Prevalence of ADHD, its Subtypes, and Comorbidity Subtype Differences

in Adult Prison Inmates

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Attention-Deficit/Hyperactivity Disorder (ADHD) is currently thought to be a complex and chronic disorder of the brain, behavior, and development. It is characterized by a persistent pattern of inattention and/or hyperactivity/impulsivity that is more frequently displayed and more severe than what is typically observed at a comparable level of development, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000).

One of the first descriptions of ADHD appears in the children’s book Struwwelpeter written by German psychiatrist Heinrich Hoffmann in 1846. In this book there are two stories (see Appendices A & B) that portray the typical symptoms of ADHD. In the first story, The Story of Fidgety Phillip, the child displays several of the inattention and hyperactivity symptoms listed in the DSM-IV-TR. The child does not seem to listen when spoken to directly, fails to give close attention to details or makes careless mistakes, has difficulty sustaining attention, and has difficulty sitting still at the dinner table. In the second, The Story of Johnny Head-In-Air, the child displays several of the inattentive symptoms listed in the DSM-IV-TR, such as being easily distracted by extraneous stimuli, losing things necessary for tasks or activities, and is often forgetful in daily activities.

Over the years ADHD has been defined and re-defined numerous times, with each of these nomenclature changes reflecting the growing understanding of the defining symptoms and etiology of ADHD. One of the first diagnostic labels of ADHD in the literature was “minimal brain damage”. This term reflects some of the early findings by Schroeder (1929), in which he found distractibility and over-activity to be the characteristic behavior traits in birth injuries.
However, the term is more commonly attributed to the psychiatrist Alfred Strauss, who in the late 1940s extended a lesion theory, that came out of the outbreak of St. Louis encephalitis between the World Wars, to explain a number of non-encephalitic patients with related motor-impulse problems and proposed that extremely overactive children be diagnosed as suffering from minimal brain damage (Lakoff, 2000). The label minimal brain damage clearly reflected the early belief that children who presented over activity, motor-impulse problems, and/or distractibility were suffering from some type of organic brain disorder. The only mention of ADHD in the original publication of the DSM (1952) was that of a single symptom of “over-activity” appearing amongst the symptoms for the diagnosis of Adjustment Reaction of Childhood, sub-classification of neurotic traits. It was not until the publication of the DSM-II (1968) that ADHD officially became a diagnostic label, although it was noted as Hyperkinetic Reaction of (Childhood or Adolescence), and was characterized by over activity, restlessness, distractibility, and short attention span, and it was seen as a disorder that usually diminished in adolescence. Leo Kanner (1972) proposed the term “minimal brain dysfunction” or MBD, because by that time, there was some speculation suspecting the organic etiology although there was no “hard” neurological evidence (e.g., EEG’s consistent of cortical injury, no other evidence of brain damage, etc.). Thus, the word “minimal” came to indicate that the organic etiology was suspected or inferred but no clear physiological evidence could be found. Even though Kanner’s proposed nomenclature was not an official supplement to DSM-II, nor was it officially sanctioned by the American Psychiatric Association, it did become popular in general literature and the name spawned a raft of empirical investigations, which, among other forces, led to DSM-III (1980) re-diagnosing ADHD. It should be noted that this new term “Hyperkinetic Reaction of
Childhood” failed to address the etiology of the disorder and demonstrates the erroneous belief that the most salient characteristic of the disorder was that of motor problems.

It was not until the *DSM-III* (1980) that the field began to focus on the attentional difficulties or deficits as the core disturbance of the disorder, thereby renaming the disorder “attention deficit disorder” (ADD) and could occur with hyperactivity (ADDH) or without hyperactivity (ADD). The disorder was characterized by developmentally inappropriate inattention, impulsivity, and hyperactivity (*DSM-III*). This new focus on the attentional difficulties was brought about by a study conducted by Douglas (1972), in which she found that ADHD was characterized by an inability to sustain attention for prolonged periods. Other novel features of the *DSM-III* ADHD diagnosis included, age of onset criteria, course, impairment, complications, risk factors, prevalence, sex ratio, familial pattern, and a categorical classification system.

In the *DSM-III-R* (1987) the disorder was renamed Attention-Deficit Hyperactivity Disorder. There is little difference between the *DSM-III-R* and *DSM-III*, except that in the *DSM-III-R* there are no subtypes, the diagnostic criteria was changed from a three-factor (e.g., inattention, hyperactivity, and impulsivity) to a single-factor model (e.g., a combination of inattention, hyperactivity, and impulsivity), and criteria for severity of ADHD were added (e.g., mild, moderate, and severe). In 1994 the American Psychiatric Association published the *DSM-IV* wherein the name that was adopted in the *DSM-III-R* was kept, but the diagnostic criteria were now a two-factor model and divided ADHD into three distinct subtypes. If an individual only meets at least 6 of 9 of the inattention criteria he or she would be diagnosed as having the inattentive subtype of ADHD; if an individual only meets at least 6 of 9 of the hyperactive/impulsivity criteria he or she would be diagnosed as having the
hyperactive/impulsive subtype of ADHD. If an individual meets both sets of criteria, he or she would be diagnosed as having the combined subtype of ADHD. In 2000, the American Psychiatric Association published the *DSM-IV-TR*, with many of the ADHD changes highlighting differences among the subtypes. For example, individuals with the inattentive and combined subtypes were stated to have academic deficits and school-related problems, whereas those with the hyperactive/impulsive subtype were stated to have more peer rejection and accidental injuries. The rest of the differences represent additional information about associated features, specific age features, and prevalence rates.

**Etiology**

*Genetics of ADHD*

Whereas the exact etiology of ADHD remains unknown, it is believed to have a strong genetic basis. In the majority of cases of ADHD there is a familial origin. Parents with ADHD have a better than 50% chance of having a child who has ADHD, and about 25% of children that have ADHD have parents who meet the diagnostic criteria for ADHD (Voeller, 2004). Heritability estimates have been empirically determined to range from .39 to .91 of the total variance (e.g., Levy, Hay, McStephen, Wood, & Waldman, 1997; Sherman, Iacono, & McGue, 1997; Willerman, 1973). Coolidge, Thede, and Young (2000) revealed that .82 of the variance in ADHD could be attributed to additive genetic influences and .18 to non-shared environmental influences. These studies show that ADHD has a strong genetic component. However, because genetics are not able to account for all cases of ADHD, the need to explore other factors that may contribute to the etiology of ADHD are needed.
Other Biological Factors

Voeller (2004) states that ADHD can also be acquired and some individuals have a combination of genetic and acquired ADHD. The role of the dopamine system in ADHD is well established because of the efficacy of dopamine agonists in the treatment of ADHD, and because the dopamine system is very sensitive to hypoxia (i.e., deficiency in the amount of oxygen reaching body tissues), any events pre- or postnatally that disrupts the flow of blood or oxygen to the brain might set the stage for later ADHD behaviors (Voeller). Another biological factor that several investigators have shown is, that, lead contamination can cause an ADHD-like picture in children, including distractibility, hyperactivity, restlessness, and lower intellectual functioning (Biederman, 2005). Any injury to the brain that affects the prefrontal-subcortical circuits can result in symptomology that resembles ADHD. For example, in one study comparing monozygotic twins who were discordant for ADHD, caudate lesions were observed in the twin with ADHD (Voeller). There are several pre- and perinatal factors that can result in ADHD, such as exposure of the fetus to alcohol, smoking, and/or metabolic disorders of the mother (i.e., diabetes, phenylketonuria; Voeller). For example, animal studies have shown a positive correlation between hyperactivity and chronic exposure to maternal nicotine intake during pregnancy (Biederman). Lastly, pregnancy and delivery complications (i.e., toxemia, eclampsia, poor maternal health, maternal age, fetal postmaturity, duration of labor, fetal distress, low birth weight, antepartum hemorrhage) seem to be predisposing for ADHD (Biederman).

