MILD TRAUMATIC BRAIN INJURY AS A UNIQUE PREDICTOR OF LATENT CLASS MEMBERSHIP FOR CHILD AND ADOLESCENT DELINQUENCY AND PSYCHOPATHOLOGY: EVIDENCE FROM A LARGE SAMPLE OF U.S. YOUTH

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by

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DEDICATION

This thesis is dedicated to my wife, Rachel. Without her unconditional positive regard, support, and friendship I would not have been able to come as far as I have, and it is because of the comforting presence of her by my side that I know I will be able go wherever I need to go.

ABSTRACT

McCormick, Brandon F., *Mild traumatic brain injury as a unique predictor of membership in latent classes of child and adolescent delinquency and psychopathology: Evidence from the Project on Human Development in Chicago Neighborhoods*. Master of Arts (Clincal Psychology), May, 2019, Sam Houston State University, Huntsville, Texas.

Psychopathology is common amongst children and adolescents. Data from representative samples of youth show that youth demonstrate a wide variety of symptoms during childhood and adolescence. Also common during this life course period is mild traumatic brain injury (mTBI). Mild traumatic brain injury is a developing public health problem. A growing body of evidence suggests that head injury is associated with the onset of a range of internalizing and externalizing psychopathologies. The current study analyzed a large sample of children and adolescents from the Project on Human Development in Chicago Neighborhoods (N = 3,008) to examine trajectories of psychopathologies. Using data from the Achenbach Childhood Behavior Checklist, growth trajectories of internalizing and externalizing psychopathology were identified between two waves of data collection. Multinomial logistic regression models were used to examine if mTBI acted as a unique predictor of class membership, while controlling for a number of variables associated with psychopathology. Results from latent class analysis identified four classes of Aggression, five classes of anxiety/depression, five classes of attention problems, three classes of delinquent behavior, and two classes of somatic symptoms. Mild traumatic brain injury was found to be a unique predictor of aggressive, anxiety/depression, and delinquent class membership, thus suggesting it is a transdiagnostic risk factor associated with general psychopathology.

KEY WORDS: Mild traumatic brain injury, Internalizing psychopathology, Externalizing psychopathology, Delinquency, Project on Human Development in Chicago Neighborhoods, Childhood Behavior Checklist.

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CHAPTER I

Mild Traumatic Brain Injury as a Unique Predictor of Latent Class Membership for Child and Adolescent Delinquency and Psychopathology: Evidence from a Large Sample of U.S. Youth

It is estimated that 2.5 million emergency department visits in the United States during 2013 were for brain injuries (Taylor, Bell, Breiding, & Xu, 2017), with the majority (75-90%) of these classified as mild traumatic brain injury (mTBI; Faul, Xu, Wald, & Coronado, 2010; Feigin et al., 2013; Tagliaferri, Compagnone, Korsic, Servadei, & Kraus, 2006). Adolescent youth are estimated to make up a large proportion (34%) of these visits (Gerritsen, Samim, Peters, Schers, & van de Laar, 2018), while 70% of cases are age 34 or younger (Feigin et al., 2013). Although it is speculated that mTBI does not result in long-lasting structural changes to the brain (Greve & Zink, 2009), the impact from this injury may permanently alter cellular function (Gennarelli & Graham, 2005). To this point, mTBIs are accompanied by myriad neurological effects including abrupt neuron depolarization, sudden release of excitatory neurotransmitters, ionic shifts, altered glucose metabolism and cerebral blood flow, and impaired axon function (Barkhoudarian, Hovda, & Giza, 2011). Recent findings suggest that mTBI is also associated with an increase in the expression of certain sequences of micro RNA (non-protein-coding associated with protein regulation), which could potentially modulate the functioning of certain brain regions (Svingos et al., 2019). Additionally, the immature neural tissue of children and adolescents differs in terms of its response to insult (Kirkwood, Yeates, & Wilson, 2006). Therefore, mTBIs experienced in youth could alter the developmental trajectory of adolescent brain development (Daneshvar et al., 2011).

The outcomes following brain injury in adolescence are further complicated, as this sensitive neurological period coincides with the development of psychopathology.

Data from the National Comorbidity Survey Replication Adolescent Supplement (NCS-R-AS) were gathered using face-to-face interviews from a total of 10,148 adolescents. From the results of this undertaking it was reported that the 12-month prevalence estimate of psychiatric diagnosis in adolescents is approximately 40%, while the lifetime prevalence was calculated to be almost 80% (Kessler et al., 2012). In addition to high prevalence rates, adolescents with psychopathological symptoms exhibit high levels of heterogeneity in both symptom profile and severity. For example, this heterogeneity can be seen in studies in which the latent structure of adolescent anxiety (Burstein et al., 2012) and depression (Lamers et al., 2012; Rodgers et al., 2013) were examined. In these studies, Burstein et al (2012), Lamers et al. (2012), and Rodgers et al. (2013) identified seven, three, and three (for females) and five (for males) latent subtypes of the specified type of psychopathology. Further, membership in these latent subtypes was reported to vary systematically based on factors such as age, gender, race, and ethnicity.

In addition to the high prevalence and heterogeneity, researchers suggest that child and adolescent psychopathology holds significant implications for adult mental health. Using empirical evidence derived from longitudinal-epidemiological-cohort studies, researchers have demonstrated that a large proportion (as high as 76%) of the current-diagnosed adult mental health population met criteria for a mental health disorder prior to age 18 (Kim-Cohen et al., 2003).

The lifelong implications of the development of psychopathology in youth necessitates implementing an early intervention or prevention perspective to determine the etiology of common adolescent mental health problems. Plomin and Daniels (1987) argued that although heredity plays an important role in the development of psychopathology, in regards to nonshared environmental influences, "The research also converges on the remarkable conclusion that these environmental factors make two children in the same family as different from one another as are pairs of children selected randomly from the population" (p. 1). Although Plomin and Daniels (1987) focused on the contribution of nonshared environmental factors that can create differences in siblings, researchers later acknowledged the importance of shared environmental factors that can influence development (Burt, 2009; Burt, McGue, Krueger, & Iacono, 2005b; Ehringer, Rhee, Young, Corley, & Hewitt, 2006). A potentially important nonshared or shared environmental factor that may influence the trajectory of childhood development is head injury, referred to in its most common form as mTBI.

The Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitative Medicine (1993) defined mTBI as any non-puncturing head trauma that results in any loss of consciousness no greater than 30 minutes, post traumatic amnesia lasting no more than 24 hours, or focal neurological deficits that may or may not be transient. Mild traumatic brain injury is a high-incidence injury in both adults and children, accounting for almost 503 out of every 100,000 emergency-room visits for Americans each year (Bararian et al., 2005). The annual incidence of mTBI is higher than multiple sclerosis, Parkinson's disease, myasthenia gravis, and Huntington's disease combined (Alexander, 1995). For

children, the incidence of mTBI is particularly high. An estimated 475,000 emergency room visits, hospital stays, and deaths of children 14 years old and younger are the result of a mTBI (Faul et al., 2010). Additionally, children and adolescents affected by mTBI utilize healthcare services at significantly higher rates than those with no history of mTBI for years beyond the initial injury (Rockhill, Fann, Fan, Hollingworth, & Katon, 2010). The importance of these findings has not been ignored by national health organizations. At the turn of the century, the National Institutes of Health Consensus Development Panel concluded that mTBI was significantly underdiagnosed, and that research surrounding the risks and outcomes of mTBI was needed (National Institutes of Health, 1999).

Historically, it has been debated whether mTBI leads to similar diffuse structural changes in the brain seen in severe traumatic brain injury (but to a lesser degree), or that mTBIs cause transient and completely reversible changes (McCrory & Berkovic, 2001). Recently, a growing body of evidence has suggested that this historical view of mTBI as a non-serious injury (Carroll et al., 2004) is a false categorization; specifically, many authors have suggested that mTBI results in wide-ranging and potentially long-lasting cognitive and/or physical (Jones et al., 2018; Lambregts et al., 2017; Leary et al., 2018; Gauthier et al., 2018; Seabury, Gaudette, & Goldman, 2018; Pacella, Arjun, Morley, Huang, & Suffoletto, 2018), as well as psychopathological symptoms (Colantonio et al., 2010; Kenny & Lennings, 2007; Epstein et al., 2016; Farrer, Frost, & Hedges, 2011; McGlade, Rogowska, & Yurglun-Todd, 2015; Newcombe et al., 2011; Schindler et al., 2017; Schofield et al., 2015; Schwartz, Connolly, & Valgardson, 2018)

In line with this assertion, it has been reported that individuals who experience a mTBI often report symptoms several months to years after their initial injury (Binder, 1986; Bolzenius, Roskos, Salmien, Paul, & Bucholz, 2015; Carroll et al., 2004; Hall, Hall, & Chapman, 2005; Mooney & Speed, 2001; Rees, 2003; Rutherford, 1989). Additionally, in studies of veterans who experienced a mTBI, it was reported that 7.5% to 40% of individuals experienced at least three post-concussion symptoms (PCS) three months post-injury (Morissette et al., 2011; Schneiderman, Braver, & Kang, 2008; Terrio et al., 2009). The wide array of PCS are commonly divided into three clusters: (a) cognitive, including reduced cognitions, reduced executive functioning, and recall deficits due to inattention; (b) physical, including headaches, sensory changes, and fatigue; and (c) and psychological, including depression, anxiety, impulsiveness, aggression, and emotional dysregulation (Caplan et al., 2010; Cicerone & Kalmar, 1995). The focus of this study will be the psychological symptom cluster.

Importance of the Developmental Psychopathology Perspective

Findings related to the prevalence, continuity, and heterogeneity of child and adolescent psychopathology, as well as the common risk factors encountered in youth, largely spring from researchers' ever-growing interest in a life-course developmental approach to psychopathology (Cicchetti & Rogosch, 2002; Sroufe & Rutter, 1984). Contributors to this area have asserted the importance of determining the factors related to the onset and progression of mental health symptomology in children and adolescents (Munir & Beardslee, 1999). Also, the categorization of children according to administratively-defined disorders may ignore important need or problem areas that do not fit neatly into their diagnosis (Achenbach, 1990).

Practically speaking, the increased understanding of the determinants and structure of psychopathology during critical developmental periods (e.g., adolescence) has important implications for clinicians who oversee treatment and prevention planning (Cicchetti & Rogosch, 2002). Also, adolescent psychopathology can be used as an independent predictor of problematic behavior in adulthood (Hofstra, van der Ende, & Verhulst, 2000). Additionally, the high frequency of multiple comorbidities (Burstein et al., 2012; Kessler et al., 2012; Lamers et al., 2012; Merikngas et al., 2010) runs counter to the importance of distinct diagnostic categories and increases the importance of identifying common risk factors (Peiper, et al., 2015). To illustrate, the presence of comorbidity is likely to confuse and distort an individual's symptomology picture (Rutter, 1997). Therefore, it is important to identify underlying risk correlates to better determine the nature of the interrelatedness of symptoms (Rutter & Sroufe, 2000). Furthermore, separate individuals are differentially susceptible to environmental input (Boyce & Ellis, 2005); be moderated by early environment or androgen exposure (Del Guidice, Ellis, & Shirtcliff, 2011; Del Guidice et al., 2018).

Benefits of Identifying Latent Subtypes of Psychopathology

In the current diagnostic nosology, diagnoses are grouped together based on common underlying features; for example, anxiety disorders are grouped together due to their common symptoms fear, anxiety, and worry (Zinbarg & Barlow, 1996). While previous research using factor analytic techniques focusing on anxiety finds factors that resemble the current diagnostic entities (Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000; Higa-McMillan, Smith, Chorpita & Hayashi, 2008; Muris, Schmidt, Engelbrecht, & Perold, 2002; Spence, 1997; Wittchen, Beesdo, & Gloster, 2009), researchers in other

studies utilizing similar methods find that there are two or three distinct anxiety clusters (Beesdo-Baum et al., 2009; Brown, Chorpita & Barlow, 1998; Krueger, 1999; Watson, 2005).

Similarly, for major depressive disorder, classification is based on the presence of an administratively-set number of symptoms, a time period in which these symptoms must be present, and the identification of impairment (Paykel, 2008; Baumeister, 2010; Wakefield, Schmitz, & Baer, 2010). Also grouped with major depression, are disorders that include similar symptoms, such as persistent depressive disorder (American Psychiatric Association, 2013). As with anxiety, however, a number of researchers have voiced dissatisfaction with the current distinct categories of depression-related disorders due to high levels of overlapping comorbidity (Ghaemi, 2008; Luyten, Blatt, van Houdenhove, & Corveleyn, 2006; Parker, 2005, 2006); thus, indicating a need for statistical methods that can "comb through" the substantial heterogeneity of human psychopathology and create more reliable classes of symptom presentations.

As an improvement on bivariate analysis, which is limited to determining whether or not pairs of disorders appear comorbidly (for examples see Last, Strauss, & Francis, 1987; Masi et al., 2004), factor analysis can determine the degree of covariation across multiple variables (Burstein et al., 2013). However, the use of factor analysis to determine the structure of psychopathology is limited by inherent biases. For example, correlations between variables can be artificially inflated if the assumption of bivariate normality is violated, as is often the case with dichotomous variables (i.e., the presence or lack of a symptom; Kraemer, 1997). In addition, factor analysis is a *variable-centered*

methodology, which is at odds with the spirit of diagnosis, treatment, and prevention – all individually-focused endeavors (Burstein et al., 2013).

Latent class analysis (LCA), which is used to group individuals into categories based on similar symptom profiles, is an alternative to factor analysis. Muthén and Muthén (2000) describe LCA as a model-based approach in which classes or subgroups of individuals are added to the model until an ideal fit is determined. The parameters that serve as the basis for the model are the probability that an individual meets all criterion required for membership in each subgroup, as well as the probability of actually being in each subgroup (Muthén & Muthén, 2000). In addition to this, LCA can provide researchers with "posterior probabilities" (Muthén & Muthén, 2000, p. 883), which allow researchers to examine the probabilities of membership in each subgroup based on a priori background variables (e.g., mTBI).

Examples and Benefits of the use of Latent Class Analysis

As previously mentioned, LCA can be utilized to classify individuals based on symptom profiles, which is ideal for deriving a simplified diagnostic picture from a complex mix of heterogeneity and comorbidity (Burstein et al., 2013). In the literature, the most common use of LCA is to identify subgroups within similar diagnostic categories such as depression or anxiety. Lamers and colleagues (2012) used data from the NCS-R-AS and the World Health Organization's Composite International Diagnostic Interview (CIDI) to derive the latent subtypes of depression. In this study, the researchers determined that a three-class solution was the most parsimonious. The three classes, from least prevalent to most prevalent, were "atypical," marked by increased appetite and weight gain, "severe typical," which included weight loss and a high number of endorsed

symptoms, and "moderate typical," comprised of decreased appetite, insomnia, and a typical depression symptom presentation.

In another study utilizing LCA to derive subtypes of a homotypic disorder cluster (Burstein et al., 2013), researchers also utilized data from a subset of the NCS-R-AS participants who positively screened for an anxiety-related disorder. Burstein and colleagues (2013) also utilized the CIDI to indicate the presence or lack of a particular anxiety-related symptom within each individual. Based on their analysis, the authors named the latent classes based on their closest correlate to DSM-IV-TR diagnoses (American Psychiatric Association, 2000). As such, the seven classes derived from the data were labelled as specific, social, separation anxiety disorder, generalized anxiety disorder, agoraphobia, panic, and complex comorbid (for class descriptions see Burstein et al., 2013, pp. 9-11).

Although the authors of the two aforementioned studies used LCA to determine the existing subtypes of a specific disorder cluster, Muthén and Muthén (2000) have also utilized this methodology to classify a more complex set of homotypic symptoms (i.e., antisocial behaviors) and sets of heterotypic symptoms (i.e., both internalizing and externalizing symptoms in adolescents; Peiper et al., 2015; Williams, Dahan, Silverman, & Petitt, 2013).

