a specific deficit in fear conditioning or emotional processing, rather they fail to properly attend to and process affective and other potentially relevant information that is not directly related to ongoing, goal-directed behavior (Newman & Lorenz, 2003). In support of this hypothesis, a number of studies have demonstrated that individuals with high levels of psychopathic traits demonstrate normal fear conditioning and emotion processing when their attention is specifically directed towards the stimuli (N. E. Anderson et al., 2017; N. E. Anderson & Stanford, 2012; Baskin-Sommers et al., 2011, 2012, 2013; Larson et al., 2013; Newman et al., 2010). Relatedly, the "*attentional bottleneck hypothesis"* posits that individuals high in psychopathic traits fail to appropriately allocate their attention and, instead, become hyper-focused on a particular aspect of the experimental paradigm (Newman & Baskin-Sommers, 2012).

Neurobiological models have largely focused on regions of the limbic system. The limbic system is made up of brain structures that are crucial for processing emotional information and using it to inform the regulation of behavior. The amygdala is considered a primary hub of the limbic system and is responsible for detecting and responding to threat cues, recognizing emotionally salient information, and stimulus reinforcement learning. Frontal brain regions, such as the orbitofrontal (OFC)/ventromedial prefrontal cortex (vmPFC), as well as the dorsolateral prefrontal cortex (dlPFC), are responsible for higher-order functions including cognitive control, behavioral regulation, decision-making, and self-monitoring, and provide top-down regulation of the amygdala (Luria, 1973).

Based on his work primarily with adolescent samples, as well as his review of prior work conducted in adults, Blair proposed a model of dysfunction contributing to the development of psychopathic/CU traits with particular emphasis on amygdala and vmPFC dysfunction, suggesting that early amygdala dysfunction gives rise to deficits in stimulus-reinforcement learning and decision-making that lead to deficits in their ability to learn to avoid associations with distress in others (Blair, 2003, 2007). Notably, lesion studies have demonstrated that individuals with vmPFC damage appear to demonstrate emotional and cognitive deficits similar to individuals high in psychopathic traits such as lack of empathy, poor impulse control, and impaired decision-making (Koenigs et al., 2012). Lower gray matter volumes in the amygdala (Boccardi et al., 2011; Ermer, Cope, et al., 2012; Yang et al., 2009) and vmPFC (Boccardi et al., 2011; Yang et al., 2005) have been identified in individuals high in psychopathic traits, providing additional support for this model.

Kiehl's (2006) paralimbic dysfunction model leveraged methods from cytoarchitectonics with data from patients with brain damage to argue psychopathy is associated with more

widespread dysfunction than prior models. Specifically, this model highlights abnormalities in regions closely connected to the amygdala and OFC/vmPFC including the anterior and posterior cingulate, insula, parahippocampal regions, and the anterior superior temporal gyrus (temporal pole). The anterior cingulate cortex (ACC) is a limbic region responsible for error and conflict monitoring, response inhibition (Tekin & Cummings, 2002), and processing of emotional facial expressions (Hornak et al., 2003), and has been consistently associated with psychopathic traits across samples (Blair et al., 1997; Brazil et al., 2009; Kiehl et al., 2000; Kosson et al., 2002; Maurer et al., 2016; Steele et al., 2016). Additionally, functional neuroimaging studies in individuals high in psychopathic traits have noted aberrant function in the posterior cingulate cortex (PCC), temporal pole, and parahippocampal gyrus associated with processing affective words as well as pictures with emotional context (Fusar-Poli et al., 2009; Kiehl et al., 1999, 2004; Maddock et al., 2003; Maddock & Buonocore, 1997; Müller et al., 2003; Williamson et al., 1991). Together, paralimbic regions appear to be associated with affective and emotional processes such as recognizing and reacting to emotionally salient information in the environment, processes that have been shown to be disrupted in adult males, adult females, and adolescents high in psychopathic traits. Not surprisingly, lower gray matter and functional deficits in paralimbic structures have been seen in individuals with psychopathic traits across male, female, and adolescent samples including the amygdala, OFC/vmPFC, insula, ACC, and PCC, parahippocampal regions, and temporal pole (A. R. Baskin-Sommers et al., 2016; Boccardi et al., 2011; Cope et al., 2014; de Oliveira-Souza et al., 2008; Ermer, Cope, et al., 2012; Ermer et al., 2013; Ly et al., 2012; Tiihonen et al., 2008; Walters et al., 2015; Yang et al., 2010). Further support for circuit-wide dysfunction has been provided by studies demonstrating impaired structural and functional connectivity between paralimbic brain structures across male, female,

and adolescent samples (Finger et al., 2012; Hoppenbrouwers et al., 2013; Marsh et al., 2011; Motzkin et al., 2011).

Neuroanatomical Models of Subtypes

Several samples have demonstrated distinct patterns of amygdala reactivity between primary and secondary subtypes. In a sample of healthy, college-age adults, a group described as having high psychopathic traits but low anxiety ("primary") demonstrated a pattern of reduced amygdala and insula activity in response to fearful faces; however, a group termed "secondary," that exhibited high psychopathic traits and high anxiety, did not show this reduction (Sethi et al., 2018). Similarly, in a sample of high-risk adolescents classified into four groups (primary, secondary, anxious, low) using LPA, primary individuals (high psychopathic traits, low-anxiety) demonstrated reduced right amygdala activity when viewing neutral faces and during threat extinction during a threat-conditioning task as compared to individuals in the other three groups (secondary, anxious, and low)(Fanti et al., 2020). Additionally, in a sample of young adults from the community separated into clusters using LPA, both primary (high psychopathic traits, low anxiety) and secondary (high psychopathic traits, high anxiety) individuals showed lower medial prefrontal cortex activation in response to images of victims of violence when compared to "high anxiety-only" individuals. Fanti and colleagues (2018) propose that this unexpected finding could be explained by the role the medial PFC plays in low empathy and guilt, which characterizes both primary and secondary individuals. Finally, in a sample of incarcerated adolescents identified as primary (high psychopathic traits, low anxiety) or secondary (high psychopathic traits, high anxiety) via LPA, primary individuals demonstrated reduced startle potentiation to aversive images when compared to a control group while secondary individuals demonstrated increased startle modulation. As startle potentiation is an amygdala mediated

process, these findings provide further support for limbic circuit differences between primary and secondary individuals (Kimonis et al., 2017).

A limitation of the extant literature regarding neurobiological differences between primary (high psychopathy, low anxiety) and secondary (high psychopathy, high anxiety) is that many of the studies described here used community samples which are unlikely to demonstrate clinical elevations in psychopathic traits. Thus, future studies further examining neurobiological or neuroanatomical differences between individuals high in psychopathic traits who differ in level of anxiety in clinical and/or forensic samples is warranted.

Heritability of Psychopathic Traits

In addition to understanding possible environmental factors contributing to the development of psychopathic traits, many studies have focused on understanding genetic and other biological influences on the development of psychopathic traits, including heritability. Several recent reviews (Dhanani et al., 2018; Moore et al., 2019; Viding & McCrory, 2012, 2018) have reported heritability estimates ranging from 25-80% with the highest heritability estimates (63-80%) reported in studies focusing on samples of clinical youth (e.g., in the top 10% of the CU trait distribution, youth with a behavioral disorder). Despite these high heritability rates, studies have also demonstrated that certain environmental factors (e.g., adoptive mother positive reinforcement, warm parenting) may be protective against the development of early CU traits (e.g., Hyde et al., 2016; Tomlinson et al., 2021).

Very few studies have estimated heritability using expert-rater measures such as the PCL-R or PCL:YV. Tuvblad and colleagues (2014) used the Psychopathy Checklist: Youth Version (PCL:YV), Child Psychopathy Scale (CPS), and Antisocial Process Screening Device (APSD) in a sample of 14-15 year old twins and found that genetic influences explained 69% of the

variance in a latent psychopathic personality factor (calculated using all three of the aforementioned measures). When looking at measurement-specific genetic influences, however, genetic influences were not found for the PCL:YV. Of note, this study was conducted in a community sample of adolescent twins, thus PCL:YV scores were noted to be positively skewed such that clinical levels of psychopathic traits were largely absent.

Taken together, the reviewed studies suggest that psychopathic traits are highly heritable; however, studies assessing heritability of psychopathic traits have primarily been conducted using caregiver- or self-report measures of callous-unemotional traits in youth (e.g., APSD, ICU, Child Psychopathy Scale) and in community samples in which the incidence of clinical levels of psychopathic traits is low. Thus, quantifying the heritability of clinical levels of psychopathic traits using expert-rater measures remains an area for future study.

Psychopathic Traits and Recidivism in Youth

Although it appears the rate of incarceration of youth has been decreasing steadily since 1995, recent estimates suggest that in the United States over one million youth are arrested each year (Puzzanchera, 2014). The majority of juvenile arrests are for low-level, non-violent crimes (e.g., minor drug offenses), approximately 22% of juveniles are arrested for higher-level, non-violent crimes (e.g., theft), and approximately 5% of juveniles are arrested for violent crimes (e.g., aggravated assault, rape, murder) (Puzzanchera, 2014). It also is estimated that approximately 49,000 are detained in correctional facilities while approximately 1 in 14 detained youth is detained in adult jails and prisons (Sawyer & Wagner, 2022). Though a relatively small proportion of juvenile arrests lead to detention and the average juvenile is incarcerated for approximately three to four months, estimates suggest that the total costs of juvenile incarceration, including indirect costs of later justice system involvement, employment, loss of

future earnings, and the like, range from $8 to $21 billion per year (Justice Policy Institute, 2015).

Moffitt (1993) proposed a model that distinguished between two trajectories of juvenile offending: *"adolescence-limited"* and *"life-course persistent."* This model posited that the majority of juvenile offenders could be characterized as *"adolescence-limited."* That is, these individuals would begin to engage in antisocial behavior during childhood and would "grow out of it" by adulthood. The idea of *"adolescence-limited"* antisocial behavior is consistent with the age-crime curve, which suggests that engagement in criminal activity peaks during the teenage years and declines by the early twenties with approximately 40-60% of adolescent offenders ceasing criminal activity by early adulthood (Farrington, 2003; Piquero, 2001). For a small proportion of juvenile offenders (~5-10%; Moffitt, 1993; Eme, 2020), however, this pattern does not hold. These individuals fall into the *"life-course persistent"* category, often beginning to engage in criminal activity during childhood (i.e., prior to the age of 12) and continuing in criminal activity into adulthood. For these individuals, severity of criminal acts appears to increase with time (Farrington, 2003; Piquero, 2001).

Depending on definitions and samples used, it is estimated that recidivism rates for adolescent offenders range from about 40-70% within a year of release (Gordon et al., 2012; Grunwald et al., 2010). In order to determine who is at greatest risk for recidivism and violence, and to inform amenability to treatment decisions, risk assessment tools have gained increasing popularity. In 1990, less than a third (31%) of state juvenile justice systems utilized risk assessment tools (Towberman, 1992), and more recent estimates suggest there are currently 34 states (68%) that utilize risk assessment tools at the state level . The PCL-R (See Douglas et al., 2018; Hemphill et al., 1998; Salekin et al., 1996 for comprehensive reviews) and PCL:YV (e.g.,

Cauffman et al., 2009; Corrado et al., 2004; Salekin, 2008; Stockdale et al., 2010; Vincent et al., 2008; See Olver & Stockdale, 2010 for meta-analysis; See also Douglas et al., 2018 for comprehensive review) have both consistently demonstrated utility in predicting general and violent recidivism and have been used both as standalone risk assessment measures and as additional sources of information to score other established risk assessment measures (e.g., Violence Risk Appraisal Guide, Harris et al., 1993; Structured Assessment of Violence Risk in Youth, Borum et al., 2005). In addition to being widely used in violence risk assessment, the PCL:YV is also used in evaluations of dangerousness and juvenile amenability to treatment as evidence suggests high levels of psychopathic traits are associated with reduced amenability to treatment and increased dangerousness; however, this practice is controversial. As previously mentioned, many debate the appropriateness of applying the construct of psychopathy to youth due to the long term negative consequences that can arise from legal decisions made on the basis of presence of psychopathic traits (Jones & Cauffman, 2008).

Burgeoning evidence supports the consideration of additional factors (e.g., anxiety, trauma history) in individuals high in psychopathic traits, as studies have suggested primary (low anxiety, low trauma) and secondary (high anxiety, high trauma) individuals high in psychopathic traits appear to differ with regard to outcomes. Across many indicators, secondary individuals, characterized by high psychopathic traits and high anxiety, appear to be the highest risk offenders; this is likely partially driven by the higher scores on the impulsive-antisocial factor, and more specifically the antisocial facet (facet 4). Secondary individuals are reportedly more prone to institutional violence (Kimonis et al., 2011), report higher rates of alcohol and other drug use, more severe disruptive behavior symptoms, and have an earlier onset of criminal behavior, though they do not appear to differ in criminal versatility (Euler et al., 2015; Hicks et

al., 2010; Olver et al., 2015). Though research on differential outcomes in primary and secondary individuals is scant thus far, given the wide-spread use of measures of psychopathic traits in forensic clinical contexts, continued work in this area is crucial.

Measurement and Predictive Utility of Psychopathic Traits across Racial and Ethnic Groups[7]

Many studies have supported the construct validity of psychopathic traits as measured by the PCL-R and PCL:YV and predictive utility for general and violent recidivism in non-Hispanic/non-Latinx, White populations. However, a small number of have specifically examined the construct validity and predictive utility of PCL-R and PCL:YV in non-White populations (e.g., Hispanic/Latinx, Black). Studies have found no significant differences in factor structure using confirmatory factor analysis (CFA) between Black and White (Cooke et al., 2001) and Puerto Rican (Windle & Dumenci, 1999) participants. Additionally, a meta-analysis conducted by Skeem and colleagues (2004) focusing on racial differences in level of psychopathic traits found that Black and White individuals did not differ significantly in level of PCL-R Factor 1 (interpersonal/affective) scores but did differ in total PCL-R scores with Black individuals scoring slightly higher than White individuals. Some studies have also found significant differences at the item level between Black and White individuals (Cooke et al., 2001). However, a similar meta-analysis examining differences between Black and White youth

[7] Historically, we in the U.S. have used the term Caucasian or European American to refer to all White individuals regardless of ancestry and the term African American to refer to all Black individuals regardless of ancestry. Thus, many of the older studies discussed here have used that terminology. As these terms are outdated and no longer considered accurate, we have opted to replace the term "African American," with "Black" and the terms "European American" and "Caucasian" with White, and "Hispanic" when discussing these studies. Additionally, we in the U.S. have historically used the term "Hispanic" to refer to individuals from Spanish-speaking countries; however, we will use "Hispanic/Latinx" here out of respect to individuals who prefer the term Latinx over Hispanic.

did not find significant differences at the level of total score (McCoy Elliott & Edens, 2006). Another study, comparing Black and White adolescents identified no differences in factor structure, reliability, or mean PCL-R[8] scores (Brandt et al., 1997). While mixed, these results generally suggest invariance of the PCL-R and PCL:YV across Black and White individuals.