At the present time, it is impossible to distinguish between acquired or genetic types of ADHD because they both manifest themselves similarly and both usually respond to treatment with the same psychostimulant medications (Voeller, 2004).
Environmental Factors

Despite the overwhelming evidence that the origin of ADHD is biologically based the role of environmental factors cannot be excluded. Experience of early social deprivation in childhood can also result in ADHD symptoms in later childhood (Voeller, 2004). For example, increased rates of attention deficit and hyperactivity have been observed in children who were raised in institutions. These children often also have a different set of associated psychiatric disorders than children with genetic ADHD and have disturbed attachment (Voeller). The risk of ADHD is also positively correlated with the number of adverse factors (i.e., poverty, maternal psychopathology, paternal criminality) that are present (Voeller).

Another environmental factor that has been proposed is that of food additives. In 1975 an eminent allergist, Benjamin F. Feingold, suggested that food additives, specifically artificial food flavors and colors, and naturally occurring salicylates were responsible for hyperactive behavior in some children (Feingold, 1975). Feingold based his conclusions on his experience with aspirin-sensitive adults who had behavioral symptoms and who improved on a diet free from artificial and natural salicylates, artificial food colorings and flavorings (Rojas & Chan, 2005). Feingold developed a diet, which he called the Kaiser-Permanente (K-P), which required children to eliminate all artificial colors and flavors as well as all foods containing salicylates (Schnoll, Burshteyn, & Cea-Aravena, 2003). Feingold reported that a substantial number (50%) of hyperactive children who followed the K-P diet showed improvement, however due to questionable methods in the collection of the data and alternative explanations this environmental factor remains controversial and inconclusive. Also out of approximately 18 studies that have been conducted to investigate Feingold’s theory since 1976, 13 of them showed no significant improvement in symptom presentation as a result of being on the K-P diet (Rojas
& Chan). Despite the literature, it does seem logical that diet might have some exacerbating effects in individuals with ADHD, but the extent of these effects is not known and therefore diet should only be used as a supplemental treatment to other, more effective treatments such as medication and/or behavioral therapies.

Prevalence

Since its inclusion in the *DSM-II* (1968), ADHD has been one of the most often diagnosed disorders of childhood. Studies estimate that about 4% to 12% of 6- to 12-year-old children in non-referred community and primary care pediatric samples have ADHD and that it approaches 50% in psychiatrically referred populations (Barzman, Fieler, & Sallee, 2004). According to the *DSM-IV-TR*, ADHD is more frequent in males than in females, with male-to-female ratios ranging from 2:1 to 9:1, depending on the type (i.e., the inattentive subtype may have a gender ratio that is less pronounced) and setting (i.e., clinic-referred children are more likely to be male). Wasserstein (2005) stated that ADHD was once thought to disappear as children matured, whereas current data indicates that it does not disappear. Rather, current thinking suggests that the features of ADHD undergo changes while still remaining clinically significant for many of the adults who had it as children. Specifically, several articles state that anywhere from 5% - 75% of children with ADHD continue to display clinically significant symptoms as adults (McGough & Barkley, 2004; Span, Earleywine, & Strybel 2002; Wasserstein, 2005). The overall prevalence of ADHD in adults is estimated at 2% - 5% (Barkley & Murphy, 1998).

With respect to the three subtypes of ADHD (i.e., inattentive, hyperactive/impulsive, and combined), a couple of the studies using children and adolescents, found that the prevalence was highest for the inattentive type (3.7% - 5.4%), followed by the combined type (1.9% - 3.6%), and
lastly with the hyperactive/impulsive type (1.9% - 2.4%; Graetz, Sawyer, Hazell, Arney, & Baghurst, 2001; Wolraich, Hannah, Pinnock, Baumgaertel, & Brown, 1996). Only one study could be found, using 812 complete male and female twin pairs ages 7 to 19 years that were identified from the Missouri Twin Registry from 1996 through 2002, where the combined subtype was revealed to be the most prevalent (11.1%), with inattentive subtype having the second highest rate (10%), and the hyperactive/impulsive subtype having the lowest rate (1.5%; Volk, Neuman, & Todd, 2005). It is important to note however, that there is a paucity of studies attempting to describe the subtypes of ADHD in adults, especially in regards to prison populations.

Prevalence rates of ADHD in both juvenile and adult prison populations are elevated compared to those seen in the general population. In a study of 1,829 participants randomly sampled from the Cook County Juvenile Temporary Detention Center found that 16.6% ($n = 1,170$) of males and 21.4% ($n = 656$) of females met the criteria for ADHD (Teplin, Abram, McClelland, Dulcan, & Mericle, 2002). The juveniles were diagnosed with ADHD using the Diagnostic Interview Schedule for Children (DISC; Shaffer, et al., 1996). With respect to the prevalence rate of ADHD in the general population, the higher rates of ADHD that have been seen in juvenile delinquents has been shown to exist cross-culturally as well, indicating that the greater rates seen in American studies are not an artifact of the American culture. Vreugdenhil, Doreleijers, Vermeiren, Wouters, and Van Den Brink (2004) found that in a sample of 204 incarcerated boys in the Netherlands 8% ($N = 204$) meet criteria for ADHD, which is higher than the 1% prevalence rate that is found within the Netherlands’ general population. Also, in a sample of 98 adolescents that were incarcerated in juvenile correction centers in Korea, 42.4% were identified as having ADHD, compared to the 7.6% - 9.5% rate that is found with the
Koreans’ general population (Chae, Jung, & Noh, 2001). There is a scarcity of studies regarding the prevalence of ADHD in the North American adult prison population, but those studies that do exist point to a prevalence of between 25% and 28% of inmates who have ADHD (Eyestone & Howell, 1994; Favarino, 1988). In another study of 129 young adult male inmates from Germany showed that 45% of the sample met criteria for ADHD, compared to the 4.2% rate that is found in young males in the general population (Rösler et al., 2004).

These studies consistently show that the elevated rate of ADHD in both juvenile and adult prison populations is not an artifact of American culture, but rather a phenomenon that is seen cross-culturally. Therefore, more research is needed to determine why there is an increased rate of ADHD in prison populations.

**ADHD Comorbidity**

According to the *DSM-IV-TR* (2000), substantial proportions (approximately half) of clinic-referred children with ADHD also have Oppositional Defiant Disorder (ODD) or Conduct Disorder (CD), and that the rates of co-occurrence of ADHD with these disorders are higher than with other mental disorders. Rösler et al. (2004) reports that during the course of ADHD nearly 50% of the cases develop conduct disorders, 30% - 50% suffer from learning disabilities, and up to 5% have tics or Tourette syndrome, while 25% have anxiety disorders, and 20% - 35% suffer from affective disorders. Also, 50% or more of adolescents and adults with ADHD will suffer from alcoholism and substance abuse disorders (Rösler et al.). Barkley (1999) states that overall, up to 44% of people classified with ADHD have at least one other psychiatric disorder, 32% have two others, and 11% have at least three other disorders. The high rate of comorbidity is also seen in other cultures as well (Chae et al., 2001). Because of the high rates of comorbid disorders
that occur with individuals suffering from ADHD, singling out the influence that ADHD alone has on one’s social outcome becomes increasingly difficult.