In the Muthén and Muthén (2000) study, 17 variables representing a range of antisocial behaviors in the National Longitudinal Survey of Youth were used. In this case, a four-class solution was the most parsimonious. Muthén and Muthén (2000) reported that Class 4 was the most prevalent class and they considered it to be normative because members in this class did not have a high probability of endorsing any antisocial

behaviors aside from marijuana use. Members of Class 3, or the person-offense class, had relatively high probabilities (.38-.68) of endorsing fighting, threatening, and conning others. According to Muthén and Muthén (2000), Class 2 was considered by the researchers to be the substance use class, as members had a high probability of endorsing items related to substance use. Finally, Class 1 was labelled by the researchers as the property offense class because members had a high likelihood of endorsing items such as damaging property, shoplifting, stealing less than $50, stealing more than $50, breaking and entering a building, and theft. Further improving the utility of the model, the authors examined age, gender, and ethnicity as predictors for class membership. From their analysis, Muthén and Muthén (2000) concluded that Class 3 members (person offenses) were most likely to be younger with the exception of young white females, and the Class 4 members' (normative) ages varied based on ethnicity and gender. Also, Class 1 (property offense) membership was low for older individuals across gender and ethnicity. Class 2 (substance use) membership was higher for older individuals, but lower overall for Black males and females.

The Muthén and Muthén (2000) example of LCA is an example of the detailed picture that such an analysis can provide. LCA identifies groups of *individuals* and not groups of variables; therefore, the authors of this study demonstrated that adolescents who displayed antisocial behavior tended to display only a grouping of similar behaviors. In addition to this, Muthén and Muthén's (2000) illuminated in their LCA analysis how the probability of membership in the different subgroupings varied systematically based on age, gender, and ethnicity.

All the aforementioned scholars (Burstein et al., 2013; Lamers et al., 2012; Muthén & Muthén 2000) focused on creating subgroups from a set of homotypic variables (i.e., all internalizing). However, other authors conducted studies, such as an analysis published by Peiper et al., (2015). In this study, the Peiper and colleagues (2015) derived subclasses from a group of heterotypic variables (i.e., mixed internalizing and externalizing). The participants for this study were 6th-12th grade students who screened positive for severe emotional disturbance on the Kentucky Incentives for Prevention Survey. Peiper et al. (2015) reported that four classes of severe emotional disturbance emerged, and they were defined by their symptom type and severity. The first class was labeled comorbid moderate, with probabilities ranging from .55-.79 of endorsing both internalizing (e.g., feeling worthless or depressed) and externalizing (feeling restless or fidgety) symptoms. The second class was identified as comorbid high and contained high probabilities (.95-.99) of endorsing all internalizing and externalizing symptoms. The next class contained moderate (.59-.77) probabilities of anxiety-related symptoms (e.g., feeling nervous), and the final class contained high probabilities (.76-.83) of endorsing depression-related symptoms (e.g., feeling so depressed that nothing can cheer you up). In addition to demographic factors, Peiper et al. (2015) used environmental factors as predictors for class membership. Specifically, the researchers determined that students who experienced conflict at home were more likely to be in all four latent classes.

Latent Class Analysis Utilizing the Child Behavior Checklist

The psychometric utility of a set of latent classes is dependent on the source of the variables from which the classes are derived. In this study, the Child Behavior Checklist (CBCL) will be employed. The CBCL is a psychometrically-sound, parent-report,

screener for emotional, behavioral, and social difficulties (Achenbach & Edelbrock, 1983). The CBCL returns profile scores of eight problem areas (i.e., anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggression), as well as broad internalizing, externalizing, and total problems composite scores. A small-but-growing number of studies have utilized the CBCL profiles derived from the CBCL scales (Basten et al., 2013; Bianchi et al., 2017; Connell et al., 2008; Rosato & Baer, 2012). Across the various samples used in these studies, including American (Connell et al.,2008; Rosato & Baer, 2012), Dutch, (Basten et al., 2013), and Italian (Bianchi et al., 2017) youth, and across the ages of the participants (i.e., both the CBCL/6-18 and the CBCL/1.5-5 were used), a four-class solution was reported to be the most parsimonious. However, none of these studies utilized mTBI as a predictor of class membership.

Support for mTBI as a Predictor of Psychopathology

Evidence of internalizing psychopathology. The ability to experimentally manipulate mTBI as a variable in human subjects carries with it obvious ethical problems; therefore, many studies conducted by scholars in this area have utilized animal models. In such experiments, animals (e.g., rats or mice) are given an experimentally-induced mTBI in a highly controlled manner to optimize internal validity. One such study compared the genetic function of rats who had been given a mTBI to that of control rats. The researchers reported that compared to controls, rats who had experienced a mTBI had reduced functioning of their striatal vesicular monoamine transporter-2 gene (VMAT-2; an important dopamine transporter gene). The inhibition of the VMAT-2 gene is positively associated with mood disorders including depression (Xu, Cao, Chao, Liu, &

Ji, 2016). In a similar study, Wright, O'Brein, Shultz, and Mychasiuk (2017) randomly assigned male and female rats to a control group, a single mTBI group, or a repeated (3 injuries) mTBI group. Wright et al. (2017) then compared the results of each group in a series of behavioral tests. For both male and female rats, only those in the repeated mTBI group showed increase in anxiety-like behaviors in a maze task. In a forced-swim task that simulates depressive-like behavior, male single and repeated mTBI rats displayed more depressive-like behaviors than female single and repeated mTBI rats. For female rats, only those in the single mTBI group displayed increased depressive-like behaviors when compared to the female controls. The female rats who had experienced repeated mTBIs displayed a decrease in depressive-like behaviors, potentially indicating sex differences in the internalizing outcomes of mTBI.

The authors of several human-model studies have reported an increase in internalizing symptoms following mTBI. In a human-model study, Epstein and colleagues (2016) focused on the morphological differences in the orbitofrontal cortex (OFC) following a mTBI. Their findings revealed that right lateral OFC thinning was significantly related to depression, and that higher reported anxiety and depression was associated with a higher number of mTBIs. Similarly, in a study of veterans conducted by Schindler and colleagues (2017), it was concluded that veterans who had experienced a mTBI reported higher levels of depression as well as increased endorsement of post-traumatic stress symptoms compared to non-mTBI controls. Finally, Scott et al. (2015) examined the adult outcomes of individuals who had experienced a pediatric mTBI and reported that females who had experienced a pediatric mTBI were 5.2 times more likely than their male counterparts to report an anxiety disorder. This, again, suggested that sex-

related differences in the internalizing outcomes following mTBI may exist. Recent findings examining the relationship between mTBI and psychopathology using a retrospective sample showed a significant relationship between mTBI and increases in anxiety/depression symptomology. Importantly, this relationship remained significant even after controlling for pre-injury levels of the same symptoms (Connolly & McCormick, In Press).

Evidence of externalizing psychopathology. As was true for internalizing symptoms, studies utilizing rats and mice have also identified potential externalizing outcomes following a mTBI. For example, Schindler and colleagues (2017) used a pressure wave to simulate an explosive injury (i.e., a common injury modality in veterans). From the results of this study, it was concluded that, at 30 days post-injury, mice who had experienced both one and three injuries displayed more sensation seeking behaviors (disinhibition) than non-injured controls. Furthermore, electrical stimulation of the nucleus accumbens (a forebrain structure associated with reward reinforcement) of the blast-exposed mice elicited more dopamine release than in control mice (i.e., increased reward activation). Schindler et al. (2017) asserted that increased reward activation can lead to an increase in thrill-seeking behavior. Also, Schindler and colleagues (2017) attempted to generalize their animal-model findings to humans by comparing the pre- and post-injury Frontal Behavior Systems Scale scores (which includes a measure of disinhibition) of active duty veterans. It was concluded from this analysis that self-reported post-injury disinhibition scores were higher than pre-injury scores. In line with this, the veterans reported engaging in more risky behaviors. Finally, a subgroup of these veterans with mTBIs was retested three years post-injury, and the

disinhibition scores remained similar to those in the initial analysis. This indicates a chronic increase in disinhibition in veterans who experienced a mTBI.

In addition to disinhibition, a number of other externalizing symptoms that commonly manifest after a brain injury have also been identified. For example, Colantonio, Harris, Ratcliff, Chase, and Ellis (2010) acknowledged that over half of their participants with a history of mTBI reported irritability, temper-related problems, and mood swings. Similarly, Schwartz et al. (2018) used structural equation modeling techniques to establish a temporal relation between injury and outcome and reported that mTBI in youth led to subsequent changes in impulsivity.

These externalizing symptoms associated with mTBI are speculated to be the reason that mTBI patients are disproportionately represented in the criminal justice system. This assertion of the mTBI-criminal justice system link has been repeatedly verified. For example, Farrer et al. (2011) conducted a meta-analysis of five studies that reported the prevalence of mTBI in juvenile offenders with at least one control group and reported that juvenile offenders had a 3.38 times higher chance of having a mTBI than the control groups. Also, in an aforementioned study, Schwartz and colleagues (2018) revealed that increases in impulsivity were followed by increases in criminal justice system involvement. Additional evidence supports assertion that individuals who experienced a mTBI are at greater risk of violent offending as well. Specifically, Kenny and Lennings (2007) indicated that compared to other offenders, juveniles who had committed severely violent offenses were 2.37 times more likely to have had experienced a head injury. Similar to internalizing psychopathology, recent findings using a retrospective design to examine the relationship between psychopathology a mTBI found

a significant increase in aggressive and delinquent behavior following mTBI even when controlling for preinjury levels of aggression and delinquency (Connolly & McCormick, In Press). Potentially mediating the relationship between mTBI and delinquency behavior, recent findings suggest that childhood neurological insult is associated with disruptions in the development of moral reasoning and decision making (Beauchamp, Vera-Estay, Morasse, Anderson, & Dooley, 2018).

Some of the brain regions affected by mTBI that are associated with externalizing symptoms have also been identified. Newcombe et al. (2011) used diffusion tensor imaging to assess the brain regions associated with decision making during the Cambridge Gambling Task for individuals with a mTBI. It was concluded that compared to controls, the mTBI patients demonstrated higher impulsivity index scores on the Cambridge Gambling Task, which was associated with increased activation in the right and left orbitofrontal gyrus, the right and left insular cortex, and the right and left caudate. Another associated brain region was identified by Epstein and colleagues (2016) who acknowledged increased cortical thinning in the right lateral orbitofrontal cortex of mTBI patients compared to controls. In addition to this, Epstein et al. (2016) reported that this increased cortical thinning was associated with higher rates of aggression.

As noted with internalizing symptoms, there are also potential sex differences in the externalizing symptom profiles of mTBI patients. McGlade et al. (2015) compared male and female veterans who had been diagnosed with a mTBI and reported that, for males only, there were significant correlations between aggression and the brain regions studied. Specifically, males showed decreased connectivity between the left orbitofrontal cortex and the left Angular gyrus. This decreased connectivity was associated with an

increase in physical aggression. Additionally, males demonstrated increased connectivity between the orbitofrontal cortex, the right cerebellum, and the right angular gyrus, which was associated with increased revenge planning (McGlade et al., 2015). Sex differences are also evident in offending behavior, as is shown by researchers in a cohort-wide study of over 30,000 juveniles in Western Australia. In this study, it was found that relative to the general population, mTBI was significantly associated with convictions for violence in males, but not females (Schofield et al., 2015).

Current Study

The present study aims to use estimate latent class analysis to evaluate the class structure of the data from each of the CBCL/4-18 scales in a large sample of U.S. youth, and, subsequently, examine the relationship of mTBI to childhood and adolescent psychopathology. It is hypothesized that, even after accounting for several control variables associated with psychopathology, mTBI will still act as a significant predictor of classes of psychopathology.

CHAPTER II

Methods

Sample

The present studies utilized data collected from the Project on Human Development in Chicago Neighborhoods (PHCDN) Longitudinal Cohort Study (LCS; Earls & Buka, 1997; Sampson, 2012). In the PHCDN-LCS, researchers initially surveyed approximately 6,000 youth and their caregivers. The youth were organized into cohorts based on their age being within 6 months of 0, 3, 6, 9, 12, 15, or 18 years. Hereafter, cohorts will be referred to by the approximate age of its members at the first wave of data collection. Following the first wave of data collection (1994-1997), the youth and their caregivers were re-interviewed at 2 and 2.5-year intervals (1997-2000 and 2000-2002).

Measures of mTBI and the CBCL were administered to participants at Waves 2 and 3; retention rates were 86% at Wave 2 and 77% at Wave 3 (Martin & Schoua-Glusberg, 2002). To improve the value of the model by reducing confounds due to transient symptoms, both Wave 2 and Wave 3 CBCL data were used when available. Additionally, data from cohorts 3, 6, 9, and 12 were used. Cohort 18 was excluded because CBCL data were not available for these individuals at Waves 2 or 3. Cohorts 0 was also excluded because, at Wave 2, these participants were examined with the CBCL ages 1.5-3 version (Achenbach, 1992), while the other Cohorts (3-15) were assessed using the CBCL ages 4-18 version (Achenbach, 1991); these two versions are not directly comparable. Cohort 15 was excluded because CBCL data were not collected for these participants at Wave 3. Participants were placed into five age categories (3-5, 6-8, 9-11, 12-14, and 15+) based on their ages at Wave 2 and Wave 3 so that longitudinal changes

in psychopathology (Kessler et al., 2005) could be assessed in latent class models. All secondary data analyses were approved by the Sam Houston State University Institutional Review Board (Appendix A).

Measures

Child Behavior Checklist. At Waves 2 and 3 the PHDCN-LCS Cohort 3, 6, 9, and 12 participants were administered the CBCL/4-18 (Achenbach, 1991). The CBCL is a widely-used standardized parent report questionnaire that is used to measure child and adolescent maladaptive behavior and emotional problems. The syndrome scales associated with internalizing psychopathology (Somatic Complaints and Anxious/Depressed) and externalizing psychopathology (Delinquent Behavior and Aggression) was used in the present studies.

Additionally, the Attention Problems syndrome scale was included and considered an aspect of externalizing psychopathology. In the original scale construction, Achenbach (1991) found that the Attention Problem scale had a moderately high a moderately high loading (.618; p. 62) on the externalizing factor but excluded it from this category because this loading was lower than the average loading of the other two externalizing syndrome scales. However, more recent iterations of the CBCL (Achenbach & Rescorla, 2000; Achenbach & Rescorla, 2003) and other authors in the literature (Burt, 2012; Krueger & South, 2009) classified attention problems as a form of externalizing psychopathology. Additionally, genetic covariation has been found between disorders involving attention problems and those involving delinquent and aggressions (Nadder, Rutter, Silberg, Maes, & Eaves, 2002; Silberg et al., 1996; Thapar, Harrington, & McGuffin, 2001; Tuvblad, Zheng, Raine, & Baker, 2009). In addition to the syndrome

scales, individual items were also used to explore the latent classes that exist within scales. As shown in Table 1, Cronbach's alphas for the items within each scale ranged from .57-.87 at Wave 2 and from .68-.88 at Wave 3. Caregivers of the participants in the PHDCN-LCS were administered a reduced form the CBCL/4-18 which excluded three items from the Attention Problems scale, five items from the Delinquent Behavior scale, and six items from the Aggression scale (see Appendix B for a full list of items included).

Table 1

Inter-item reliabilities for Child Behavior Checklist Items for Waves 2-3 Cohorts 3-12

Wave 2		Wave 3		
CBCL Scale	Cronbach's Alpha	CBCL Scale	Cronbach's Alpha	Items
Somatic Complaints	.73	Somatic Complaints	.75	9
Anxious/Depressed	.80	Anxious/Depressed	.81	13
Attention Problems	.73	Attention Problems	.75	6
Delinquent Behaviors	.57	Delinquent Behaviors	.68	8
Aggression	.87	Aggression	.88	13

Note. See Appendix B for a full list of items included

Mild traumatic brain injury. Mild traumatic brain injury data were gathered for Wave 2 (i.e., mTBI experienced from birth to Wave 2 data collection) participants from the parent responses to the question, "Has [child's name] ever had a bad head injury or concussion?" To ensure that injuries were mTBIs, the following criteria were assessed: (a) injuries that resulted in loss of consciousness lasting under 30 minutes (Lumba-Brown et al., 2016; Mild Traumatic Brain Injury Committee, 1993) were included; (b) injuries *not* resulting in loss of consciousness, but requiring a physician's visit. Injuries meeting one of these criteria were coded as "1," and all other injuries were coded as "0."