In contrast to work comparing Black and White individuals, relatively little work has been conducted examining the psychometric properties of the PCL-R/PCL:YV in Hispanic/Latinx populations. However, one study supported Cooke and Michie's (2001) 3-factor model of psychopathic traits in a sample of Hispanic/Latinx federal inmates (Tubb, 2002), and another found similar mean PCL-R scores and correlations with substance use, trait anxiety, age, and intelligence when comparing Latinx inmates to matched samples of Black and White inmates (Sullivan et al., 2006).

With regard to predictive utility, one study identified no differences in predictive validity of the PCL:YV between Native Canadian and White Canadian youth (Schmidt et al., 2006). Other studies have found that PCL-R scores were related to violence (Walsh, 2013) and recidivism (J. R. Anderson et al., 2018) in Black and White offenders, but not Latinx offenders. Additionally, a meta-analysis found that predictive validity of the PCL-R is weaker in studies that include higher proportions of individuals belonging to racial and/or ethnicity minority groups (Blais et al., 2014). That being said, the PCL-R has demonstrated predictive utility in several other studies with high proportions of Latinx offenders. Together these studies provide evidence that the PCL-R and PCL:YV are useful clinical tools across racial and ethnic groups;

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[8] An early version of the PCL:YV which the authors referred to as a "revised version of the PCL-R…which eliminated certain inapplicable items and modified the scoring of one item (criminal versatility) to accommodate the shorter life histories of juvenile offenders" (p.430) was used in this study.

however, evidence suggests that continued attention to racial and ethnic breakdown of study samples and other cultural factors when conducting studies and interpreting results is imperative.

Summary

Taken together, prior evidence supports theories put forth by Karpman (1941, 1948), Porter (1996), and others distinguishing between "constitutional" primary psychopathy and "acquired" secondary psychopathy groups who each demonstrate clinical levels of psychopathic traits, but differ based on absence or presence of anxiety, respectively, as well as trauma history.

Furthermore, research suggests that subtypes of individuals with psychopathic traits can be differentiated based on neurobiological and physiological differences, including emotion recognition and processing, fear and aversive conditioning, and startle responsiveness, as well as differences between the structure and function of paralimbic circuitry implicated in these processes.

Finally, although the study of divergent outcomes between primary (low anxious) and secondary (high anxious) individuals with psychopathic traits is in its infancy, a number of differences have already been identified. The differing levels of risk for recidivism and potential implications for treatment selection and determination of treatment responsiveness, further highlight the importance of understanding primary and secondary individuals for the purposes of research, risk-assessment, prevention, and treatment.

The Current Study

The primary aim of the present study was to determine whether subgroups of individuals could be identified who parallel primary (high psychopathic traits, low anxiety) and secondary (high psychopathic traits, high anxiety) groups previously described in the literature. Because the present analysis sought to examine variability in psychopathic traits and anxiety across the full

range of scores, LPA was conducted in a sample of high-risk adolescent male offenders without utilizing researcher-imposed cut-offs (i.e., without limiting our sample to only include youth with high levels of psychopathic traits). Consistent with prior literature, we hypothesized that in addition to a primary psychopathy group (high psychopathic traits, low anxiety) and a secondary psychopathy group (high psychopathic traits, high anxiety), an anxious group (low psychopathic traits, high anxiety) and a low psychopathology group (low psychopathic traits, low anxiety) would be identified. Next, we examined whether identified groups differed in (a) trauma history; (b) gray matter volume in paralimbic regions; and (c) general and violent recidivism. We hypothesized that the secondary (high psychopathy, high anxiety) group would demonstrate (a) more severe and chronic histories of childhood trauma and (b) reduced gray matter volume in paralimbic regions. Additionally, though we hypothesized both high psychopathic traits groups (primary and secondary groups) would reoffend faster and have higher rates of reoffending than low psychopathic traits groups (anxious and low psychopathology groups), we further hypothesized that individuals in the secondary (high psychopathic traits, high anxiety) group would have higher rates of violent reoffending than the primary psychopathy (high psychopathy, low anxiety) group.

CHAPTER 2

Methods

Participants

The sample includes data from the National Institute of Mental Health (NIMH)–funded SouthWest Advanced Neuroimaging Cohort, Youth sample (SWANC-Y), the original sample consisted of 498 juvenile offenders (78 female) who were incarcerated at a maximum-security juvenile detention facility in New Mexico and for whom data were collected between June 2007 and March 2011. All research protocols were approved by the Ethical and Independent Review Services (E&I), the Office for Human Research Protections (OHRP), and the juvenile detention center where data collection occurred. Individuals volunteered to participate after providing written informed consent (if ≥ 18 years of age) or providing written informed assent and parent/guardian written informed consent (if < 18 years of age). Participants were excluded if they had a history of seizures, major psychotic disorder (i.e., mood with psychotic features, schizophrenia, schizoaffective), bipolar disorder, traumatic brain injury with loss of consciousness greater than 30 minutes, other major medical problems, or a reading level below grade four. Participants were paid a flat rate for participation in the study, commensurate with the standard institutional hourly rate.

Of these 420 male participants for whom data were available, 55 were excluded per the aforementioned exclusion criteria and 98 participants were transferred, withdrew, or did not complete the protocol prior to release. Thus, the final sample consisted of 267 adolescent male offenders. Participants in the final sample ranged from 13 to 20 years of age at baseline (M=17.43, SD=1.08). Racial/ethnic breakdown of the final sample was as follows: Hispanic or Latinx (67.8%), non-Hispanic/non-Latinx White (10.5%), Native American or Alaskan Native

(6.7%), Black or African American (3.7%), Native Hawaiian or Pacific Islander (<1%), Multiracial (9.4%). Four participants did not report race/ethnicity (<1%). At baseline, participants were incarcerated for crimes that included murder, assault, rape, arson, weapons possession, burglary, fraud, drug possession/distribution, and criminal mischief.

Assessments

Wide Range Achievement Test, Third Edition (WRAT-3)

The Wide Range Achievement Test (Wilkinson, 1993) is an achievement test designed to assess academic achievement skills across reading, spelling, and mathematics. The WRAT-3, Word Reading subtest measures untimed letter identification and word recognition. Both age-equivalent and grade-equivalent scores can be derived based on raw score. Grade equivalent score ("Pre-K" to ">12") was used to provide an estimate of reading level for each participant. Individuals with estimated reading levels below grade four (n = 4) were excluded to ensure the consent form and all measures administered were within participants' capabilities to read and/or comprehend.

General Intelligence (IQ)

Full-scale IQ was estimated at baseline using a two subtest form of the Wechsler Adult Intelligence Scale (WAIS-III; Wechsler, 1997) for participants 16 years of age and older and the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2003) for participants younger than 16 years of age. The two subtests, Vocabulary and Matrix Reasoning, provide a reliable estimate of full scale IQ (Denney et al., 2015). Mean IQ estimate for the sample is 92.60 (SD = 11.69, Range 71 to 134). An IQ less than 70 resulted in exclusion from all analyses (n = 4).

Traumatic Brain Injury

A post-head injury symptoms questionnaire (adapted from King et al., 1995) that assesses history, number, and duration of traumatic brain injuries (TBI), in addition to related symptoms was administered at baseline to evaluate history of traumatic brain injury. Participants were excluded if they reported a traumatic brain injury resulting in loss of consciousness for longer than 30 minutes or had MRI findings indicative of brain injury by radiological review (n = 7).

Mental Illness and Substance Use

Participants underwent a comprehensive evaluation at baseline for comorbid DSM-IV-TR Axis I disorders using the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS; Kaufman et al., 1997). The K-SADS is a semi-structured interview used to measure past and current symptoms of mood, anxiety, psychotic, substance use, and disruptive behavior disorders in children aged 6-18 years and identify disorders for which participants met criteria based on DSM-IV-TR criteria. Participants with a history of psychosis, including schizophrenia spectrum disorders, mood disorder (major depressive disorder or bipolar disorder) with psychotic features, or a history of bipolar disorder were excluded from further analysis (n = 12).

Additionally, for the purpose of these analyses, the total number of substances for which participants met lifetime abuse or dependence criteria from the K-SADS were calculated to be used as a proxy for severity of substance use.

Psychopathy Checklist: Youth Version (PCL:YV)

The PCL: YV (Forth et al., 2003) is a downward extension of the PCL-R used to provide a dimensional assessment of psychopathic traits among youth. PCL: YV scores were obtained through a comprehensive review of institutional records and a semi-structured interview that reviewed individuals' school, family, work, and criminal histories, as well as interpersonal and

emotional skills. Interviews were conducted by trained researchers and videotaped for reliability assessment. Individuals were scored on 20 items scored on a three-point scale from 0 (does not apply) to 2 (definitely applies), based on pervasiveness, severity, and chronicity of each item, for a total score of 0 to 40. PCL:YV facets scores (interpersonal, affective, lifestyle, and antisocial) were calculated based on published guidelines and scores were prorated for item omission (Forth et al., 2003). For adults, the accepted diagnostic cutoff for psychopathy is 30 and above (Hare 1991); however, clinically, no diagnostic cutoff is used for youth as concern has been raised regarding the implications of labeling a child or adolescent with the stigmatizing term "psychopath" (Edens & Vincent, 2008).

12% of interviews (randomly selected) were double rated to ensure reliability (intraclass correlation coefficient (ICC 1,1) = .90 for PCL:YV total scores).

Multidimensional Anxiety Scale for Children – Child-Report (MASC-C)

The MASC – C (March, 1997) is a self-report instrument administered at baseline that consists of 39 items used to assess anxiety symptoms in youth. The MASC – C consists of four primary subscales: Physical Symptoms, Social Anxiety, Separation Anxiety/Panic, and Harm Avoidance. Items are scored using a four-point Likert scale (i.e., never true, rarely true, sometimes true, often true). Total scores are calculated by summing scores across all items. Normative scores (i.e., T-scores) can then be calculated. T-scores above 65 are considered to be elevated with T-scores of 70 or above representing "clinically significant" levels of anxiety. The MASC has demonstrated sound psychometric properties and predictive utility in identifying the presence and severity of anxiety and specific anxiety disorders in children and adolescents (Dierker et al., 2001; Grills-Taquechel et al., 2008; Wei et al., 2014). For the purpose of the

present study, raw MASC total scores were used to provide a dimensional measure of global anxiety symptoms.

Trauma Checklist (TCL)

Prior work has focused on a variety of measures of trauma primarily focused on direct experience of maltreatment, abuse, and neglect; however, evidence also suggests a link between observed trauma and psychopathic traits (Schraft et al., 2013). Thus, the present study aimed to use a more comprehensive measure of experience of trauma that captures both direct experience of trauma (e.g., maltreatment, abuse/neglect) *and* exposure to observed trauma (e.g., community violence).

Experience of childhood trauma was assessed using the Trauma Checklist (TCL; Dargis et al., 2019), a comprehensive measure assessing the presence and severity of childhood trauma across seven categories using information gathered from institutional records, video-taped interviews, and self-report assessments. These seven categories measure different instances of experienced trauma (i.e., happening to the individual), including physical abuse, emotional abuse, sexual abuse, and neglect/poverty; instances of trauma occurring in the environment the individual was raised in, such as observing trauma happening to others or instances of community violence; and experience of traumatic loss. For each of these seven categories, traumatic experiences are scored on a scale of 0 (not present/no evidence), 1 (few/minor instances), or 2 (many/serious/prolonged instances), with TCL Global scores potentially ranging from 0 to 14. In addition to global scores, the TCL allows for the calculation of chronicity scores for each trauma category by summing scores across three different age bins (e.g., 0 – 6, 7 – 12, and 13 – 18) for each trauma category with a possible score of 6 for each individual category and total possible TCL Global Chronicity score of 42. Factor analysis of the TCL has identified two

factors with physical abuse, emotional abuse, sexual abuse, and neglect/poverty loading on factor 1 and observed trauma, community violence, and traumatic loss loading on factor 2. For each participant, scoring of the TCL was conducted by two independent raters who categorized and rated trauma experiences for each participant. ICCs suggested interrater reliability was moderate to high across all categories: Global (r = .83), physical abuse (r = .86), emotional abuse (r = .72), sexual abuse (r = .83), neglect/poverty (r = .68), observed trauma (r = .71), community violence (r = .75), and traumatic loss (r = .71). After independent coding of the TCL, the two raters met to come to a consensus regarding final scores to ensure accuracy of scoring.

MRI Data Acquisition

High-resolution T1-weighted structural MRI scans were acquired on the Mind Research Network's Siemens 1.5T Avanto mobile scanner, stationed at the correctional facility, using a multi-echo MPRAGE pulse sequence (repetition time = 2530 ms, echo times = 1.64 ms, 3.50 ms, 5.36 ms, 7.22 ms, inversion time = 1100 ms, flip angle = 7°, slice thickness = 1.3 mm, matrix size = 256 × 256) yielding 128 sagittal slices with an in-plane resolution of 1.0 mm × 1.0 mm. Data were pre-processed and analyzed using Statistical Parametric Mapping software (SPM12; Wellcome Department of Cognitive Neurology, London, UK; http://www.fil.ion.ucl.ac.uk/spm). First, T1 images were automatically oriented to anterior-posterior commissure (AC-PC) alignment using the auto_acpc_reorient algorithm (https://github.com/lrq3000/auto_acpc_reorient), and were inspected to ensure proper realignment.

Images were then analyzed via the Unified Segmentation approach as implemented in SPM12 (Ashburner & Friston, 2005). Unified Segmentation allows for image registration based on Gaussian mixture modelling, tissue classification with warped prior probability maps, and

bias correction to be combined in the same generative model. During spatial normalization data were resampled to 2 × 2 × 2 mm. Subsequent segmentation partitioned the images into gray matter, white matter, and cerebrospinal fluid, which were then modulated to preserve total volume. Voxels with a matter value of <.15 were excluded in order to remove possible edge effects between gray and white matter, following methods used in previously published work from our lab (see Ermer et al., 2012). Finally, segmented images were smoothed with a 10-mm full-width at half-maximum Gaussian kernel.

Follow-Up Procedures

Arrest records for the State of New Mexico were sourced from the New Mexico Administrative office of Courts (NMAOC) via the Center for Science and Law (scilaw.org). The dataset contains more than 7.27 million records and spans criminal cases in the courts of New Mexico from February 1977 through December 2021. Biographical information (name, date of birth and SSN) for all study participants was gathered from their criminal records. In addition to the biographical information, release date from juvenile custody closest to the PCL:YV assessment was compiled for all the participants. To account for inadvertent human data entry errors, broad search criteria including partial matches based on permutations and combinations of the last name, first name, date of birth and SSN of participants were used to catalog arrest records. Partially matched arrest records were verified against criminal records to ensure accuracy. For participants who did not appear in the NMAOC database following release, various federal, state and county online public records were searched in addition to community contacts including social media and web searches (on websites such as White Pages, Been

Verified) to account for possible recidivism in another state. Participants who died[9] after being released from incarceration were also identified (n = 45/482).