Another comorbid characteristic of ADHD has been proposed to be executive function deficits of the frontal lobes. The term executive functions (EF) has been defined in the literature (e.g., Luria, 1966; Pineda et al., 1998; Reader, Harris, Schuerholz, & Denckla, 1994; Welsh & Pennington, 1988; Weyandt & Willis, 1994) as a unique domain of cognitive abilities that involves organization in space and time, selective inhibition, response preparation, goal-attainment planning, and cognitive flexibility. This set of functions is thought to be relatively independent from other cognitive functions such as sensation, perception, language, and memory, yet thought to overlap with attention, reasoning, and problem-solving. The neural substrate for the EF has not been precisely delineated, but they are thought to be mediated by prefrontal cortices of the brain (e.g., Pennington & Ozonoff, 1996; Stuss, 1992). Reader et al., in a study of 48 ADHD children (mean age 9.5 years), found that ADHD children with and without reading disabilities were similarly impaired on some but not all measures of EF. They concluded that ADHD children seem to be at risk for EF deficits. Pennington and Ozonoff (1996), in a review of 18 studies of EF deficits in ADHD, found that 15 of the studies showed a significant difference between ADHD children and controls on at least one or more measures of EF. They concluded that ADHD children might have a mix of specific deficits (like an essential EF deficit) and some general deficits (such as a general cognitive inefficiency). Indeed, the finding is so robust that ADHD in childhood is accompanied by EF deficits that Pennington and Ozonoff (1998) have considered EF deficits as the “core deficit” in ADHD.

It should also be noted that there is some debate over whether the high rates of comorbidity that are seen in ADHD reflects the true nature of the disorder or whether it is an
artifact of overlapping diagnostic criteria or a poorly defined definition of the disorder. Nevertheless, it seems reasonable, despite the criticisms mentioned previously; that individuals with ADHD would be at an increased risk of suffering from other co-occurring disorders (especially mood, anxiety, and substance abuse disorders) because of the significant impact the disorder has on one’s social, academic, and/or occupational functioning. The increased risk may also be exacerbated by the stereotypes (e.g., laziness, stupidity, slothfulness) that are attributed to individuals who suffer from this disorder.

In regards to the comorbidity rates in the adult population Murphy and Barkley (1996) stated that the adults with ADHD showed significantly greater prevalence of oppositional, conduct, and substance abuse disorders, and greater illegal substance use than control adults. Also, that adult’s with ADHD displayed greater self-reported psychological maladjustment, more driving risks (speeding violations), and more frequent changes in employment (Murphy & Barkley). This study demonstrates that the high rate of comorbidity that is seen in children who have ADHD may continue into adulthood.

ADHD Subtypes and Comorbidity

Several studies have shown comorbidity differences in children between the three subtypes of ADHD and higher rates compared to control groups, but no studies could be found that looked at comorbidity as a function of ADHD subtype in an adult population. Willcutt, Pennington, Chhabildas, Friedman, and Alexander (1999) found, in a sample that ranged from 8- to 18-year olds, that all three subtypes were associated with significant elevations of ODD and CD; however, multiple regression analyses revealed that hyperactive/impulsive symptoms were more strongly associated with both ODD and CD than were inattention symptoms. These results suggest that there is a strong relationship between externalizing disorders (e.g., ODD and CD)
and the hyperactive/impulsive component of ADHD. The inattentive and combined type were associated with higher levels of depression than either the hyperactive/impulsive subtype or controls, which indicates that depression may be associated with only the subtypes that have significant inattention (Willcutt et al.). In another study Eiraldi, Power, and Nezu (1997), children with the combined type showed significantly higher levels of externalizing disorders than children with the inattentive type and controls, but there were no differences between the combined or inattentive subtypes regarding levels of internalizing disorders (e.g., depression and anxiety). These results provide further support that externalizing disorders have a strong relationship with the hyperactive/impulsive component of ADHD, and that internalizing disorders have a strong relationship with the inattentive component of ADHD. Faraone, Biederman, Weber, and Russell (1998) found, in a sample of children and adolescents, that compared to the other two types the combined type, had significantly higher rates of CD, ODD, bipolar, language, and tic disorders, and that the hyperactive/impulsive and inattentive groups did not differ in rates of any of the disorders.

A review of these studies, previously cited, appear to show that all three of the subtypes of ADHD in childhood have significantly higher rates of comorbid disorders than controls, with the combined type consistently showing the highest rates of the three subtypes. No studies either in children or adults, to date, could be found that looked at the comorbidity of the personality disorders with the ADHD subtypes. Overall, the studies appear to suggest the usefulness of making a diagnostic distinction among the ADHD subtypes.

It was the purpose of the present study to examine the prevalence of ADHD, its subtypes, and psychopathological comorbidity differences among the three ADHD subtypes in an adult prison population. In addition, it is the goal of this study to extend previous research by using
adult prisoners as the population and including measures of personality disorders. Because a majority of the previous studies examining ADHD subtypes and comorbidity were performed using children or adolescents, one can only infer from those findings that similar patterns of comorbidity will exist in adults.

Therefore, in the current study, it was hypothesized (1A) that the overall prevalence rate of ADHD in this prison population will be greater than that found in adults in a general population. This hypothesis is predicated on large and numerous recent studies of incarcerated adolescents and adults as reviewed previously. Based on child and adolescent ADHD subtypes studies, it was hypothesized (1B) that the inattentive subtype should be the most prevalent followed by the combined subtype and lastly the hyperactive/impulsive subtype. This hypothesis is drawn from the abundant research indicating that the hyperactivity and impulsivity symptoms attenuate with age. With regard to comorbidity issues in ADHD, it was hypothesized (2) that all three ADHD subtypes will have greater rates of prevalence of internalizing disorders (i.e., Hypothesis 2A for depression and Hypothesis 2B for anxiety) than the control group of inmates without ADHD; because the literature has demonstrated that internalizing disorders (i.e., depression and anxiety) are strongly comorbid with ADHD. Also, because the literature reveals a strong relationship between the inattentive component of ADHD and internalizing disorders, it was hypothesized (3) that the inattentive and combined ADHD subtypes will have higher rates of internalizing disorders (i.e., Hypothesis 3A for depression and Hypothesis 3B for anxiety) compared to the hyperactive/impulsive subtype. Based on previous literature reviewed earlier that demonstrated a strong relationship between EF deficits and ADHD, it was also hypothesized (4) that all ADHD subtypes will have greater levels of EF deficits than controls, and the hypothesis will be further explored to determine whether there are differential EF deficits among
the ADHD subtypes. It was also hypothesized (5) that all ADHD subtypes will have higher rates of endorsement for drug and alcohol abuse than controls based on work by Murphy and Barkley (1996).

In addition, there will be five additional exploratory purposes investigating the following: Hypothesis (6A) are there gender differences in prison inmates in their ADHD levels on a continuous measure of ADHD and Hypothesis (6B) are there gender differences in prevalence rates on a categorical measure of ADHD? Hypothesis (7) is there differential comorbidity among the three ADHD subtypes for personality disorders (12 from *DSM-IV-TR* and 2 from *DSM-III-R*) and whether they differ in comorbidity compared to a control group of inmates. Hypothesis (8) do the three ADHD subtypes have differential comorbidity for schizophrenia and do they differ compared to a control group of inmates? Hypothesis (9) do the three ADHD subtypes differ in levels of psychotic thinking and do they differ compared to a control group of inmates? Finally, Hypothesis (10) do the three ADHD subtypes differ in levels of general neuropsychological dysfunction (NPD) and do they differ from a control group?