Control variables. Several control variables were added to the latent class analysis (LCA) models to help determine the unique predictive power of head injury. Race (McLaughlin, Hilt, & Nolen-Hoeksema, 2007), neighborhood disadvantage (Ross, 2000; Santiago, Wadsworth, & Stump, 2011), parent-child conflict (Burt, Kreuger, McGue, & Iacono, 2003; Burt, McGue, Krueger, & Iacono, 2005a), victimization (Klomek et al., 2007; Kirk & Hardy, 2014; Turner, Finkelhor, & Ormrod, 2009; Zona & Milan, 2011), immediate family member mental health history (Hatoum, Rhee, Corley, Hewitt, & Freidman, 2018, Rand & Ronald, 2018; van Hulle, Waldman, & Lahey, 2018), and verbal intelligence (Ayduk, Rodriguez, Mischel, Shoda, & Wright, 2007) have been shown to relate to various internalizing and externalizing disorders; therefore, these variables will be used as controls in the present study.

The race of the participants was recorded by the primary caregivers at the time of data collection. Race (i.e., Caucasian, African American, Hispanic, and multiple or other) variables were dummy coded with Caucasian as the reference category Age data was gathered for both Wave 2 and 3 participants.

To measure neighborhood disadvantage, Wave 2 data regarding participant neighborhoods were used. The participants in the PHDCN-LCS live within 80 neighborhood clusters (NCs). Data from the 1990 U.S. census were used to create the NCs using a multistage probability sampling method (see Leventhal & Brooks-Hunn, 2011, p. 1683). For the present study, NCs were categorized as low poverty (<20% of individuals living below the poverty line), moderate poverty (20%-30% below poverty line), or high poverty (>30% below poverty line); this categorization is drawn from common definitions used by U.S. Government agencies (U.S Census Bureau, 1995; Peters, 2009) and in the literature (Leventhal & Brooks-Hunn, 2011; O'Hare & Mather, 2003; Orr et al., 2003; Wilson, 1987). These variables were dummy coded with low poverty as the reference category.

Parent-child conflict was measured at Wave 2 by creating a total index score from the sum of the yes responses to the following yes or no questions: I will read you a list of things that you or any other adult family member who cares for [participant name] might have done when there was a problem with him or her… Has any adult in the last year when there was a problem with [participant name] …sulked and/or refused to talk about an issue; insulted or sworn at [participant name]; stomped out of the room or house or yard; threatened to hit or throw something at him/her; thrown, smashed, or kicked something; thrown something at him/her. The internal consistency for the items that comprise the parent-child conflict index score is considered satisfactory ($\alpha = .735$; Bland & Altman, 1997).

To assess victimization, the number of "yes" answers was summed for each participant at Wave 2 for the following primary caregiver survey items: Has [participant

name] ever been… hit, slapped, punched, or beaten up; attacked with a weapon such as a knife or bat; shot (not including a BB gun or other type of toy gun); shot at, but not actually wounded (not including a BB gun or other type of toy gun); in a serious accident where s/he or someone else was hurt very badly or died; sexually assaulted, molested, or raped; threatened to be seriously hurt (includes being threatened with a weapon).

Family mental health histories were gathered from the number of immediate family members (i.e., biological father, mother, and siblings) with a history of internalizing or externalizing disorders prior to Wave 2.

In line with previous research (Leventhal, Xue, & Brooks-Gunn, 2006; Sampson, Morenoff, & Raudenbush, 2005; Sampson, Sharkey, & Raudenbush, 2007) using the PHCDN-LCS sample, verbal intelligence was estimated using the age-scaled scores from the Vocabulary subtest of the Wechsler Intelligence Scale for Children-Revised (WISC-R; Wechsler, 1974). The WISC-R was not administered to Cohort 3 at Wave 2; therefore, data from Wave 3 was used to estimate the verbal intelligence of Cohort 3 participants. For Cohorts 6, 9, and 12, there was a significant correlation ($r = .49$, $p < .001$) between Wave 2 and Wave 3 WISC-R scores. Table 2 presents the descriptive statistics for all variables.

Table 2

Descriptive Statistics

	Mean/Percent	SD/n	Min.	Max.	N
mTBI			-	-	-
Aggressive Behavior$_{Wave2}$	1.77	1.84	0	14	2,765
Aggressive Behavior$_{Wave3}$	1.84	2.11	0	15	2,490
Anxiety/Depression$_{Wave2}$	1.41	2.08	0	16	2,765
Anxiety/Depression$_{Wave3}$	1.65	2.62	0	18	2,490
Attention Problems$_{Wave2}$	4.28	4.16	0	24	2,765
Attention Problems$_{Wave3}$	4.29	4.19	0	28	2,490
Delinquency$_{Wave2}$	3.26	2.98	0	16	2,765
Delinquency$_{Wave3}$	3.14	3..05	0	16	2,490
Somatic Symptoms$_{Wave2}$	2.51	2.61	0	17	2,765
Somatic Symptoms$_{Wave3}$	2.72	2.81	0	18	2,490
Neighborhood SES					
High Poverty	30.00%	902	-	-	-
Moderate Poverty	41.00%	1233	-	-	-
Low Poverty	26.70%	803	-	-	-
Parent-Child Conflict	1.86	0.77	0	3	3,006
Victimization	1.00	1.408	0	7	2,966
0 Victimizations	51.80%	1,559	-	-	-
1 Victimization	21.50%	647	-	-	-
2 Victimizations	11.10%	335	-	-	-
3 Victimizations	6.80%	204	-	-	-
4 Victimizations	3.90%	117	-	-	-
5 Victimizations	2.20%	67	-	-	-
6 Victimizations	0.90%	26	-	-	-
7 Victimizations	0.40%	11	-	-	-
Family History of Externalizing	0.18	0.61	0	5	2,994
Family History of Internalizing	0.24	0.541	0	4	2,994
Verbal IQ	8.38	3.04	1	19	2,036
Age	9.43	3.35	3.8	16.1	3,008
Race					
African American	30.00%	902	-	-	-
Hispanic	41.00%	1233	-	-	-
Caucasian	14.10%	425	-	-	-
Multiple or Other	12.60%	378	-	-	-
Sex					
Female	49.70%	1495	-	-	-
Male	50.30%	1513	-	-	-

Notes: mTBI = mild traumatic brain injury.

Analytic Plan

The data in the current study was analyzed in a two-step process. First, to determine the optimal number of classes to explain the heterogeneity in participant psychopathology, the following process was repeated using the CBCL scale data. Using M*plus* version 7.2 (Muthén & Muthén, 1998-2012) with full information maximum likelihood estimation to adjust for missing data, LCA models were estimated separately for each of the CBCL scales. The various possible class solutions were evaluated using the Bayesian Information Criterion (BIC), the sample-sized adjusted BIC values, the adjusted Lo-Mendel-Rubin Test, entropy values, and the overall interpretability and substantive value of identified classes (Nylund, Asparouhov, & Muthén, 2007). Class solutions with a lower BIC and sample-sized adjusted BIC represent a better fitting model (Kass & Wasserman, 1995). Importantly, the BIC has been shown to outperform other information criterions (Nylund et al., 2007). A significant Lo-Mendel-Rubin test value indicates the *K*-class model provides a better fit than the *K*-1 model (Nylund et al., 2007). Entropy values closer to one indicate a better fitting model (Celeux & Soromenho, 1996). Second, multinomial logistic regressions were calculated to examine the association between mTBI, the control variables, and class membership. Robust standard errors were used to address non-independence between participants coming from the same neighborhood and/or household.

CHAPTER III

Results

What are the Class Structures for Delinquency and Psychopathology?

Beginning with aggression, based on all model fit indices (Table 3), a four-class solution was found to fit the data best. Trajectories of aggression for each class between Waves 2 and 3 are presented in Figure 1. The growth model includes a class displaying consistently low levels of aggression, hereafter called the Consistently Low Aggression class (n = 2,326; 78.0% of the sample); a class initially displaying high levels of aggression with aggression decreasing over time, hereafter called the High and Decreasing Aggression class (n = 294; 9.9% of the sample); a class showing moderate levels of aggression with increasing aggression over time, hereafter called the Moderate and Increasing Aggression class (n = 277; 9.3% of the sample); and a class showing consistently high levels of aggression, here after called the Consistently High Aggression class (n = 81; 2.7% of the sample).

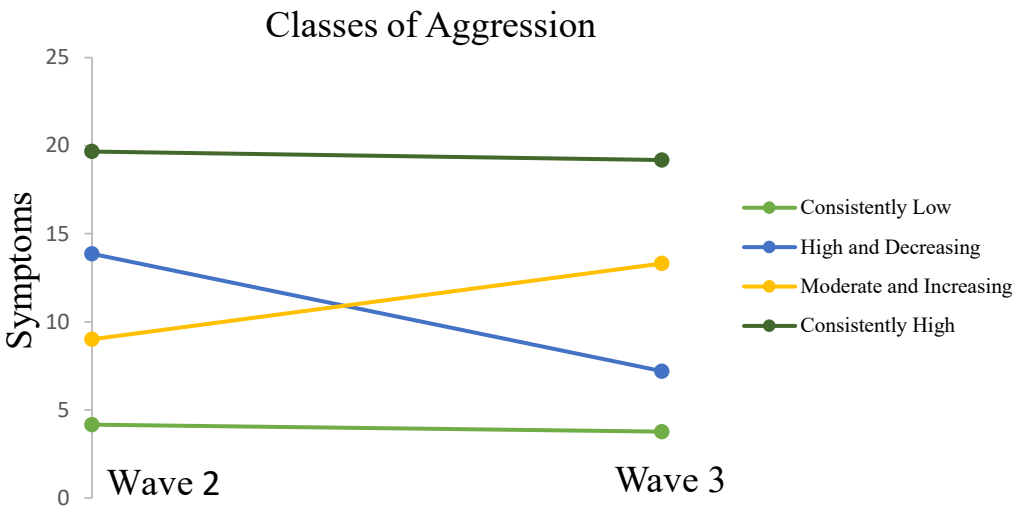

Figure 1. Graphical display of identified latent classes of aggression.

Next, a class solution was estimated for the Anxiety/Depression scale. Based on the fit indices (Table 3), a five-class solution was preferred. Trajectories of anxiety/depression for each class between Waves 2 and 3 are shown in Figure 2. This model includes a class with consistently low levels of anxiety/depression (Consistently Low Anxiety/Depression class; *n* = 2,363; 79.0% of the sample); a class with initially moderate levels of anxiety/depression that slowly decrease over time (Moderate and Slowly Decreasing Anxiety/Depression class; *n* = 285; 9.6% of the sample); a class showing initially low but increasing levels of anxiety and depression (Low and Increasing Anxiety/Depression class; *n* = 164; 5.5% of the sample); a class displaying moderate and quickly decreasing levels of anxiety/depression (Moderate and Quickly Decreasing Anxiety/Depression class; *n* = 112; 3.8% of the sample); and a class with initially high and increasing levels of anxiety/depression (High and Increasing Anxiety/Depression class; *n* = 54; 1.8% of the sample).

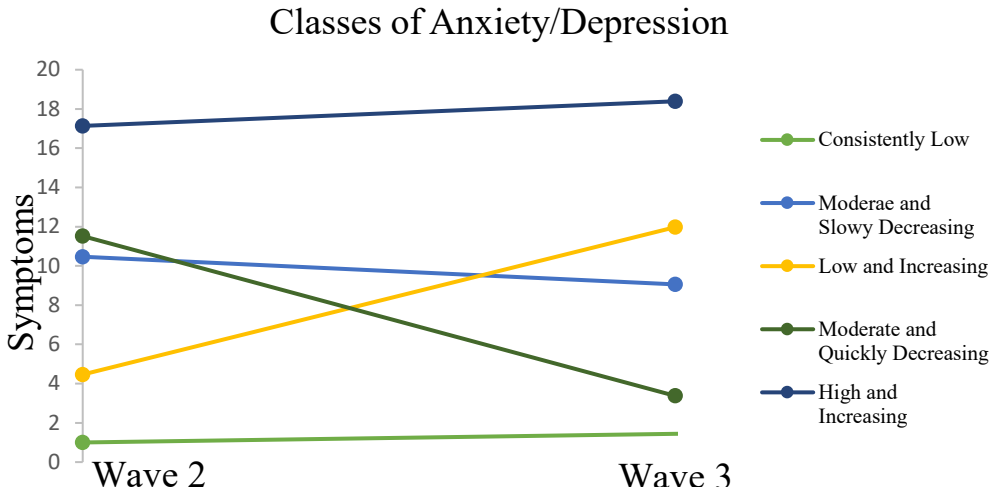

Figure 2. Graphical display of identified latent classes of anxiety/depression.

For the Attention Problems scale, based on all model fit indices (Table 3), a five-class solution was preferred. Trajectories of attention problems for each class between Waves 2 and 3 are shown in Figure 3. The class-solution includes a class showing consistently low attention related problems (Consistently Low Attention Problems class; *n* = 1,996; 67% of the sample); a class displaying initially low but increasing levels of attention problems (Low and Increasing Attention Problem class; *n* = 519; 17% of the sample); a class with moderate but decreasing levels of attention problems (Moderate and Decreasing Attention Problem class; *n* = 283; 9.5% of the sample); a class showing consistently high levels of attention problems (Consistently High Attention Problems class; *n* = 118; 4.0% of the sample); and a class with initially moderate and increasing levels of attention problems (Moderate and Increasing Attention Problems class; *n* = 62; 2.1% of the sample).

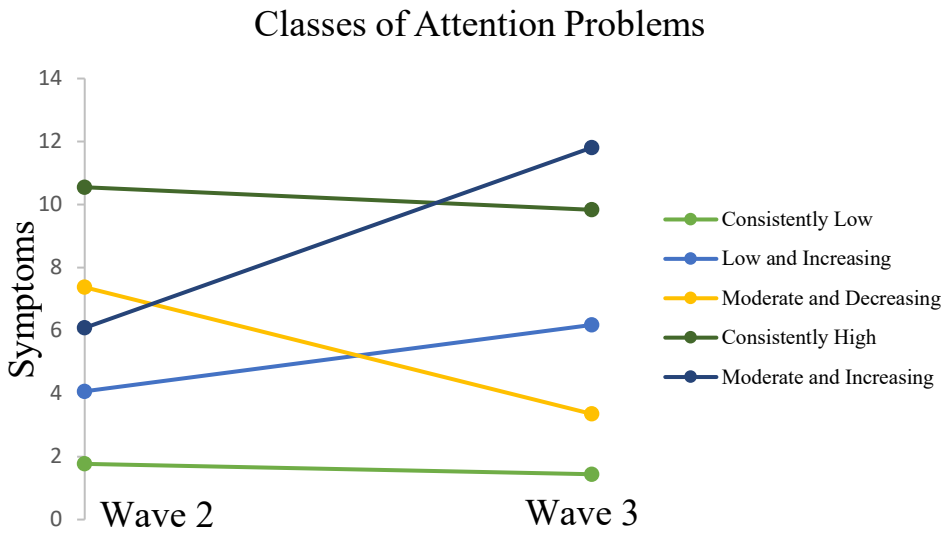

Figure 3. Graphical display of identified latent classes of attention problems.

Based on model fit indices (Table 3), a three-class solution was preferred for the Delinquency Scale data. Trajectories of delinquent behavior for each class between

Waves 2 and 3 are shown in Figure 4. This model includes a class with consistently low levels of delinquency (Consistently Low Delinquency class; *n* = 2,626; 88.0% of the sample); a class displaying initially moderate and decreasing levels of delinquent behavior (Moderate and Decreasing Delinquency class; *n* = 205; 6.9% of the sample); and a class with low initial levels of delinquency that increase over time (Low and Increasing Delinquency class; *n* = 147; 4.9% of the sample).