Binary recidivism data (i.e., arrested, not re-arrested) were coded and crimes committed post release-date were classified across several categories (e.g., misdemeanor, felony, violent felony). General recidivism is the broadest recidivism category and included arrests for misdemeanors and felony offenses but excludes minor traffic related offenses. Felony recidivism is defined as any arrest for a felony. Felony crimes were further classified into violent and non-violent felonies. Violent felonies broadly include arrests for crimes such as assault, battery, robbery, kidnapping, attempted murder, and homicide. In instances where an individual case record included several charges, the highest severity type of crime was assigned to the case (General Arrest < Felony < Violent Felony).

In addition to binary outcomes (yes/no) for rearrest, recidivism variables also were coded as time at risk post-release. The time at risk for participants who were rearrested was calculated as the time in months between release from prison and the arrest of interest. For participants who were not re-arrested post release, the time at risk was calculated as the time from date of release to December 31st, 2021, the day up to which arrest records were available (M = 143.85, SD = 17.77, Range: 75.72 – 174.48)[10]. For deceased participants who did not reoffend, their time at risk was calculated as the number of months between their release date and date of death.

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[9] Death rate includes all participants who died during the following up period including those who died prior to recidivating and those who died after recidivating.

[10] Mean follow up time in years: ~12 years. Range of follow up time in years: ~6 years to ~14.5 years. These statistics are reported in months for participants who were living at the end of the follow-up period (n = 237) as 30 participants in the final sample died during the follow up period. Length of follow-up including deceased participants, when considering death as the end of the follow up period, is 3.62 – 174.48 months (M = 137.55, SD = 29.60).

Analysis Strategy

Identifying Subgroups

Latent profile analysis (LPA) is a form of finite mixture model that attempts to infer hidden, or "latent," groups within a dataset of observed continuous data, using unsupervised learning techniques (Hallquist & Wright, 2014). To address the first aim – identifying subgroups of incarcerated youth – LPA was conducted using MPlus 8.4 Statistical Software (Muthén, & Muthén, 2017). Five continuous variables were entered into the model: psychopathic traits as measured by the four facets of the PCL:YV (i.e., interpersonal, affective, lifestyle, and antisocial) and anxiety as measured by the MASC. A single LPA model is defined by a fixed number of clusters. The optimal solution is identified when the average latent class probabilities for the most likely class membership are greater than or equal to .80 (Rost, 2006). The Bayesian information criterion (BIC) and sample-size adjusted BIC were utilized to determine the LPA model of best fit with an appropriate number of clusters. Models with lower BIC values are preferred. Additionally, the Lo-Mendell-Rubin (LMR) likelihood difference assesses the fit between two nested models that differ by one class. A significant *p*-value indicates that the identified model (*k* classes) is a significantly better fit for the data than a model with one fewer class (*k* - 1), and a non-significant *p*-value indicates that the model with one fewer class (*k* - 1) is a better fit than the identified model (*k* classes). Each of the described model comparison strategies provides useful information regarding the best-fitting model and the optimal number of classes, thus, a set of strategies including BIC, LMR *p*-value, and classification accuracy was used to select viable model solutions.

Validation of Subgroups

Descriptive statistics and bivariate correlations were computed for all relevant study variables. To validate identified subgroups, planned group comparisons involved a series of one-way analyses of variance (ANOVAs) to determine whether groups differed significantly on PCL: YV facet scores and anxiety (MASC). Additionally, as prior studies have found that individuals characterized as belonging to primary and secondary groups differ in presence and severity of childhood trauma exposure, one-way ANOVAs were conducted to determine whether groups differ in severity and chronicity of childhood trauma exposure as measured by the TCL. The identified groups were also compared on age at baseline, IQ-estimate, and number of substance dependences.

Gray Matter Volume Comparisons of Identified Clusters

Although two widely-accepted measures of gray matter have been used in the literature (i.e., gray matter volume and gray matter concentration), this study focused on gray matter volume (GMV), which assesses local gray matter tissue volumes, correcting for effects of normalization of data to a standard template (Ashburner & Friston, 2000; Good et al., 2001; Mechelli et al., 2005).

SPM12 was used for second-level analyses. Specifically, ANOVA was used to identify voxels that demonstrate significant gray matter differences across identified groups. An initial exploratory analysis was performed to test for whole-brain, distributed gray matter effects. Next, to test *a priori* hypotheses about specific regions that might differ between groups, region of interest (ROI) analyses were conducted to determine whether significant gray matter volume differences existed between identified groups in regions previously identified in this sample as being associated with psychopathic traits (Ermer et al., 2013). Values were extracted from peak

voxels in the identified regions of interest (i.e., amygdala, lateral orbitofrontal cortex, medial orbitofrontal cortex, anterior cingulate cortex, posterior cingulate cortex, temporal poles, parahippocampal regions, and hippocampus) and used in subsequent ANCOVAs (see table 1 for peak voxel coordinates for ROIs). Volumetric analyses require accounting for individual variation in the total brain volume; thus, an estimate of total intracranial volume (TIV; white matter + gray matter + cerebrospinal fluid) was estimated using the Computational Anatomy Toolbox extension in SPM12 (CAT12; http://www.neuro.uni-jena.de/cat/). The CAT12 approach utilizes an adaptive maximum *a posteriori* (Rajapakse et al., 1997), or hypothesis free approach, which allows for better segmentation of more variable sections such as the cerebrospinal fluid (CSF), hence its use for TIV calculation. The CAT12 TIV estimate was entered as a nuisance covariate, in addition to age at scan, for all analyses.

Table 1
Region of Interest Peak Voxel Coordinates

	Regions of Interest (MNI Coordinates)			
	Hemisphere	**x**	**y**	**z**
Amygdala	L	-12	-40	8
	R	24	-38	2
Medial OFC	-	-10	34	-22
Lateral OFC	L	-10	32	-24
	R	12	18	-18
ACC	-	16	18	14
PCC	-	4	-46	12
Hippocampus	L	-16	2	-18
	R	30	10	-32
Parahippocampal Gyrus	L	-22	6	-18
	R	24	2	-16
Temporal Pole	L	-32	6	-34
	R	52	10	-16

Note. Montreal Neurological Institute (MNI) x, y, and z coordinates are reported for the peak voxel in each region.

Recidivism Analyses

Chi square analyses were conducted to determine whether groups differed in likelihood of being rearrested for any crime, being rearrested for a felony, and being arrested for a violent felony following release.

Next, we aimed to visualize the proportion of participants who were rearrested for each type of offense over the follow-up period. A Kaplan-Meier estimator is commonly used to non-parametrically estimate a survival function of a population as a function of time. Using time to rearrest from the release date, Kaplan-Meier survival curves were computed for time (in months) to (1a) any arrest, (b) felony arrest, and (c) violent felony arrest. Log rank tests were used to make group comparisons for each type of recidivism (i.e., general rearrest, felony rearrest, and violent rearrest).

CHAPTER 3

Results

Descriptive Statistics

Descriptive statistics and bivariate correlations among relevant variables are reported in Table 2 and Table 3, respectively. PCL:YV total and facet scores (interpersonal, affective, lifestyle, and antisocial) were positively correlated with TCL global score, TCL total chronicity score, and TCL abuse/neglect scores, as well as number of substances for which an individual met abuse or dependence criteria. TCL observed trauma/traumatic loss scores were positively correlated with PCL:YV total, lifestyle, and antisocial scores but not interpersonal and affective scores. Anxiety, as measured by the MASC, was negatively correlated with PCL:YV affective and antisocial scores but not correlated with PCL:YV total, interpersonal, or lifestyle scores. Unexpectedly, TCL scores were not significantly correlated with anxiety.

Table 2
Descriptive Statistics

	N	Range	M (SD)
Age at consent	267	13.75 – 20.41	17.43 (1.08)
Age at release	267	14.35 – 21.02	18.25 (1.30)
IQ Estimate	246	71 – 134	92.60 (11.69)
Substance Use	261	0 – 9	3.24 (1.82)
MASC	234	4 – 94	33.82 (17.02)
PCL:YV Total	267	2 – 35	23.46 (6.12)
PCL:YV Interpersonal	267	0 – 7	2.16 (1.85)
PCL:YV Affective	267	0 – 8	4.46 (1.80)
PCL:YV Lifestyle	267	0 – 10	6.32 (2.03)
PCL:YV Antisocial	266	0 – 10	8.27 (1.67)
TCL Global	228	2 – 14	7.72 (2.59)
TCL Abuse/Neglect	228	0 – 8	2.65 (2.05)
TCL Observed Trauma/Loss	228	1 – 6	5.07 (1.23)
TCL Chronicity – Total	228	2 – 35	14.39 (6.56)

Note. Descriptive statistics for overall sample across relevant study variables.
IQ estimate = Score from 2-subtest Wechsler Adult Intelligence Scale-III or Wechsler Intelligence Scale for Children-IV; Substance Use = summed number of substance abuse/dependence diagnoses; MASC = Multidimensional Anxiety Scale for Children; PCL:YV – Psychopathy Checklist: Youth Version, Int. = interpersonal; TCL = Trauma Checklist

Table 3
Bivariate Correlations (n = 267)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Age at Baseline	--											
2. IQ Estimate	.041	--										
3. PCL:YV Total	**-.134***	-.083	--									
4. PCL:YV – Int.	-.024	.124	**.338****	--								
5. PCL:YV – Aff.	-.088	-.058	**.540****	**.431****	--							
6. PCL:YV – Life	**-.152***	-.116	**.900****	**.331****	**.452****	--						
7. PCL:YV – Ant.	**-144***	**-.190****	**.848****	**.250****	**.495****	**.532****	--					
8. TCL Total	-.046	.057	**.329****	**.171****	**.167***	**.262****	**.320****	--				
9. TCL Factor 1	-.020	.126	**.224****	**.179****	**.148***	**.140***	**.272****	**.884****	--			
10. TCL Factor 2	-.063	-.093	**.318****	.063	.104	**.318****	**.222****	**.629****	**.193****	--		
11. TCL Chronicity	-.076	.089	**.369****	**.201****	**.191****	**.286****	**.376****	**.893****	**.816****	**.517****	--	
12. MASC	.003	.034	**-.140***	.074	**-.134***	-.087	**-.159***	.009	.065	-.097	.012	--
13. Substance Use	-.109	.012	**.403****	**.274****	**.220****	**.397****	**.293****	**.172***	.085	**.218****	**.222****	-.067

Note. Pearson correlations (r) between relevant study variables
IQ estimate = score from 2-subtest Wechsler Adult Intelligence Scale-III or Wechsler Intelligence Scale for Children-IV; PCL:YV – Psychopathy Checklist: Youth Version, Int. = interpersonal, Aff = affective, Life = lifestyle, Ant. = antisocial; TCL = Trauma Checklist, Factor 1 = Abuse/Neglect, Factor 2 = Observed Trauma/Traumatic Loss; MASC = Multidimensional Anxiety Scale for Children; Substance Use = summed number of substance abuse/dependence diagnoses.

Significant correlations are indicated in boldface. * p <. 05; ** p < .001

Identifying Subgroups using Latent Profile Analysis

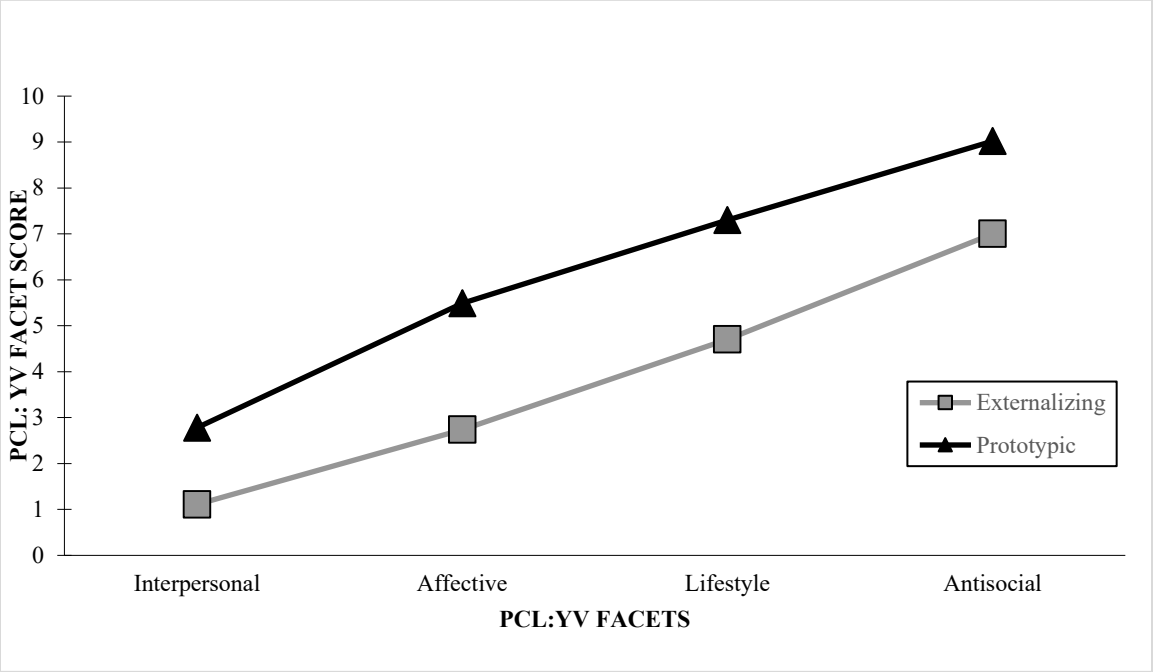
Contrary to expectation, sample-size adjusted BIC and LRT indicated that a two-class solution best fit the data (Table 4). Individuals in group 1, labeled the externalizing group, and individuals in group 2, labeled the prototypic group, differed in PCL: YV facet scores (Figure 1) but did not differ in anxiety as measured by the MASC ($F(1,259) = 0.52$, $p=.472$; Figure 2). Specifically, individuals in the prototypic group had higher interpersonal ($F(1,265) = 63.66$, $p<.001$), affective ($F(1,265) = 322.58$, $p<.001$), lifestyle ($F(1,265) = 165.174$, $p<.001$), and antisocial ($F(1,264) = 136.46$, $p<.001$) facet scores. Groups did not differ in estimated IQ ($F(1,244) = 0.47$, $p=.493$) and did not differ meaningfully on age ($F(1,265) = 4.02$, $p=.05$). See table 5 for descriptive statistics for LPA groups.