**Method**

**Participants and Procedure**

The initial group of participants was 4,872 inmates consecutively admitted to the Colorado Department of Corrections (CDOC) over a period of approximately nine months from September 22, 2004 to May 17, 2005. The data was collected as part of the normal intake process to the Colorado prison system. All inmates were evaluated at the diagnostic and reception center in Denver, Colorado. The CCI is administered routinely to all inmates upon entrance to the reception and diagnostic center. All data was collected archivally from the departmental database maintained by the CDOC. Each inmate, in approximately a 2-hour testing period, completes
approximately four intake tests including the Coolidge Correctional Inventory (CCI). All tests were administered in groups of 20 to 45 inmates.

Measure

Coolidge Correctional Inventory (CCI; Coolidge, 2004). The CCI is a 250-item, self-report measure, with each item answered on a 4-point Likert-type scale ranging from 1 (strongly false) to 4 (strongly true). There are two validity scales, one a 3-item scale measuring random responding (in which it is highly unlikely there would be any answer other than strongly false, e.g., I played quarterback for the Denver Broncos) and a 97-item denial-malingering scale (in which excessively low scores are indicative of denial and excessively high scores are indicative of malingering). In the present study, the following CCI scales were analyzed: 14 personality disorder scales (12 from DSM-IV-TR and 2 from DSM-III-R), five DSM-IV-TR Axis I clinical scales (generalized anxiety disorder, major depressive disorder, posttraumatic stress disorder, ADHD, and schizophrenia and its psychotic thinking subscale), three neuropsychological syndrome scales measuring general neuropsychological dysfunction (with 3 subscales assessing memory and attention problems, language dysfunction, and neurosomatic symptoms), executive function deficits of the frontal lobes (with 3 subscales measuring decision-making difficulties, poor planning, and a failure to complete tasks), and mild neurocognitive disorder from the appendix of DSM-IV-TR. Also analyzed were three hostility scales of the CCI, measuring anger, dangerousness and impulsiveness, an overall maladjustment scale, and two critical items assessing drug and alcohol abuse.

The original normative data for the present CCI sample consisted of a sample of convenience (\(N = 718\)) of purportedly normal, unincarcerated adults (\(M\) age = 30.3 years old, SD = 15.2 years; age range from 16 to 83 years old). There were 358 males and 358 females.
Approximately 76% were White, 4% were Black, 7% were Hispanic, 3% were Asian, and 10% were in a mixed ethnicity category. Approximately, 65% were single or divorced at the time of test administration, 25% were married, and 10% were in an “other” category. The preliminary internal scale reliabilities for the CCI were good with a median $\alpha = .75$ (range: $\alpha = .58$ to .85), and factor analyses supported the expected conceptual structures (Babé, 2000). The original CATI, upon which the CCI is based, has excellent test-retest (median) reliability (.90) across its scales (Coolidge & Merwin, 1992).

**Initial Data CCI Screening Procedure**

Based upon previous research with the MCMI in prison populations (Retzlaff et al., 2002), the present 4,872 CCI inmate profiles were screened for random responding, excessive denial, and an excessive number of omitted items. Overall, 13% (657 protocols) were eliminated from further analysis due to random responding. According to the CCI manual (Coolidge, 2004), a score below 120 (greater than 1.8 $SD$ below the normative CATI mean) on the denial-malingering scale is indicative of excessive denying and may be eliminated from analyses. Also, a score on this scale greater than 299 may be indicative of malingering (Note: in a previous CATI study (Coolidge et al., 2000) of 30 long-term inpatients with schizophrenia, 29 had scores less than 300 on the denial-malingering scale). These cutoff scores resulted in the elimination of an additional 4% (202) of the inmates’ protocols. Finally, 1% (51) of the protocols were dropped from the present study due to failure to answer at least 235 of the 250 CCI items (again according to the CCI manual). Thus, a total of 19% of the original sample (910) were eliminated from the final statistical analyses, resulting in a remaining sample of 3,962 valid inmate protocols.

**Final Initial Sample Demographics**
The mean age of the participants was 33.6 years ($SD = 9.5$), with a range from 17 to 73 years. Approximately 87% of the sample were male ($n = 3,439$) and 13% were female ($n = 523$). Ethnic background of the participants was 51.8% White, 18% Black, 27.7% Hispanic, 2% American Indian, and 0.6% Asian. Approximately 64% of the sample had at least a high school diploma or high school equivalency (GED). Approximately 72% of the inmates were incarcerated for the first time (in Colorado), and about 9% were incarcerated for the third time or more. Approximately 34% were incarcerated for a crime of violence.

**Final ADHD Sample and Control Group Screening Procedures**

The categorical approach, used in the *DSM-IV-TR* (2000), was used as the basis for group inclusion in this study. The 18 items in the CCI that address the 18 criteria for ADHD in *DSM-IV-TR* were collapsed into (0) for answers 1 or 2 indicating that the participant is not endorsing the symptom in question, and into (1) for answers 3 or 4 indicating that the participant is endorsing the symptom in question. The nine CCI items that address the nine *DSM-IV-TR* inattentive criteria and the nine items that address the hyperactive/impulsive symptoms were summed. Therefore, according to the categorical approach used in the *DSM-IV-TR*, those participants who met at least six of the nine inattentive criteria and less than six of the hyperactive/impulsive criteria were included in the inattentive group ($n = 150$); those participants who met at least six of the nine hyperactive/impulsive criteria and less than six of the inattentive criteria were included in the hyperactive/impulsive group ($n = 198$); and those participants who met at least six of the nine inattentive symptoms and at least six of the nine hyperactive/impulsive symptoms were included in the combined group ($n = 68$). The control group ($n = 411$) was obtained by randomly sampling approximately 12% of the remaining sample of inmates ($n = 3,546$), who failed to meet the criteria needed to be included in one of the
three ADHD groups. The percentage to be randomly sampled was determined by dividing the sum of the three ADHD groups (n = 416) by the remaining sample of inmates (n = 3,546). This was done in order to have a control group that was more similar in size to the other three groups.

**Final ADHD Sample and Control Group Demographics**

The inattentive group (n = 150) had a mean age of 33.89 years old (SD = 9.63 years; age range from 17 to 61). The hyperactive/impulsive group (n = 198) had a mean age of 33.66 years old (SD = 8.89 years; age range from 19 to 59). The combined group (n = 68) had a mean age of 32.68 years old (SD = 10.15 years; age range from 19 to 60). The control group (n = 411) had a mean age of 33.64 years old (SD = 9.91 years; age range from 18 to 70). See Table 1 for the complete demographical information on all four groups.

One-way analysis of variance (ANOVA) was used to establish that there were no significant differences in age among the three ADHD subtype groups and the control group, F(3, 823) = 0.26, p > .05. A chi-square analysis was used to establish that there were no significant differences in sex among the three ADHD subtypes and the control group, χ²(3, N = 827) = 3.53, p > .05. Another chi-square analysis was used to establish that there were no significant differences in ethnicity among the three ADHD subtypes and the control group, χ²(12, N = 827) = 11.31, p > .05. According to the results the three ADHD groups and the control group were comparable on age, sex, and ethnicity.

**Results**

**Categorical versus Dimensional Diagnosis**

For the personality disorders scales and the ADHD scale a categorical method was used to determine the presence or absence of a disorder, that is, meeting the minimum number of polythetic criteria as specified in the *DSM-IV-TR*. For all other scales, a T score of 70 or above
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on any scale was considered to be clinically significant (i.e., the disorder in question is highly likely to be present). The T score method was used, either because the scale was not in the DSM-IV-TR or because the CCI scale did not cover all of the minimum criteria as indicated in the DSM-IV-TR.

Hypothesis 1A: The overall prevalence rate of ADHD in this prison population will be greater than that found in adults in a general population.