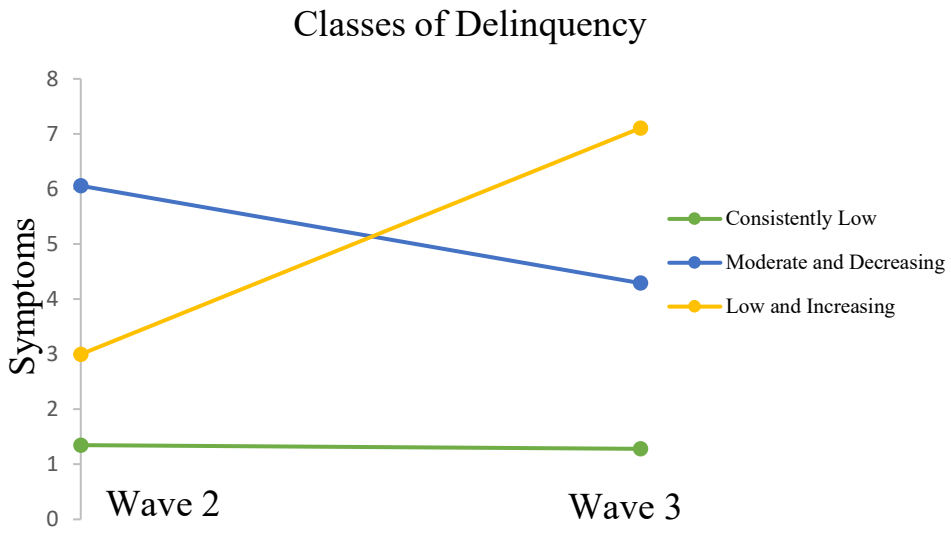

Figure 4. Graphical display of identified latent classes of delinquency.

Regarding the Somatic Symptoms Scale, model fit indices (Table 3) indicated a two-class solution is preferred. Trajectories of somatic symptoms for each class between Waves 2 and 3 are shown in Figure 5. This class solution includes a class with consistently low levels of somatic symptoms (Consistently Low Somatic Symptoms Class; *n* = 2728; 91.6% of the sample) and a class displaying moderate and stable levels of somatic symptoms (Consistently Moderate Somatic Symptoms Class; *n* = 250; 8.4% of the sample).

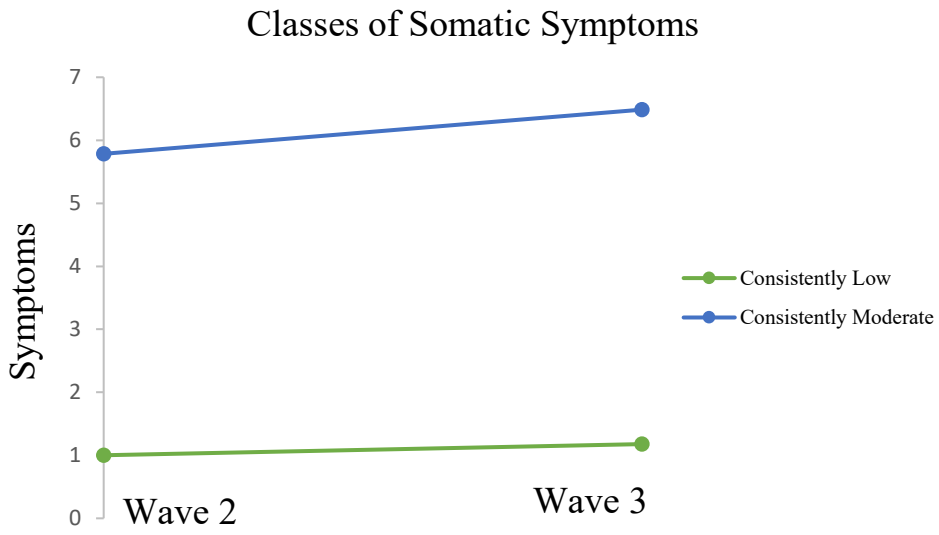

Figure 5. Graphical display of identified latent classes of somatic symptoms.

Table 3

Identification of Latent Classes

	Log Likelihood	BIC	Sample Size Adjusted BIC	Adjusted Lo-Mendel-Rubin Test	Entropy	Class Size				
						1	2	3	4	5
Aggression										
Class (2)	-15089.543	30243.079	30217.660	529.50***	.845	2641	337	-	-	-
Class (3)	-14966.050	30020.089	29985.138	237.106**	.838	2534	277	167	-	-
Class (4)	**-14883.874**	**29795.749**	**29835.252**	**157.77**	**.808**	**2326**	**294**	**277**	**81**	**-**
Class (5)	-14817.461	29770.906	29716.891	124.98**	.787	1948	686	152	131	61
Anxiety/Depression										
Class (2)	-14153.267	28370.525	28345.106	707.656***	.872	2623	355	-	-	-
Class (3)	-13980.751	28049.491	28014.540	398.711***	.859	2502	298	178	-	-
Class (4)	-13838.265	27788.516	27744.032	273.57***	.848	2382	300	212	84	-
Class (5)	**-13772.452**	**27680.886**	**27626.871**	**126.361**	**.857**	**2363**	**285**	**164**	**112**	**54**
Attention Problems										
Class (2)	-12482.824	25029.640	25004.221	511.301***	.789	2567	411	-	-	-
Class (3)	-12337.634	24763.256	24728.305	278.764***	.799	2226	622	130	-	-
Class (4)	-12227.247	24566.480	24521.996	211.942*	.789	2053	423	366	136	-
Class (5)	**-12170.055**	**24476.093**	**24422.078**	**109.808**	**.804**	**1996**	**519**	**283**	**118**	**62**
Delinquency										
Class (2)	-10206.603	20477.197	20451.778	756.839***	.905	2765	213	-	-	-
Class (3)	**-10078.480**	**20244.949**	**20209.998**	**245.994**	**.886**	**2626**	**205**	**147**	**-**	**-**
Class (4)	-9917.199	19946.384	19901.901	309.658*	.859	2424	338	165	51	-
Class (5)	-9866.571	19869.125	19815.109	97.206	.834	2140	542	152	120	24
Somatic Symptoms										
Class (2)	**-10780.367**	**21624.727**	**21599.308**	**957.249**	**.931**	**2728**	**250**	**-**	**-**	**-**
Class (3)	-10472.564	21033.118	20998.167	590.979*	.901	2611	227	140	-	-
Class (4)	-10181.285	20474.556	20430.072	519.065**	.905	2318	494	101	65	-
Class (5)	-10027.154	20190.291	20136.275	295.930*	.911	2328	407	128	93	22

Notes: BIC = Bayesian Information Criteria. *** $p < .001$; ** $p < .01$; * $p < .05$

Does mTBI Predict Delinquency and Psychopathology Class Membership?

Stage two of the analysis used multinomial logistic regression was used to examine the associations between mTBI and class membership while accounting for several confounding variables. Table 4 shows the multinomial logistic coefficients and odds ratios (OR) with the Consistently Low Aggression Class as the reference group. The analysis reveals that compared to the individuals in the consistently low class, participants in the High and Decreasing Aggression Class were over 4 times more likely to have experienced a mTBI (OR=4.65, p<.001), participants in the Moderate and Increasing Aggression Class were over 5 times more likely to have experienced a mTBI

(OR=5.21, $p < .001$), and participants in the Consistently High Aggression Class were almost 7 times more likely to have experienced a mTBI (OR=6.98, $p< 001$). The left portion of Table 5 displays the multinomial logistic coefficients and odds ratios with the High and Decreasing Aggression Class as the reference group. This analysis shows that compared to individuals in the high and decreasing class, participants in the Moderate and Increasing Aggression Class were over 1.5 times more likely to have experienced a mTBI (OR=1.75, $p<.01$), while individuals in the Consistently High Aggression class were not significantly more likely to have experienced a mTBI (OR=1.02, $p>.05$). The right portion of Table 5 displays the multinomial logistic coefficients and odds ratios with the Moderate and Increasing Aggression class as the reference. Compared to participants in the moderate and increasing class, participants in the Consistently High Aggression Class are over 2.5 times more likely to have experienced a mTBI (OR=2.67, $p<.05$)

Table 4

Predictors of Latent Class Membership – Aggression

	Aggressive Behavior		
	High and Decreasing	Moderate and Increasing	Consistently High
Reference Group	Consistently Low		
mTBI	1.46*** [4.65]	1.50*** [5.21]	2.03*** [6.98]
Family History of Externalizing	1.08** [1.90]	1.11** [2.08]	1.68*** [3.15]
Family History of Internalizing	.59 [1.10]	.50 [1.02]	.71* [1.21]
Neighborhood SES	-.47*** [.81]	-.43*** [.85]	-.61*** [.72]
Parent-Child Conflict	1.11*** [2.58]	1.37*** [3.12]	1.45*** [3.60]
Victimization	.95*** [1.71]	1.13*** [2.04]	1.20*** [2.18]
Verbal IQ	-.09*** [.91]	-.12*** [.88]	-.20*** [.80]
Age	-.23*** [.93]	-.17** [.96]	-.32*** [.89]
African American	.98* [1.93]	1.27*** [2.27]	1.70*** [3.10]
Hispanic	.48 [1.01]	.39 [1.05]	.35 [1.07]
Multiple or Other	.36 [1.01]	.30 [1.05]	.32 [1.02]
Male	.40** [1.37]	.49** [1.62]	.63*** [2.10]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 5

Predictors of Latent Class Membership – Aggression

	Aggression		Aggression
	Moderate and Increasing	Consistently High	Consistently High
Reference Group	High and Decreasing		Moderate and Increasing
mTBI	1.11** [1.75]	.87 [1.02]	1.29*** [2.67]
Family History of Externalizing	.82 [1.09]	.51 [1.01]	.94** [1.42]
Family History of Internalizing	.60 [1.11]	.55 [1.06]	.63 [1.17]
Neighborhood SES	-.21** [.76]	-.17 [.97]	-.42*** [.86]
Parent-Child Conflict	.92** [1.83]	.70 [1.20]	.79** [1.29]
Victimization	.90** [1.59]	.82* [1.31]	.95*** [1.71]
Verbal IQ	.11* [1.10]	-.07* [.93]	-.11** [.89]
Age	-.19** [.94]	-.21** [.91]	-.28*** [.90]
African American	.79* [1.28]	.61 [1.05]	.84** [1.53]
Hispanic	.45 [1.03]	.41 [1.01]	.42 [1.01]
Multiple or Other	.31 [1.01]	.28 [1.00]	.34 [1.02]
Male	.36* [1.22]	.27 [1.09]	.39** [1.27]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 6 shows the multinomial logistic coefficients and odds ratios with the Consistently Low Anxiety/Depression Class as the reference. This analysis reveals that compared to participants in the consistently low class, individuals in the Moderate and Slowly Decreasing Anxiety/Depression Class were approximately 2 times more likely to have screened positive for a mTBI (OR=2.13, $p<.01$), participants in the Low and Increasing Anxiety/Depression Class were almost 2.5 times more likely to have experienced a mTBI (OR=2.42, $p<.01$), and individuals in the High and Increasing Class were almost 3 times more likely to have screened positive for a mTBI (OR=2.93, $p < .001$). However, compared to the consistently low class, participants in the Moderate and

Quickly Decreasing Anxiety/Depression class were not significantly more likely to have experienced a mTBI (OR=1.11, $p>.05$).

Table 7 displays the multinomial logistic coefficients and odds ratios with the Low and Increasing Anxiety/Depression Class as the reference. Compared to participants in the low and increasing class, participants in the High and Decreasing Anxiety/Depression Class were over 2 times more likely to have screened positive for a mTBI (OR=2.23, $p<.01$), but the participants in the Moderate and Quickly Decreasing Anxiety/Depression Class were not significantly more likely to have suffered a mTBI (OR=1.08, $p>.05$).

Table 6

Predictors of Latent Class Membership – Anxiety/Depression

	Anxiety/Depression			
	Moderate and Slowly Decreasing	Low and Increasing	Moderate and Quickly Decreasing	High and Increasing
Reference Group	Consistently Low			
mTBI	.86** [2.13]	.93** [2.42]	.66 [1.11]	1.02*** [2.93]
Family History of Externalizing	.59 [1.10]	.57 [1.08]	.51 [1.03]	.92** [1.74]
Family History of Internalizing	.85* [1.46]	.98*** [1.81]	.76* [1.32]	1.10*** [2.02]
Neighborhood SES	-.20* [.90]	-.38** [.89]	-.14 [.99]	-.42*** [.87]
Parent-Child Conflict	.66 [1.15]	.83** [1.94]	.60 [1.05]	1.16*** [2.76]
Victimization	.74* [1.59]	.93*** [1.67]	.54 [1.29]	1.29*** [2.28]
Verbal IQ	-.02 [.99]	-.03** [.97]	-.01 [.99]	-.05** [.95]
Age	-.09 [.97]	.10* [1.06]	-.03 [.99]	.14** [1.08]
African American	.63* [1.12]	.85** [1.37]	.37 [1.03]	1.17*** [2.06]
Hispanic	.32 [1.04]	.37 [1.04]	.45* [1.15]	.48* [1.19]
Multiple or Other	.27 [1.01]	.30 [1.02]	.28 [1.02]	.25 [1.00]
Male	.28** [1.27]	-.31*** [.69]	-.14* [.88]	.39*** [1.40]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 7

Predictors of Latent Class Membership – Anxiety/Depression

	Anxiety/Depression	
	Moderate and Quickly Decreasing	High and Increasing
Reference Group	Low and Increasing	
mTBI	.64 [1.08]	.90** [2.23]
Family History of Externalizing	.52 [1.02]	.60 [1.05]
Family History of Internalizing	-.30** [.85]	1.32*** [2.92]
Neighborhood SES	.21* [1.10]	-.36*** [.90]
Parent-Child Conflict	.61 [1.02]	.87** [1.73]
Victimization	.28 [1.04]	1.17*** [1.86]
Verbal IQ	.04* [1.16]	-.01 [.99]
Age	.11* [1.07]	.12** [1.11]
African American	-.21 [.99]	.62* [1.11]
Hispanic	.42* [1.13]	.30 [1.01]
Multiple or Other	.25 [1.00]	.27 [1.01]
Male	.29** [1.30]	.17* [1.18]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets*** $p < .001$; ** $p < .01$; * $p < .05$.

The left portion of Table 8 displays the multinomial logistic coefficients and odds ratios with the Moderate and Slowly Decreasing Anxiety/Depression Class as a reference. Compared to the reference class, the individuals in Low and Increasing Anxiety/Depression Class is almost 2 times more likely to have had a mTBI (OR=1.98, $p<.05$), and participants in the High and Decreasing Anxiety/Depression Class were approximately 3 times more likely to have experienced a mTBI (OR=3.10, $p<.001$). However, compared to the moderate and slowly declining class, participants in the Moderate and Quickly Decreasing class were not significantly more likely to have screened positive for a mTBI (OR=1.13, $p>.05$). The right portion of Table 8 displays the multinomial logistic coefficients and odds ratios with the Moderate and Quickly Decreasing Anxiety/Depression Class as a reference. Compared to participants in this

class, participants in the High and Increasing Anxiety/Depression Class were over 2.5 times to have had a mTBI (OR=2.79, $p<.001$).

Table 8

Predictors of Latent Class Membership – Anxiety/Depression

	Anxiety/Depression			Anxiety/Depression
	Low and Increasing	Moderate and Quickly Decreasing	High and Increasing	High and Increasing
Reference Group	Moderate and Slowly Decreasing			Moderate and Quickly Decreasing
mTBI	.83* [1.98]	.70 [1.13]	1.10*** [3.10]	.96*** [2.79]
Family History of Externalizing	.52 [1.04]	.50 [1.01]	1.01*** [1.87]	1.12*** [1.98]
Family History of Internalizing	.92** [1.69]	.78 [1.35]	1.17*** [2.13]	1.25*** [2.31]
Neighborhood SES	-.26** [.91]	-.12 [.99]	-.41*** [.86]	-.37** [.88]
Parent-Child Conflict	.77* [1.34]	.59 [1.07]	.95** [2.17]	.99*** [2.20]
Victimization	.67* [1.42]	.49 [1.10]	.89*** [1.89]	.91*** [1.95]
Verbal IQ	-.01 [.99]	.01 [1.00]	-.04** [.96]	-.05*** [.95]
Age	-.12** [1.07]	-.03 [.99]	-.15** [1.12]	-.15** [1.12]
African American	.67* [1.16]	.32 [1.01]	.88** [1.76]	.89** [1.77]
Hispanic	.31 [1.01]	.30 [1.00]	.42* [1.12]	.40* [1.10]
Multiple or Other	.30 [1.00]	.30 [1.00]	.34 [1.01]	.32 [1.01]
Male	.36** [1.36]	-.02 [.98]	.28** [1.27]	.31** [1.31]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 9 displays the multinomial logistic coefficients and odds ratios with the Consistently Low Attention Problems Class as the reference group. Compared to participants in this class, individuals in the other Attention Problems classes were not significantly more likely to have suffered a mTBI (ORs=.97-1.04, ps>.05). Table 10 displays the multinomial logistic coefficients and odds ratios with the Moderate and Decreasing Class as a reference group. Compared to participants in this reference group, the participants in the Moderate and Increasing Attention Problems Class were

approximately 1 time more likely to have experienced a mTBI (OR=1.10, p>.05), while participants in the Consistently High Attention Problems Class were not significantly more likely to have suffered a mTBI (OR=1.02, p>.05).

