A Dissertation
Submitted to the Faculty
of
Xavier University
in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Psychology
by
Samantha Himes
May 10, 2013

Approved:

Karl Stukenberg, Ph. D., ABPP
Chair, Department of Psychology

Kathleen J. Hart, Ph. D., ABPP
Dissertation Chair
An Examination of the Executive Functioning of Juvenile Offenders
Dissertation Committee

Chair
Kathleen J. Hart, Ph. D., ABPP
Professor of Psychology

Member
John Barrett, Ph.D.
Associate Professor

Member
Susan LaVelle-Ficke, Psy. D.
Clinical Psychologist
Acknowledgements

I was intensely anxious on the first day of graduate school that perhaps the department had made a mistake. Dr. Schultz discussed the process and all that I would need to complete in order to earn my degree. It was intimidating and yet I knew that it was exactly what I wanted to do. As I progressed through the program, I kept thinking that I had overcome the worst, the semester with the most work or the most difficult class. However, I found new and more challenging experiences as I progressed. As I look back on my path through all of these challenges, I now know that while I often felt alone, deep in the library or sitting at my desk at home, I always had support.

My family has always been beside me. I know that who I am today is because of the support that my family has given me. I want to thank my parents for teaching me to overcome challenges and for giving me the confidence to pursue my dreams. Even when I doubted myself you never gave up on me or told me to change my path. I also want to thank my brother and sister without whom I would never have learned to have a tough skin or to enjoy the little things in life. It was often them who gave me a reason to take a break from graduate school and remember the important things. Finally, I want to thank Ernie for all he has done to support me. As we travel further in life together, I know that I will always have a reasonable, silly, and supportive person to share in the journey.

Thank you to my classmates who have lived every moment with me from tears to exciting new beginnings. The supportive environment that the program and my peers created allowed me to keep going. I always knew that no matter how stressed I was there were others who knew just how I felt. In the end I feel blessed to have learned alongside so many wonderful people and create lifelong friendships.

Finally, the faculty at Xavier have taught me much about myself personally and professionally. Dr. Hart has been a wonderful structured and compassionate dissertation chair. I have learned a lot about what I need to achieve my goals. She taught me to never take life too seriously and always be humble. I thank her for helping me complete my dissertation and for being a great role model.

I know that there are many people who have touched my life that have made this dissertation possible and I want to thank them all. I am excited to have finished this part of my journey and hope to never finish growing as a professional.
# Table of Contents

<table>
<thead>
<tr>
<th>Acknowledgements</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>ii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>iii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>iv</td>
</tr>
<tr>
<td>List of Appendices</td>
<td>v</td>
</tr>
</tbody>
</table>

## Chapter

I. Review of the Literature .............................................................................. 1
II. Rationale and Hypotheses ........................................................................... 26
III. Method ........................................................................................................ 29
IV. Proposed Analyses ...................................................................................... 36

## References

38

V. Dissertation .................................................................................................. 46

References ......................................................................................................... 73

Tables ................................................................................................................ 80

Figures .............................................................................................................. 91

Appendices ......................................................................................................... 92

Summary ............................................................................................................. 96
<table>
<thead>
<tr>
<th>Chapter V</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age and Race Distribution for Sample.</td>
<td>80</td>
</tr>
<tr>
<td>2. Mean Number of Charges per Juvenile Offender</td>
<td>81</td>
</tr>
<tr>
<td>3. WISC-IV Scores Compared to Standardization Sample</td>
<td>82</td>
</tr>
<tr>
<td>4. African American Participants’ WISC-IV Scores Compared to the African American Standardization Sample</td>
<td>83</td>
</tr>
<tr>
<td>5. Mean and Standard Deviation of Each Cluster on Important Scales</td>
<td>84</td>
</tr>
<tr>
<td>6. MANOVA Comparing Clusters on WISC-IV and MANOVA Comparing Clusters on Behavioral Measures</td>
<td>85</td>
</tr>
<tr>
<td>7. Post Hoc Comparisons of Clusters</td>
<td>86</td>
</tr>
<tr>
<td>8. Age and Number of Offences by Cluster</td>
<td>88</td>
</tr>
<tr>
<td>9. Age and Charge Differences Between Clusters</td>
<td>89</td>
</tr>
<tr>
<td>10. Racial Differences Between Clusters</td>
<td>90</td>
</tr>
</tbody>
</table>
List of Figures

Figure                                          Page

Chapter V

1. Mean Cluster Scores on the Behavioral Measures from the CBCL, AARS, and
   Conners'.................................................................91
List of Appendices

<table>
<thead>
<tr>
<th>Chapter V</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Approval Letter from Hillcrest Training School</td>
<td>92</td>
</tr>
<tr>
<td>B. Approval Letter from Xavier University IRB</td>
<td>94</td>
</tr>
</tbody>
</table>
Chapter I

Review of the Literature

Children and adolescents who engage in illegal behaviors or behaviors that violate the rights of others are known as juvenile delinquents or offenders (Bartol & Bartol, 2008). These behaviors may include aggressiveness, truancy, theft, vandalism, drug and alcohol abuse, sexual promiscuity, and defiance of authority figures. When these behaviors are carried out without regard for other people and are not socially acceptable, they might also be considered antisocial behaviors (Morgan & Lilienfeld, 2000).

The number of cases managed by the juvenile court system is on the rise. In 2007 there were 44% more juvenile court cases than in 1985 (Knoll & Sickmund, 2010). However, the prevalence of juvenile delinquency (JD) varies by geographic region, gender, and race. There is a higher rate of JD within neighborhoods with high rates of poverty and racial segregation than in neighborhoods without these issues, and more boys are arrested than girls (Knoll & Sickmund; Piquero, Moffitt, & Lawton, 2005). The arrest rate seems to reflect gender differences in behavior patterns. In a sample of 5,212 public school children in elementary and middle school, as many as 54% of the male participants reported criminal involvement versus only 23% of the female participants (Babinski, Hartsough, & Lambert, 1999). Although girls tend to offend less frequently than boys, there has been a steady increase in the proportion of female juvenile offenders, with 30% more girls being arrested in 2007 than in 1985 (Knoll & Sickmund, 2010).
There are also significant racial disparities in JD. African American youths are disproportionately represented among juvenile offenders; whereas African American youth account for 16% of juveniles (individuals below the age of 18), 33% of youths who come to the attention of the juvenile justice system are African American (Knoll & Sickmund, 2010). General risk factors for JD, such as impulsivity, aggressive behavior, difficult temperament, poverty, segregation, family violence, and emotionally abusive family members are more common in racial minority communities, and greater exposure to a higher number of risk factors is felt to increase the likelihood that an individual will become a juvenile offender (Knoll & Sickmund; Pquero et al., 2005).

The antisocial behavior of juveniles predicts a variety of later problems, including future convictions and time spent in prison, a higher prevalence of psychological symptoms, more substance abuse, poor family relationships including abusive relationships with partners, lower socioeconomic status (Moffitt, Caspi, Harrington & Milne, 2002), antisocial personality disorder (APD), depression, and psychosis, among others (Bartol & Bartol, 2008; Moffitt et al., 2002).

Juvenile offenders vary considerably in the rate and seriousness of their offenses. Those children and adolescents engaging in more serious antisocial behavior are likely to have more severe outcomes (Moffitt et al., 2002). Examining patterns in behavior to identify those children and adolescents who are at greater risk for JD may help prevent these serious problems later in life as well as rehabilitate the developing behavior problems. It is clear youths who engage in criminal behavior and society at large would benefit from a better understanding of the factors that significantly contribute to an individual’s tendency to engage in delinquent behaviors.
Theories of JD

The causes, patterns, and courses of JD have been examined from a variety of perspectives. These perspectives include biopsychosocial theories, family systems theories, social control theory and developmental theories. Each of these theories has strengths and weaknesses.

Biopsychosocial model.

The biopsychosocial model focuses on biological and genetic factors, psychological factors, and social factors as antecedents to the development of antisocial behavior (Fabian, 2010; Pope & Thomas, 2007). In addition, the biopsychosocial model weighs the relative risk factors, those factors that increase the likelihood of a particular problem occurring, and protective factors, those factors that decrease the likelihood of a particular problem occurring, within each antecedent of developing antisocial behavior.

Social factors that have been implicated in the development of antisocial behavior include negative peer relationships, poor parenting and abuse (e.g., family violence), and the level of involvement of the community (Fabian, 2010; Pope & Thomas, 2007). Biological factors that pose a risk for the development of antisocial behavior include problematic prenatal development, frontal lobe impairment, and possible genetic patterns indicated by family histories of antisocial behavior (Fabian; Pope & Thomas). Prenatal complications are also a risk factor because poor maternal health, fetal maldevelopment, prenatal exposure to substances, and poor maternal nutrition can lead to low birth weight which, in turn, is associated with poorer early development (Bartol & Bartol, 2008; Fabian; Piquero et al., 2005). It is believed that the physiological impairments that occur at any age predispose some children to develop antisocial behavior later, including
serious illnesses or head trauma that cause neurological impairment; these events are associated with impulsivity and difficulty regulating emotions, which are also associated with juvenile delinquency (Piquero et al.).