Hypothesis 1B: The inattentive subtype should be the most prevalent followed by the combined subtypes and lastly the hyperactive/impulsive subtype.

According to the frequency distribution, 10.5% (N = 3962) of the inmates met the official diagnostic criteria for ADHD according to the DSM-IV-TR (i.e., inattentive subtype: six (or more) symptoms of inattention (but fewer than six symptoms of hyperactivity/impulsivity), hyperactive/impulsive subtype: six (or more) symptoms of hyperactivity/impulsivity (but fewer than six symptoms of inattention), and combined type: six (or more) symptoms of inattention and six (or more) symptoms of hyperactivity/impulsivity). Of the 10.5% inmates with ADHD, 36% (N = 411) had the inattentive subtype, 48% (N = 411) had the hyperactive/impulsive subtype, and 16% (N = 411) had the combined subtype. Consequently, the most prevalent subtype was the hyperactive/impulsive subtype, the second most was the inattentive subtype, and the least prevalent subtype was the combined subtype. The results, therefore, provide support for hypothesis 1A, but fail to provide support for hypothesis 1B.

Hypothesis 2A: All three ADHD subtypes will have greater rates of prevalence of internalizing disorders (i.e., Hypothesis 2A for depression) than the control group of inmates without ADHD.
Hypothesis 3A: The inattentive and combined ADHD subtypes will have higher rates of internalizing disorders (i.e., Hypothesis 3A for depression) compared to the hyperactive/impulsive subtype.

These two hypotheses were tested by a 2 x 4 chi-square test which indicated a significant relationship between depression (presence vs. absence) and the three ADHD subtypes (inattentive, hyperactive/impulsive, and combined) and control group, $\chi^2(3, N = 827) = 111.37, p < .001$. The proportion of variance in depression accounted for by the three ADHD subtypes and control group was, $\phi^2 = .13$, which accounts for a moderate amount of variance. This finding provides support that the results possess practical significance. Further examination revealed that the inmates who were in the control group had a lower rate of depression 1.9% ($n = 411$), than the inmates who were in the inattentive group 28.0% ($n = 150$), the combined group 27.9% ($n = 68$), and the hyperactive/impulsive group 6.6% ($n = 198$). The results also revealed that both the inattentive group and combined group appeared to have higher rates of depression than the hyperactive/impulsive group. Therefore, the results provide support for both hypothesis 2A and hypothesis 3A.

Hypothesis 2B: All three ADHD subtypes will have greater rates of prevalence of internalizing disorders (i.e., Hypothesis 2B for anxiety) than the control group of inmates without ADHD.

Hypothesis 3B: The inattentive and combined ADHD subtypes will have higher rates of internalizing disorders (i.e., Hypothesis 3B for anxiety) compared to the hyperactive/impulsive subtype.

The results of the chi-square test indicates a significant relationship among anxiety (presence vs. absence) and the three ADHD subtypes (inattentive, hyperactive/impulsive, and combined) and control group, $\chi^2(3, N = 827) = 54.68, p < .001$. The proportion of variance in
anxiety accounted for by the three ADHD subtypes and control group was, $\phi^2 = .07$, which accounts for a small amount of variance. This finding indicates that the results lack practical significance; therefore, results should be interpreted with caution. The results revealed that the inmates who were in the control group had a lower rate of anxiety 1.0% ($n = 411$) than the inmates who were in the inattentive group 21.0% ($n = 150$), the combined group 13.2% ($n = 68$), and the hyperactive/impulsive group 2.5% ($n = 198$). Furthermore, the results revealed that both the inattentive group and combined group had higher rates of anxiety than the hyperactive/impulsive group. Therefore, the results provide support for both hypothesis 2B and hypothesis 3B.

**Hypothesis 4:** All ADHD subtypes will have greater levels of EF deficits than controls, and the hypothesis will be further explored to determine whether there are differential EF deficits among the ADHD subtypes.

The results of the one-way ANOVA yielded a significant effect of group membership (i.e., inattentive, hyperactive/impulsive, combined, or control) on the level of EF deficits, $F(3, 826) = 91.41, p < .001$, as well as a large level of practical significance, $\eta^2 = .25$. Post-hoc analyses using the Tukey HSD test indicated that the combined ($M = 58.12, SD = 9.21$) and inattentive groups ($M = 57.73, SD = 10.54$), although not significantly different from each other, had significantly higher levels of EF deficits than both the hyperactive/impulsive group ($M = 48.63, SD = 8.85$) and control group ($M = 45.42, SD = 8.41$). In addition, the hyperactive/impulsive group had a significantly higher level of EF deficit than the control group. Thus, the results provide support for this hypothesis.

**Hypothesis 5:** All ADHD subtypes will have higher rates of endorsement for drug and alcohol abuse than controls.
According to the results of the 2 x 4 chi-square test, there was a significant relationship between the endorsement for drug and alcohol abuse and the three ADHD subtypes (inattentive, hyperactive/impulsive, and combined) and control group, $\chi^2(3, N = 827) = 14.55, p < .01$. The proportion of variance in the endorsement for drug and alcohol abuse accounted for by the three ADHD subtypes and control group was, $\phi^2 = .02$, which accounts for a small amount of variance. This findings suggests that the results lack practical significance and could then be an artifact of having too much power, therefore, the results should be interpreted with caution. Nonetheless, the results demonstrated that the inmates who were in the control group had a lower rate of endorsement for drug and alcohol abuse 41.6% ($n = 411$), than the inmates who were in the inattentive group 55.3% ($n = 150$), hyperactive/impulsive group 55.1% ($n = 190$), and the combined group 53.0% ($n = 68$). These results provide support for this hypothesis, but due to the lack of practical significance, they should be interpreted with caution.

*Hypothesis 6A: Are there gender differences in prison inmates in their ADHD levels on a continuous measure of ADHD?*

An independent $t$ test revealed that females had a higher mean on the ADHD scale ($M = 48.19$, $SD = 13.84$) compared to the males ($M = 45.39$, $SD = 12.72$), $t(3960) = -4.63, p < .001$. The effect size for this analysis was extremely small, $r = .07$, indicating that the results lack practical significance and are most likely due to an abuse of power. The results provide statistical support for this hypothesis, however, due to the lack of practical significance it should be concluded that the results do not provide support for this hypothesis.

*Hypothesis 6B: Are there gender differences in prevalence rates on a categorical measure of ADHD?*
A 2 x 2 chi-square test was used to test hypothesis 5B (in which the presence vs. absence of ADHD was determined using the diagnostic criteria according to the *DSM-IV-TR*), according to the results there was a significant relationship between sex and ADHD, $\chi^2(1, N = 3962) = 13.59, p < .001$. This analysis yielded an effect size ($\phi^2 = .003$) that is well below the minimal level that indicates a small effect size (i.e., $\phi^2 = .01$). Therefore, this finding indicates that the results lack practical significance and could then be an artifact of having too much power; therefore, the results should be interpreted with caution. The analysis revealed that 9.8% ($n = 3439$) of the male inmates met the diagnostic criteria for ADHD and that 15.1% ($n = 523$) of the female inmates met the diagnostic criteria for ADHD. The results of this analysis provide statistical support for this hypothesis, however, due to the lack of practical significance it should be concluded that the results do not provide support for this hypothesis.

**Hypothesis 7: Is there differential comorbidity among the three ADHD subtypes for personality disorders (12 from DSM-IV-TR and 2 from DSM-III-R) and whether they differ in comorbidity compared to a control group of inmates?**

All 14 of the chi-square tests yielded a significant relationship among the control group, the three ADHD subtypes, and the personality disorders (see Table 2). There were four analyses that yielded a small amount of practical significance (see Table 2), and, therefore the relationships revealed in those analyses should be interpreted with caution, as they lack practical significance. The results from these analyses provide support for this Hypothesis.