Table 9

Predictors of Latent Class Membership – Attention Problems

	Attention Problems			
	Low and Increasing	Moderate and Decreasing	Consistently High	Moderate and Increasing
Reference Group	Consistently Low			
mTBI	-.40 [.97]	-.27 [.99]	.58 [1.03]	.61 [1.04]
Family History of Externalizing	.87** [1.58]	.52 [1.07]	.93*** [1.76]	.80** [1.46]
Family History of Internalizing	.41 [1.11]	.40 [1.10]	.53 [1.17]	.52 [1.15]
Neighborhood SES	.08 [1.02]	.06 [1.01]	-.24** [.88]	-.20** [.90]
Parent-Child Conflict	.96*** [2.03]	.71 [1.62]	1.13*** [2.70]	.82* [1.90]
Victimization	-.15 [.99]	-.11 [.99]	.50 [1.27]	.43 [1.19]
Verbal IQ	.03 [1.03]	.02 [1.02]	-.03 [.98]	-.01 [.99]
Age	.01 [1.01]	.01 [1.01]	-.10* [.97]	-.03 [.99]
African American	.27 [1.02]	.23 [1.01]	.59* [1.20]	.41 [1.07]
Hispanic	.30 [1.02]	.29 [1.02]	.31 [1.02]	.30 [1.02]
Multiple or Other	.25 [1.01]	.27 [1.01]	.30 [1.01]	.27 [1.01]
Male	.68*** [1.68]	-.19* [.81]	.79*** [1.79]	.12 [1.12]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 10

Predictors of Latent Class Membership – Attention Problems

	Attention Problems	
	Consistently High	Moderate and Increasing
Reference Group	Moderate and Decreasing	
mTBI	.55 [1.02]	.70* [1.10]
Family History of Externalizing	.81** [1.48]	.77* [1.44]
Family History of Internalizing	.59 [1.20]	.60 [1.20]
Neighborhood SES	-.15* [.93]	-.09 [.98]
Parent-Child Conflict	.96*** [2.04]	.84* [1.91]
Victimization	.43 [1.19]	.45 [1.20]
Verbal IQ	-.01 [.99]	-.01 [.99]
Age	-.06 [.98]	-.01 [.99]
African American	.49 [1.11]	.28 [1.02]
Hispanic	.32 [1.03]	.31 [1.02]
Multiple or Other	.30 [1.01]	.29 [1.01]
Male	.52** [1.52]	.15 [1.15]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

The left section of Table 11 displays the multinomial logistic coefficients and odds ratios with the Low and Increasing Attention Problems Class as the reference group. Compared to this reference group, participants in the other classes were not more likely to have screened positive for mTBI (ORs=0.97-1.01, *p*s>.05). The right section of Table 11 displays the multinomial logistic coefficients and odds ratios with the Consistently High Attention Problems Class as a reference. Compared to the consistently high class, participants were not more likely to have experienced a mTBI (OR=0.99, *p*>.05).

Table 11

Predictors of Latent Class Membership – Attention Problems

	Attention Problems			Attention Problems
	Moderate and Decreasing	Consistently High	Moderate and Increasing	Moderate and Increasing
Reference Group	Low and Increasing			Consistently High
mTBI	-.29 [.97]	.52 [1.01]	-.10 [.99]	-.09 [.99]
Family History of Externalizing	-.63 [.89]	.49 [1.06]	.42 [1.05]	.40 [1.04]
Family History of Internalizing	.48 [1.06]	.59 [1.13]	.51 [1.10]	.45 [1.05]
Neighborhood SES	.10* [1.18]	-.07 [.98]	-.06 [.99]	-.06 [.99]
Parent-Child Conflict	-.64 [.87]	.79** [1.65]	.54 [1.14]	.59 [1.17]
Victimization	-.10 [.99]	.47 [1.20]	.15 [1.02]	.18 [1.04]
Verbal IQ	.03 [1.03]	-.01 [.99]	-.01 [.99]	.02 [1.02]
Age	.01 [1.01]	-.08 [.97]	-.01 [.99]	.01 [1.01]
African American	.37 [1.14]	.41 [1.17]	.39 [1.15]	.38 [1.14]
Hispanic	.32 [1.08]	.30 [1.06]	.31 [1.06]	.36 [1.13]
Multiple or Other	.31 [1.07]	.29 [1.03]	.33 [1.08]	.28 [1.02]
Male	.42** [1.42]	.10 [1.10]	.02 [1.02]	.02 [1.02]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

The left section of Table 12 displays the multinomial logistic coefficients and odds ratios with the Consistently Low Delinquency Class as the reference group\. Compared to participants in the reference group, the individuals in the Moderate and Decreasing Delinquency Class were over 1.5 times more likely to have experienced a mTBI (OR=1.63, $p < .05$), and participants in the Low and Increasing Delinquency Class were approximately 2 times more likely to have experienced a mTBI (OR=2.17, $p < .001$). The right portion of Table 12 displays the multinomial logistic coefficients and odds ratios with the Moderate and Decreasing Delinquency Class as a reference. Compared to the moderate and decreasing class, participants in the Low and Increasing

Class were not significantly more likely to have screened positive for mTBI (OR=1.38, $p>.05$).

Table 12

Predictors of Latent Class Membership – Delinquency

	Delinquency		Delinquency
	Moderate and Decreasing	Low and Increasing	Low and Increasing
Reference Group	Consistently Low		Moderate and Decreasing
mTBI	.76* [1.63]	.92*** [2.17]	.56 [1.38]
Family History of Externalizing	.92*** [1.77]	.98*** [1.81]	1.09*** [1.92]
Family History of Internalizing	.62 [1.15]	.79* [1.33]	.70 [1.24]
Neighborhood SES	-.27* [.92]	-.50*** [.79]	-.41*** [.84]
Parent-Child Conflict	.74* [1.25]	.89** [1.50]	.65** [1.18]
Victimization	.49* [1.36]	.63** [1.49]	.50* [1.37]
Verbal IQ	-.08*** [.92]	-.10*** [.90]	-.05*** [.95]
Age	-.06** [.97]	-.10*** [.91]	-.03** [.98]
African American	.74** [1.64]	.93*** [1.88]	.81***[1.70]
Hispanic	.41 [1.02]	.38 [1.01]	.35 [1.00]
Multiple or Other	.36 [1.00]	.37 [1.00]	.36 [1.00]
Male	-.04 [.99]	1.96*** [2.98]	1.45*** [2.46]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p < .001$; ** $p < .01$; * $p < .05$.

Table 13 displays the multinomial logistic coefficients and odds ratios with the Consistently Low Somatic Symptoms Class as a reference group. Compared to individuals in the reference group, participants in the Consistently Moderate Somatic Symptoms Class were not more likely to have experienced a mTBI.

Table 13

Predictors of Latent Class Membership – Somatic Symptoms

	Somatic Symptoms
	Consistently Moderate
Reference Group	Consistently Low
mTBI	.42 [1.08]
Family History of Externalizing	.61 [1.09]
Family History of Internalizing	1.10** [1.81]
Neighborhood SES	-.27 [.98]
Parent-Child Conflict	.89** [1.74]
Victimization	.99*** [1.86]
Verbal IQ	-.01 [.99]
Age	.12 [1.03]
African American	.56 [1.10]
Hispanic	.48 [1.02]
Multiple or Other	.43 [1.01]
Male	-.16** [.86]

Notes: Multinomial logistic coefficients. Odds-ratios are presented in brackets. *** $p <$ .001; ** $p <$ .01; * $p <$ .05.

CHAPTER IV

Discussion

The results of the current study reveal that LCA was able to identify heterogeneity in the psychopathology of the sample derived from the PHCDN with the models containing two-to-five-class solutions. In this sample, participants showed the highest degree of heterogeneity in their trajectories of anxiety/depression and attention problems (five-class solutions), followed by the trajectories of aggressive (four-class solution) and delinquent (three-class solution) behavior, and the least amount in their trajectories of somatic symptoms (two-class solution).

More importantly, confirming the original hypothesis, mTBI acted as a unique predictor of class membership. Additionally, the number of control variables added to the model served to strengthen the robust interpretation of this effect. As such, despite the strong associations between the control variables and the various forms of psychopathology, mTBI appears to act as a powerful transdiagnostic risk factor. Conceptually, the findings of the current study invoke the possibility of mTBI as a contributor to the *p* factor of general psychopathology (Caspi et al., 2014). Specifically, the presents results show that mTBI may act as a predictor of general psychopathology across the internalizing and externalizing dimensions.

Several additional key findings related to mTBI and class membership should be noted. First, the comparison between the Consistently Low Aggression Class and the Consistently High Aggression Class yielded an effect size showing an almost seven-fold increase in the likelihood of mTBI history for class members. This effect was the strongest derived from the present analysis, thus providing strong support for mTBI as a

unique predictor in this highly aggressive class of participants. Further, the examination of multiple comparisons between aggressive classes showed a general increase in the likelihood of mTBI as symptom severity increased. That is, consistently low, followed by high and decreasing, moderate and increasing, and finally, the most severe, consistently high. This was again generally supported in subsequent comparisons. This general trend is additionally seen in anxiety/depression, and delinquency classes. Although class membership is significantly related to mTBI, future research should focus on the potential mediating variables that further differentiate the predictors of class membership.

However, such a trend was not observed with attention problems or somatic symptoms. For attention problems, mTBI is only more likely to have been reported in members of the moderate and increasing class compared to the moderate and decreasing class. However, mTBI was not more prevalent in any of the classes when compared to the least severe symptom class (i.e., consistently low). The same holds true for the somatic symptom classes, as participants in the consistently moderate class were not more likely to have had a mTBI compared to members in the consistently low class. Members of the consistently moderate group were more likely to have a family history of internalizing symptoms, higher rates of parent-child conflict, higher rates of victimization, and to be female. This non-significance was also reported in a similar study using the PHDCN sample. This study found that after controlling for pre-injury levels of psychopathology, mTBI did not significantly predict an increase in either attention- or somatic-related symptoms (Connolly & McCormick, In Press).

Although speculative, other recent findings may explain these null-findings. To elucidate, six of the nine somatic symptoms assessed in the CBCL/4-18 (Achenbach,

1991) are commonly reported following mTBI (Willer & Leddy, 2006). However, only one of the symptoms measured in the PHDCN (i.e., fatigue) commonly occurs one to two years following insult (Starkey et al., 2018). As the current study utilized the sum of reported symptoms from each CBCL sub-scale, the current analyses may not be sensitive to trajectories of somatic symptoms reported after mTBI. Prior research examining attention problems has identified a significant association between mTBI and secondary-onset attention-deficit/hyperactivity disorder (Narad et al., 2018). However, survival analyses showed the risk of secondary onset increased over time, peaking at 6.8 years post-injury. This follow-up period is beyond the scope the current study.

Several limitations to the present study should be noted. First, the present study utilized a rudimentary screening process for mTBI. Specifically, parents were asked if their child had suffered a head injury or concussion, and severity was assessed via loss of consciousness and if the parents sought medical attention for their children. Future research should utilize more well-validated instruments such as the Ohio State Traumatic Brain Injury Identification method (Corrigan & Bogner, 2007) to examine the associations between head injury severity and psychopathology. Similarly, while the present study identified a positive association between mTBI and more-severe-psychopathology class membership, the current methodology precludes the ability to make casual interpretation. Thus, future research should replicate these results with methodology, such as quasi-experimental design, to strengthen causal inference.

Additionally, this study utilized data from a geographically-limited sample of children and adolescents in and around the greater Chicago area, therefore limiting the generalizability of the findings. Also, while the modelling approach of the present study

uncovered trajectories of psychopathology over a 2 to 2.5-year period, follow-up data beyond this period is not readily available. Therefore, future research should attempt to replicate these findings and further analyze the trajectories of psychopathology across the lifespan; although, as noted previously, adult psychopathology is highly related to childhood psychopathology (Kim-Cohen et al., 2003). Finally, while the present study identified latent classes separately for each CBCL/4-18 scale, future research should identify classes of psychopathology spanning multiple scales of internalizing and externalizing psychopathology. Further, such studies should examine the unique predictive power of mTBI for membership in such comorbid classes.

The results of the present study hold important implications for medical and public health professionals. First, while rates of mTBI diagnoses are increasing (Rosenthal, Foraker, Collins, & Comstock, 2014), potentially due to increased awareness and improved screening procedures, pediatricians, emergency room personnel, and other medical professionals should be aware of the mental health implications of mTBI. Additionally, parents should be informed of the mental health symptoms that may arise as a result of a mTBI and be instructed to seek follow-up care at first sign of changes in emotions, personality, or behavior. Also, children and adolescents may benefit from preemptive intervention efforts designed to reduce the development of psychopathology. More specifically, identifying youth with trajectories of severe and persistent behavioral problems for intervention programs allows for the maximally beneficial use of limited treatment resources (Glenn, 2018). The current study identified classes of varying severity trajectories, and this identification may help to determine treatment priorities and resource distribution.

CHAPTER V

Conclusion

A rapidly growing body of research has identified a connection between childhood and adolescent mTBI and a range of internalizing and externalizing psychopathology including delinquency. However, efforts to identify important risk factors related to the onset of these disorders is hampered by the heterogeneity in the profiles and trajectories displayed by adolescents and children suffering from psychopathology.

The goals of the present study were twofold. First, to explain the heterogeneity in the expression of both internalizing and externalizing psychopathology in childhood and adolescence, growth modeling techniques were applied to a large, diverse, and longitudinal sample of U.S. youth derived from the PHDCN. This analysis revealed differences in heterogeneity by symptom cluster with best-fitting models ranging from two to five class solutions.

Next, regression models were estimated to examine the unique contribution of mTBI to the prediction of latent class membership while controlling for a number of control variables shown to be related to both internalizing and externalizing psychopathology. The results of this analysis showed a robust association between mTBI and aggressive, delinquent, and anxious/depressed class membership. Moreover, effect-size estimates showed the likelihood of having experienced a mTBI generally related positively with the increase of psychopathology severity trajectories.

The results of this study provide evidence that mTBI may act as a powerful risk factor for general psychopathology across the internalizing-externalizing spectrum. As

such, these findings hold important implications for parents, mental health, and medical professionals who may come into contact with children and adolescents who have experienced a mTBI. Future research should strengthen the evidence of these findings by utilizing quasi-experimental designs and further explore the trajectories of psychopathology and their relationship to mTBI.

REFERENCES

Achenbach. T. M. (1990) Conceptualization of developmental psychopathology. In M. Lewis & S. M. Miller (Eds.), *Handbook of developmental psychopathology.* Boston, MA: Springer. Retrieved from https://doi.org/10.1007/978-1-4615-7142-1_1

Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile.* Burlington, VT: University of Vermont Department of Psychiatry.

Achenbach, T. M. (1992). *Manual for the Child Behavior Checklist/2-3 and 1992 Profile.* Burlington, VT: University of Vermont Department of Psychiatry.

Achenbach, T. M., & Edelbrock, C. S. (1983). *Manual for the Child Behavior Checklist: and Revised Child Behavior Profile.* University of Vermont, Department of Psychiatry.

Achenbach, T. M., & Rescorla, L. A. (2000). *Manual for the ASEBA preschool forms & profiles.* Burlington, VT: University of Vermont Department of Psychiatry.

Achenbach, T. M., & Rescorla, L. A. (2003). *Manual for the ASEBA Adult Forms and Profiles.* Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families.

Alexander, M. P. (1995). Mild traumatic brain injury: Pathophysiology, natural history, and clinical management. *Neurology, 45,* 1253-1260.