Psychological factors that have been proposed to pose a risk for the development of antisocial behavior include inadequate attachment, difficult temperament, low intelligence and poor academic performance (Pope & Thomas, 2007). Poor emotion regulation is common among juvenile offenders and this factor is thought to be related to inadequate care giving. Specifically, a child needs a steady, reliable caregiver to help him or her learn how to regulate his/her emotions (Reid, Patterson & Snyder, 2002).

These risk and protective factors (such as, easy temperament and supportive family interactions) also interact with each other and must be weighed in light of other risk and protective factors (Fabian, 2010). Protective factors may be related to risk factors or a protective factor may outweigh a risk factor. For example, a strong maternal relationship may be due to a poor paternal relationship. These interactions increase the complexity and comprehensiveness of the theory. The complexity created by the relative importance placed on a variety of factors makes this theory strong. However, this theory does not explain the mechanisms behind the development of risk and protective factors.

**Systems theory.**

Parenting and other social risk factors are components of systems theory that have been implicated in the development of JD (Henggeler, Schoenwald, Borduin, Rowland, & Cunningham, 1998). Systems theory is one of the most popular theories among clinicians treating externalizing disorders, such as conduct disorder and oppositional defiant disorder, which are commonly associated with JD. This theory shifts the linear
focus of one cause and one effect to multiple causalities that are simultaneously occurring, mutually influential, and interrelated phenomena (Henggeler et al., 1998). This theory includes elements of the social ecology theory developed by Bronfenbrenner, who proposed that individuals are changing entities who are actively restructuring their environments while also being influenced by the environment (Henggeler et al.). The theory proposes a series of nested levels of influence in which an individual lives, starting with individual characteristics (such as temperament) and ending with societal influences (such as the media). Influential variables in family systems theory for the development of antisocial behavior include the child’s hyperactivity and temperament, mother’s depression, attachment style, and, possibly most importantly, parenting style and the parent-child relationship (Reid et al., 2002). Parent characteristics, child characteristics, and the interaction of the two variables are hypothesized to lead to development of positive and negative behavior patterns. Peer influences later in the child’s life also have an impact upon the child’s development (Reid et al., 2002). In systems theory, it is the transaction of these factors that creates antisocial behavior.

Social control theory.

The social control theory of criminal behavior, developed by Hirschi (2002; 2004), emphasizes the relationship between a person and his or her community. Social control theory assumes delinquent acts “result when an individual’s bond to society is weak or broken” (Hirschi, 2002, p. 75). Understanding delinquency, in turn, involves understanding the elements of these social bonds, which include attachments to family and friends, commitment to future aspirations, involvement in prosocial activities, and personal beliefs about criminal behavior (Hirschi, 2002; 2004). These elements play out
developmentally: an adolescent becomes particularly at risk for offending when he or she has few activities, little affiliation with prosocial people, questions conventional beliefs (such as religion), and has few aspirations or future goals (perhaps because of academic difficulties). Contrary to Moffitt (1993), who proposed a developmental perspective in which antisocial behavior is more likely to occur within general developmental pathways and there are certain periods when a child or adolescent is more likely to offend, social control theory states criminal behavior can occur at any time and is not restricted to developmental pathways.

Critics of this theory cite the difficulty quantifying components (e.g., the belief element) and the theory’s failure to account for individual differences (Church, Wharton, & Taylor, 2009). In particular, social control theory has been criticized for its failure to account for neurological deficits. Savolainen et al. (2010) examined the ability of levels of social control versus the influence of ADHD to predict criminal behavior in a large sample of children born in 1986 in the United States. These children were evaluated and monitored for criminal behavior, conduct problems, verbal deficits, symptoms of ADHD, family structure, and other social supports from birth until they were 16 years old. Results provided support for both theories. Family connections were found to be very important predictors of later criminal behavior and the life time perspective of social control theory suggests the importance of looking beyond early lifetime experiences. However, social control theory could not account for two of the strongest predictors of JD: attention problems and verbal deficits. The strong predictive role of these neurologically based deficits supported Moffitt’s (1993) developmental theory which hypothesizes neurocognitive deficits as well as a developmental timeline.
Developmental perspectives.

There are a variety of theories that implicate how developmental and environmental effects may impact the development of antisocial behavior. Some of these theories, such as that developed by Moffitt (1993), indicate a progression of behavior along two possible paths. Developmental theories generally implicate both social and other environmental factors. An additional feature commonly associated with antisocial behavior is neurocognitive factors. For decades, studies have shown that intelligence, which serves as a measure of overall neurocognitive development, is lower among children who display antisocial behaviors (Cornell & Wilson, 1992; Culberton, Feral, & Gabby, 1989; Ilsen, 2010; Law & Faison, 1996). In some studies, juvenile offenders score as much as 8 points lower on intelligence tests than their non-offending peers. Juvenile offenders also demonstrate poorer verbal and executive functioning relative to their other abilities (Kraus & Wolf, 2007; Moffitt, 1990b; Morgan & Lilienfeld, 2000; Pope & Thomas, 2007).

The Moffitt taxonomic theory.

In 1993, Moffitt proposed a highly influential theory regarding the patterns of antisocial behavior based on longitudinal data. She proposed two general patterns of behavior: life-course persistent (LCP) and adolescent limited (AL). LCP antisocial behavior has a poor prognosis with an early onset and a persistence of antisocial behavior. These children begin demonstrating antisocial behavior during childhood and are predicted to have continued legal, interpersonal and mental health problems throughout life. The types of behaviors displayed by the individual will differ depending on circumstances and the age of the individual. Statistics support this feature of Moffitt's
taxonomy: the odds of subsequent offenses following an early (before age 13) arrest are 39.7 times greater than if this arrest were to occur in adolescence (Reid et al., 2002). According to Piquero and White (2003) more academic struggles; living with a single mother; poor cognitive abilities; and being male were all predictive of LCP offending. It has also been predicted that LCP individuals may have personality traits (such as, callousness and impulsivity) similar to individuals with psychopathy, which is seen in a very small portion of adults with antisocial personality disorder (Sevecke, Kosson, & Krischner, 2009).

AL antisocial behavior involves more normative antisocial tendencies of adolescence (Moffitt, 1993). Moffitt contends that, as a result of a “maturity gap” (the gap between the legal and physical ability to engage in certain activities), some adolescents engage in illegal behavior that is indistinguishable from that of LCP offenders, except that it only occurs during adolescence. Adolescents in this group are more likely to engage in behaviors that allow them to have power and independence. Moffitt originally proposed that AL behavior desists in early adulthood, but follow up data from the original longitudinal study suggests that symptoms from child and adolescent antisocial behavior can linger well into adulthood before ceasing (Moffitt & Caspi, 2005). Specifically, men who had been classified as showing AL behavior were more likely than a control group to engage in illegal acts as adults, have significantly elevated neuroticism scores, be viewed by others (and describe themselves) as impulsive, be abusive in interpersonal relationships, have lower status jobs, and lower income than a control group who had not engaged in illegal acts as juveniles (Harrington & Milne, 2002; Moffitt & Caspi, 2005). However, the most severe outcomes were seen in those
men who had been classified as engaging in LCP antisocial behaviors. For example, individuals classified as LCP were more likely to have abusive interpersonal relationships including physical assault than those classified as having AL antisocial behavior.

Unique neurological and cognitive profiles have also been suggested by this theory. Moffitt (2007) proposed different neurocognitive profiles for AL and LCP individuals. The neurological and cognitive profiles of juvenile offenders may prove informative in rehabilitation efforts as neurological and cognitive functioning are linked to behaviors. However, the cognitive or neurological profiles of juvenile offenders involve differences as well as commonalities. Studies have examined cognitive and neurological differences based upon behavioral profiles. Vermeiren, De Cripple, Schwab-Stone, Ruchkin, and Deboutte (2002) assessed three groups of Flemish male adolescent offenders with varying amounts of previous and future offenses. Overall cognitive functioning, verbal comprehension, attention and concentration, psychomotor performance, and cognitive flexibility were measured. Compared to boys without early offenses, the boys who had early offenses and offenses upon follow-up had lower overall intelligence, poorer auditory verbal memory, poorer attention and concentration, and more impulsivity. These results indicate differences in neurological and cognitive profiles of juvenile offenders. However, the researchers categorized the participants based on their behaviors rather than their cognitive functioning which may not have allowed for greater differentiation of all the possible neurological profiles.