Table 4
Latent Profile Analysis Results (n = 267): Model Fit Indices

Model Fit/Latent Class Solution	1	**2**	3
Log-Likelihood	-698.38	-597.52	-543.31
No. of Free Parameters	10	16	22
BIC-adjusted	1420.69	**1233.81**	1139.86
LRT-adjusted	-	**.002**	.097
Classification Accuracy Avg.	-	**.92**	.88

Note. Values in bold indicate the optimal number of groups
BIC = Bayesian Information Criterion; LRT-adjusted = Lo-Mendell Rubin Adjusted Likelihood Ratio Test

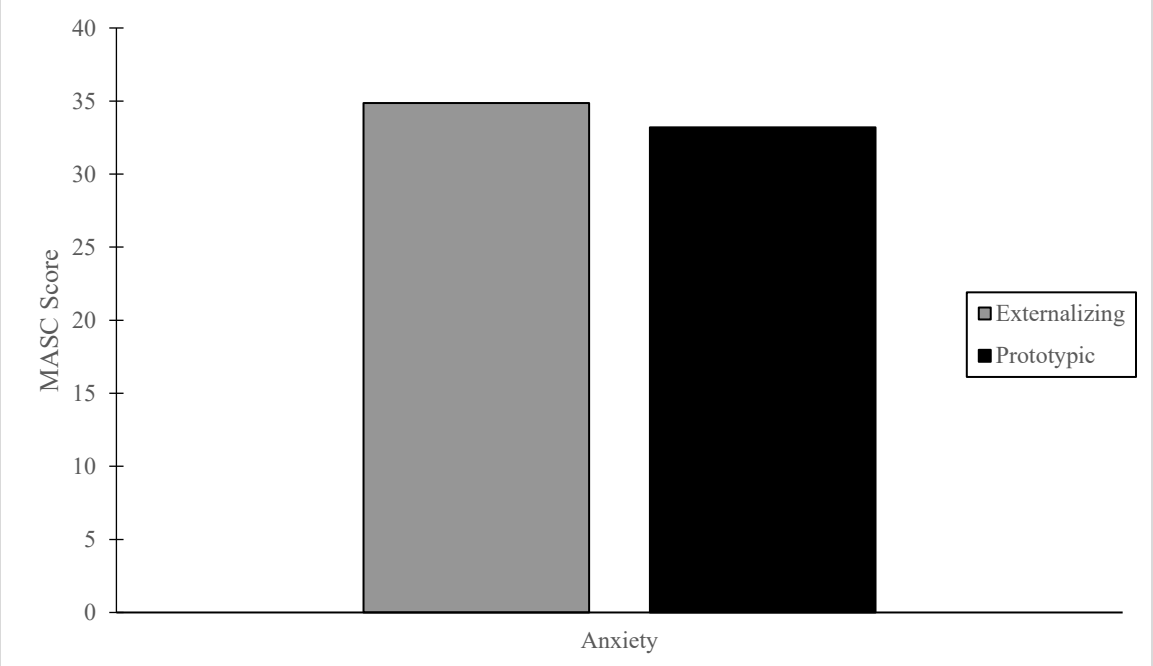
Figure 1
Group Differences in PCL:YV Facets: Externalizing vs. Prototypic



Note. Mean scores for each PCL:YV facet are shown for each group identified via LPA in the overall sample (n = 267).

Group differences on all facets are significant at p<.001.

Figure 2
Group Differences in Anxiety



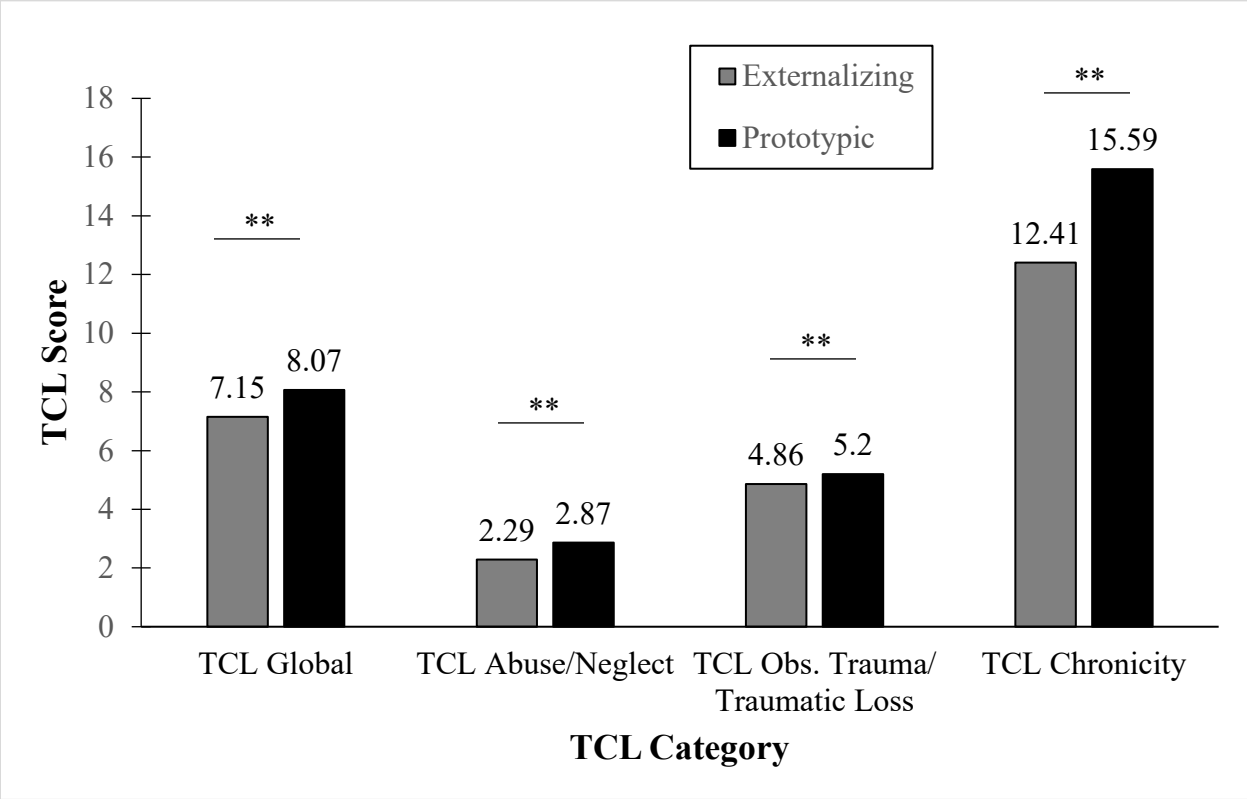
Note. Mean scores MASC (Multidimensional Anxiety Scale for Children) scores for each group identified via LPA in the overall sample (n = 267). Groups did not significantly differ in anxiety.

Subgroup Comparisons

Trauma and Substance Use

Identified subgroups differed in overall experience of trauma as well as chronicity of trauma such that individuals in the prototypic group had significantly higher TCL global ($F(1,226) = 6.94$, $p=.009$), abuse/neglect ($F(1,226) = 4.39$, $p=.04$), observed trauma/traumatic loss ($F(1,226) = 4.05$, $p=.045$), and chronicity ($F(1,226) = 13.33$, $p<.001$) scores (Figure 3, Table 5). Despite this difference in experience of trauma, groups did not differ significantly in likelihood of a PTSD diagnosis (χ^2 (1, N = 261) = .203, $p=.652$). Individuals in the prototypic group also met criteria for, on average, one additional substance abuse/dependence diagnosis when compared with the externalizing group ($F(1,259) = 25.23$, $p<.001$).

Figure 3
Group Differences on Trauma Variables: Externalizing vs. Prototypic



Note. Mean scores for Trauma Checklist (TCL) Global, Factor 1 (Abuse/Neglect), Factor 2 (Observed Trauma/Traumatic Loss), and Chronicity scores are shown for each group identified via LPA in the overall sample (n = 267).

Groups significantly differed on all trauma variables. **p<.001

Table 5
Group Differences on All Variables: Externalizing vs. Prototypic

	Externalizing (n = 100)		Prototypic (n = 167)	
	Range	Mean (SD)	Range	Mean (SD)
Age at Consent	13.75 – 20.42	17.60 (1.00)	14.25 – 19.33	17.33 (1.12)
Age at Release	14.35 – 21.01	18.29 (1.24)	14.73 – 21.02	18.23 (1.34)
IQ Estimate	71 – 134	93.26 (12.87)	73 – 128	92.20 (10.94)
PCL:YV Total	**2 – 26**	**17.27 (3.82)**	**18 – 35**	**27.17 (3.79)**
PCL:YV Interpersonal	**0 – 5**	**1.11 (1.14)**	**0 – 7**	**2.78 (1.91)**
PCL:YV Affective	**0 – 5**	**2.74 (1.17)**	**2 – 8**	**5.49 (1.25)**
PCL:YV Lifestyle	**0 – 8**	**4.70 (1.75)**	**4 – 10**	**7.30 (1.50)**
PCL:YV Antisocial	**0 – 10**	**7.00 (1.74)**	**5 – 10**	**9.02 (1.08)**
MASC	5 – 77	34.87 (15.65)	4 – 94	33.20 (17.81)
TCL Global	**2 – 14**	**7.15 (2.62)**	**2 – 14**	**8.07 (2.52)**
TCL Abuse/Neglect	**0 – 8**	**2.29 (2.05)**	**0 – 8**	**2.87 (2.02)**
TCL Obs. Trauma/Loss	**1 – 6**	**4.86 (1.34)**	**1 – 6**	**5.20 (1.15)**
TCL Chronicity	**2 – 27**	**12.41 (8.90)**	**2 – 35**	**15.59 (6.66)**
Substance Use	**0 – 8**	**2.55 (1.71)**	**0 – 9**	**3.66 (1.76)**

Note. Descriptive statistics for each group identified via LPA in the overall sample (n = 267).

IQ estimate = Score from 2-subtest Wechsler Adult Intelligence Scale-III or Wechsler Intelligence Scale for Children-IV; PCL:YV – Psychopathy Checklist: Youth Version; TCL = Trauma Checklist; MASC = Multidimensional Anxiety Scale for Children; Substance Use = Summed number of substance abuse/dependence diagnoses.

Significant group differences ($p<.05$) are indicated in bold.

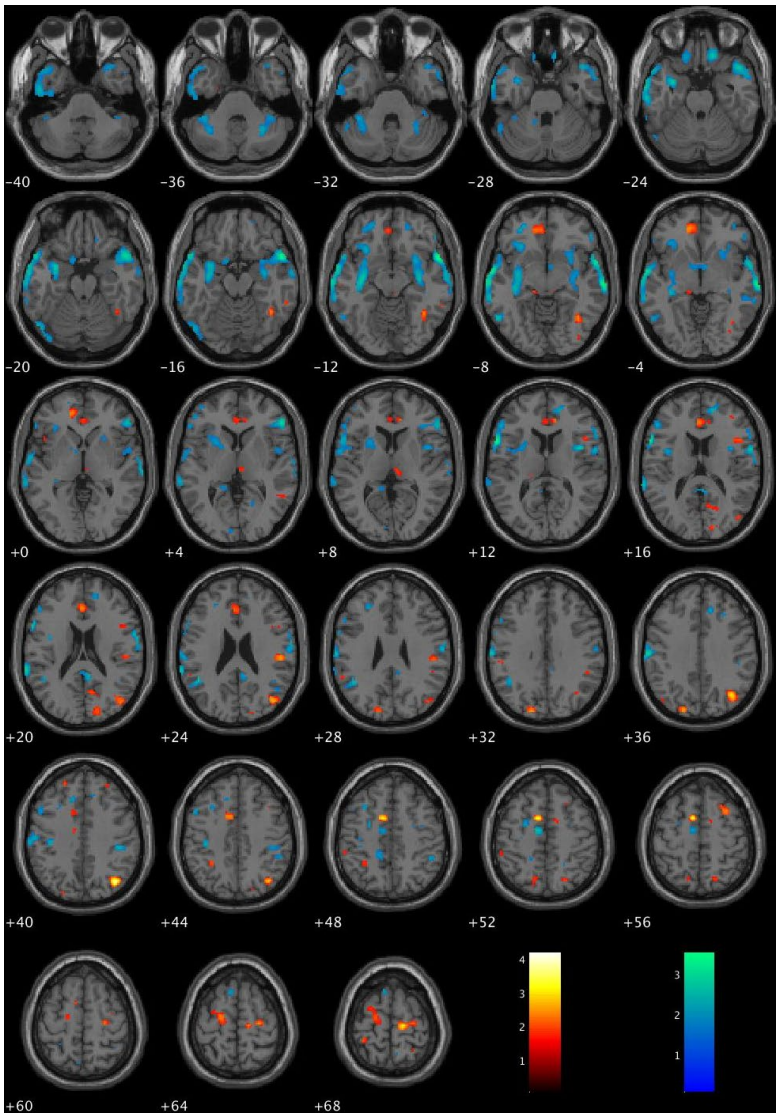
Limbic Gray Matter Volumes

Whole-brain analyses at an uncorrected threshold (unc, $p<.05$) revealed small distributed effects, including clusters in the bilateral temporal pole and bilateral caudate (Figure 4). However, whole-brain analysis corrected for multiple comparisons (FDR, $p<.05$) revealed no regions in which groups significantly differed in GMV.

Findings from ROI analyses suggested groups differed in temporal lobe gray matter volumes but did not differ in gray matter volume in other limbic regions of interest (i.e., bilateral amygdala, bilateral lateral OFC, medial OFC, ACC, PCC, bilateral parahippocampal gyrus, bilateral hippocampus). Specifically, individuals in the prototypic group ($M = .53$, $SD = .051$)

demonstrated reduced gray matter volume in the right temporal pole ($F(1, 213) = 4.87$, $p = .028$) when compared to the externalizing group ($M = .55$, $SD = .044$). Gray matter volume differences in the left temporal pole between prototypic ($M = .50$, $SD = .047$) and externalizing ($M = .51$, $SD = .045$) groups approached significance ($F = 3.825$, $p = .052$).

Figure 4
Whole Brain Analysis: Prototypic vs. Externalizing



Note. Warm colors indicate regions for which prototypic > externalizing; cool colors indicate regions for which prototypic < externalizing.

Threshold: p<.05, uncorrected

Recidivism

Of the 267 male juvenile offenders in the final sample, 30 participants were deceased, 83.5% (n = 223) of the sample had been arrested at least once following release, 75.2% (n = 201) of the sample had been arrested for a felony, and 57.3% (n = 153) of the sample had been arrested for a violent felony. See Table 6 for recidivism rates by category, and Table 7 for time to rearrest statistics. These recidivism rates are consistent with those for the original sample (n = 420). Specifically, of the original 420, rearrest data were available for 407 participants. Of those, 40 participants were deceased, 84% (n = 340) of the sample had been arrested at least once following release, 75% (n = 306) of the sample had been arrested for a felony, and 56% (n = 230) of the sample had been arrested for a violent felony.