Alves, W., Macciocchi, S. N., & Barth, J. T. (1993). Post-concussive symptoms after uncomplicated mild head injury. *The Journal of Head Trauma Rehabilitation, 8*(3)*,* 48-59.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Ayduk, O., Rodriguez, M. L., Mischel, W., Shoda, Y., & Wright, J. (2006). Verbal intelligence and self-regulatory competencies: Joint predictors of boys' aggression. *Journal of Research in Personality, 41*(2), 374-388. Retrieved from https://doi.org/10.1016/j.jrp.2006.04.008

Barkhoudarian, G., Hovda, D. A., & Giza, C. C. (2011). The molecular pathophysiology of concussive brain injury. *Clinics in Sports Medicine, 30*(1), 33-48. doi:10.1016/j.csm.2010.09.001

Basten, M. M. G. J., Althoff, R. R., Tiemeier, H., Jaddoe, V. W. V., Hofman, A., Hudziak, J. J., … van der Ende, J. (2013). The dysregulation profile in young children: Empirically-defined classes in the Generation R study. *Journal of the American Academy of Child and Adolescent Psychiatry, 52*(8), 841-850. doi:10.1016/j.jaac.2013.05.007

Baumeister, H. (2010). A clinical significance criterion is essential for diagnosing subthreshold depression. *American Journal of Psychiatry, 167*(7)*,* 866.

Bazarian, J. J., Mcclung, J., Shah, M. N., Cheng, Y. T., Flesher, W., & Kraus, J. (2005). Mild traumatic brain injury in the United States, 1998-2000. *Brain Injury, 19*(2)*,* 85-91.

Beauchamp, M. H., Vera-Estay, E., Morasse, F., Anderson, V., & Dooley, J. (2018). Moral reasoning and decision-making in adolescents who sustain traumatic brain injury. *Brain Injury, 33*(1), 32-39. doi:10.1080/02699052.2018.1531307

Beesdo-Baum, K., Hofler, M., Gloster, A. T., Klotsche, J., Lieb, R., Beauducel, A., & Wittchen, H. U. (2009). The structure of common mental disorders: A replication study in a community sample of adolescents and young adults. *International Journal of Methods in Psychiatric Research, 18*(4), 204-220. doi:10.1002/mpr.293

Bianchi, V., Brambilla, P., Garzitto, M., Colombo, P., Fornasari, L., Bellina, M.,… Nobile, M. (2017). Latent classes of emotional and behavioural problems in epidemiological and referred samples and their relations to DSM-IV diagnoses. *European Child and Adolescent Psychiatry, 26*(5), 549-557. doi:10.1007/s00787-016-0918-2

Binder, L. M. (1986). Persisting symptoms after mild head injury: A review of the postconcussive syndrome. *Journal of Clinical and Experimental Neuropsychology, 8*(4), 323-346. doi:10.1080/01688638608401325

Bland, J. M., & Altman, D. G. (1997). Statistics notes Cronbach's alpha. *British Medical Journal, 314,* 372.

Bolzenius, J. D., Roskos, P. T., Salmien, L. E., Paul, R. H., & Bucholz, R. D. (2015). Cognitive and self-reported psychological outcomes of blast-induced mild traumatic brain injury in veterans: A preliminary study. *Applied Neuropsychology Adult, 22*(2), 79-87. doi:10.1080/23279095.2013.845823

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: An evolutionary-developmental theory of the origins and functions of stress reactivity. *Developmental Psychopathology, 17,* 271-201.

Brown, T. A., Chorpita, B. F., & Barlow, D. H. (1998). Structural relationships among dimensions of the DSM-IV anxiety and mood disorders and dimensions of negative affect, positive affect, and autonomic arousal. *Journal of Abnormal Psychology, 107*(2), 179-192.

Burstein, M., Georgiades, K., Lamers, F., Swanson, S. A., Cui, L., He, J., … Merikangas, K. R. (2012). Empirically-derived subtypes of lifetime anxiety disorders: Developmental and clinical correlates in U.S. adolescents. *Journal of Consulting and Clinical Psychology, 80*(1), 102-115. doi:10.1037/a0026069

Burt, S. A. (2009). Rethinking environmental contributions to child and adolescent psychopathology: A meta-analysis of shared environmental influences. *Psychological Bulletin, 135*(4), 608-637. doi:10.1037/a0015702

Burt, S. A., Kreuger, R. F., McGue, M., & Iacono, W. (2003). Parent-child and the comorbidity among child externalizing disorders. *Archives of General Psychiatry, 60*(5), 503-513. doi:10.1001/archpsyc.60.5.505

Burt, S. A., McGue, M., Krueger, R. F., & Iacono, W. G. (2005a). How are parent-child conflict and childhood externalizing symptoms related over time? Results from a genetically informative cross-lagged study. *Development and Psychopathology, 17*, 145-165. doi:10.10170S095457940505008X

Burt, S. A., McGue, M., Krueger, R. F., & Iacono, W. G. (2005b). Sources of covariation among the child-externalizing disorders: Informant effects and the shared environment. *Psychological Medicine, 35*(8), 1133-1144.

Carroll, L. J., Cassidy, J.D., Peloso, P. M., Borg, J., von Holst, H., Holm, L., … Pepin, M. (2004). Prognosis for mild traumatic brain injury: Results from the WHO collaborating centre task force on mild traumatic brain injury. *Journal of Rehabilitative Medicine, 43,* 84-105. doi:10.1080/16501960410023859

Caspi, A., Houts, R. M., Belsky, D. W., Goldman-Mellor, S. J., Harrington, H, Israel, S., … Moffitt, T. E. (2014). The p factor: One general psychopathology factor in the structure of psychiatric disorders? *Psychological Science, 2*(2), 119-137.

Caplan, L., Irvins, B., Poole, J., Vanderploeg, R., Jaffee, M., & Schwab, K. (2010) The structure of postconcussive symptoms in 3 US military samples. *The Journal of Head Trauma Rehabilitation, 25*(6), 447-458. doi:10.1097/HTR.0b013e3181d5bdbd

Celeux, G., & Soromenho, G. (1996). An entropy criterion for assessing the number of clusters in a mixture model. Journal of classification, 13(2), 195-212. Retrieved from https://hal.inria.fr/inria-00074799

Chorpita, B. F., Yim, L., Moffitt, C., Umemoto, L. A., & Francis, S. E. (2000). Assessment of symptoms of DSM-IV anxiety and depression in children: A revised child anxiety and depression scale. *Behavior Research and Therapy, 38,* 835-855.

Cicchetti, D., & Rogosch, F. A. (2002). A developmental psychopathology perspective on adolescence. *Journal of Consulting and Clinical Psychology, 70*(1), 6-20. doi:10.1037//0022-006X.70.1.6

Cicerone, K. D., & Kalmar, K. (1995). Persistent postconcussion syndrome: The structure of subjective complaints after mild traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 10*(3), 1-17.

Colantonio, A., Harris, J. E., Ratcliff, G., Chase, S., & Ellis, K. (2010). Gender differences in self-reported long term outcomes following moderate to severe traumatic brain injury. *BMC Neurology, 10*(1)*,* 102-109.

Connell, A., Bullock, B. M., Dishion, T. J., Shaw, D., Wilson, M., & Gardner, F. (2008). Family intervention effects on co-occurring early childhood behavioral and emotional problems: A latent transition analysis approach. *Journal of Abnormal Child Psychology, 36*(8)*,* 1211-1225. doi:10.1007/s10802-008-9244-6

Connolly, E., & McCormick, B. F. (In Press). Mild traumatic brain injury and psychopathology in adolescence: Evidence from the Project on Human Development in Chicago Neighborhoods. *Journal of Adolescent Health.*

Corrigan, J. D., & Bogner, J. Initial reliability and validity of the Ohio State University TBI Identification Method. *The Journal of Head Trauma Rehabilitation, 22*, 318-329.

Daneshvar, D. H., Riley, D. O., Nowinski, C. J., McKee, A. C., Stern, R. A., & Cantu, R. C. (2011). Long term consequences: Effects on normal development profile after concussion. *Physical Medicine & Rehabilitation Clinics of North America, 22*(4), 683-700. doi:10.1016/j.pmr.2011.08.009

Del Giudice, M., Ellis, B. J., & Shirtcliff, E. A. (2011). The Adaptive Calibration Model of stress responsivity. *Neuroscience and Biobehavioral Reviews, 35*(7), 1562-1592.

Del Giudice, M., Barrett, E. S., Belsky, J., Hartman, S., Martel, M. M., Sangenstedt, S., & Kuzawa, C. W. (2018). Individual differences in developmental plasticity: A role for early androgens? *Psychoneuroendocrinology, 90,* 165-173.

Earls, F., & Buka, S. L. (1997). *Project on Human Development in Chicago Neighborhoods: Technical Report.* Rockville, MD: National Institute of Justice.

Ehringer, M. A., Rhee, S. H., Young, S., Corley, R., & Hewitt, J. K. (2006). Psychopathologies of childhood and adolescence: A study of twins and their siblings. *Journal of Abnormal Child Psychology, 34*(1)*,* 1-17. Retrieved from https://doi.org/10.1007/s10802-005-9000-0

Epstein, D. J., Legarreta, M., Bueler, E., King, J., Mcglade, E., & Yurgelun-Todd, D. (2016). Oribitofrontal cortical thinning and aggression in mild traumatic brain injury patients. *Brain and Behavior, 6*(12)*,* 1-10. doi:10.1002/brb3.581

Farrer, T. J, Frost, R. B., & Hedges, D. W. (2011). Prevalence of traumatic brain injury in juvenile offenders: A meta-analysis. *Child Neuropsychology, 19*(3), 225-234. doi:10.1080/09297049.2011.647901

Faul, M., Xu, L., Wald, M. M., & Coronado, V. G. (2010). *Traumatic brain injury in the United States: Emergency Department Visits, Hospitalizations and Deaths 2002-2006.* Atlanta, GA: Centers for Disease Control and Prevention, National Center for Inquiry and Prevention Control. Retrieved from www.cdc.gov/TraumaticBrainInjury

Feigin, V. L., Theadom, A., Barker-Collo, S., Starkey, N. J., McPherson, K., Kahan, M., … Ameratunga, S. (2013). Incidence of traumatic brain injury in New Zealand: A population-based study. *The Lancet Neurology, 12*(1), 53-64. doi:10.1016/S1474-4422(12)70262-4

Gauthier, S., LeBlanc, J., Seresova, A., Laberge-Poirier, A., Correa, J. A., Alturki, A. Y., ... de Guise, E. (2018). Acute prediction of outcome and cognitive-communication impairments following traumatic brain injury: The influence of age, education and site of lesion. *Journal of Communication Disorders, 73*, 77-90. Retrieved from https://doi.org/10.1016/j.jcomdis.2018.04.003

Gennarelli, T. A., & Graham, D. I. (2005). Neuropathology. In J. M. silver et al. (Eds.), *Textbook of traumatic brain injury.* Washington D.C.: American Psychiatric Publishing.

Gerritsen, H., Samim, M., Peters, H., Schers, H., & van de Laar, F. A. (2018). Incidence, course and risk factors of head injury: A retrospective cohort study. *BMJ Open, 8*(5), 1-8.

Ghaemi, S. N., (2008). Why Antidepressants are not antidepressants: STEP-BD, STAR*D, and the return of neurotic depression. *Bipolar Disorders, 10*(8)*,* 957-968.

Glenn, A, L. (in press). Using biological factors to individualize interventions for youth conduct problems: Current state and ethical issues. *International Journal of Law and Psychiatry*. Retrieved from https://doi.org/10.1016/j.jijlp.2018.04.008

Greve, M. W., & Zink, B. J. (2009). Pathophysiology of traumatic brain injury. *Mount Sinai Journal of Medicine, 76*(2), 97-104. Retrieved from https://doi.org/10.1002/msj.20104

Hall, R. C. W., Hall, R. C. W., & Chapman, M. J. (2005). Definition, diagnosis, and forensic implications of postconcussional syndrome. *Psychosomatics, 46*(3), 195-202.

Hatoum, A. S., Rhee, S. H., Corley, R. P., Hewitt, J. K., & Freidman, N. P. (2018). Etiology of stability and growth of internalizing and externalizing behavior problems across childhood and adolescence. *Behavior Genetics, 48*(4), 298-314. Retrieved from https://doi.org/10.1007/s10519-018-9900-8

Higa-McMillan, C. K., Smith, R. L., Chorpita, B. F., & Hayashi, K. (2008). Common and unique factors associated with DSM-IV-TR internalizing disorders in children. *Journal of Abnormal Child Psychology, 36*(8), 1279-1288. doi:10.1007/s10802-008-9250-8

Hofstra, M. B., Van der Ende, J., & Verhulst, F. C. (2000). Continuity and change from psychopathology from childhood into adulthood: A 14-year follow-up study. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*(7), 850-858. Retrieved from https://doi.org/10.1097/00004583-200007000-00013

Jones, K. M., Barker-Collo, S., Parmar, P., Starkey, N., Theadom, A., Ameratunga, S., & Feigin, V. L. (2018). Trajectories in health recovery in the 12 months following a mild traumatic brain injury in children: findings from the BIONIC Study. *Journal of Primary Health Care, 10*(1), 81-89. Retrieved from https://doi.org/10.1071/HC17038

Kass, R. E., & Wasserman, L. (1995). A reference Bayesian test for nested hypotheses and its relationship to the Schwarz criterion. *Journal of the American Statistical Association, 90,* 634-928.

Kenny, D. T., & Lennings, C. J. (2007). The relationship between head injury and violent offending in juvenile detainees. *Crime and Justice Bulletin, 107,* 15-31.

Kessler, R. C., Avenevoli, S., Costello, J., Georgiades, K., Green, J. G., Gruber, M. J., … Merikangas, K. R. (2012). Prevalence, persistence, and sociodemographic correlates of DSM-IV disorders in the national comorbidity survey replication adolescent supplement. *Archives of General Psychiatry, 69*(4), 372-380. doi:10.1001/archgenpsychiatry.2011.160

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry, 62*(6), 593-602. doi:10.1001/archpsyc.62.6.593

Kim-Cohen, Caspi, A., Moffitt, T. E., Harrington, H., Milne, B., & Poulton, R. (2003). Prior juvenile diagnoses in adults with mental disorder: Developmental follow-back of a prospective-longitudinal cohort. *Archives of General Psychiatry, 60*(7), 709-717. doi:10.1001/archpsyc.60.7.709

Kirk, D. A., & Hardy, M. (2014). The acute and enduring consequences of exposure to violence on youth mental health and aggression. *Justice Quarterly, 31*(3), 539-567. doi:10.1080/07418825.2012.737471

Kirkwood, M. W., Yeates, K. O., & Wilson, P. E. (2006). Pediatric sports related concussion: A review of the clinical management of an oft-neglected population. *Pediatrics, 117*(4), 1359-1371. doi:10.1542/peds.2005-0994

Klomek, A. B., Marrocco, F., Kleinman, M., Schonfeld, I. S., & Gould, M. S. (2007). Bullying, depression, and suicidality in adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*(1), 40-49. Retrieved from https://doi.org/10.1097/01.chi.0000242237.84925.18

Kraemer, H. C. (1997). What is the 'right' statistical measure of twin concordance (or diagnostic reliability and validity)? *Archives of General Psychiatry, 54,* 1121-1124.

Kreuger, R. F. (1999). The Structure of common mental disorders. *Archives of General Psychiatry, 56*(10), 921-926.

Laker, S. R. (2011). Epidemiology of concussion and mild traumatic brain injury. *Physical Medicine & Rehabilitation, 3*(10.2), 354-358. Retrieved from https://doi.org/10.1016/j.pmrj.2011.07.017

Lambregts, S. A. M., Smetsers, J. E. M., Verhoeven, I. M. A. J., de Kloet, A. J., van der Port, I. G. L., Ribbers, G. M., & Catsman-Berrevoets, C. E. (2017). Cognitive function and participation in children and youth with mild traumatic brain injury two years after injury. *Brain Injury, 32*(2), 230-241. doi:10.1080/02699052.2017.1406990

Lamers, F., Burstein, M., He, J., Avenevoli, S., Angst, J., & Merikangas, K. R. (2012). Structure of major depressive disorder in adolescents and adults in the US general population. *The British Journal of Psychiatry, 201*(2), 143-150.

Last, C. G., Strauss, C. C., & Francis, G. (1987). Comorbidity among childhood anxiety disorders. *The Journal of Nervous and Mental Disorders, 175*(12), 726-730.