**Neuropsychological theories of JD.**

The cognitive functioning of juvenile offenders has caught the attention of researchers for several decades (Elliott & Mirsky, 2002; Fabian, 2010; Golden, Jackson,
EXECUTIVE FUNCTIONING OF JUVENILE OFFENDERS

Peterson-Rohne, & Gotkovsky, 1996; Moffitt, 1990b; Teichner & Golden, 2000). More recently, this has resulted in specific theories relating to neuropsychological functioning patterns. As previously noted, numerous studies have documented that, in general, the cognitive functioning of juvenile offenders is different from that of children and adolescents who do not come to the attention of juvenile courts. The previously described theories incorporated elements of neuropsychological abnormalities as part of the conceptualization (e.g., Hirschi, 2002; Moffitt, 1990b).

As discussed previously, it is clear from the number of research studies completed on the differential functioning of juvenile offenders that neurocognitive functioning is an important factor in the development of antisocial behavior. To fully understand the differences, typical development must first be examined. More specifically, it is important to focus upon the development of those neurocognitive functions that are most important for executive functioning and verbal functioning, as these areas seem to be underdeveloped among juvenile offenders.

According to Blakemore and Choudhury (2006), two important processes, myelination and synaptic pruning, occur between childhood and adolescence. Myelination is the process during which neurons begin to form a layer of myelin, an insulator that increases speed of nerve impulse transmission. Myelination begins in the first few years of life with the sensory and motor neurons and continues until the last areas of the brain are myelinated. Generally, those neurons in the frontal lobe, associated with executive functioning, complete the myelination process during late adolescence and early adulthood. Synaptic pruning is the process by which neural circuits eliminate connections or synapses that are no longer utilized frequently (Blakemore & Choudhury).
Synaptic pruning is an experience-dependent process and creates allows the brain to function more efficiently. Synaptic pruning occurs at its highest rate during the first few years of life, but continues well into adolescence and young adulthood. Again during adolescence, synaptic pruning primarily occurs in the prefrontal cortex where many of the functions associated with executive functioning are carried out (Anderson et al., 2001; Blakemore & Choudhury). Myelination and synaptic pruning occur during crucial times in development, including adolescence, to allow that individual to make quick judgments and plan their behavior more easily. However, among juvenile offenders these capabilities seem hindered (Elliott & Mirsky, 2002; Moffitt, 1990a).

Theories implicating the neuropsychological functioning of juvenile offenders are vast and varied. Moffitt (1993) implicates neuropsychological functioning in her theory of antisocial behavior, whereas the social control theory implicates the intellectual capacity of individuals and how those children interact socially (Hirschi, 2002). Strain theory states that those with greater cognitive strengths are better able to reach achievements and create more realistic aspirations (Hirschi). When the child’s or adolescent’s aspirations are above his or her intellectual capacities, this creates strain and frustration that may, in turn, lead to delinquent means to achieve his or her goals.

*Intelligence and JD.*

The extensive research on the neurocognitive functioning of juvenile offenders is rooted in the decades-long examination of intellectual functioning of juvenile offenders (e.g., Altus & Clark, 1949; Wechsler, 1944). More recently, attention has focused more specifically on executive functioning and verbal functioning (Elliott & Mirsky, 2002; Fabian, 2010; Golden et al., 1996; Moffitt, 1990a; Teichner & Golden, 2000).
As a recent example of studies on intellectual functioning, Teichner and Golden (2002) found that the average intelligence quotient (IQ) of a group of violent delinquents was in the Low Average range. This low IQ score indicates that the average juvenile offender is likely to have lower cognitive functioning than the average child or adolescent who is not a juvenile offender.

Research dating to the 1940s has demonstrated that juvenile offenders perform better on tests examining their non-verbal reasoning abilities than their verbal reasoning abilities, suggesting specific verbal deficits (Altus & Clark, 1949; Wechsler, 1944). Teichner and Golden (2000) indicated that this verbal deficit is likely to become problematic in a variety of areas such as problem solving, mediating verbal conflicts and learning in academic environments. Lower verbal abilities are likely to have a crucial impact on juvenile offenders’ school functioning. In one study, the reading ability of adolescent juvenile offenders with ADHD was significantly lower than other juvenile offenders without ADHD (Moffitt, 1990a). Poor performance on reading and other language based tasks provides additional evidence of a verbal deficit relative to that individual’s non-verbal abilities, a verbal and non-verbal ability split among juvenile offenders. This split among functioning on verbal and performance or non-verbal tasks indicates a significant problem for juvenile offenders. However, the difference between verbal and non-verbal skills is not as clear as it may seem.

The finding that Verbal IQ (VIQ) is lower than Performance IQ (PIQ) on the Wechsler Intelligence Scales among juvenile offenders (Cornell & Wilson, 1992; Law & Faison, 1996) is known as the VIQ<PIQ difference and was originally identified by David Wechsler (Law & Faison). However, not all evidence supports the VIQ<PIQ
difference. Golden, et al. (1996) suggested that there was not enough conclusive evidence for a verbal deficit relative to non-verbal functioning. In fact, prior to the fourth edition of the WISC, many of the subtests that comprised the VIQ measured executive functioning, not verbal functioning. Isen (2010) completed a meta-analysis of studies investigating the VIQ<PIQ difference. He found that there were racial differences in the occurrence of VIQ<PIQ differences, with African American children less likely to show a VIQ<PIQ difference than Caucasian children. Further, differences depended upon the type of test that had been given. Specifically, he found that those studies that did not use the full Wechsler scale were more likely to find a VIQ<PIQ difference than those that did use the full Wechsler scale. Law and Faison (1996) found no evidence of a VIQ<PIQ difference in their small (n=30) sample of male and female juvenile offenders. However, given the small sample size, there might not have been enough power to find such a difference. The low VIQ scores did indicate a significant language deficit among juvenile offenders. In addition, other studies have also indicated this difference is likely to occur less often with the new revisions of the WISC, because of the use of four index scores (processing speed, working memory, verbal comprehension, and Perceptual Reasoning) (Golden et al., 1996; Isen, 2010).

The development of index scores allows for the examination of specific executive functioning, working memory, and processing speed. Working memory is the ability to hold and manipulate information in the mind (Sattler, 2001). This ability relies heavily on skills such as attention, short-term memory, and concentration as well as the coordination of skills. Processing speed includes such skills as attentional control, cognitive flexibility, and impulse control (Sattler). These skills are all associated with executive functioning.
Executive functioning and JD

The executive functioning of juvenile offenders has become an area of research focus in recent years, as there is an assumption that this critical area may differentiate juvenile offenders from adolescents without court contact. Executive functioning is associated primarily with the frontal lobe in the brain, and includes a variety of abilities such as attentional control (i.e., selective attention), cognitive flexibility (i.e., the ability to shift attention), self-monitoring, and goal setting (e.g., initiating, planning, problem solving and strategic behavior) (Anderson et al., 2001). According to Elliott and Mirsky (2002), frontal lobe dysfunction is associated with cognitive inflexibility, poor planning, poor concept formation, poor abstract reasoning, difficulty setting goals, and difficulties organizing large amounts of information.

Executive functioning skills develop rapidly through early and middle childhood, and more slowly during late childhood and adolescence, with some of these abilities such as attentional control having their most significant development around 15 years of age (Anderson et al., 2001). The behavioral changes in these areas are associated with continued myelination well past 15 years of age. Anderson et al. examined the executive functioning in a cross-sectional sample of Australian adolescents (n=139) using the WISC-III, Contingency Naming Test, Verbal Fluency Test, Tower of London, and Complex Figure of Rey Test. They found that older adolescents have a greater attentional capacity and complete tasks more quickly than younger adolescents. Additionally, older adolescents demonstrate better developed planning and problem solving skills than younger adolescents.
Moffitt (1990a) contends that the executive functioning of juvenile offenders is particularly problematic. Based on a review of the literature, Elliott and Mirsky (2002) concluded that juvenile delinquents are especially prone to having executive dysfunction, as much research has pointed towards deficits in organization, planning, and abstract reasoning. Carroll et al. (2006) compared early-onset, late onset, and non-offenders \((n=129)\) based on self-report of delinquent behaviors, performance on the Stroop Test, Time Perception, and on a risk taking game measuring impulsivity. They found that impulsiveness predicted delinquent behavior, but that early onset juvenile offenders were not significantly different from late onset juvenile offenders on this characteristic. Olson, Hooper, Collins, and Luciana (2007) investigated impulsivity with a sample of 92 participants between the ages of 9 and 23. Participants were mostly Caucasian and had higher than average intelligence. Each participant completed a *Wechsler Abbreviated Scale of Intelligence* (WASI), the *Youth Self-Report* and *Adult Self-Report* forms to measure psychopathology, and participated in a delay or probability discounting task that would measure the impulsivity of the participant. Results revealed that increased impulsivity was associated with externalizing symptoms and that the younger the individual was the more impulsive they were (Olson et al., 2007).