**Hypothesis 8: Do the three ADHD subtypes have differential comorbidity for Schizophrenia and do they differ in comorbidity compared to a control group of inmates?**

The results of the 2 x 4 chi-square yielded a significant relationship between schizophrenia and the three ADHD groups and control group, $\chi^2(3, N = 827) = 125.09, p < .001$. 
The proportion of variance in schizophrenia accounted for by the three ADHD subtypes and control group was, \( \phi^2 = .15 \), which accounts for a moderate amount of variance. The results demonstrated that the inmates who were in the control group had a lower rate of schizophrenia 1.9% (\( n = 411 \)), than the inmates who were in the inattentive 29.3% (\( n = 150 \)), hyperactive/impulsive 13.1% (\( n = 198 \)), and combined group 39.7% (\( n = 68 \)). Also, the inattentive and combined groups had higher rates of schizophrenia than the hyperactive/impulsive group, with the combined group having a higher rate than the inattentive group. These results provide support for this hypothesis.

*Hypothesis 9: Do the three ADHD subtypes differ in levels of psychotic thinking and do they differ compared to a control group of inmates?*

The assumption of homogeneity of variance was violated. Therefore, alternative tests to a one-way ANOVA and post-hoc analyses were used that correct for this violation. However, because the results from the original ANOVA and post-hoc analyses were equivalent to the results yielded by the alternative tests, the results from the original ANOVA and post-hoc analyses were reported.

The results of the one-way ANOVA yielded a significant effect of group membership (i.e., inattentive, hyperactive/impulsive, combined, or control) on the level of psychotic thinking, \( F(3, 823) = 119.58, p < .001 \), as well as a large level of practical significance, \( \eta^2 = .30 \). Post-hoc analyses using the Tukey HSD test indicated that the combined group \( (M = 72.35, SD = 13.47) \) and the inattentive group \( (M = 69.47, SD = 14.74) \), although not significantly different from each other, had a significantly higher level of psychotic thinking than the hyperactive/impulsive group \( (M = 61.49, SD = 11.80) \) and the control group \( (M = 51.73, SD = 10.63) \). Also, the
hyperactive/impulsive group had a significantly higher level of psychotic thinking than the control group. These results support this hypothesis.

**Hypothesis 10: Do the three ADHD subtypes differ in levels of general neuropsychological dysfunction (NPD) and do they differ from a control group of inmates?**

The assumption of homogeneity of variance was violated. Therefore, alternative tests to a one-way ANOVA and post-hoc analyses were used that correct for this violation. However, because the results from the original ANOVA and post-hoc analyses were equivalent to the results yielded by the alternative tests, the results from the original ANOVA and post-hoc analyses were reported.

The results of the one-way ANOVA yielded a significant effect of group membership (i.e., inattentive, hyperactive/impulsive, combined, or control) on the level of NPD, $F(3, 823) = 199.98, p < .001$, as well as a large level of practical significance, $\eta^2 = .42$. Post-hoc analyses using the Tukey HSD test indicated that the combined group ($M = 65.14, SD = 11.66$) and the inattentive group ($M = 65.35, SD = 10.69$), although not significantly different from each other, had a significantly higher level of NPD than the hyperactive/impulsive group ($M = 52.11, SD = 9.55$) and the control group ($M = 45.39, SD = 8.99$). Also, the hyperactive/impulsive group had a significantly higher level of NPD than the control group. These results support this hypothesis.

**Discussion**

The purpose of this study was to examine the prevalence of ADHD, its subtypes, and psychopathological comorbidity differences among the three ADHD subtypes in an adult prison population. With regard to Hypothesis 1A, which predicted that the overall prevalence rate of ADHD in inmates would be greater than the general population, was supported. This finding is consistent with the literature that has found the prevalence rate of ADHD to be elevated in both
juvenile and adult prison populations, when compared to the prevalence rate found in the general population.

Hypothesis 1B, which predicted that the inattentive subtype would be the most prevalent subtype, was not supported. Interestingly the most prevalent subtype was the hyperactive/impulsive subtype, with the inattentive subtype being the second most prevalent, and the combined subtype being the least prevalent. This finding contrasts the subtype prevalence rates that were drawn from studies using children or adolescence’s as their population. The latter comparison was necessary because of the paucity of studies investigating the prevalence rates of the ADHD subtypes in adults (either in the general, psychiatric, or prison populations). However, these results are perplexing in a number of ways. First, all of the studies reviewed indicated that the hyperactive/impulsive subtype is the least prevalent subtype. Secondly, the prevailing thought is that compared to the inattentive symptoms that may actually worsen with age, the hyperactive symptoms may remit with age (Hurtig et al., 2007). One possible explanation for this finding is that the prison environment is artificially elevating the endorsement of the hyperactive symptoms. For example, physical confinement to a small, enclosed area may exacerbate or provoke hyperactive/impulsive symptomology. Another explanation is that the hyperactive symptoms do not remit with age but rather attenuate, while, still remaining clinically significant. Lastly, these results may be due to the uniqueness of this specific prison population, that is, individuals with the hyperactive/impulsive subtype may be at greater risk to end up in prison. Further research will be needed to determine whether these results are valid or due to one of the alternative explanations or other explanations.

Both Hypotheses 2A and 2B, which predicted that all three ADHD subtypes would have greater rates of internalizing disorders (i.e., depression for 2A and anxiety for 2B) than the
control group, were supported. All three ADHD subtypes had higher rates of both depression and anxiety compared to the control group of inmates. This finding supports the plethora of research that indicates that having ADHD increases one's risk for internalizing disorders (i.e., depression and anxiety).

Furthermore, both Hypotheses 3A and 3B, which predicted that the inattentive and combined subtypes would have higher rates of internalizing disorders (i.e., depression for 3A and anxiety for 3B) than the hyperactive/impulsive subtype, were supported. This finding provides support for past research that has found that the inattentive component is more strongly associated with internalizing disorders than the hyperactive/impulsive component. This finding has important implications for both research and treatment. The implication for research is the need to answer why the inattentive component is more strongly associated with internalizing disorders than the hyperactive/impulsive component. The implication for treatment is that clinicians need to be more adamant about making the diagnostic distinction among the ADHD subtypes, as it may prove useful in the treatment of internalizing disorders and in the prevention of relapse in individuals with ADHD.

The results also provided support for Hypothesis 4, which predicted that all ADHD subtypes would have greater levels of EF deficits than controls. This finding helps to reinforce the hypothesis, stated by Pennington and Ozonoff (1998), that EF deficits may be the “core deficit” in ADHD. Furthermore, the hypothesis was further explored to determine whether there were differential EF deficits among the ADHD subtypes. It should be noted that there are no studies to date that could be found that compared the ADHD subtypes on levels of EF deficits. Interestingly, the results indicated that the inattentive and combined groups, although not different from each other, had significantly higher levels of EF deficits compared to the
hyperactive/impulsive group. This finding implies that the inattentive component is more strongly associated with EF deficits than the hyperactive/impulsive component. There is the possibility, however, that this association is artifactual. A core feature of EF deficits is inattention, thus, the inattentive component of ADHD may superficially resemble an EF deficit but may not have the same neurological underpinnings. However, there is also the possibility that the finding is not artifactual and the EF deficits associated with the inattentive component of ADHD may be more profound and severe than the association with the hyperactive/impulsive component of ADHD. This finding, if substantiated, would have important implications for the treatment of inmates diagnosed with ADHD.