Leary, J. B., Kim, G. Y., Bradley, C. L., Hussain, U. Z., Sacco, M., Bernad, M., ... Chan, L. (2018). The association of cognitive reserve in chronic-phase functional and neuropsychological outcomes following traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 33*(1), 28-35. Retrieved from https://doi.org/10.1097/HTR.0000000000000329

Leventhal, T., & Brooks-Hunn, J. (2011). Changes in neighborhood poverty from 1990 to 2000 and youth's problem behaviors. *Developmental Psychology, 47*(6), 1680-1698. doi:10.1037/a0025314

Leventhal, T., Xue, Y., & Brooks-Hunn, J. (2006). Immigrant differences in school-age children's verbal trajectories: A look at four racial/ethnic groups. *Child Development, 77*(5), 1359-1374. Retrieved from http://www.jstor.org/stable/3878438

Lumba-Brown, A., Yeates, K. O., Gioia, G, G., Turner, M., Benzel, E., Suskauer, S., … Timmons, S. (2016). *Report from the Pediatric Mild Traumatic Brain Injury Work Group: Systematic review and clinical recommendations for healthcare providers on the diagnosis and management of mild traumatic brain injury in children.* Atlanta, GA: Centers for Disease Control.

Luyten, P., Blatt, S. J., van Houdenhove, B., & Corveleyn, J. (2006). Depression research and treatment: Are we skating to where the puck is going to be? *Clinical Psychology Review, 26*(8), 985-999.

Martin, K. R., & Schoua-Glusberg, A. (2002). *Project on Human Development in Chicago Neighborhoods Longitudinal Cohort Study: Field data collection report.* Cambridge, MA: Harvard University.

Masi, G., Millepiedi, S., Mucci, M., Poli, P., Bertini, N., & Milatoni, L. (2004). Generalized anxiety disorder in referred children and adolescents. *The Journal of the American Academy of Child and Adolescent Psychiatry, 4*(6), 752-760. doi:S0890-8567(09)61325-3 10.1097/01.chi.0000121065.29744.d3

McCrory, P. R., & Berkovic, S. F. (2001). The history of clinical and pathophysiological concepts and misconceptions. *Neurology, 57*(12), 2283-2289. doi:10.1212/WNL.57.12.2283

McGlade, E., Rogowaska, J., & Yurgelun-Todd, D. (2015). Sex differences in orbitofrontal connectivity in male and female veterans with TBI. *Brain Imaging and Behavior, 9*(3)*,* 535-549. doi:10.1007/s11682-015-9379-3

McLaughlin, K. A., Hilt, L. M., & Nolen-Hoeksema, S. (2007). Racial/ethnic differences in internalizing and externalizing symptoms in adolescents. *Journal of Abnormal Child Psychology, 35*(5), 801-816. Retrieved from https://doi.org/10.1007/s10802-007-9128-1

Merikangas, K. R., He, J., Burstein, M. S., Swanson, S. A., Avenevoli, S., Cui, L., … Swendsen, J. (2010). Lifetime prevalence of mental Disorders in US adolescents: Results from the National Comorbidity Study-Adolescent Supplement (NCS-A). *Journal of the American Academy of Child and Adolescent Psychiatry*, *49*(10), 980–989. Retrieved from http://doi.org/10.1016/j.jaac.2010.05.017

Middleboe, T., Anderson, H. S., Birket-Smith, M., & Friis, M. L. (1992). Minor head injury: Impact on general health after 1 year. A prospective follow-up study. *Acta Neurologica Scandanavia, 85*(1)*,* 5-9.

Mild Traumatic Brain Injury Committee. (1993). Committee of the head injury interdisciplinary special interest group of the American Congress of Rehabilitation Medicine. Definition of mild traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 8*(3), 86-867.

Mooney, G., & Speed, J. (2011). The association between mild traumatic brain injury and psychiatric conditions. *Brain Injury, 15*(10), 365-877. doi:10.1037/a0025462

Morissette, S. B., Woodward, M., Kimbrel, N. A., Meyer, E. C., Kruse, M. I., Dolan, S., & Gulliver, S. B. (2011). Deployment-related TBI, persistent postconcussive symptoms, PTSD, and depression in OEF/OIF veterans. *Rehabilitation psychology, 56*(4), 340. doi:10.1037/a0025462.

Munir, K. M., & Beardslee, W. R. (1999). Developmental psychiatry: is there any other kind?. *Harvard Review of Psychiatry*, *6*(5), 250-262.

Muris, P., Schmidt, H., Engelbrecht, P., & Perold, M. (2002). DSM-IV-defined anxiety disorder symptoms in South African children. *Journal of the Academy of Child and Adolescent Psychiatry, 41*(11), 1360-1368. doi:S0890-8567(09)60642-010.1097/00004583-200211000-00018

Muthén, L. K., & Muthén, B. O. (1998-2012). *Mplus user's guide.* Los Angeles, CA: Muthén and Muthén.

Muthén, B. O., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes.

Alcoholism: Clinical and Experimental Research, 24(6), 882-892. doi:0145-6008/00/2406-0882$03.00/0

Nadder, T. S., Rutter, M., Silberg, J., Maes, H., & Eaves, L. (2002). Genetic effects on the variation of attention deficit-hyperactivity disorder (ADHD) and oppositional-defiant disorder/conduct disorder (ODD/CD) symptomologies across informant and occasion of measurement. *Psychological Medicine, 32*(1), 39-53. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/11883729

Narad, M. E., Kennelly, M., Zhang, N., Wade, S. L., Yeats, K. O., Taylor, H. G., … Kurowski, B. G. (2018). Secondary attention-deficit/hyperactivity disorder in children and adolescents 5 to 10 years after traumatic brain injury. *JAMA Pediatrics, 172*(5), 437-443. doi:10.1001/jamapediatrics.2017.5746

National Institutes of Health. (1999). NIH consensus development panel on rehabilitation of persons with traumatic brain injury. *JAMA, 282,* 974-983.

Newcombe, V. F. J., Outtrim, J. G., Chatfield, D. A., Manktelow, A., Hutchinson, P. J., Coles, J. P., Williams, G. B., … Menon, D. K. (2011). Parcellating the neuroanatomical basis of impaired decision-making in traumatic brain injury. *Brain, 134*(3)*,* 759-768.

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14*(4), 535-569.

O'Hare, W., & Mather, M. (2003). *The growing number of kids in severely distressed neighborhoods: Evidence from the 2000 census.* Baltimore, MD: Annie E. Casey Foundation and Population Reference Bureau.

Orr, L., Feins, J. D., Jacob, R., Beecroft, E., Sanbonmatsu, L., Katz, L. F., … Kling, J. R. (2003). *Moving to Opportunity interim impacts evaluation.* Washington, DC: U.S. Department of Housing and Urban Development.

Pacella, M., Prabhu, A., Morley, J., Huang, S., & Suffoletto, B. (2018). Postconcussive symptoms over the first 14 days after mild traumatic brain injury: an experience sampling study. *The Journal of Head Trauma Rehabilitation, 33*(3), 31-39. doi:10.1097/HTR.0000000000000335

Parker, G. (2005). Beyond major depression. *Psychological Medicine, 35*(4)*,* 467-474.

Parker, G. (2006). Through a glass darkly: The disutility of the DSM nosology of depressive disorders. *Canadian Journal of Psychiatry, 51*(14)*,* 879-886.

Paykel, E. S. (2008). Basic concepts of depression. *Dialogues in Clinical Neuroscience*, *10*(3), 279-289.

Peiper, N., Clayton, R., Wilson, R., Illback, R., O'Brien, E., Kerber, R., …Hornung, C. (2015). Empirically derived subtypes of serious emotional disturbance in a large adolescent sample. *Social Psychiatry and Psychiatric Epidemiology, 50*(6)*,* 983-994. doi:10.1007/s00127-015-1017-2

Peters, D. J. (2009). Typology of American poverty. *International Regional Science Review, 32,* 19-39. doi:10.1177/0160017608325795

Plomin, R., & Daniels, D. (1987). Why are children in the same family so different from one another? *Behavioral and Brain Sciences, 10*(1)*,* 1-16.

Rand, D., & Ronald, L. S. (2018). Life-course contingencies in the development of adolescent antisocial behavior. In T. Thornberry (Ed.), *Developmental theories of crime and delinquency* (pp. 46-82). New York, NY: Routledge.

Rees, P. M. (2003). Contemporary issues in mild traumatic brain injury. *Archives of Physical Medicine and Rehabilitation, 84*(12), 1885-1894. doi:10.1016/j.apmr.2003.03.001

Rockhill, C. M., Fann, J. R., Fan, M. Y., Hollingworth, W., & Katon, W. J. (2010). Healthcare costs associated with mild traumatic brain injury and psychological distress in children and adolescents. *Brain Injury, 24*(9), 1051-1060. doi:10.3109/02699052.2010.494586

Rodgers, S., Holtforth, G., Muller, M., Hengartner, M. P., Rossler, W., & Ajdacic-Gross, V. (2014). Symptom-based subtypes of depression and their psychosocial correlates: A person-centered approach focusing on the influence of sex. *Journal of Affective Disorders, 156,* 92-103.

Rosato, S. N., & Baer, J. C. (2012). Latent class analysis: A method for capturing heterogeneity. *Social Work Research, 36*(1), 61-69. Retrieved from https://doi.org/10.1093/swr/svs006

Rosenthal, J. A., Foraker, R. E., Collins, C. L., & Comstock, R. D. (2014). National high school athlete concussion rates from 2005-2006 to 2011-2012. *The American Journal of Sports Medicine, 42*(7), 1710-1715. doi:10.1177/0363546514530091

Ross, C. E. (2000). Neighborhood disadvantage and adult depression. *Journal of Health and Social Behavior, 41*(2), 177-187. Retrieved from http://www.jstor.org/stable/2676304

Rutherford, W. H. (1989) Postconcussion symptoms: Relationship to acute neurological indices, individual differences, and circumstances of injury. In H. Levin, H

Eisenberg, & A. Benton (Eds.), *Mild head injury* (pp. 217-228) New York City, NY: Oxford University Press.

Rutter, M. (1997). Comorbidity: Concepts, claims and choices. *Criminal Behavior and Mental Health, 7*(4)*,* 265-285.

Rutter, M., & Sroufe, L. A. (2000). Developmental psychopathology: Concepts and challenges. *Development and Psychopathology, 12*(3)*,* 265-296.

Sampson, R. J. (2012). *Great American city: Chicago and the enduring neighborhood effect*. Chicago, IL: University of Chicago Press.

Sampson, R. J., Morenoff, J. D., & Raudenbush, S. (2005). Social anatomy of racial and ethnic disparities in violence. *American Journal of Public Health, 95*(2), 224-232. doi:10.2105/AJPH.2004.037705

Sampson, R. J., Sharkey, P., & Raudenbush, S. W. (2007). Durable effects of concentrated disadvantage on verbal ability among African-American children, *PNAS, 105*(3), 845-852. Retrieved from http://www.pnas.org/cgi/doi/10.1073/pnas.0710189104

Santiago, C. D., Wadsworth, M. E., & Stump, J. (2011). Socioeconomic status, neighborhood disadvantage, and poverty-related stress: Prospective effects on psychological syndromes among diverse low-income families. *Journal of Economic Psychology, 32*(2), 218-230. Retrieved from https://doi.org/10.1016/j.joep.2009.10.008

Schindler, A. G., Meabon, J. S., Pagulayan, K. F., Hendrickson, R. C., Meeker, K. D., Cline, M., … Cook, D. G. (2017). Blast-related disinhibition and risk seeking in mice and combat veterans: Potential role for dysfunctional phasic dopamine

release. *Neurobiology of Disease, 106,* 23-34. Retrieved from https://doi.org/10.1016/j.nbd.2017.06.004

Schneiderman, A. I., Braver, E. R., & Kang, H. K. (2008). Understanding sequelae of injury mechanisms and mild traumatic brain injury incurred during the conflicts in Iraq and Afghanistan: Persistent postconcussive symptoms and posttraumatic stress disorder. *American Journal of Epidemiology, 167*(12), 1446-1452. doi:10.1093/aje/kwn068

Schofield, P. W., Malacova, E., Preen, D. B., D'Este, C., Tate, R., Reekie, J., … Butler, T. (2015). Does traumatic brain injury lead to criminality? A whole-population retrospective cohort study using linked data. *PLoS ONE, 10*(7), 1-13. doi:10.1371/journal.pone.0132558

Schwartz, J. A., Connolly, E. J., & Valgardson, B. A. (2018). An evaluation of the directional relationship between head injuries and subsequent changes in impulse control and delinquency in a sample of previously adjudicated males. *Journal of Criminal Justice*. *56,* 70-80. Retrieved from https://doi.org/10.1016/j.jcrimjus.2017.08.004

Scott, C., McKinlay, A., McLellan, T., Britt, E., Grace, R., & McFarlane, M. (2015). A comparison of adult outcomes for males compared to females following pediatric traumatic brain injury. *Neuropsychology, 29*(4), 501-508. Retrieved from http://dx.doi.org/10.1037/neu0000074

Seabury, S. A., Gaudette, E., Goldman, D. P. (2018). Assessment of follow-up care after emergency department presentation for mild traumatic brain injury and

concussion. Results from the TRACK-TBI study. *JAMA Network Open, 1*(1), 180210-180223. doi:10.1001/jamanetworkopen.2018.0210

Silberg, J., Rutter, M., Meyer, J., Maes, H., Hewitt, J. K., Simonoff, E., … Eaves, L. (1996). Genetic and environmental influences on the covariation between hyperactivity and conduct disturbance in juvenile twins. *Journal of Child Psychology and Psychiatry, 37*(7), 803-816. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/8923223

Spence, S.H. (1997). Structure of anxiety symptoms among children. *Journal of Anxiety Disorders, 106*(2), 280-297.

Sroufe, L. A., & Rutter, M. (1984). The domain of developmental psychopathology. *Child Development, 55,* 17-29.

StataCorp (2013). *Stata statistical software: Release 13.* College Station, TX: StataCorp LP.

Starkey, N. J., Jones, K., Case, R., Theadom, A., Barker-Collo, S., Feigin, V. (2018). Post-concussive symptoms after mild traumatic brain injury during childhood and adolescence. *Brain Injury, 32*(5), 617-626. doi:10.1080/02699052.2018.1339533

Svingos, A. M., Asken, B. M., Bauer, R. M., DeKosky, S. T., Hromas, G. A., Jaffree, M. S., … Clugston, J. R. (2019). Exploratory study of sport-related concussion effects on peripheral micro-RNA expression. *Brain Injury, 33*(3), 1-7. doi:10.1080/02699052.2019.1573379

Tagliaferri, F., Compagnone, C., Korsic, M., Servadei, F., & Kraus, J. (2006). A systematic review of brain injury epidemiology in Europe. *Acta Neurochirurgica, 148*(3), 255-268. Retrieved from https://doi.org/10.1007/s00701-005-0651-y

Taylor, C. A., Bell, J. M., Breiding, M. J., & Xu, L. (2017). Traumatic brain injury-related emergency department visits, hospitalizations, and deaths – United States, 2007-2013. *Morbidity and Mortality Weekly Report – Surveillance Summaries, 66*(9), 1-16. doi:10.15585/mmwr.ss6609a1

Terrio, H., Brenner, L. A., Ivins, B. J., Cho, J. M., Helmick, K., Schwab, K., ... Warden, D. (2009). Traumatic brain injury screening: Preliminary findings in a US Army Brigade Combat Team. *The Journal of Head Trauma Rehabilitation, 24*(1), 14-23. doi:10.1097/HTR.0b013e31819581d8

Thapar, A., Harrington, R., & McGuffin, P. (2001). Examining the comorbidity of ADHD-related behaviours and conduct problems using a twin study design. *British Journal of Psychiatry, 179,* 224-229. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/11532799

Turner, H. A., Finkelhor, D., & Ormrod, R. (2009). The effects of adolescent victimization on self-concept and depressive symptoms. *Child Maltreatment, 15*(1), 76-90. Retrieved from https://doi.org/10.1177%2F1077559509349444

Tuvblad, C., Zheng, M., Raine, A., & Baker, L. A. (2009). A common genetic factor explains the covariation among ADHD ODD and CD symptoms in 9–10 year old boys and girls. *Journal of Abnormal Child Psychology, 37*(2), 153–167. http://doi.org/10.1007/s10802-008-9278-9

U.S. Census Bureau. (1995). *Statistics brief: Poverty areas.* Retrieved from http://www.census.gov/apsd/www/statbrief/sb95_13.pdf

Van Hulle, C. A., Irwin, W., & Lahey, B. B. (2018). Sex differences in the genetic and environmental influences on self-reported non-aggressive and conduct disorder

symptoms in early and middle adolescence. *Behavior Genetics, 48*(4), 271-282. Retrieved from https://doi.org/10.1007/s10519-018-9907-1

Wakefield, J. C., Schmitz, M. F., & Baer, J. C. (2010). Does the DSM-IV clinical significance criterion for major depression reduce false positives? Evidence from the National Comorbidity Survey Replication. *American Journal of Psychiatry, 167*(3), 298-304.