Table 6
Recidivism Rates by Category

	Type of Recidivism					
	Any Rearrest		Felony Rearrest		Violent Felony Rearrest	
	Yes	No	Yes	No	Yes	No
Total Sample (n = 267)	223 (84%)	44 (16%)	201 (75%)	66 (25%)	153 (57%)	114 (43%)
LPA 1 – Total Sample						
Prototypic (n = 167)	149 (89%)	18 (11%)	138 (83%)	29 (17%)	108 (65%)	59 (35%)
Externalizing (n = 100)	74 (74%)	26 (26%)	63 (63%)	37 (37%)	48 (48%)	55 (55%)
Above vs Below Threshold						
Above threshold (n = 92)	77 (84%)	15 (16%)	74 (80%)	18 (20%)	61 (66%)	31 (34%)
Below threshold (n = 175)	146 (83%)	29 (17%)	127 (73%)	48 (27%)	92 (53%)	83 (47%)
LPA 2 – Above Threshold						
Primary (n = 77)	68 (88%)	9 (12%)	65 (84%)	12 (16%)	53 (69%)	24 (31%)
Secondary (n = 15)	9 (60%)	6 (40%)	9 (60%)	6 (40%)	7 (47%)	8 (53%)

Note. Number of participants who were rearrested ("yes") or not rearrested ("no) for each category of offending: any rearrest, felony rearrest, and violent felony rearrest. Number of participants rearrested are reported for (a) the entire final sample (n = 267), (b) broken down by groups identified in LPA 1 using the entire final sample, (c) broken down by those scoring at or above threshold on the PCL:YV (total score ≥ 27) vs. those score below threshold on the PCL:YV (total score < 27), and (d) broken down by groups identified in LPA 2 using only individuals scoring at or above threshold on the PCL:YV (total score ≥ 27).

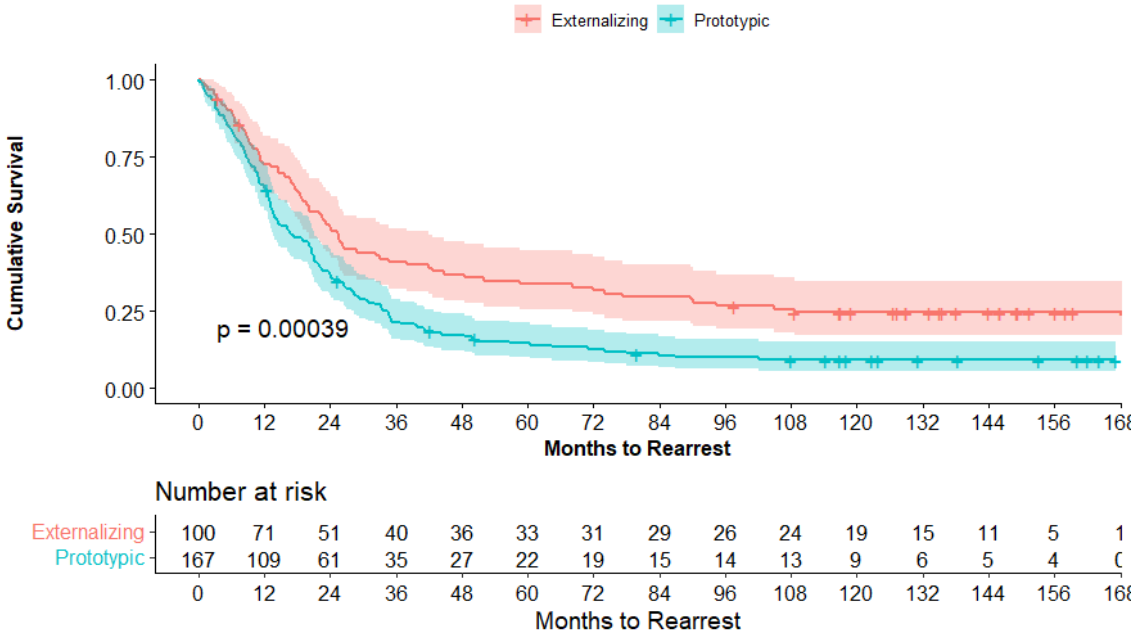
Chi square analyses revealed the prototypic group demonstrated a higher likelihood of rearrest across categories including likelihood for rearrested for any crime (χ^2 (1, N = 267) = 10.53, p=.001), being rearrested for a felony (χ^2 (1, N = 267) = 12.96, p<.001), and being arrested for a violent felony (χ^2 (1, N = 267) =9.89, p=.002) following release (Table 6). Further, irrespective of the type of crime (any rearrest; felony rearrest only; violent felony rearrest only), log rank tests indicated that the time to reoffend was significantly different between the two groups with the prototypic group recidivating more quickly than the externalizing group (all p≤.001; See Table 7 for time to rearrest by category and figures 5, 6, and 7 for survival curves).

Table 7
Time to Rearrest by Category

	Type of Recidivism											
	Months to Rearrest				Months to Felony Rearrest				Months to Violent Felony Rearrest			
	M	SD	Min	Max	M	SD	Min	Max	M	SD	Min	Max
Total Sample (n = 267)	38.6	45.0	0.1	169.1	52.8	50.8	.0.1	173.3	79.6	56.0	0.4	174.1
LPA 1 – Total Sample												
Prototypic (n = 167)	30.0	36.6	0.1	167.1	43.1	43.9	0.1	173.3	71.8	55.2	0.4	173.3
Externalizing (n = 100)	52.8	53.5	0.6	169.1	68.9	57.1	0.6	169.1	92.5	55.3	1.6	174.1
Above vs Below Threshold												
Above threshold (n = 92)	31.2	42.2	0.1	167.1	40.2	43.8	0.1	167.1	65.5	54.8	0.4	172.1
Below threshold (n = 175)	42.4	46.0	0.6	169.1	59.4	53.0	0.6	173.3	86.9	55.4	1.6	174.1
LPA 2 – Above Threshold												
Primary (n = 77)	25.8	35.1	0.4	167.1	36.3	38.9	0.4	167.1	62.8	52.4	0.4	168.1
Secondary (n = 15)	58.9	62.4	0.1	164.1	60.2	61.5	0.1	164.1	79.7	66.4	1.5	172.1

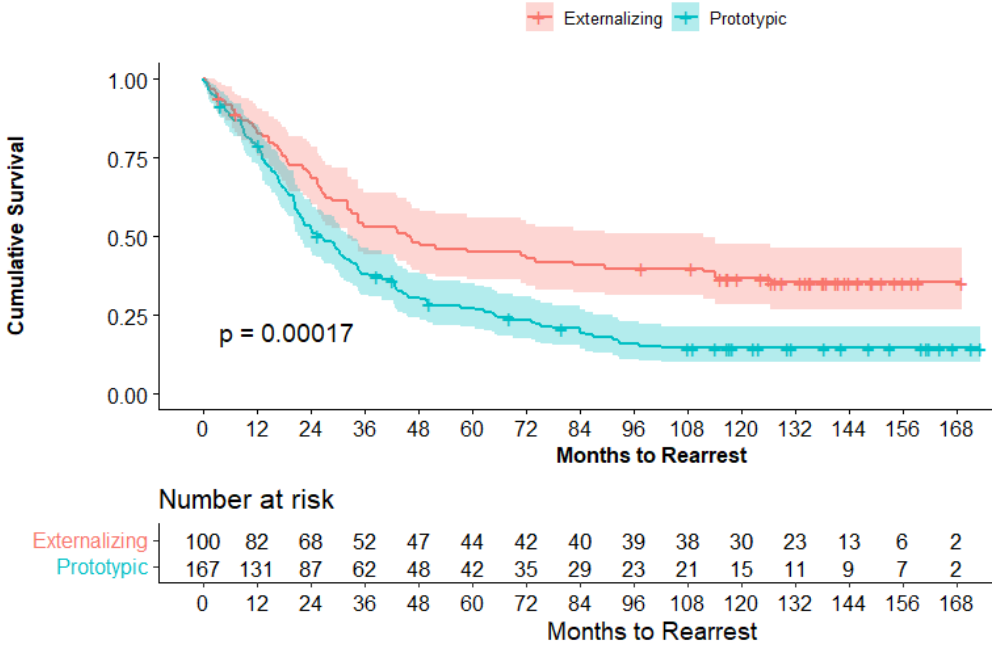
Note. Descriptive statistics for time to rearrest for each category of offending: any rearrest, felony rearrest, and violent felony rearrest. Descriptive statistics are reported for time to rearrest for (a) the entire final sample (n = 267), (b) broken down by groups identified in LPA 1 using the entire final sample, (c) broken down by those scoring at or above threshold on the PCL:YV (total score ≥ 27) vs. those score below threshold on the PCL:YV (total score < 27), and (d) broken down by groups identified in LPA 2 using only individuals scoring at or above threshold on the PCL:YV (total score ≥ 27).

Figure 5
Survival Curve for Any Rearrest: Prototypic vs Externalizing



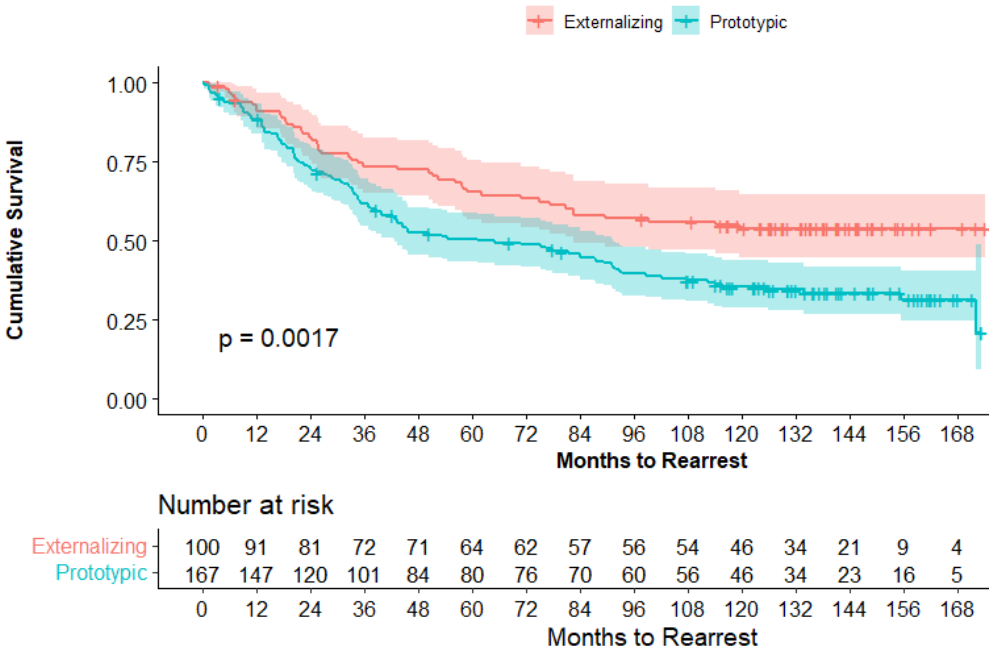
Note. Kaplan Meier survival analyses for any rearrest comparing individuals identified via LPA using the overall sample (n=267). *p* value determined by log rank test.

Figure 6
Survival Curve for Felony Rearrest: Prototypic vs. Externalizing



Note. Kaplan Meier survival analyses for felony rearrest comparing individuals identified via LPA using the overall sample (n=267). *p* value determined by log rank test.

Figure 7
Survival Curve for Violent Felony Rearrest: Prototypic vs. Externalizing



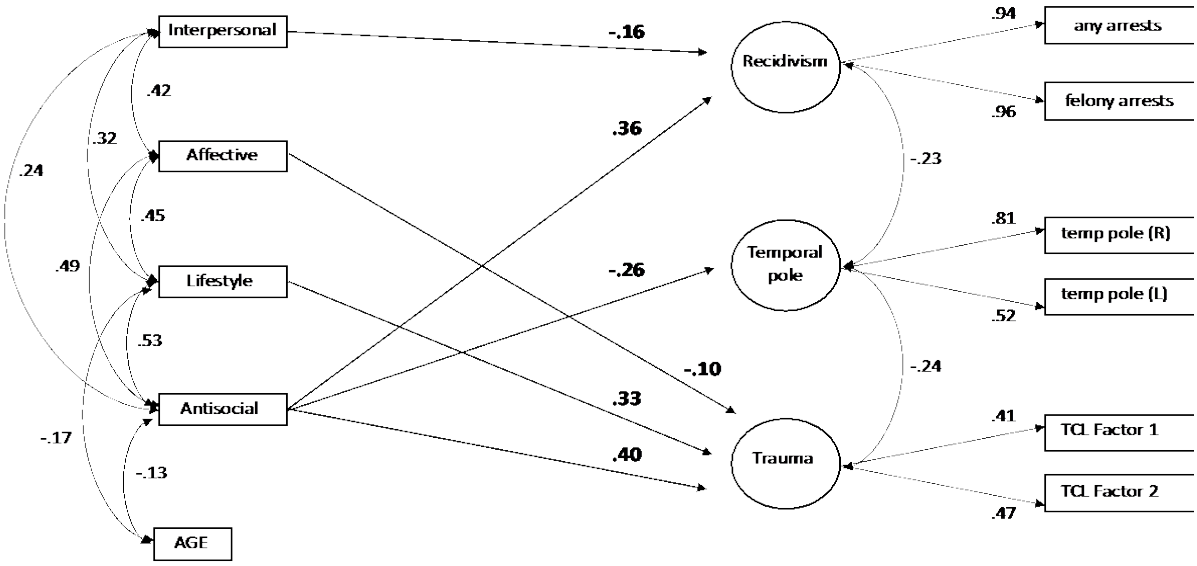
Note. Kaplan Meier survival analyses for violent felony rearrest comparing individuals identified via LPA using the overall sample (n=267). *p* value determined by log rank test.

Supplemental Analyses

Structural Equation Modeling (SEM) Results

SEM analyses were conducted to further examine the relationship between PCL:YV facets and trauma, temporal pole gray matter volumes, and recidivism. To assess model fit, the incremental comparative fit index (CFI) and the absolute root mean square error of approximation (RMSEA) index were used (Hu & Bentler, 1999). Traditional cut-offs CFI ≥ .90 and RMSEA ≤ .80 were considered to be indicative of acceptable model fit.

Figure 8
Structural Equation Modeling Results: PCL:YV Facets Predicting Recidivism, Temporal Pole GMV, and Trauma



Note. Results from SEM analysis in the overall sample demonstrating associations between PCL: YV facets and supraordinate recidivism, temporal pole gray matter volume, and trauma variables.
Correlation coefficients are shown only for significant correlations.

Figure 8 provides a graphical representation and standardized model parameters for the SEM results. Model fit was good (CFI = .94, RMSEA = .06). SEM results reveal that the antisocial facet of the PCL: YV is associated with increased experience of trauma and recidivism, as well as decreased temporal pole gray matter volume. Additionally, the trauma and recidivism superordinate factors are inversely associated with the temporal pole volume superordinate factor. Together, the pattern of associations suggests that increased trauma is associated with lower temporal pole volume which is, in turn, associated with increased recidivism. Results also suggest the interpersonal facet of the PCL: YV is associated with decreased rearrest and the affective facet of the PCL: YV has a modest inverse association with trauma, while the lifestyle facet of the PCL: YV is associated with increased trauma. Of note, trauma and recidivism were not correlated.