The literature has previously demonstrated that individuals with ADHD are at a much greater risk for alcohol and substance abuse. With regard to Hypothesis 5, which predicted that all ADHD subtypes would have higher rates of endorsement for drug and alcohol abuse when compared to the control group, the results of the current study provided statistical support for the hypothesis. However, due to the small effect size, the results should be interpreted with caution. The lack of practical significance is not surprising when the population that is being studied (i.e., prison inmates) is taken into consideration. According to a nationally representative survey in 1997, more than 80% of state prisoners and 70% of federal prisoners reported past drug use (Mumola, 1999). Therefore, because such a large proportion of inmates have a history of substance abuse, the large effect size that is usually found when comparing individuals with ADHD to individuals without ADHD on rates of drug and alcohol abuse is not as robust when using a prison population as a sample.

With regard to Hypotheses 6A and 6B, which predicted that there would be gender differences in the levels and rates of ADHD, respectively, the results revealed that females had a
higher mean on the ADHD scale compared to males, and that females had a higher prevalence rate of ADHD compared to males, respectively. However, the effect sizes were extremely small, and, therefore, the differences in means and prevalence rates were practically negligible. It is concluded that male and female levels on the ADHD scale and prevalence rates on the categorical measure are comparable. It is also possible that these latter results are unique and likely due to the population being studied. It may be that females who end up in prison have more psychological problems than their male counterparts due to societal influences that tend to sway the judicial system to refrain from sending women to prison until all other options are exhausted. Therefore, the male-to-female ratios in ADHD ranging from 2:1 to 9:1 that are found in the general population, according to the *DSM-IV-TR* (2000), will be less pronounced within a prison population.

With regard to the exploratory Hypothesis 7, which predicted that there would be differential comorbidity among the three ADHD subtypes and that they would differ compared to a control group, analyses revealed some interesting findings. It should be noted that to date no literature could be identified that examined these questions and that due to the large amount of power only those analyses that yielded a moderate or large effect size will be discussed. Therefore, five of the analyses (dependent, histrionic, narcissistic, obsessive/compulsive, and sadistic) will not be discussed as the results lacked practical significance. Regarding the remaining nine personality disorders, the three ADHD subtypes had higher rates of personality disorders compared to the control group. The combined and inattentive groups had consistently higher rates than the hyperactive/impulsive group. Lastly, the combined group had consistently higher rates than the inattentive group on all the personality disorders except for the schizotypal personality disorder, where the two groups had comparable rates, and the schizoid personality
disorder where the inattentive group had a higher rate. Preliminarily, these findings may suggest that there are differential rates of psychopathology among the ADHD subtypes. These findings, if replicated again reinforce the importance of a proper diagnosis of ADHD in prison populations, including subtype diagnosis, and it reinforces the importance of subsequent differential treatment programs that address not only the issues associated with ADHD but also the comorbid psychopathology. However, these results may be an artifact of the prison environment. For example, inmates may need to adopt certain behavioral traits (e.g., paranoia, detachment, aggressiveness, deceitfulness) while in prison in order to survive.

With regard to exploratory Hypothesis 8, which predicted that the ADHD subtypes would have differential comorbidity for schizophrenia and that they would differ compared to a control group, the results revealed that the combined group had the highest prevalence rate of schizophrenia compared to the inattentive and hyperactive/impulsive groups. Also, that the inattentive group had a higher prevalence rate of schizophrenia compared to the hyperactive/impulsive group. With regard to exploratory Hypothesis 9, which predicted that the three ADHD subtypes would differ in levels of psychotic thinking and differ compared to a control group, the results revealed that the combined and inattentive groups, although not significantly different from one another, had significantly higher levels of psychotic thinking compared to the hyperactive/impulsive group.

These findings, taken at face value, appear to reveal that individuals with ADHD, particularly those with inattentive and combined subtypes, are much more likely to suffer from schizophrenia and/or have aberrant thought processes. In support of the latter statement, it has been observed that some proportion of individuals who are at a genetically high risk for developing schizophrenia met the criteria for an ADHD diagnosis (Oner and Munir, 2005).
However, a possible explanation of these findings is that impaired attention and abnormalities of psychomotor activity (e.g., pacing or fidgeting) are common in both schizophrenia and ADHD. Whereas, typical cases of ADHD and schizophrenia are easily distinguishable, the two may be difficult to separate in less prototypical cases (Egeland, 2007). Therefore, the elevated rates of schizophrenia that are seen in the ADHD groups may be an artifact of the symptom overlap between the two disorders. In fact, this may explain why the rate of schizophrenia is higher in the combined group compared to the other two groups, in that, in order to meet the diagnosis for the combined type one must display both the inattentive and hyperactive/impulsive symptomology.

Yet another possible explanation for why the rates of schizophrenia are higher in the three ADHD groups is the poor specificity of the Schizophrenia scale of the CCI. For example, there are items in the scale that address the social/occupational dysfunction that is commonly observed in individuals who have schizophrenia. Inmates may be endorsing these items as a result of the lifestyle change and negative affects on ones life that accompanies being sent to prison.

The aforementioned alternative explanations are only appropriate in explaining the findings regarding the higher rates of schizophrenia and not for the higher levels of psychotic thinking that were found. This may be due to a key difference in the two scales, the Psychotic Thinking scale only measures the positive symptoms of schizophrenia (e.g., hallucinations and delusions), whereas, the Schizophrenia scale taps both the positive and negative (e.g., affective flattening, alogia, or avolition) symptoms, as well as the social/occupational dysfunction that commonly accompanies individuals who suffer from this disorder. Because of this key distinction, the psychotic thinking scale possesses excellent specificity and does not have any items on its scale that tap either impaired inattention or abnormalities of psychomotor activity.
that would lead to an artificially elevated score due to overlapping symptomology. Therefore, the high levels of psychotic thinking that were evident in the ADHD groups are not likely due to a specificity problem or a symptom overlap issue. One alternative explanation for why the ADHD groups appear to have higher levels of psychotic thinking compared to a control group may be that the aberrant thought is the result of substance abuse/withdrawal rather than a pervasive biological illness. This explanation is further strengthened by the vast amount of literature that indicates the high prevalence rate of alcohol and/or substance abuse in individuals with ADHD; also, the leading treatment for the disorder involves the use of sympathomimetic or psychostimulants that increase the amount of dopamine in the brain, which is known to lead to aberrant thought if abused. One such study conducted by Stahlberg, Søderstrøm, Rastam, and Gillberg (2004) found a 10% prevalence of psychotic symptoms among patients with ADHD. Therefore, future research is needed that addresses these issues in order to delineate the true relationship between ADHD and schizophrenia or psychotic thinking.

Finally, with regard to exploratory Hypothesis 10, which predicted that the three ADHD subtypes would differ in levels of general neuropsychological dysfunction and differ compared to a control group, the results revealed that the combined and inattentive groups, although not significantly different from one another, had significantly higher levels of NPD compared to the hyperactive/impulsive group. These results support previous research that shows individuals with ADHD have higher levels of NPD. Therefore, the interesting finding of the present results is the indication that the inattentive component is more strongly associated with the general NPD than the hyperactive/impulsive component. More research is needed to delineate the relationship between the inattentive component of ADHD and general NPD.
It is important to note that the NPD scale of the CCI has a broad array of neuropsychological deficits associated with brain insult and injury, congenital (e.g., genetic, birth-related) and environmental factors and brain diseases. As such, this CCI scale has been previously demonstrated (Coolidge, Mull, Becker, Stewart, & Segal, 1998) to be sensitive to a wide variety of symptoms covering three areas of memory and attentional problems, language difficulties, and neurosomatic difficulties, such as, physical symptoms associated with cortical and subcortical dysfunction (e.g., balance and coordination problems). Thus, the finding that NPD is higher in the combined and inattentive groups requires further investigation to determine the specific nature of the neuropsychological dysfunction and how it may differ from the combined and inattentive to the hyperactive/impulsive subtype. Therefore, future research should certainly attend to the specific nature of the neuropsychological dysfunction.