The diagnosis of ADHD consists of symptoms related to executive functioning including inattention, hyperactivity, and impulsivity (APA, 2000). ADHD is frequently comorbid with conduct disorder and oppositional defiant disorder (Sevecke et al., 2009). Among juvenile offenders, the prevalence of ADHD is higher than in the average population (Altus & Clark; Cornell & Wilson, 1992; Law & Faison, 1996; Teichner & Golden, 2002; Wechsler, 1944). Further, some studies (e.g., Carroll et al., 2006) have
found that the antisocial behavior of juvenile offenders diagnosed with ADHD is more severe and more frequent than that of juvenile offenders without ADHD. ADHD and other executive functioning deficits have also been found to be statistical predictors of later antisocial behaviors (e.g., Moffitt, 1990a).

Moffitt (1990a) followed 435 boys from Dunedin, New Zealand from birth to age 15, with assessments every two years. This study examined a variety of variables including antisocial behavior measured by parent and teacher rating on the Rutter Child Scales; family adversity, including a variety of variables considered risk factors for antisocial behavior; verbal cognitive ability as measured by either the WISC-R or Stanford-Binet (if the child was below age 5); reading achievement using the Burt Word Reading Test; motor functions; prenatal problems; and symptoms attention deficit disorder (ADD; the precursor for ADHD). Boys identified as having ADD, but no antisocial behaviors, ADD and antisocial behaviors, without ADD, but engage in antisocial behaviors, and non-disordered boys were compared. Antisocial behavior was observed in non-juvenile offenders with ADD only during middle childhood when they were more likely to demonstrate antisocial behavior than the control group of children without ADD (Moffitt, 1990a). In the same study, juvenile offenders without ADD were significantly older than juvenile offenders with ADD, suggesting that if ADD is not present, the child or adolescent is more likely to demonstrate AL antisocial behavior.

According to Sevecke et al. (2009), ADHD may have less influence upon JD than the presence of a conduct disorder diagnosis for boys. However, ADHD is still a significant predictor of JD among girls when conduct disorder was being statistically
controlled. However, overall the study indicated that both ADHD and conduct disorder were predictive of JD.

Many studies implicate either verbal or executive functioning deficits, or both, among juvenile offenders. However, Savolainen et al. (2010) indicated that it may be the interaction between verbal and executive functioning deficits that is most problematic. A longitudinal study of 5,010 children in northern Finland measured, ADHD symptoms using the *Strengths and Weaknesses of ADHD Symptoms and Normal Behavior* scale and history of criminal convictions. It was revealed that a diagnosis of ADHD and verbal deficits were only predictive of criminal behavior when combined. Either ADHD or verbal deficits alone was not more predictive of criminal behavior than the presence of no deficit. While much research has focused on one or the other, few studies have examined this interaction effect between executive functioning and verbal abilities.

**Categorizing Juvenile Offenders**

The differentiation of juvenile offenders is helpful for a variety of reasons. Moffitt (1990b) suggested that we need to further understand subgroups of juvenile offenders and their neuropsychological functioning in order to find a place to intervene with these individuals and especially those individuals who will pose the greatest risks to community safety. Likewise, the assumption that similarly diagnosed individuals will represent meaningful and homogenous categories may be overly relied upon (McDermott, Glutting, Jones, & Watkins, 1989). The assumption of homogeneity when heterogeneity is reality may lend to false assumptions. The generalities concluded about juvenile offenders with regards to executive functioning and verbal abilities may not fully represent the diversity of individual functioning possibilities. To date, studies of juvenile
EXECUTIVE FUNCTIONING OF JUVENILE OFFENDERS

offenders have included categorization based on behaviors (e.g., first time offenders compared to repeat offenders; offenders who have engaged in violent versus non-violent crimes), general scores (e.g., overall intelligence), diagnoses or broad categorizations (e.g., juvenile offenders versus non-juvenile offenders). However, each of these methods seems to fall short of either objectivity or specificity. Even in those studies with greater specificity, the researcher created the groups and did not follow the natural divisions within the data itself. More recently, statistical methods have been used to create categories; a popular method has been cluster analysis (Mun, Windle, & Schainker, 2008; Teichner et al., 2000).

Cluster Analysis.

Cluster analysis (CA) is a grouping technique that utilizes multivariate statistics to group the objects or people being categorized, based on similar characteristics (Hair & Black, 2000). The main objectives of CA include taxonomy description or an exploratory classification of objects, data simplification for further analysis, and relationship identification that cannot always be revealed through individual observations (Hair & Black, 2000).

The clusters or groups are formed to maximize within cluster homogeneity while maximizing external, or between clusters, heterogeneity. Groups are formed based on cluster variates, which are the set of variables representing the characteristics used to compare objects (Hair & Black, 2000).

To determine the number of clusters, the relative similarity between clusters is identified. CA measures similarity by calculating distance, or the amount of difference between two objects. The smaller the distance between two objects, the more similar
those objects are. Euclidean distance is the most commonly chosen measure of distance because the joining of objects to any given cluster does not affect the measure of distance for the other objects in the cluster. To create standardized data the distance is squared creating more clarity between objects. Euclidean distance squared is the most commonly used distance measurement.

An important decision in the process of CA is choosing a clustering algorithm. There are two primary types of clustering algorithms, nonhierarchical and hierarchical. Hierarchical clustering can be agglomerative, where each object starts as its own cluster and then the closest clusters are combined, or divisive, where all objects are included in one large cluster and then reduced until objects are in their own clusters (Hair & Black, 2000). Complete linkage and Ward’s method are the most commonly used and the most effective of the hierarchical clustering techniques. Complete linkage involves linking or clustering based on the maximum and minimum similarity. One of the most common methods, Ward’s method, utilizes hierarchical CA. Ward’s method involves finding the distance between two clusters based on the sum of squares between the two clusters. However, Ward’s method has been demonstrated as biased to produce clusters with a small number of objects (Hair & Black). In spite of this limitation, researchers still utilize this method because cluster variance is minimized.

Nonhierarchical clustering procedures involve selecting a starting point (often the first observation without missing data, called the “seed”) then including all other objects within a specified threshold distance (Hair & Black, 2000). Then another seed is chosen and the assignment continues until all objects are assigned. There are three approaches within nonhierarchical clustering: sequential threshold, parallel threshold and
optimization. In sequential threshold assignment, one cluster seed is selected to include objects within a specified distance and so on. Parallel threshold involves selecting several cluster seeds simultaneously in the beginning and assigning objects within the threshold distance to the nearest seed. This method is the quickest cluster analysis method. The final method is optimization which allows for the reassignment of objects should an object become closer to another cluster (Hair & Black).

There are limitations to both hierarchical and nonhierarchical approaches. Nonhierarchical cluster analysis depends upon the ability of the researcher to select appropriate seed points, but is less susceptible to outliers, distance measures, and inclusion of irrelevant or inappropriate variables (Hair & Black, 2000). Hierarchical methods are more susceptible to outliers, especially complete linkage, and can be less useful with samples in excess of 400 cases. A more appropriate technique may be to combine hierarchical and nonhierarchical techniques in a mixed design. Mun et al., (2008) utilized a mixture model based cluster analysis technique which utilized finite mixture distributions. This specific method can be used to approximate what would be expected in the general population, thus producing findings that are easier to generalize. Mixed methods includes first using a hierarchical technique to establish the appropriate number of clusters and then use a nonhierarchical method with the cluster centers as the initial seed points (Hair & Black, 2000). The final number of clusters is determined by examining the measure of distance at each step. When the similarity measure exceeds a specified value or when the successive values between steps jump suddenly the previous number is the final solution.
The validity of the clusters can be determined by using other variables known to vary between clusters to determine if they follow the expected pattern; discriminant analysis of the clusters may also be used. Previous studies have used analysis of variance (ANOVA) to determine external validity (e.g., Waxman & Casey, 2006). Significant differences between the clusters supports that relevant subgroups have been identified.

CA and JD.

Very few researchers have utilized cluster analysis as a technique to explore differential cognitive functioning of juvenile offenders. Raine et al. (2005) utilized Ward's hierarchical method of CA with Euclidian squared method of measuring distance to examine patterns of neuropsychological functioning of a large sample of youths from an urban community. The sample included 250 highly antisocial individuals and 253 randomly chosen children, from the same community who were followed from age 7 to 17 years old. They first performed CA to produce clusters based on the number, length and severity of their criminal behavior. Further analysis included multiple analysis of variance, analysis of variance and chi-square tests to compare the cluster groups on measures of neuropsychological functioning.