Watson, D. (2005). Rethinking mood and anxiety disorders. A quantitative Hierarchical Model for DSM-V. *Journal of Abnormal Psychology, 114*(4), 522-536.

Wechsler, D. (1974). *Wechsler Intelligence Scale for Children-Revised.* New York, NY: Psychological Corporation.

Willer, B., Leddy, J. J. (2006). Management of concussion and post-concussion syndrome. *Current Treatment Options in Neurology, 8,* 415-426.

Williams, S., Dahan, J., Silverman, W. K., & Pettit, J. W. (2013). Heterogeneous classes of co-occurring externalizing symptoms in a sample of youth referred for anxiety disorders. *Journal of Anxiety Disorders, 27*(3), 340-346.

Wilson, W. J. (1987). *The truly disadvantaged: The inner city, the under-class, and public policy.* Chicago, IL: University of Chicago Press.

Witchen, H. U., Beesdo, K., & Gloster, A. T. (2009). The position of anxiety disorders in structural models of mental disorders. *Psychiatric Clinics of North America, 32*(3), 465-481. doi:S0193-953X(09)00058-610.1016/j.psc.2009.06.004

Wright, D. K., O'Brein, T. J., Shultz, S. R., & Mychasiuk, R. (2017). Sex matters; Repetitive mild traumatic brain injury in adolescent rats. *Annals of Clinical and Translational Neurology, 4*(9), 640-654. doi:10.1002/acn3.441

Xu, X., Cao, S., Chao, H., Liu, Y., & Ji, J. (2016). Sex-related differences in striatal dopaminergic system after traumatic brain injury. *Brain Research Bulletin, 124,* 214-221. Retrieved from http://dx.doi.org/10.1016/j.brainresbull.2016.05.010

Zinbarg R. E., & Barlow, D. H. (1996). Structure of anxiety and anxiety disorders: A hierarchical model. *Journal of Abnormal Psychology, 105*(2), 181-193.

Zona, K., & Milan, S. (2011). Gender differences in the longitudinal impact of exposure to violence on mental health in urban youth. *Journal of Youth and Adolescence, 40*(12), 1674-1690. doi:10.1007/s10964-011-9649-3

APPENDIX A

Sam Houston State University

Date: Nov 21, 2018 3:35 PM CST

TO: Brandon Mccormick
David Nelson, Eric Connolly
FROM: SHSU IRB
PROJECT TITLE: Mild traumatic brain injury as a unique predictor of latent class membership for child and adolescent delinquency, criminal justice involvement, and psychopathology: Evidence from a large sample of U.S. youth
PROTOCOL #: IRB-2018-169
SUBMISSION TYPE: Initial
ACTION: Exempt
DECISION DATE: November 21, 2018
EXEMPT REVIEW CATEGORY: Category 4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Greetings,

Thank you for your submission of Initial Review materials for this project. The Sam Houston State University (SHSU) IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations.

Since Cayuse IRB does not currently possess the ability to provide a "stamp of approval" on any recruitment or consent documentation, it is the strong recommendation of this office to please include the following approval language in the footer of those recruitment and consent documents: IRB-2018-169/November 21, 2018.

We will retain a copy of this correspondence within our records.

*** What should investigators do when considering changes to an exempt study that could make it nonexempt?**

It is the PI's responsibility to consult with the IRB whenever questions arise about whether planned changes to an exempt study might make that study nonexempt human subjects research.

In this case, please make available sufficient information to the IRB so it can make a correct determination.

If you have any questions, please contact the IRB Office at 936-294-4875 or irb@shsu.edu. Please include your project title and protocol number in all correspondence with this committee.

Sincerely,

Donna Desforges
IRB Chair, PHSC

APPENDIX B

Prompt: I am going to read a list of items that describe behavior problems that many children have. Please tell me whether each statement has been (2) OFTEN true, (1) SOMETIMES true, or (0) NOT true of [participant name] during the past 6 months.

Somatic Complaints

1. Feels Dizzy
2. Overtired

Has physical problems with no known medical cause, like…

3. Aches or pains, not including headaches
4. Headaches
5. Nausea, feels sick
6. Problems with eyes
7. Rashes or other skin problems
8. Stomach aches or cramps
9. Vomiting, throwing up

Anxious/Depressed

1. Complains of loneliness
2. Cries a lot
3. Fears he or she might do something bad
4. Feels he/she has to be perfect
5. Feels or complains that no one loves him/her
6. Feels others are out to get him/her
7. Feels worthless or inferior
8. Is nervous, high-strung, or tense
9. Too fearful or anxious
10. Feels too guilty
11. Self-conscious or easily embarrassed
12. Suspicious
13. Unhappy, sad, or depressed
14. Worries

Attention Problems

1. Can’t concentrate, can’t pay attention for long
2. Can’t sit still, is restless, or hyperactive
3. Confused or seems to be in a fog
4. Day dreams or gets lost in his/her thoughts
5. Is impulsive or acts without thinking
6. Poor school work

7. Stares blankly
8. Acts young (Not included)
9. Twitches (Not included)
10. Clumsy (Not included)

Delinquent Behavior

1. Doesn't seem to feel guilty after misbehaving
2. Hangs out with others who get in trouble
3. Lies or cheats
4. Prefers being with older kids
5. Runs away from home
6. Sets fires
7. Swears or uses obscene language
8. Truant, skips school
9. Steals from home (Not included)
10. Steals from outside the home (Not included)
11. Thinks about sex often (Not included)
12. Uses drugs or alcohol (Not included)
13. Vandalizes (Not included)

Aggression

1. Argues a lot
2. Cruelty, Bullying, or meanness to others
3. Demands a lot of attention
4. Destroys things belonging to his/her family or others
5. Disobedient at home
6. Disobedient at school
7. Gets in many fights
8. Screams a lot
9. Stubborn, sullen, or irritable
10. Sudden changes in mood or feelings
11. Teases a lot
12. Has temper tantrums or a hot temper
13. Threatens people
14. Brags (Not included)
15. Destroys own things (Not included)
16. Jealous (Not included)
17. Attacks others (Not included)
18. Shows off (Not included)
19. Loud (Not included)

VITA

Brandon F. McCormick
Curriculum Vitae

EDUCATION

Master of Arts, Clinical Psychology May 2019

Sam Houston State University, Huntsville, TX

Bachelor of Arts, Psychology May 2017

Penn State University, University Park, PA

Bachelor of Arts, Criminology May 2017

Penn State University, University Park, PA

Paterno Fellowship Program August 2013 – May 2017

Penn State University, University Park, PA

- Honors Program including advanced academic coursework, thesis, study abroad and/or internship, ethics study and leadership/service commitment

Schreyer's Honors College August 2015 – May 2017

Penn State University, University Park, PA

- Penn State University's honors college. Schreyer's scholars are given additional opportunities for academic enrichment, and career advancement. In return Schreyer's Scholars are expected to maintain a high GPA, enroll in rigorous honors courses, and complete an honors thesis

RESEARCH EXPERIENCE

Graduate Student Researcher March 2018 – Present

Advisor: Dr. Justin Allen

Personality in Education Research Lab, Sam Houston State University, Huntsville, TX

- Research focus: The Manifestation Determination Review process for K-12 students, and the behavioral correlates of emotional disturbance in youth
- Additional Responsibilities: Oversaw a group of three undergraduate researchers, to ensure prompt completion of tasks, facilitated idea generation, and mentored as needed

Graduate Student Researcher January 2018 – Present

Advisor: Dr. Eric Connolly

Life-Course Biosocial Lab, Sam Houston State University, Huntsville, TX

- Research Focus: The long-term effects of mild traumatic brain injury in youth including internalizing symptoms, externalizing symptoms, and delinquency

Research Assistant January 2014 – May 2017

Advisor: Dr. Reginald Adams

Social Perception and Emotion Lab, Penn State University, University Park, PA

- Research Focus: The use of humor as a coping mechanism to deal with negative life events
- Additional Responsibilities: Oversaw undergraduate researchers to ensure prompt completion of tasks, aided in the generation of experimental stimulus using a variety of programs, ran participants, and collected articles for literature reviews

PAPERS AND PRESENTATIONS

Masters of Arts Thesis

McCormick, B. F., (2019). Mild traumatic brain injury as a unique predictor of latent class membership for child and adolescent delinquency and psychopathology: Evidence from a large sample of U.S. youth. Master of Arts (Clinical Psychology), May, 2019, Sam Houston State University, Huntsville, TX.

Manuscripts in Press

Connolly, E. J., & **McCormick, B. F.** (In Press). Mild traumatic brain injury and emerging psychopathology in adolescence: Evidence from the Project on Human Development in Chicago Neighborhoods – Longitudinal Cohort Study. *Journal of Adolescent Health.*

Manuscripts in Preparation

McCormick, B. F., Connolly, E. J., & Nelson, D. (In Prep). Mild traumatic brain injury as a risk factor for childhood and adolescent justice involvement: Evidence from the Project on Human Development in Chicago Neighborhoods – Longitudinal Cohort Study.

McCormick, B. F., Connolly, E. J., & Nelson, D. (In Prep). Neighborhood clusters of mild traumatic brain injury and crime: Evidence from the Project on Human Development in Chicago Neighborhoods – Longitudinal Cohort Study.

Allen, J. P., & **McCormick, B. F.** (In Prep). A meta-analysis of single case design studies examining the effectiveness of video self-modeling for youth with emotional disturbance.

Connolly, E. J., Isbell, K. D., & **McCormick, B. F.** (In Prep). The effect or childhood concussion on adolescent delinquent behavior and contact with the justice system: Evidence from a population-based sample of U.S. youth.

Allen, J. P., Conn, T., & **McCormick, B. F.** (In Prep). Expert perceptions of behavioral manifestations of disabilities.

Noland, R.M., Maloney, K., Yenne, E., **McCormick, B. F.**, & Organ, J. A. (In Prep). Comparison of test administrator use of a keyboard, stylus writing and pencil

writing during WAIS-IV verbal subtest administration: Are there meaningful differences?

Undergraduate Honors Thesis

McCormick, B. F. (2017). *Laugh it off: The Reappraisal of Negative Life Events Through Humorous Memoir Writing.* Honors Thesis, Bachelor of Arts (Psychology), May, 2017, The Pennsylvania State University, University Park, PA.

Posters / Presentations

McCormick, B. F., Connolly, E. J., & Nelson, D. (2019, March). *Mild Traumatic Brain Injury and Emerging Psychopathology in Adolescence: Evidence from the Project on Human Development in Chicago Neighborhoods*. International Brain Injury Association, 13th World Congress on Brain Injury. Toronto, Canada.

McCormick, B. F., Steiner, T. G., & Adams, R. B. (2017, April). *Laugh it off: The Reappraisal of Negative Life Events Through Humorous Memoir Writing.* Psi Chi Psychology National Honors Society Undergraduate Research Conference, University Park, PA.

McCormick, B. F., Steiner, T. G., & Adams, R. B. (2016, April). *The Reappraisal of Negative Life Events Through Humorous Memoir Writing.* Psi Chi Psychology National Honors Society Undergraduate Research Conference (Conceptual Poster), University Park, PA.

INSTRUCTIONAL EXPERIENCE

Graduate Assistant Writing Tutor, Academic Success Center January 2018 - Present
Sam Houston State University, The Woodlands, TX

- Facilitated the enhancement of the writing assignments of undergraduate to doctoral level students. Helped students with the APA formatting, syntax, organization, grammar, and clarity of their papers for 20 hours per week
- Conducted lectures on APA format and style to undergraduate and graduate level courses
-

Teaching Assistant, Corrections January 2016 – May 2017

Penn State University, University Park, PA

- Primary duties: Created a service learning project in which students will create a lecture designed to help inmate gain employment upon community re-entry
- Teaching responsibilities: Held regular meetings to aid students with project progress, and to ensure timely completion

Invited Lecturer, Forensic Psychology September 2016

Penn State University, University Park, PA

- Invited to lecture on experiences in the field of mental health treatment with a correctional population

Teaching Assistant, Basic Research Methods in Psychology August 2015 - December 2015

Penn State University, University Park, PA

- Primary duties: Facilitated classroom learning activities with 150 undergraduate students, answered students' questions regarding course material in class and via email, created weekly practice quizzes, and aided in curriculum planning
- Teaching responsibilities: Facilitated review sessions prior to each examination

INTERNSHIPS / PRACTICAL EXPERIENCE

Practicum II/III Placement August 2018 – December 2018

Montgomery County Mental Health Treatment Faculty, Conroe, TX

- Conducted intake assessments
- Conducted competency to stand trial evaluations
- Participated in an interdisciplinary treatment team to devise effective competency restoration treatment protocols

Practicum I February 2018 – May 2018

Sam Houston State University, Huntsville, TX

- Conducted individual psychotherapy with volunteer clients
- Created treatment plans and monitored the progress of ongoing mock clients
-

Practicum I Placement February 2018 – April 2018

Texas Department of Criminal Justice, Ellis Unit, Huntsville, TX

- Worked closely with correctional mental health professionals
- Conducted supervised individual psychotherapy with a number of inmates
- Administrated weekly or twice-weekly anger management group sessions with 10-14 inmates

Therapeutic Support Counselor July 2017 – August 2017

Camp Kon-O-Kwee Spencer, Fombell, PA

- Worked as a one-on-one counselor at a day camp for adults with disabilities
- Facilitated my camper's daily involvement in activities and peer interactions
- Assisted other campers with a variety of Developmental, Autism Spectrum, and physical disorders

Mental Health Unit Intern July 2016 - September 2016

Mental Health Management Services, Inc, State Correctional Institute-Pittsburgh,

Pittsburgh, PA

- Worked closely with an interdisciplinary team including psychiatrists, social workers, music therapists, psychiatric nurses, mental health workers, and clinical psychologists
- Assisted in the stabilization of acute psychiatric patients with severe mental illness on the SCI-Pitt Mental Health Inpatient Treatment Unit
- Observed or assisted with the clinical work of a Master's level psychologist, music therapist, social worker, and psychiatrist
- Observed and conducted informal diagnostic intake assessments
- Wrote clinical progress notes on a weekly basis, or following therapeutic interactions
- Utilized empirically supported cognitive behavioral and other therapeutic activities in large group, small group, or one-on-one settings to help inmates reach treatment goals

AWARDS

Office of Graduate Studies Travel Grant

Sam Houston State University, Huntsville, TX

Office of Graduate Studies General Scholarship for Spring 2019

Sam Houston State University, Huntsville, TX

Office of Graduate Studies General Scholarship for Fall 2018

Sam Houston State University, Huntsville, TX

Graduate Scholarship College of Humanities and Social Sciences for 2018-2019

Sam Houston State University, Huntsville, TX

Graduate Scholarship College of Humanities and Social Sciences for 2017-2018

Sam Houston State University, Huntsville, TX

Mona Shibley Bird Memorial Scholarship for Excellence as an Undergraduate in Psychology

Penn State University, University Park, PA

Distinguished Graduating Senior in Criminology Award

Penn state University, University Park, PA

Hintz Honors Scholar Endowment in the College of the Liberal Arts

Penn State University, University Park, PA

College of the Liberal Arts Student Activity Enrichment Funding

Penn State University, University Park, PA

William G. and Elizabeth K. Leitzell Merit Scholarship

Penn State University, University Park, PA

PROFESSIONAL MEMBERSHIPS

- International Brain Injury Association
- Psi Chi Psychology National Honor Society

Professional Service

Executive Board August 2014-May 2017

Psych Squad, Psychology Interest Club, Penn State University, University Park, PA