Certainly, one strength of this paper was the large sample size which allows the results to possess greater generalizability. Another strength was the categorical method that was used in this study to indicate the presence or absence of personality disorders and ADHD according to the *DSM-IV* polythetic criteria. This method provides clearer estimates of prevalence rates as compared to continuous measures, and it allows for the formation of subtype groups also based on the official diagnostic criteria listed in the *DSM-IV*.

There are at least three limitations of the current study. First, the psychometric concepts of sensitivity and specificity cannot be examined because structured or semi-structured interviews were not conducted to verify the results of the self-report survey. Second, because of the unique demographics that are found within the Colorado prison system (i.e., majority of inmates are white) the results may not generalize to the United States prison population as a whole, in that, minorities are the majority within the United States prison population. Third, truth
or falsity of self-reports of inmates is a critical issue in inmate populations. In the present study, both strong deniers and strong endorsers of psychopathology were eliminated from further analyses, resulting in an elimination of about 19% of the original sample, whereas, a previous study of a reputedly reliable and valid measure of psychopathology (MCMI) tested with the same Colorado prison population eliminated only 11% of the inmates. Thus, the present study eliminated nearly double the number of inmates than a previous study, but it is not known whether this exclusion makes this present study more accurate or less accurate. It is preliminarily thought as a result of the examination of this data that denial of self-report psychopathology is a much greater problem within this type of population than is self-reported malingering. Indeed, this is an area of important future research.

In conclusion, the results of this study would appear to indicate that Axis I syndromes, Axis II personality disorders, and neuropsychological problems are as prominent in prison populations as the literature suggests or even more prominent than previously thought. Indeed, if these results are found to be supported by future research, then the implications of such findings would be of critical importance in the treatment and rehabilitation of inmates. Thus, if the correctional system aims to effectively treat and rehabilitate its inmates, then it must not only screen for the historically familiar psychopathology that has been known to be prevalent in prison (e.g., depression and violence), but rather it must also aim to effectively screen inmates for psychopathology that is both neurologically and genetically based (i.e., ADHD, personality disorders, psychotic thinking, EF deficits, and neuropsychological dysfunction) as these disorders will inherently affect the course, type, and effectiveness of treatment programs. Therefore, the use of a comprehensive screening instrument like the CCI would appear to be of significant value in the assessment and rehabilitation of prison inmates.
References


Description, acceptability, prevalence rates, and performance in the MECA study.


Let me see if Philip can
Be a little gentleman;
Let me see, if he is able
To sit still for once at table:
Thus Papa bade Phil behave;
And Mamma look’d very grave.
But fidgety Phil,
He won’t sit still;
He wriggles
And giggles,
And then, I declare,
Swings backwards and forwards
And tilts up his chair,
Just like any rocking horse;—
“Philip! I am getting cross!”
See the naughty restless child
Growing still more rude and wild.
Till his chair falls over quite.
Philip screams with all his might.
Catches at the cloth, but then
That makes matters worse again.
Down upon the ground they fall.
Glasses, plates, knives, forks and all.
How Mamma did fret and frown.
When she saw them tumbling down!
And Papa made such a face!
Philip is in sad disgrace.
Where is Philip, where is he?
Fairly cover'd up you see!
Cloth and all are lying on him;
He has pull'd down all upon him.
What a terrible to-do!
Dishes, glasses, snapt in two!
Here a knife, and there a fork!
Philip, this is cruel work.
Table all so bare, and ah!
Poor Papa, and poor Mamma
Look quite cross, and wonder how
They shall make their dinner now.
Appendix B

9. THE STORY OF JOHNNY HEAD-IN-AIR.

As he trudg'd along to school,
It was always Johnny's rule
To be looking at the sky
And the clouds that floated by;
But what just before him lay,
In his way,
Johnny never thought about;
So that every one cried out—
"Look at little Johnny there,
Little Johnny Head-In-Air!"

Running just in Johnny's way,
Came a little dog one day;
Johnny's eyes were still astray
Up on high,
In the sky;
And he never heard them cry—
"Johnny, mind, the dog is nigh!"
Bump!
Dump!
Down they fell, with such a thump,
Dog and Johnny in a lump!
Once, with head as high as ever,
Johnny walk'd beside the river.
Johnny watch'd the swallows trying
Which was cleverest at flying.
Oh! what fun!
Johnny watch'd the bright round sun
Going in and coming out;
This was all he thought about.
So he strode on, only think!
To the river's very brink,
Where the bank was high and steep,
And the water very deep;
And the fishes, in a row,
Stared to see him coming so.

One step more! Oh! sad to tell!
Headlong in poor Johnny fell.
And the fishes, in dismay,
Wagg'd their tails and ran away.
There lay Johnny on his face,
With his nice red writing case;
But, as they were passing by,
Two strong men had heard him cry;
And, with sticks, these two strong men
Hook'd poor Johnny out again.

Oh! you should have seen him shiver
When they pull'd him from the river,
He was in a sorry plight!
Dripping wet, and such a fright!
Wet all over, everywhere,
Clothes, and arms, and face, and hair,
Johnny never will forget
What it is to be so wet.

And the fishes, one, two, three,
Are come back again, you see;
Up they came the moment after,
To enjoy the fun and laughter.
Each popp'd out his little head.
And, to tease poor Johnny, said:
"Silly little Johnny, look,
You have lost your writing-book!"
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</table>
### Table 2.

**Chi-Square Results for Hypothesis 6**

<table>
<thead>
<tr>
<th>Personality Disorder’s</th>
<th>Percent within ADHD Group Presenting Personality Disorder</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Inattentive Group</td>
</tr>
<tr>
<td>Antisocial</td>
<td>22.6</td>
<td>48.7</td>
</tr>
<tr>
<td>Avoidant</td>
<td>20.2</td>
<td>66.7</td>
</tr>
<tr>
<td>Borderline</td>
<td>10.0</td>
<td>52.0</td>
</tr>
<tr>
<td>Dependent</td>
<td>1.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Depressive</td>
<td>4.6</td>
<td>34.7</td>
</tr>
<tr>
<td>Histrionic</td>
<td>7.3</td>
<td>25.3</td>
</tr>
<tr>
<td>Narcissistic</td>
<td>15.6</td>
<td>20.7</td>
</tr>
<tr>
<td>Obsessive/Compulsive</td>
<td>20.7</td>
<td>34.0</td>
</tr>
<tr>
<td>Paranoid</td>
<td>14.6</td>
<td>52.7</td>
</tr>
<tr>
<td>Passive/Aggressive</td>
<td>4.9</td>
<td>44.0</td>
</tr>
<tr>
<td>Schizotypal</td>
<td>5.6</td>
<td>41.3</td>
</tr>
<tr>
<td>Schizoid</td>
<td>11.2</td>
<td>49.3</td>
</tr>
<tr>
<td>Sadistic</td>
<td>9.7</td>
<td>22.0</td>
</tr>
<tr>
<td>Self-Defeating</td>
<td>3.9</td>
<td>22.7</td>
</tr>
</tbody>
</table>

*Note. $p < .001$. $\phi^2$ = Squared Cramer’s V; $\phi^2 < .10$ are considered small, $\phi^2 \geq .10$ or $\phi^2 < .25$ are considered medium, and $\phi^2 \geq .25$ are considered large.*