Raine et al.'s (2005) four cluster solution supported Moffitt's (1993) taxonomy of JD: the analysis identified a control group who displayed a stable, low amount of antisocial behavior, an adolescence limited cluster (i.e., high antisocial behavior during adolescence), a childhood limited cluster (i.e., high amount of antisocial behavior during earlier childhood that dropped to a low amount of antisocial behavior during adolescence), and a life course persistent group (i.e., a high level of antisocial behavior throughout). These groups were then compared on a variety of variables, including
intelligence, memory, frontal lobe functioning, dichotic listening abilities, and prevalence of ADHD, abuse, poverty, parental pathology, and history of head injuries. LCP and childhood limited individuals had the highest number of risk factors and deficits in functioning. LCP individuals had lower verbal abilities and overall IQ compared to controls and AL participants, poorer spatial memory than controls, poorer attentional processes than controls, higher prevalence of ADHD than both controls and AL participants, higher prevalence of abuse than controls and AL participants, higher rates of poverty than controls, and were more likely to have experienced head trauma resulting in unconsciousness than controls and childhood limited participants. Childhood limited individuals had lower IQ than controls on performance, verbal and overall intelligence scales, lower verbal memory than controls, higher prevalence of ADHD, abuse, poverty, and parental pathology when compared to controls. The AL group had the fewest deficits besides the control group including no differences when compared to the control group, but lower immediate memory. While this study provides interesting information in regards to the cognitive and neurological functioning of juvenile offenders, it did not create groups based on cognitive functioning, which could potentially leave out important neuropsychological patterns.

Teichner et al. (2000) used CA to assess the neurocognitive functioning among juvenile offenders. Adolescents \( (n=77) \) from an outpatient drug and behavioral problems clinic were assessed for neurological functioning, problem behaviors, and mental health functioning. The researchers performed a hierarchical cluster procedure and utilized analysis of variance procedures to compare clusters. Contrary to Raine et al. (2005), Teichner et al. (2000) categorized the participant based upon their neurocognitive
functioning. Results included a four cluster solution, which the authors identified as a left hemisphere deficit and verbal deficit group; a mild verbal deficit group; an executive functioning deficit group; and a no deficit group. Analysis of the demographic characteristics of the groups revealed that the left hemisphere and verbal deficit and executive functioning deficit groups were significantly younger, had less education, and were more likely to be in special education than those with mild verbal deficits or no deficits.

Spare-Warner (2010) used CA to analyze the WISC-IV and Woodcock-Johnson 3rd edition scores generated by a sample of 430 female juvenile offenders. This resulted in a five clusters solution that she labeled: “Average,” “Low Average,” “Verbal Weakness,” “Extremely Low,” and “Low VCI/PRI.” The Average, Low Average, and Extremely Low Average clusters had WISC-IV scores that were consistently in these ranges. However, the Verbal Weakness cluster had significantly poor performance on verbal tasks and the Low VCI/PRI cluster had poorer performance on verbal and non-verbal tasks than those tasks that measure working memory and processing speed. In addition, the mean IQ and achievement scores of the entire sample were significantly lower than the standardization sample mean, confirming previous research. The study indicates that there are several achievement and neurocognitive profiles that can be created within a sample of juvenile offenders. These results are important with regard to female juvenile offenders, but as indicated previously, the neurocognitive profiles of female juvenile offenders have been found to be different from that of male juvenile offenders (Law & Faison, 1996).
Each of these studies has utilized CA to identify different methods of categorizing juvenile offenders related to their executive functioning. Närhi, Lento-Salo, Ahonen, & Marttunen (2010) utilized the subgroups formed by Teichner and Golden (2000) to compare groups of 77 children and adolescents with conduct disorder and 48 controls without disorders based on scores from achievement testing, WISC-R, Auditory Verbal Learning Test, and the Trail Making Test, part B. Groups that were formed included the no deficit group, the diffuse deficit group, verbal deficit group, and executive functioning deficit group. A multivariate analysis of variance indicated that neurological deficits were common among those groups with a high prevalence of learning disability. Surprisingly those with more neurological deficits did not have more psycho-social risk factors, and did not have more severity or aggressiveness in their behavior. However, CA is very subjective to specific populations and needs much replication before groupings are solidified.

There are a variety of theories that have attempted to account for a child’s development of antisocial behavior. A common factor cited in several of those studies is the child’s neurocognitive functioning (Hirschi, 2002; Moffitt, 1993; Pope & Thomas, 2007). In particular, the role that verbal and/or executive functioning deficits play in studies have demonstrated that, not only do juvenile offenders perform significantly lower than non-delinquent peers on tests of intelligence, but that their performance on verbal tasks is significantly poorer than that of their performance on non-verbal tasks (Teichner & Golden, 2000). However, it is important to note that these studies did not differentiate between those verbal tasks that also require executive functioning and those that solely measure verbal comprehension. The high prevalence of disorders of executive
functioning, such as ADHD, among juvenile offenders also supports further investigation into the role that deficits in these critical cognitive functions may play in development of juvenile offending (Sevecke et al., 2009). Recent studies using CA have identified interesting subgroups of juvenile offenders, but no study to date has attempted to create subgroups of male juvenile offenders based on patterns of cognitive functioning.
Chapter II

Rationale and Hypotheses

Current research indicates that the needs of juvenile offenders are vast, as many of these children experience difficulties such as psychiatric disorders, learning disabilities, and cognitive challenges (Piquero et al., 2005). In particular, numerous studies have found that the cognitive functioning of juvenile offenders, as a group, is below average (e.g., Golden et al., 1996; Kraus & Wolf, 2007; Teichner & Golden, 2000), with specific deficits in executive and verbal functioning (e.g., Golden et al., 1996; Pope & Thomas, 2007). However, there is little information about the specific differences among juvenile offenders within these abilities.

Cluster analysis is a statistical technique that has been used to create meaningful subgroups to better understand the heterogeneity of a large group. To date most cluster analysis involving juvenile offenders has been based on behaviors such as substance use, sexual promiscuity (Mun et al., 2008), delinquent behaviors, and depressive symptoms (Raine et al., 2005). A recent study has used cluster analysis to create groups based on neurocognitive differences in a sample of juvenile offenders but, this study was not specific to executive functioning (Teichner et al., 2000). Spare-Werner (2011) utilized a cluster analysis to evaluate patterns in cognitive functioning of female juvenile offenders. Of the five clusters generated, there was no specific executive functioning cluster, but these profiles were based upon female offenders who have been previously demonstrated to have different cognitive and behavioral profiles than male offenders (Moffitt, 1990b).
More specific investigation into differences in executive functioning among male juvenile offenders may inform future research, which may include developing new intervention programs. The current study will examine patterns of intelligence test (WISC-IV) scores in a large sample of juvenile offenders. In addition to evaluating the sample’s IQ scores against that of the standardization sample, cluster analysis of the subtest scores will be used to identify subgroups of offenders who exhibit similar patterns of cognitive functioning. Clusters based on these profiles will then be compared on dimensions associated with executive functioning.

The following alternate hypotheses are proposed to be tested:

H1: The overall intellectual functioning of the juvenile offender sample, as measured by WISC-IV Full Scale IQ, is significantly lower than that of the WISC-IV standardization sample and the African American norms created by Sattler (2003).

H2: The executive functioning of the juvenile offender sample, as measured by WISC-IV Processing Speed Index (PSI) and Working Memory Index (WMI) scores, is significantly lower than that of the WISC-IV standardization sample and the African American norms created by Sattler (2003).

H3: At least one of the clusters in a cluster solution based on the WISC-IV index scores is characterized by executive functioning deficits.

To validate the cluster solutions, select scores from the Achenbach Child Behavior Checklist/6-18 (CBCL) (Achenbach et al., 2001), Conners' Rating Scales-Revised (CRS-R) (Conners, 1997), and Adolescent Anger Rating Scale (AARS) (Burney, 2001) will be compared across the generated clusters. The scales selected will be those that measure behaviors related to executive functioning deficits. Specifically, those
clusters indicating executive functioning deficits are expected to have mean CBCL, CRS-R, and AARS scores that are significantly higher than those clusters that do not demonstrate executive functioning deficits. The Attention Problems, Attention Deficit/Hyperactivity Problems (ADHDP), and Aggressive Behavior scales on the CBCL, Cognitive Problems, Hyperactivity, and ADHD Index scales on the CPRS-R, and the Reactive Aggression scale on the AARS measure features of behavioral regulation that are associated with deficits in executive functions.
Chapter III

Method

Participants

Data to be utilized in this study are maintained in a database of information gathered through the Multidimensional Assessment Program (MAP) operated by the Hamilton County Juvenile Court. This program involves juvenile offenders who complete a 14 day, residential evaluation. The program was developed to assist the court in making decisions regarding the appropriate intervention needs of each individual offender. During the evaluation, assessment information is gathered by a multi-disciplinary team that includes performance on a variety of standardized tests, including the WISC-IV (Wechsler, 2003). A previous study (Bumberry, 2007) utilized information maintained in this database, which included 940 male juvenile offenders. The sample was predominantly African American (69.9%) with a mean age of 15.40 years (SD= 1.23; range=13-17). All data for the current study will be based on boys.

Measures

Wechsler Intelligence Scale for Children, fourth edition.