"Above Threshold" vs "Below Threshold" Psychopathic Traits

Because established groups primarily differed in level of psychopathic traits, further analyses were conducted to determine whether identified groups provided any information above and beyond a traditional high versus low psychopathic traits (or "psychopathic" versus" non-psychopathic") distinction using cut-off scores. Participants were separated based on total PCL: YV scores into below threshold (PCL: YV total < 27, n = 175) and above threshold (PCL: YV > 27, n = 92) groups (see table 8 for descriptive statistics by group). Above threshold and below threshold groups did not differ in level of anxiety ($F(1,232) = 0.40$, p=0.53). Consistent with findings using LPA-established groups, individuals in the above threshold group appeared to have higher TCL global ($F(1,226) = 10.88$, p=.001), abuse/neglect ($F(1,226) = 10.06$, p=.002), and chronicity scores ($F(1,226) = 12.02$, p<.001) but, in contrast to LPA-established groups, did not differ from the below threshold group on observed trauma/traumatic loss scores ($F(1,226) = 2.60$, p=.108). Individuals in the above threshold group met criteria for approximately one additional substance abuse/dependence diagnosis ($F(1,259) = 33.109$ p<.001), and did not differ in estimated IQ ($F(1,244) = 0.07$, p=.786) or age ($F(1,265) = 2.93$, p=.088). Regarding recidivism, individuals in the above threshold and below threshold groups did not differ significantly on likelihood of any rearrest (χ^2 (1, N = 267) = 0.003, p=.955), time to any rearrest (p=0.06; figure 9), or likelihood of felony rearrest (χ^2 (1, N = 267) = 2.00, p=.157). Groups did differ in time to felony rearrest (p=0.01; figure 10), likelihood of violent felony rearrest (χ^2 (1, N = 267) = 4.65, p=.031), and time to committing a violent felony (p=.005; figure 11). See table 6 for number of individuals rearrested, by category. See table 7 for time to rearrest statistics.

Table 8
"Below Threshold" versus "Above Threshold" Group Differences on All Variables

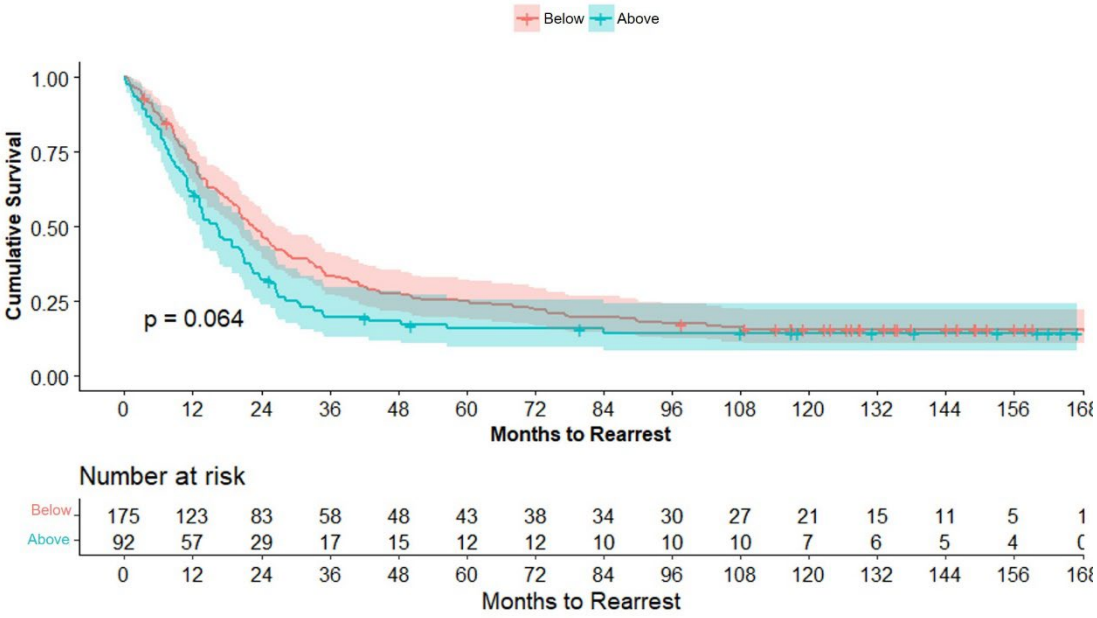
	Below Threshold (PCL:YV total score < 27; n = 175)		Above Threshold (PCL:YV total score ≥ 27; n = 92)	
	Range	Mean (SD)	Range	Mean (SD)
Age at Consent	**13.75 – 20.42**	**17.67 (1.02)**	**14.67 – 18.92**	**17.27 (1.19)**
Age at Release	14.35 – 21.02	18.23 (1.25)	15.28 – 21.02	18.30 (1.40)
IQ Estimate	71 – 134	92.75 (11.80)	74 – 128	92.32 (11.54)
PCL:YV Total	**2 – 26.3**	**20.03 (4.44)**	**27 – 35**	**29.99 (2.41)**
PCL:YV Interpersonal	**0 – 5**	**1.29 (1.17)**	**0 – 7**	**3.80 (1.77)**
PCL:YV Affective	**0 – 7**	**3.64 (1.55)**	**3 – 8**	**6.02 (1.05)**
PCL:YV Lifestyle	**0 – 9**	**5.51 (1.86)**	**4 – 10**	**7.87 (1.34)**
PCL:YV Antisocial	**0 – 10**	**7.68 (1.70)**	**6 – 10**	**9.38 (0.85)**
MASC	5 – 77	34.35 (16.07)	4 – 94	32.89 (18.67)
TCL Global	**2 – 14**	**7.31 (2.47)**	**2 – 14**	**8.47 (2.64)**
TCL Abuse/Neglect	**0 – 8**	**2.34 (2.02)**	**0 – 8**	**3.22 (2.00)**
TCL Obs. Trauma/Loss	1 – 6	4.97 (1.28)	2 – 6	5.25 (1.12)
TCL Chronicity	**2 – 30**	**13.30 (6.18)**	**2 – 35**	**16.37 (6.79)**
Substance Use	**0 – 8**	**2.80 (1.65)**	**2 – 9**	**4.10 (1.84)**

Note. Descriptive statistics for high scorers and low scorers. "High" scorers were defined as those scoring at or above 27 on the PCL: YV. "Low" scorers were defined as those scoring below 27 on the PCL: YV.

IQ estimate = Score from 2-subtest Wechsler Adult Intelligence Scale-III or Wechsler Intelligence Scale for Children-IV; PCL: YV – Psychopathy Checklist: Youth Version; TCL = Trauma Checklist, Obs. Trauma/Loss = Observed trauma/traumatic loss; MASC = Multidimensional Anxiety Scale for Children; Substance Use = Summed number of substance abuse/dependence diagnoses.

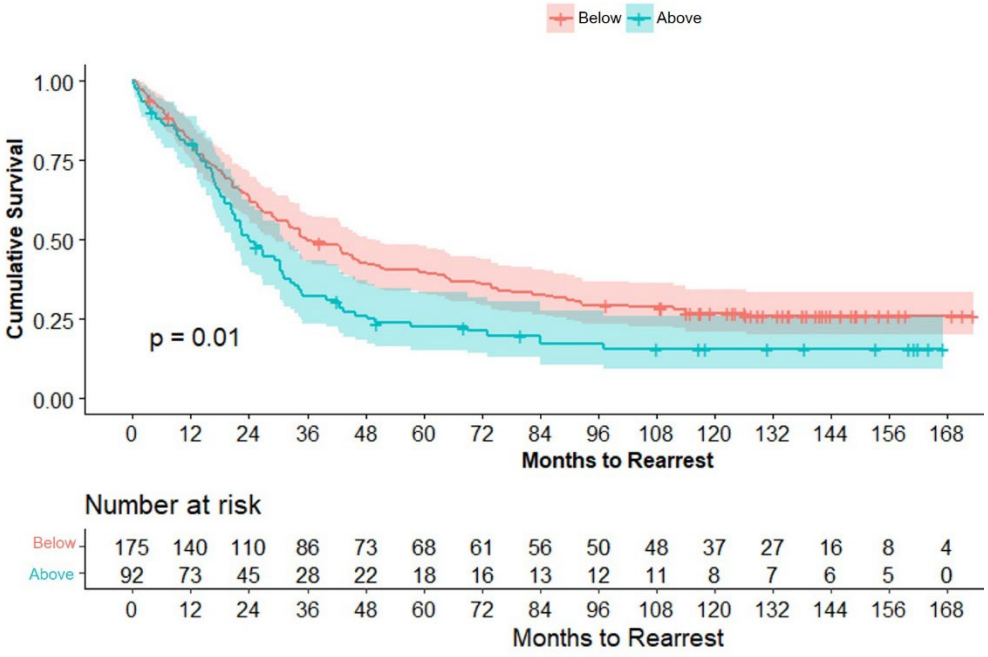
Significant group differences ($p<.05$) are indicated in bold.

Figure 9
Survival Curves for Any Rearrest: "Below Threshold" vs. "Above Threshold" Psychopathic Traits



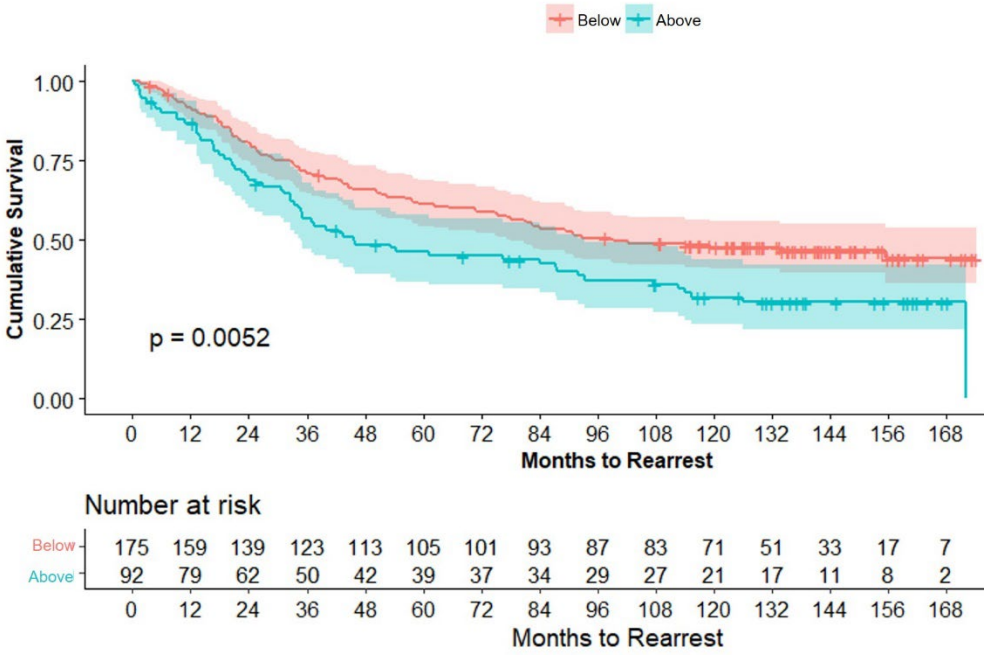
Note. Kaplan Meier survival analyses for any rearrest. "High" scorers were defined as those scoring at or above 27 on the PCL: YV. "Low" scorers were defined as those scoring below 27 on the PCL: YV. *p* value determined by log rank test.

Figure 10
Survival Curve for Felony Rearrest: "Below Threshold" vs. "Above Threshold" Psychopathic Traits



Note. Kaplan Meier survival analyses for felony rearrest. "Above Threshold" scorers were defined as those scoring at or above 27 on the PCL: YV. "Below Threshold" scorers were defined as those scoring below 27 on the PCL: YV.

Figure 11
Survival Curve for Violent Felony Rearrest: Low vs. High Psychopathic Traits



Note. Kaplan Meier survival analyses for violent felony rearrest. "Above Threshold" scorers were defined as those scoring at or above 27 on the PCL: YV. "Below Threshold" scorers were defined as those scoring below 27 on the PCL: YV. *p* value determined by log rank test.

LPA in High Psychopathic Traits Group

In order to replicate prior work that has identified primary and secondary subtypes by conducting latent profile analysis or model-based cluster analysis in only individuals high on psychopathic traits (Kimonis et al., 2011), an additional LPA was conducted in a subsample of individuals with a PCL: YV total score at or above 27. A score of 27 was chosen because it is within the standard error of measurement from the established clinical diagnostic cut-off of 30, and allows us to directly replicate prior work. Sample-size adjusted BIC and LRT, indicated that a two-class solution best fit the data (see Table 9 for model fit statistics; see Table 10 for descriptive statistics by groups). Individuals in the two groups did not differ significantly on overall PCL: YV score ($F(1,90) = 3.102$, $p=0.082$) or interpersonal ($F(1,90) = 2.04$, $p=0.156$), affective ($F(1,90) = 1.36$, $p=0.246$), and lifestyle ($F(1,90) = 0.000$, $p=0.999$) scores. However,

individuals in group 1 (n = 77), labeled primary, had significantly higher antisocial scale scores ($F(1,90) = 192.59$, $p<.001$) and significantly lower anxiety ($F(1,82) = 13.85$, $p<.001$) than individuals in group 2 (n = 15), labeled secondary. (Table 10; See figures 12 and 13) Groups did not differ in severity (TCL Global: $F(1,79) = 2.32$, $p=0.131$; Abuse/Neglect $F(1,79) = 1.43$, $p=0.236$; Observed Trauma/Traumatic Loss $F(1,79) = 2.06$, $p=0.155$) or chronicity ($F(1,79) = 1.39$, $p=0.241$) of trauma exposure, estimated IQ ($F(1,83) = 0.58$, $p=0.450$), age ($F(1,90) = 0.02$, $p=0.879$), or number of substance abuse/dependence diagnoses ($F(1,85) = 0.01$, $p=0.93$). The primary group was found to have a greater likelihood of being rearrested for any crime (χ^2 (1, N = 92) = 7.374, $p=.007$) and greater likelihood of being arrested for a felony (χ^2 (1, N = 92) = 4.76, $p=.029$), but groups did not differ in likelihood of being arrested for a violent felony (χ^2 (1, N = 92) = 1.35, $p=.245$). The primary group was also found to be rearrested more quickly following release when all crimes were considered (p = .03; figure 14); however, no group differences were found in time to rearrest for felonies (p = .10; figure 15), generally, or violent felonies (p = .21, figure 16), specifically. See table 6 for number of individuals rearrested, by category. See table 7 for time to rearrest statistics.