The Wechsler Intelligence Scale for Children, fourth edition (WISC-IV; Wechsler, 2003) is a widely used measure of intellectual functioning. The WISC-IV is designed to assess children and adolescents between the ages 6 and 17 years old. This test is best known for its excellent "standardization, reliability, and concurrent and construct validity" (p 311, Sattler, 2008). The WISC-IV includes four index scores, Verbal
Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI) along with a Full Scale score (FSIQ) (Sattler). WMI and PSI scores measure executive functions such as working memory, attention and concentration and the speed at which an individual processes information. They are contributed to by the subtests Digit Span, Letter-Number Sequencing, Coding, and Symbol Search.

Norms for the WISC-IV were developed based upon a sample that reflected major demographic characteristics of the 2000 census data (Wechsler, 2003), which was 62% Caucasian individuals. Because the data for the present study will be predominantly African American, and previous studies have found that the average FSIQ of African American children is approximately 11.5 points lower than Caucasian children (Sattler, 2008), the present study will involve comparison against the standardization norm (M=100, SD=15) (Wechsler, 2003), as well as the mean for African American children that is cited in the (M= 91.86, SD=15.42 for the FSIQ, M=96.12, 15.35 for WM, and M=95.00, SD=15.66 for PS) (Sattler & Dumont, 2004).

The WISC-IV has been demonstrated to have good reliability and validity. Internal consistency coefficients for those subtests being utilized are .79 (Symbol Search), .85 (Coding), .90 (Letter-Number Sequencing), and .87 (Digit Span) (Wechsler, 2003). The internal consistency coefficient is .88 for PSI, .92 for WMI, and .97 for FSIQ (Wechsler, 2003). Similar internal consistency coefficients were found among special populations. The test-retest reliability for the subtests being utilized are .80 (Symbol Search), .84 (Coding), .83 (Letter-Number Sequencing), and .83 (Digit Span) (Wechsler,
2003). The test-retest reliability is .86 for PSI, .89 for WMI, .93 for FSIQ (Wechsler, 2003).

Intercorrelation studies provide evidence of convergent and discriminant validity for the WISC-IV. All subtests were found to be significantly correlated within respective index scores (Wechsler, 2003). In cross-validation studies, factor analysis supported the four index scores (Wechsler). The WISC-IV is also highly correlated with other Wechsler scales and other measures of intellectual functioning such as the children’s memory scale (Wechsler).

Child Behavior Checklist, 6-18.

The Child Behavior Checklist, 6-18 (CBCL) (Achenbach & Rescorla, 2001) is a 113-item measure used in a variety of settings to assess behavior patterns of children and adolescents. Parents report the presence or absence of a wide range of behaviors that include problem behaviors (e.g., anxiety, delinquent behavior, and attention problems) and pro-social behaviors (e.g., social activities). There are four competence scales, eight syndrome scales and six diagnostic scales (Achenbach & Rescorla, 2001).

The CBCL’s norms were based on a sample of 1,753 children and adolescents who were predominantly Caucasian (72%) (Achenbach & Rescorla, 2001). Normalized t-scores were developed at two age levels 6-11 and 12-18 years and for each gender (Achenbach & Rescorla). Generally good reliability and validity are reported for the CBCL. The Attention Problems scale has a test-retest reliability of .92, the ADHDP scale has a test-retest reliability of .93, and the Aggressive Behavior scale has a test-retest reliability of .90 (Achenbach & Rescorla). The internal consistency, as measured by a Cronbach’s alpha score, for the Attention Problems scale was .86, for the Aggressive
Behavior scale was .94, and for the ADHDP scale was .84. Validity was supported by strong correlations between the CBCL and other similar behavioral measures such as the Conners' Rating Scale- Revised, and with descriptions of such behavioral problems, such as the DSM-IV.

The scales to be examined in this study are the Attention Problems, ADHDP, and Aggressive Behavior scales because these scales are thought to be closely associated with ADHD and other executive functioning deficits. The Attention Problems, ADHDP, and Aggressive Behavior scales have been used in a variety of settings to indicate attention problems (Achenbach & Rescorla, 2001). Specifically the Attention Problems scale addresses inattention symptoms, the ADHDP scale assesses for symptoms of ADHD, and the Aggressive Behavior scale assess symptoms related to emotion regulation difficulties. The research has indicated symptoms of ADHD as well as aggressive behavior as indicative of executive functioning difficulties (Carroll et. al., 2006).

Conners’ Rating Scales-Revised.

The Conners’ Rating Scales Revised (CRS-R) (Conners, 1997) were developed to assess symptoms of ADHD. The Conners’ Parent Rating Scale Revised: Long Form (CPRS-R:L) measures parent observation of ADHD symptom behaviors. The scale includes 80 items with 14 subscales. The subscales to be used in the current study are specific to behaviors consistent with executive functioning deficits such as the Cognitive Problems, Hyperactivity, and ADHD Index scales. The Cognitive Problems Scale provides information regarding inattentive symptoms of ADHD, whereas the Hyperactivity scale provides information regarding excessive energy and impulsivity related to ADHD. Finally, the ADHD Index is described by the author of the scale as,
the best initial indicator of whether a child is likely to have an attention problem"
therefore it was also included in the current study (Conners, p. 47).

The CPRS-R:L is based on normative data collected from a sample of 2,482
children and adolescents between ages 3 and 17 years that were rated by either a parent or
guardian (Conners, 1997). The sample was predominantly Caucasian (83%), 4.8% were
African American, and 11.7% were identified as other races/ethnicities (Conners). Norms
were created based on age and sex due to both age and sex differences in symptom
presentation of ADHD. The internal consistency of the CPRS-R:L scales is excellent, .93
(male) and .87 (female) for the Cognitive Problems scale, .91 (male) .87 (female) for the
Hyperactivity scale, and .94 (males) and .92 (females) for the ADHD Index. The standard
error of measurement for the CPRS-R:L ranges between 3.048 for the Cognitive
Problems scale and 1.079 on the Hyperactivity scale. The test-retest reliability is good
ranging among those scales to be used from .85 (Hyperactivity) to .69 (Cognitive
Problems) (Conners). These measurements of reliability indicate a range between good to
excellent. However, the Cognitive Problems scale may demonstrate some instability.
Finally, studies have demonstrated good validity for the measure as well. A three factor
solution has supported the three symptoms scales (Oppositional, Cognitive Problems, and
Hyperactivity) (Conners). In addition, other behavioral measures of symptoms assessed
on the CPRS-R:L are highly correlated. In addition, the CPRS-R:L is correlated with
other versions of the measure (Conners).

**Adolescent Anger Rating Scale.**

The *Adolescent Anger Rating Scale* (AARS) (Burney, 2001) is a 41-item measure
that yields three scores measuring different dimensions of anger. The Instrumental Anger
scale measures aggression that involves forethought and planning, the Reactive Anger scale measures impulsive aggression, and the Anger Control scale measures coping skills to manage anger. These scales culminate in a Total Anger score. Adolescents rate items on a 4-point likert-type scale (i.e., Hardly Ever, Sometimes, Often, and Very Often) (Burney). Raw scores are converted to T-scores ($M=50; SD=10$).

Normative data for the AARS is based on a sample of 1,116 middle school students and 1,213 adolescents in high school students (Burney, 2001). This sample included 60% Caucasian adolescents in middle school and 53 % Caucasian in high school. The sample also included 51% females, in middle school and 60% females in high school, although normative tables are based both on age and gender due to differential expression of aggression by age and sex.

The overall reliability of the AARS was good, with alpha coefficients ranging from .80 to .92 for the middle school group and .81 to .94 for the high school group (Burney, 2001). Specific item correlations range from .34 to .65 and test-retest reliability coefficients for specific subscales range from .71 to .79 (Burney). The three scores of the AARS have been supported by factor analysis, and the AARS is also correlated with other measures of anger including the Anger Control Problems and Conduct Problems scales of the Conners-Wells Self-Report Scales Long Version (Conners, 1997) and the Multidimensional Anger Inventory (Burney, 2001).

The scales to be used in the current study are the Reactive Anger scale and the Anger Control scales. These scales measure an adolescent’s ability to control their anger and manage their behavior (Burney 2001). Behavioral control and emotion regulation, including anger, are executive functions discussed earlier (Anderson et al., 2001).
Procedure

Permission to utilize the database containing data from a sample of juvenile offenders has been obtained from the Hamilton County Juvenile Court and approval will be sought from the Xavier University Institutional Review Board. All information in the database is anonymous. Cases in the database will be utilized for the current study if they include data from a valid WISC-IV protocol, CBCL protocol, CPRS-R:L, and AARS protocol.
Chapter IV

Proposed Analysis

The first two hypotheses of the present study propose differences between the FSIQ, PSI and WMI scores of the WISC-IV and the mean of those scores derived by the standardization sample and the African American norms developed by Sattler (2003). In order to test these hypotheses, one sample t-tests will be used.

The third hypothesis involves the statistical grouping of the sample based on the WISC-IV subtest scores. To address this hypothesis, hierarchical cluster analysis will be used. Hierarchical clustering can be agglomerative, where each object starts as its own cluster and then the closest clusters are combined, and divisive, where all objects are included in one large cluster and then reduced until objects are in their own clusters (Hair & Black, 2000). Ward developed a cluster algorithm that involves finding the distance between two clusters based on the sum of squares between the two clusters. At every step of the analysis every possible combination is considered when determining distance between clusters minimizing error. According to Hair and Black (2000), this algorithm has certain limitations including producing clusters with a small number of objects. However, the reduction in error has made this algorithm one of the most popular. At least a three cluster solution is hypothesized, at least one of which is characterized by executive functioning deficits. These clusters will be compared using an ANOVA to characterize each cluster based on WISC-IV index scores.
To validate the derived clusters, an ANOVA comparing all of the clusters will be conducted. Significant differences between the derived clusters on the grouping variables, (in this case, the WISC-IV subtest scores) indicate that meaningful clusters have been developed. The validity of the clusters can also be determined by using other variables that are likely to differ between clusters (Hair & Black, 2000). If the variables differ in a pattern that follows what would be expected, then the analysis further supports that meaningful clusters have been developed. The analysis of variance (ANOVA) will be used to compare the clusters based upon variables that have been associated with executive functioning. In the current study, clusters will be compared based on select scores on the CBCL, CPRS-R:L, and AARS. Specifically, this analysis will focus on those scales that are associated with behaviors consistent with executive functioning deficits, including the Attention Problems, Attention Deficit/Hyperactivity Problems, and Aggressive Behavior scales from the CBCL, the Cognitive Problems, Hyperactivity, and ADHD Index scales on the CPRS-R:L, and the Reactive Aggression scale from the AARS.
References


Bumbery, L. (2007). *Personality and behavioral patterns of juvenile offenders as measured by the MACI and the CBCL* (Doctoral dissertation). Xavier University, Cincinnati, OH.


Chapter V

Dissertation

Abstract

The current study sought to provide a description of the neurocognitive functioning of a sample of male juvenile offenders with special attention to executive functioning. The WISC-IV scores of a sample of 599 male juvenile offenders evaluated through a multidisciplinary juvenile court assessment program were analyzed. The sample included predominantly African American boys (77%) with a mean age of 14.75 ($SD = 1.18$). A mixed model cluster analysis, based on WISC-IV index scores, yielded a three cluster solution labeled “Below Average”, “Low processing speed”, and “Very Low Functioning” groups. The “Very Low Functioning” group demonstrated significantly lower CBCL scores in the areas of attention, more symptoms of Attention Deficit/Hyperactivity, and Anger Control problems than the other clusters. The findings support previous research which indicates neurocognitive diversity among juvenile offenders.
An Examination of the Executive Functioning of Juvenile Offenders

The number of cases managed by the juvenile court system is on the rise. In 2007 there were 44% more juvenile court delinquency cases than in 1985 (Knoll & Sickmund, 2010). The arrest rate of juveniles seems to reflect gender differences in behavior patterns. In a sample of 5,212 public school children in elementary and middle school, as many as 54% of the male participants reported criminal involvement versus only 23% of the female participants (Babinski, Hartsough, & Lambert, 1999). African American youth are disproportionately represented among juvenile offenders; whereas African American youth account for 16% of individuals below the age of 18, 33% of youths who come to the attention of the juvenile justice system are African American (Knoll & Sickmund, 2010).

The criminal behavior of juveniles predicts a variety of later problems, including future convictions and time spent in prison, a higher prevalence of psychological symptoms, more substance abuse, poor family relationships including abusive relationships with partners, lower socioeconomic status (Moffitt, Caspi, Harrington & Milne, 2002), antisocial personality disorder (APD), depression, and psychosis, among others (Bartol & Bartol, 2008; Moffitt et al., 2002). Many theories have hypothesized about the factors that lead juvenile offenders to engage in criminal behaviors. Identified risk factors include low socioeconomic status, being from a minority race, being male, having negative peer relationships, poor parent-child relationships, abuse, having a low level of affiliation with neighborhoods and school, poor fetal development, low birth weight, neurological impairment, low intellectual functioning, and poor academic
performance (Knoll & Sickmund, 2010; Piquero, Moffitt, & Lawton, 2005; Pope & Thomas, 2007).

Research on the cognitive functioning of juvenile offenders dates to the 1940s (Altus & Clark, 1949; Wechsler, 1944), and studies have consistently found that the overall intellectual functioning of juvenile offenders is lower than average, typically found to be within the Low Average range. Another common finding was that juvenile offenders often demonstrate stronger performance on tests of non-verbal reasoning abilities relative to performance on measures of verbal skills and verbal reasoning (Altus & Clark; Cornell & Wilson, 1992; Law & Faison, 1996; Teichtner & Golden, 2002; Wechsler, 1944). However, there has also been debate about the universality of a possible "verbal deficit" among juvenile offenders based upon the finding (e.g., Cornell & Wilson 1992; Isen, 2010; Law & Faison, 1996) of higher Performance IQ scores than Verbal IQ scores on the Wechsler Intelligences Scale for Children (WISC). Golden, et al. (1996) suggested that there was not enough evidence to conclude that juvenile offenders have a verbal deficit relative to non-verbal skills. In fact, many of the subtests that comprised the VIQ in the 3rd edition of the WISC (Wechsler, 1991), such as Digit Span, which are now understood to measure executive functioning (i.e., abilities in planning, attention, control of thoughts and behaviors, and working memory) not verbal functioning (Isen, 2010).

Isen (2010) completed a meta-analysis of studies investigating the VIQ<PIQ difference found among juvenile offenders and concluded that race was an important part of these differences. Specifically, he found that African American children are less likely to show a VIQ<PIQ difference than Caucasian children. Furthermore, the type of test used, and the portions of the test used, played a role in the likelihood a verbal deficit would be
found. For example, those studies that did not use all the subtests of the Wechsler scale were more likely to find a VIQ<PIQ difference than those that did use all of the subtests.

Studies also have indicated that the VIQ<PIQ difference is less likely to occur with the most recent version of the WISC that have organized subtests into four index scores (processing speed, working memory, verbal comprehension, and perceptual reasoning) (Golden et al., 1996; Isen, 2010). The development of index scores allows for examination of more specific functions, including executive functions through the Working Memory Index, which measures the ability to hold and manipulate information in the mind and relies heavily on skills such as attention, short-term memory, and concentration (Sattler, 2008). The Processing Speed Index also measures attentional control, cognitive flexibility, and impulse control that are also associated with executive functioning.

Attention has shifted from primarily verbal deficits to focus more specifically on executive functioning and verbal functioning (Elliott & Mirsky, 2002; Fabian, 2010; Golden et al., 1996; Moffitt, 1990a; Teichner & Golden, 2000). Executive functioning is associated primarily with the frontal lobe in the brain, and includes a variety of abilities such as attentional control (i.e., selective attention), cognitive flexibility (i.e., the ability to shift attention), self-monitoring, and goal setting (e.g., initiating, planning, problem-solving and strategic behavior) (Anderson et al., 2001). According to Elliott and Mirsky, frontal lobe dysfunction is associated with cognitive inflexibility, poor planning, poor concept formation, poor abstract reasoning, difficulty setting goals, and difficulties organizing large amounts of information. In a finding that supports this overall view, Savolainen et al. (2010) indicated that it may be the interaction between verbal and
executive functioning deficits that is most problematic for juvenile offenders. They measured the ADHD symptoms and history of criminal convictions in a longitudinal study of 5,010 children in northern Finland and found that a diagnosis of ADHD and verbal deficits were only predictive of criminal behavior when combined.

Moffitt (1990) was one of the first researchers to indicate that the executive functioning of juvenile offenders is particularly problematic. Based on a review of the literature, Elliott and Mirsky (2002) concluded that juvenile offenders are especially prone to having executive dysfunction, as much research has pointed towards deficits in organization, planning, and abstract reasoning. Carroll et al. (2006) compared early-onset, late onset, and non-offenders (n = 129) based on self-report of delinquent behaviors, performance on measures of executive functions, and on a risk taking game measuring impulsivity. They found that impulsiveness predicted delinquent behavior, but that early onset juvenile offenders were not significantly different from late onset juvenile offenders on this characteristic.