Table 9
Latent Profile Analysis Results (n = 92): Model Fit Indices

Model Fit/Latent Class Solution	1	**2**
Log-Likelihood	-94.86	**-73.98**
No. of Free Parameters	10	**16**
BIC-adjusted	203.39	**169.82**
LRT-adjusted	-	**.09**
Classification Accuracy Avg.	-	**.97**

Note. Values in bold indicate the optimal number of groups
BIC = Bayesian Information Criterion; LRT-adjusted = Lo-Mendell Rubin Adjusted Likelihood Ratio Test

Table 10
"Primary" versus "Secondary" Group Differences on All Variables

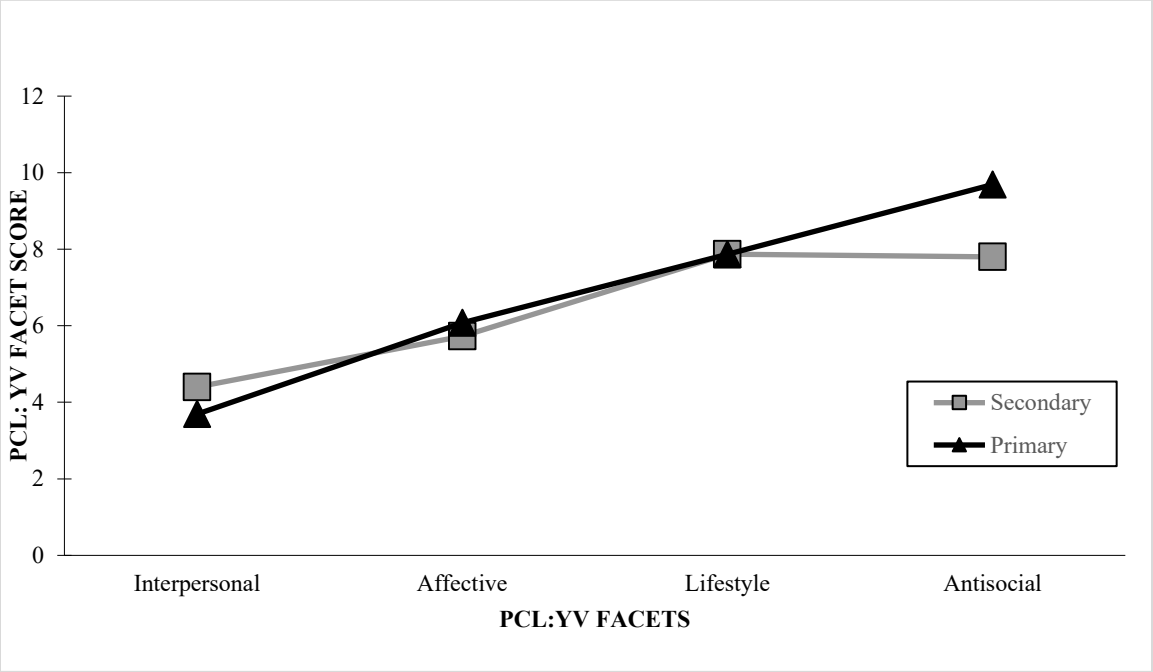
	Primary (n = 77)		Secondary (n = 15)	
	Range	Mean (SD)	Range	Mean (SD)
Age at Consent	14.67 – 18.75	17.27 (1.25)	16.00 – 18.75	17.32 (0.87)
Age at Release	15.28 – 21.02	18.29 (1.42)	16.75 – 21.01	18.36 (1.32)
IQ	74 – 128	91.93 (12.04)	83 – 111	94.67 (7.88)
PCL:YV Total	**27 – 35**	**30.18 (2.46)**	**27 – 32**	**29.00 (1.93)**
PCL:YV Interpersonal	0 – 7	3.69 (1.76)	1 – 7	4.40 (1.77)
PCL:YV Affective	4 – 8	6.08 (0.97)	3 – 8	5.73 (1.39)
PCL:YV Lifestyle	4 – 10	7.87 (1.35)	5 – 10	7.87 (1.36)
PCL:YV Antisocial	**9 – 10**	**9.69 (0.47)**	**6 – 8**	**7.80 (0.56)**
MASC	**4 – 94**	**29.87 (17.35)**	**28 – 79**	**49.37 (17.51)**
TCL Global	2 – 14	8.67 (2.55)	3 – 12	7.50 (2.90)
TCL Factor 1	0 – 8	3.34 (1.97)	0 – 6	2.64 (2.10)
TCL Factor 2	2 – 6	5.33 (1.09)	3 – 6	4.86 (1.23)
TCL Chronicity	2 – 35	16.78 (6.60)	5 – 24	14.43 (7.55)
#SUD	2 – 9	4.11 (1.84)	2 – 9	4.07 (1.91)

Note. Descriptive statistics for groups identified via LPA in high scorers (n=92). "High" scorers defined by PCL: YV ≥ 27.

IQ estimate = Score from 2-subtest Wechsler Adult Intelligence Scale-III or Wechsler Intelligence Scale for Children-IV; PCL: YV – Psychopathy Checklist: Youth Version; TCL = Trauma Checklist, Obs. Trauma/Loss = Observed trauma/traumatic loss; MASC = Multidimensional Anxiety Scale for Children; Substance Use = Summed number of substance abuse/dependence diagnoses.

Significant group differences ($p<.05$) are indicated in bold.

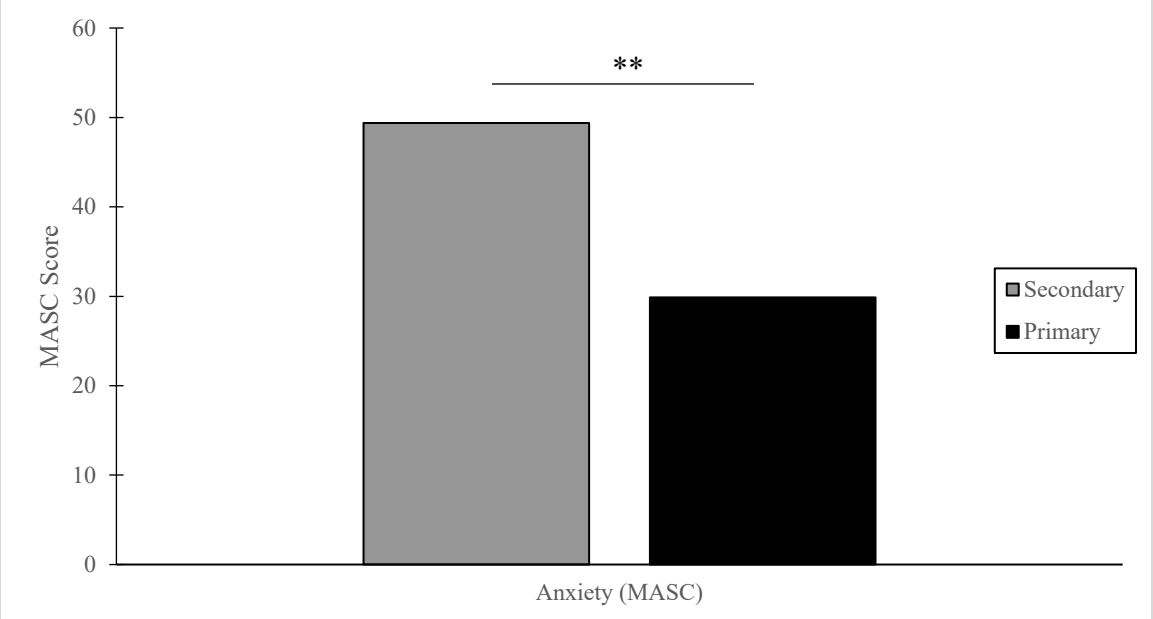
Figure 12
Group Differences in PCL:YV Facets: Primary vs. Secondary



Note. Mean scores for each PCL:YV facet are shown for each group identified via LPA in high scorers (n=92).

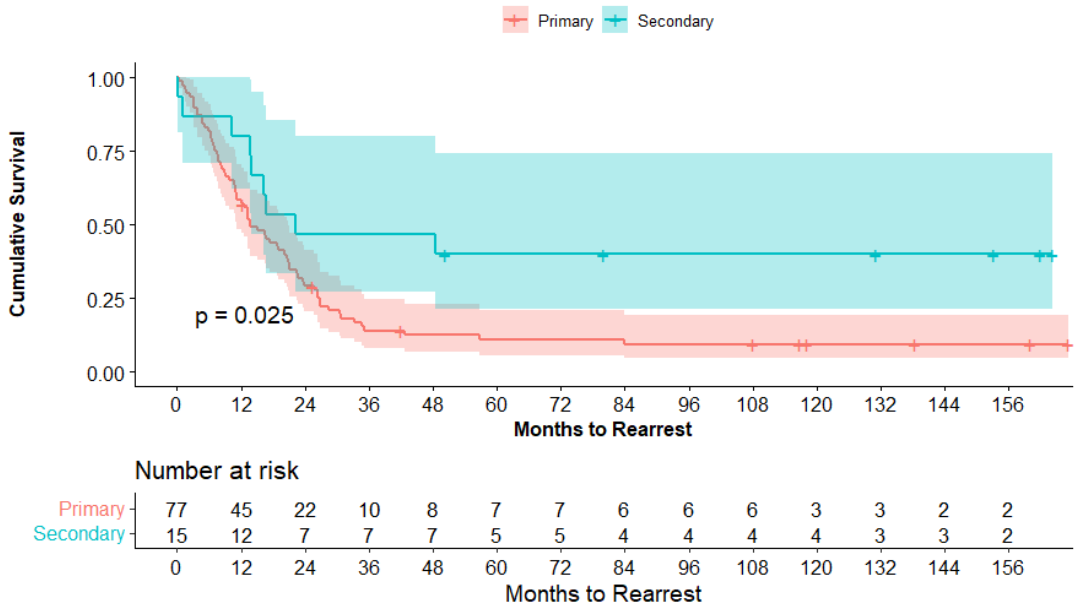
Groups difference on antisocial facet is significant at p<.001. Groups did not differ in other facets.

Figure 13
Group Differences in Anxiety: Primary vs. Secondary



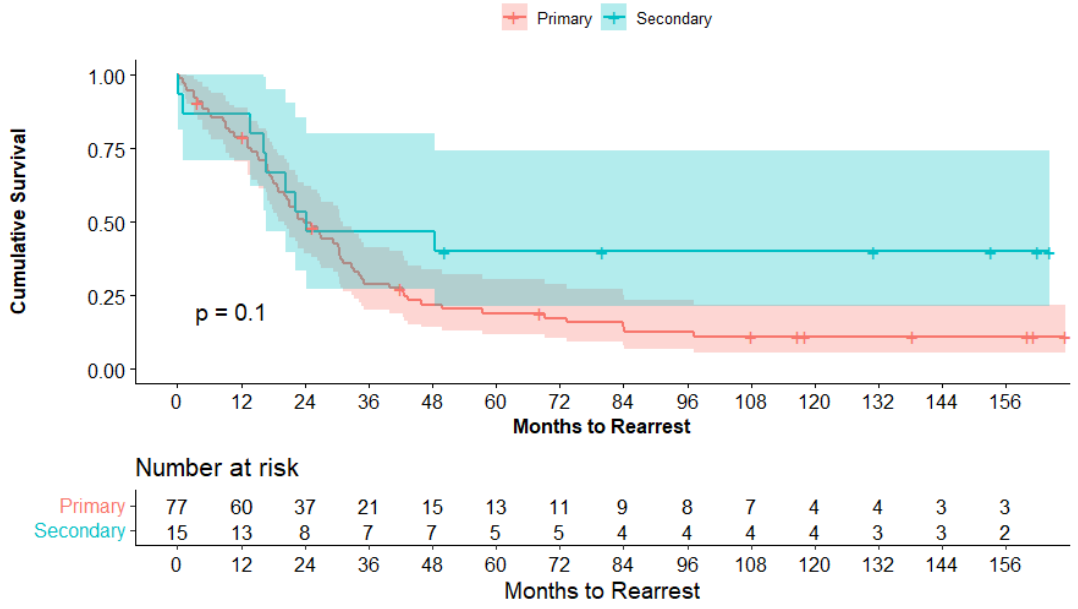
Note. Mean scores MASC (Multidimensional Anxiety Scale for Children) scores for each group identified via LPA in high scorers (n=92). Groups significantly differed on level of anxiety p<.001.

Figure 14
Survival Curves for Any Rearrest: Primary vs. Secondary



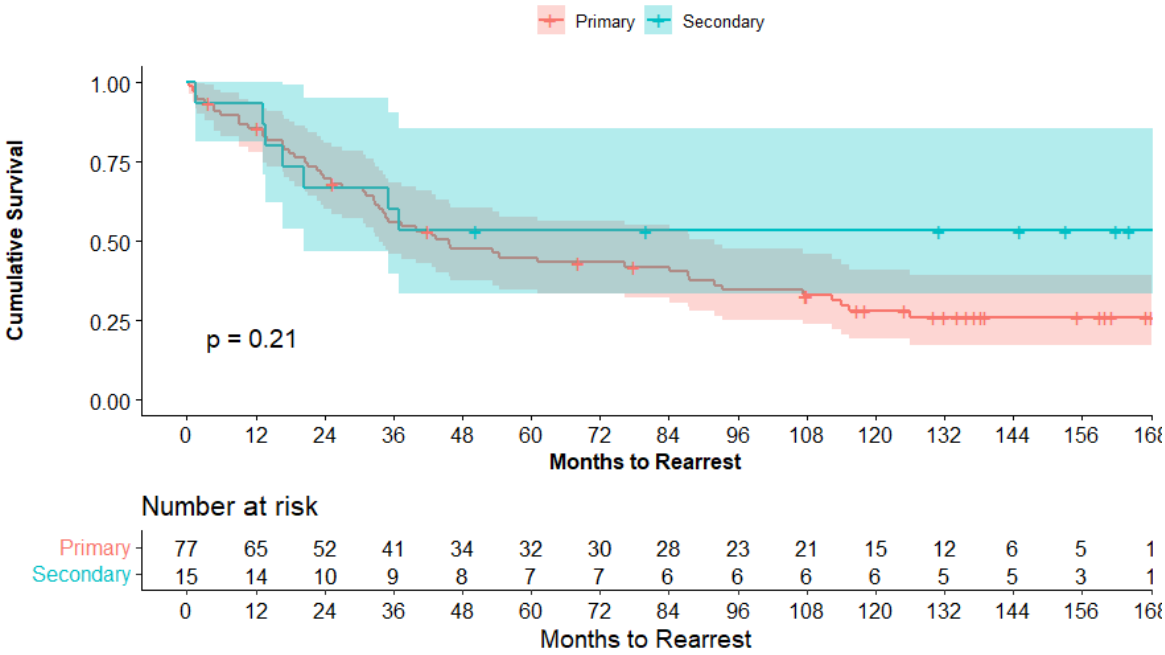
Note. Kaplan Meier survival analyses for any rearrest for each group identified via LPA in high scorers (n=92). *p* value determined by log rank test.

Figure 15
Survival Curves for Felony Rearrest: Primary vs. Secondary



Note. Kaplan Meier survival analyses for felony rearrest for each group identified via LPA in high scorers (n=92). *p* value determined by log rank test.

Figure 16
Survival Curves for Violent Felony Rearrest: Primary vs. Secondary



Note. Kaplan Meier survival analyses for violent felony rearrest for each group identified via LPA in high scorers (n=92). *p* value determined by log rank test.

CHAPTER 4

Discussion

The present study aimed to identify subgroups of incarcerated youth based on level of psychopathic traits and anxiety and determine whether identified groups differed in (a) experience of trauma, (b) paralimbic gray matter volume, and (c) reoffending up to 15 years following release. In doing so, this study sought to add to extant literature examining hypothesized heterogeneity within the construct of psychopathy, elucidate environmental factors (e.g., trauma) that may be relevant for the development of psychopathic traits and criminal behavior in youth, and contribute valuable information regarding neural correlates and outcomes with the hope of informing future prevention and intervention efforts.

Identifying Subgroups and Environmental Correlates

Contrary to findings in prior studies, primary and secondary subgroups of individuals with high psychopathic traits and differing levels of anxiety were not identified. Instead, groups identified via LPA best resemble Mealey's (1995a, 1995b) description of primary "sociopaths" (psychopaths) who score high across both interpersonal-affective and impulsive-antisocial factors and secondary "sociopaths" who have elevated lifestyle-antisocial traits without elevated interpersonal-affective traits.

Several possible factors could account for the differences between our results and prior studies attempting to identify subgroups of youth with psychopathic traits. First and foremost, prior work attempting to distinguish youth based on level of anxiety and psychopathic traits has primarily utilized self-report measures (e.g., ICU, YPI). Importantly, previous research has demonstrated limited agreement between the PCL:YV and self-report measures of psychopathic/CU traits in youth (e.g., ICU, YPI, APSD), suggesting they may not be assessing

the same construct (Andershed et al., 2007; Cauffman et al., 2009; Dolan & Rennie, 2006; Fink et al., 2012; Kelsey et al., 2015; Lee et al., 2003; Skeem & Cauffman, 2003). Of the few studies using the PCL:YV to identify primary and secondary subtypes, results have been mixed (Kimonis et al., 2011; Lee et al., 2010; Waller & Hicks, 2019). Future work conducting separate LPA using multiple measures of psychopathic/CU traits to allow for comparison of methods within the same sample may provide clarity. Additionally, the sample described here is comprised of particularly high-risk juvenile offenders with higher PCL:YV scores than prior studies utilizing the PCL:YV to identify subtypes (Lee et al., 2010; Waller & Hicks, 2019) and highly skewed PCL:YV lifestyle and antisocial facet scores. Lastly, though some work in adults has found the PCL-R to be invariant in studies comparing White and Hispanic/Latinx individuals (Sullivan et al., 2006; Windle & Dumenci, 1999), limited work (primarily focusing on invariance between Black and White youth) has been conducted regarding the measurement invariance of the PCL:YV (McCoy Elliott & Edens, 2006). Thus, the racial and ethnic breakdown of the current sample, consisting primarily of Hispanic/Latinx youth (69%) may be another important factor contributing to differences between the present findings and past studies. Nevertheless, the use of an expert rater measure for the measurement of psychopathic traits and trauma history and the ethnically diverse, high-risk sample can be viewed as particular strengths of the present study.

Interestingly, though groups identified using LPA using the full sample did not differ in level of anxiety, individuals in the prototypic group appeared to have significantly higher severity and chronicity of childhood trauma. These findings provide support for experience of trauma as a potential etiological mechanism for the development of psychopathic traits. It is important to note, however, that although groups differed statistically in terms of severity and

chronicity of trauma, differences between groups on TCL scores were relatively small and may not represent clinical differences between the groups. Additionally, prior experience of trauma does not necessarily equate to trauma-related symptoms or a trauma-related response, and due to the correlational nature of this study care should be taken drawing conclusions regarding directionality of causation among study variables. Indeed, only 7% of the sample met criteria for posttraumatic-stress disorder and the proportion of PTSD diagnoses did not differ between the groups. Despite these limitations, these results add to an extensive body of literature (see Craig et al., 2021 and Ireland et al., 2020 for recent reviews) that has consistently demonstrated a link between psychopathic/CU traits, experiences of early childhood maltreatment (e.g., abuse, neglect) and observed trauma (e.g., community violence, familial violence, traumatic loss) which supports the role of trauma as a potential etiological mechanism that is associated with the development of psychopathic traits for a subset of individuals. The underlying mechanisms by which experience of trauma may contribute to the development of psychopathic/CU traits have long been hypothesized but are still poorly understood. Researchers have hypothesized that youth who experience early trauma may experience a disruption in moral socialization due to an inability to process socialization cues as a result of high sensitivity to negative affect or due to lack of warm, responsive caregivers, resulting in no longer relying on caregivers for socialization cues. Alternatively, researchers have hypothesized that experience of early aversive experiences results in avoidance, emotional numbing, and inhibition of empathy as a coping mechanism to reduce distress in the context of chaotic and/or traumatic environments (Ireland et al., 2020; Kerig et al., 2012). Continued research to further elucidate the mechanisms underlying this potential pathway, including in the context of potential primary and secondary groups is warranted. A specific focus on differentiating between types of early traumatic experiences (e.g.,

experienced trauma, abuse, neglect vs observed trauma. traumatic loss, community violence), as well as quantifying trauma-related symptoms and determining the relevance and impact on and association with the development of psychopathic traits may be fruitful.

Neural Correlates

Results suggest a difference in temporal pole gray matter volume bilaterally between groups identified using LPA in the full sample. The temporal pole is well connected to other limbic regions including the amygdala and orbitofrontal cortex via the uncinate fasciculus. It also sends and receives projections to and from the basal forebrain and has similar patterns of connectivity to the amygdala (Olson et al., 2007). The temporal pole has been associated with emotion processing and empathy. In fact, research has consistently demonstrated lower empathy in individuals with smaller temporal pole gray matter volumes including older adults with dementia and associated atrophy of the temporal pole (Bartochowski et al., 2018; Cerami et al., 2014; Dermody et al., 2016; Herlin et al., 2021; Rankin et al., 2006) and youth and adults with certain psychopathology including schizophrenia (Benedetti et al., 2009; Herold et al., 2009; Kasai et al., 2003) and psychopathic/CU traits (Cope et al., 2014; de Oliveira-Souza et al., 2008; Ermer, Cope, et al., 2012; Ermer et al., 2013; Gregory et al., 2012). Lower temporal pole gray matter volume has also been associated with deficits in semantic processing (Herlin et al., 2021), as well as poor emotion regulation, disinhibition, and impulsivity (Veronelli et al., 2017) which can be seen in individuals high in psychopathic traits (Kiehl et al., 1999, 2004). Particularly relevant in the context of group differences identified here, prior research has also demonstrated an association between gray matter volume in the temporal pole and exposure to trauma and childhood maltreatment (De Brito et al., 2013; Kolla et al., 2014; Lim et al., 2018; Mielke et al., 2016) and that reduced temporal pole volume is associated with increased likelihood of rearrest

(Kiehl et al., 2018). Together, the presented findings provide evidence regarding potential neurobiological differences (e.g., temporal pole GMV) between individuals with psychopathic traits based on etiological factors (e.g., experience of trauma).

Recidivism

Prior studies assessing the predictive utility of psychopathic traits as measured by the PCL:YV have been mixed, as some studies have not found the PCL:YV to not be predictive of recidivism (Douglas et al., 2008; Edens & Cahill, 2007; Shepherd & Strand, 2016) while others, including a meta-analysis (Edens et al., 2007), have shown the PCL:YV to be predictive of general and violent recidivism up to 7 years following release (Corrado et al., 2004, 2015; Gretton et al., 2001; Schmidt et al., 2006; Stockdale et al., 2010; Vincent et al., 2008). In contrast to prior claims that the predictive utility of the PCL:YV diminishes over time (Cauffman et al., 2009), these results provide evidence in support of psychopathic traits as important in identifying those who are at highest risk of reoffending in youth up to 15 years following release – the longest follow-up window, to our knowledge, in published literature utilizing the PCL:YV. Specifically, results suggest the prototypic group was significantly more likely to be rearrested and was rearrested more quickly, across rearrest categories (any rearrest, felony rearrest, and violent felony rearrest), than individuals in the externalizing group. Groups identified based on a diagnostic cut-off score (i.e., above threshold vs. below threshold psychopathic traits groups), on the other hand, did not differ significantly on general recidivism, though they did differ in violent recidivism. These differing results suggest that the LPA is capturing group differences that are not captured by a “high psychopathic traits” versus “low psychopathic traits” cut-off. One possible explanation for these differences is that, while LPA groups differed across all categories of experience of trauma (abuse/neglect and observed trauma/traumatic loss), groups identified

via cut-off score did not appear to differ in observed trauma/traumatic loss scores (TCL Factor 2). Thus, it is possible that this factor, which also captures exposure to community violence, may be associated with external risk factors such as associations with delinquent peers, gang affiliation, socioeconomic status, and neighborhood factors, which are known to increase risk for recidivism (Aguilar Ruiz & Pereda, 2022; Kennedy et al., 2019; Mrug & Windle, 2010).

Is there Evidence for Primary and Secondary Groups?

Though the present study sought to examine variability in psychopathic traits and anxiety across the entire sample without using researcher-imposed cut-offs, an additional LPA was run in individuals with PCL: YV total scores greater than or equal to 27 in order to replicate prior work focusing exclusively individuals in the clinical range on the PCL:YV (Kimonis et al., 2011) and provide clarity regarding whether the absence of primary and secondary groups identified via LPA in the present study was due to methodological differences, sample differences, or other factors. In this additional LPA, two groups did emerge, which resembled primary and secondary subgroups. These groups did not differ in level of interpersonal, affective, or lifestyle traits; however, they did differ in level antisocial traits, as well as anxiety. Unexpectedly, these "primary" and "secondary" groups did not differ in experience of trauma but significantly differed in time to general rearrest and likelihood of general rearrest and felony rearrest. Findings should be interpreted with caution due to the very small sample size used for this analysis and large discrepancy in group size. Despite these limitations, these findings do replicate, to an extent, prior findings by Kimonis and colleagues (2011) and suggest that continued work attempting to identify and characterize subgroups of individuals with psychopathic traits (e.g., primary and secondary) who differ in level of anxiety (and/or trauma history) using is clearly indicated.

Limitations

Findings should be interpreted within the context of several limitations. First and foremost, as previously mentioned, due to the correlational nature of the study and relatively small group differences identified, care should be taken in drawing conclusions regarding casual effects. Additionally, total score on the MASC was used to assess anxiety which collapses across physical symptoms, harm avoidance, separation anxiety/panic, and social anxiety. Thus, this tool may not only be susceptible to the typical limitations of a self-report measure (e.g., over- or underreporting) but may also be conflating different definitions of fear and anxiety by collapsing across subscales. Future studies examining group differences on subscale scores may be informative to identify specific components of anxiety that are related to subtypes of psychopathic personality. Additionally, though it was not a primary variable of interest in the present study, assessment of severity of substance use could be improved by using symptom count or and inventory of consequences due to alcohol and drug use, rather than number of substances for which an individual meets criteria for substance abuse or dependence. Finally, recidivism was defined in the present study by rearrest. This definition of recidivism has many benefits when compared with self-reported recidivism, which can be subject to underreporting, and reconviction, which may not always accurately reflect the crime committed or their true guilt or innocence. However, recidivism defined as rearrest inevitably results in both false negative and false positive. Specifically, we may not be capturing those crimes for which individuals were not caught (i.e., false negatives) and, because we are using rearrest rather than reconviction, we may be attributing crimes to particular individuals that they did not actually commit. Indeed, prior research has found that having a prior criminal history increases one's risk of being rearrested in part due to the increased risk of false accusations (Stolzenberg et al., 2021).

Despite these limitations, and though expected primary and secondary subgroups of juvenile offenders were not identified in the present study, these results provide (a) additional support for the PCL:YV as an important predictor of outcomes for justice-involved youth and (b) evidence in support of trauma as a potential etiological pathway impacting neurobiology and potentially leading to the development of psychopathic traits thereby increasing likelihood of recidivism. It is important to note that, although groups identified using LPA in the full sample[11] appeared to primarily differ in level of overall psychopathic traits, group membership appeared to provide information above and beyond the traditional high versus low ("psychopathic" versus "non-psychopathic" distinction using a diagnostic cut-off score (e.g., 27 or 30). Indeed, results from the present study suggest that, although comparing individuals with scores above and below a widely accepted clinical cut-off has predictive utility regarding likelihood of more severe offenses (e.g., felonies and violent felonies), group membership per the current study also predicted likelihood of and time to rearrest for any offense (i.e., general recidivism). These results, therefore, suggest that utilizing person-centered approaches to develop a more thorough understanding of the heterogeneity in the construct of psychopathy has the potential to improve predictive utility of clinical measures.

Implications

The results presented here, as well as future work in this area, have important clinical implications for justice-involved youth regarding (a) risk assessment and amenability to treatment decisions and (b) prevention and treatment efforts. Existing empirical evidence and

[11] Full sample here refers to the use of the "final sample" of n = 267 used for the initial latent profile analysis in order to distinguish from the LPA conducted in the "Above threshold" subsample (n = 92) use for the second LPA.

results from the present study suggest that assessment of psychopathic traits using measures such as the PCL:YV independently of assessment of internalizing distress and trauma history, may affect prediction of outcomes. In the context of risk assessment and amenability to treatment, this can have significant downstream consequences for justice-involved youth. Additional work exploring the unique predictive utility of psychopathic traits above and beyond other known static and dynamic risk factors of recidivism, and the added utility of considering factors such as trauma history and internalizing distress, will be informative for risk assessment and amenability to treatment decisions in justice-involved youth. Furthermore, beyond predicting who is at greater risk for recidivism following release from incarceration, studies such as this, seeking to understand and identify neural, environmental, and clinical predictors of recidivism, including the construct of psychopathy, play an important role in prevention and intervention efforts, especially as those with high psychopathic traits have long been characterized as "untreatable" (Bailey et al., 2015; Harris & Rice, 2006; Polaschek, 2014; Polaschek & Daly, 2013; Polaschek & Skeem, 2018; Reidy et al., 2013; Salekin, 2002). Indeed, though research aiming to understand pathways to and predictors of recidivism is important, it is crucial that studies in this area begin to shift focus towards development and implementation of prevention and treatment strategies based on existing empirical evidence. Given that incarceration impacts one's ability to achieve gainful employment following release (Apel & Ramakers, 2018) and increases likelihood of being subsequently rearrested (Stolzenberg et al., 2021), developing effective methods of prevention to reduce risk of initial incarceration and introduction to the justice-system's so-called "revolving door" as well as effective methods of treatment to reduce reincarceration is imperative.

Summary

Though the specific hypothesized subtypes were not identified in the present study, this work contributes to literature describing heterogeneity within psychopathy, extends work exploring environmental and neural correlates of psychopathic traits in youth, and provides additional support for psychopathic traits as an important predictor of outcomes for justice-involved youth with the hope of informing risk assessment, as well as prevention and intervention efforts. Specifically, findings presented here provide evidence for a potential pathway for the development of psychopathic traits in which an individual exposed to trauma in childhood exhibits associated reductions in limbic gray matter (including in the temporal pole), and develops psychopathic traits. Path model results provide further evidence that, although the superordinate trauma factor is not directly linked to increased recidivism, temporal lobe volumes may mediate the relationship between experience of trauma and increased recidivism such that increased trauma is associated with reduced temporal lobe volumes with is, in turn, associated with increased recidivism. Though the present study cannot provide causal evidence towards these theories, future work seeking to further understand the role of neurobiology in this pathway and more fully understand the link between childhood traumatic experiences, development of psychopathic traits, and recidivism is warranted.

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