The diagnosis of Attention Deficit/Hyperactivity Disorder (ADHD) has been described as a disorder in executive functioning (Moffitt, 1990), and the prevalence of ADHD is much higher among juvenile offenders than in the average population (Palacios & Semrud-Clikeman, 2005). Further, some studies (e.g., Carroll et al., 2006) have found that the antisocial behavior of juvenile offenders diagnosed with ADHD is more severe and more frequent than that of juvenile offenders without ADHD. ADHD and other executive functioning deficits have also been found to be statistical predictors of later antisocial behaviors (e.g., Moffitt, 1990).
Although previous studies have identified areas of frequent neurocognitive difficulties among juvenile offenders, it is clear that there is considerable neurocognitive diversity among this group. To further investigate diversity in relevant characteristics, several researchers have used a statistical technique called cluster analysis, which is a grouping or descriptive technique that utilizes multivariate statistics to group the objects or people being categorized, based on similar characteristics (Hair & Black, 2000). The clusters or groups are formed to maximize within cluster homogeneity while maximizing external, or between clusters, heterogeneity. Groups are formed based on the set of variables representing the characteristics used to compare objects (Hair & Black). There are two main types of CA; hierarchical and nonhierarchical, each with its advantages and disadvantages. More recently, a mixture model CA technique has been developed that combines hierarchical and nonhierarchical techniques (Mun, Windle, & Schainker, 2008). Once clusters are identified, cluster validity can be determined by using other variables known to vary between clusters to determine if they follow the expected pattern. Previous studies have used analysis of variance (ANOVA) to determine external validity (e.g., Waxman & Casey, 2006). Significant differences between the clusters supports that relevant subgroups have been identified.

Very few researchers have utilized cluster analysis as a technique to explore differential cognitive functioning of juvenile offenders. Raine et al. (2005) utilized Ward’s hierarchical method of CA with Euclidian squared method of measuring distance to examine patterns of neuropsychological functioning of a large sample of youths from an urban community. From the sample of 503 participants (250 juvenile offenders, 253 control), they identified a four cluster solution that supported Moffitt’s (1993) taxonomy
of juvenile offenders which differentiates juvenile offenders as those who will offend throughout life, life course persistent (LCP), and individuals with offenses that will be limited to adolescence, adolescent limited (AL). Results indicated that the LCP cluster members had lower verbal abilities, poorer attention, and lower overall IQ. There was also a higher prevalence of ADHD, higher rates of poverty. Childhood limited (CL) cluster members had a similar IQ to that of the LCP cluster with poor attention and lower overall IQ, but with greater verbal deficits. The AL group had the fewest deficits besides the control group. This study is informative regarding cognitive and neurological functioning of juvenile offenders, but it did not form groupings based on cognitive functioning, which could potentially leave out important neuropsychological patterns.

Teichner et al. (2000) subjected juvenile offenders’ scores on cognitive measures to CA and reached a four cluster solution, which the authors identified as a left hemisphere deficit/verbal deficit group; a mild verbal deficit group; an executive functioning deficit group; and a no deficit group. Analysis of the demographic characteristics of the groups revealed that the left hemisphere/verbal deficit and executive functioning deficit groups were significantly younger, had less education, and were more likely to be in special education than those in the mild verbal deficit or no deficit groups. Spare-Werner (2010) used CA to analyze the WISC-IV and Woodcock-Johnson 3rd edition scores generated by a sample of 430 female juvenile offenders. This resulted in a five clusters solution that she labeled: “Average,” “Low Average,” “Verbal Weakness,” “Extremely Low,” and “Low VCI/PRI.” This study did not specifically identify executive function deficits among female juvenile offenders.
In light of the need for more in-depth investigation of the executive functioning of male juvenile offenders, the current study sought to investigate: the overall intellectual functioning of the male juvenile offender sample compared to the normative WISC-IV scores and to subject WISC-IV Index scores to CA to identify patterns of cognitive functioning.

Method

Participants

The current study’s data were gathered from male juvenile offenders who were evaluated through a multidisciplinary assessment program operated by a juvenile court in an urban county in the Midwest. This program involved juvenile offenders who completed a 14-day residential evaluation in order to assist the court in identifying the intervention needs of each offender referred to the program. The evaluation included administration of a variety of standardized tests, including the measures analyzed in this study.

The dataset used in this study included test scores of children who were evaluated between January 2006 and July 2010. Of the 2,792 male cases in the database, 2,191 files were missing relevant scores, and two files were removed due to errors in the Wechsler Intelligence Scale for Children-IV scores that had been entered into the database, resulting in a final sample size of 599 participants. Table 1 presents the demographic characteristics of the sample. As can be seen, age ranged from 11 to 17 years ($M=14.75$; $SD=1.18$), and the majority (77%) were identified as African American. The mean number of charges is detailed in Table 2. On average, participants had at least 1 felony
charge and 4 misdemeanor charges. None of the participants had been charged with more serious offenses such as murder or aggravated murder.

Measures

Wechsler Intelligence Scale for Children, fourth edition (WISC-IV; Wechsler, 2003). The WISC-IV is a widely used measure of intellectual functioning for children and adolescents between the ages 6 and 17 years old. The WISC-IV produces standard scores on four indices: Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI) along with a Full Scale score (FSIQ) (Wechsler, 2003). WMI and PSI scores measure executive functions such as working memory, attention and concentration, and the speed at which an individual processes information (Wechsler).

The WISC-IV is known for its excellent "standardization, reliability, and concurrent and construct validity" (Sattler, 2008, p. 311). The internal consistency coefficient is between .88 (PSI) and .97 (FSIQ) (Wechsler, 2003). Similar internal consistency coefficients were found among special populations. The test-retest reliability is between .86 (PSI) and .93 (FSIQ) (Wechsler, 2003). Norms for the WISC-IV were developed based upon a sample that reflected major demographic characteristics of the 2000 census data, which was 62% Caucasian individuals (Wechsler, 2003). Because the majority of the sample for the present study were African American, and previous studies have found that the average FSIQ of African American children is approximately 11.5 points lower than Caucasian children (Sattler, 2008), the present study compared the African American juveniles' scores against the standardization norm (M=100, SD=15)
(Wechsler, 2003), as well as the mean for African American children (Sattler & Dumont, 2004).

**Child Behavior Checklist, 6-18** (CBCL; Achenbach & Rescorla, 2001). The CBCL is a 113-item measure used in a variety of settings to assess behavior patterns of children and adolescents. Parents report the presence or absence of a wide range of behaviors that include problem behaviors (e.g., anxiety, delinquent behavior, and attention problems) and pro-social behaviors (e.g., social activities). There are four competence scales, eight syndrome scales and six diagnostic scales (Achenbach & Rescorla, 2001).

The CBCL’s norms were based on a sample of 1,753 children and adolescents who were predominantly Caucasian (72%) (Achenbach & Rescorla, 2001). Generally good reliability and validity are reported for the CBCL. The test-retest reliability for scales used for the current study range from .90 (Aggressive Behavior Scale) to .93 (ADHDP; Achenbach & Rescorla). The internal consistency, as measured by a Cronbach’s alpha, ranged from .84 (ADHDP) to .94 (Aggressive Behavior scale; Achenbach & Rescorla). Validity was supported by strong correlations between the CBCL and other similar behavioral measures.

The scales examined in this study are the Attention Problems, ADHDP, and Aggressive Behavior because these scales have been associated with ADHD and other executive functioning deficits. The Attention Problems, ADHDP, and Aggressive Behavior scales have been used in a variety of settings to indicate attention problems and executive functioning difficulties (Achenbach & Rescorla, 2001; Carroll et. al., 2006). Specifically, the Attention Problems scale addresses inattention symptoms, the ADHDP
scale assesses for symptoms of ADHD, and the Aggressive Behavior scale assess symptoms related to emotion regulation difficulties.

**Conners’ Parent Rating Scale-Revised Long Form** (CPRS-RL; Conners, 1997). The CPRS-R:RL measures parent observation of ADHD symptom behaviors. The scale includes 80 items with 14 subscales. The subscales used in the current study include Cognitive Problems Scale, Hyperactivity Scale, and ADHD Index scales. The ADHD Index is described by the author of the scale as, “the best initial indicator of whether a child is likely to have an attention problem” while the other scales are predictive of executive functioning deficits (Conners, p. 47).

The CPRS-R:RL is based on normative data collected from a sample of 2,482 (83% Caucasian) children and adolescents between 3 and 17 years (Conners, 1997). The internal consistency of the CPRS-R:RL is excellent ranging from .91 (Hyperactivity Scale) to .94 (ADHD Index; Conners). The test-retest reliability is good ranging among those scales used from .85 (Hyperactivity) to .69 (Cognitive Problems) (Conners). These measurements of reliability indicate a range between good to excellent. Finally, studies have demonstrated good validity for the measure as well. A three factor solution has supported the three symptoms scales (Oppositional, Cognitive Problems, and Hyperactivity; Conners). In addition, other behavioral measures of symptoms assessed on the CPRS-R:RL are highly correlated.

**Adolescent Anger Rating Scale** (AARS; Burney, 2001). The AARS is a 41-item measure that yields three scores measuring different dimensions of anger. The Instrumental Anger scale, the Reactive Anger scale, the Anger Control scale, and the Total Anger score. Adolescents rate items on a 4-point likert-type scale (i.e., Hardly
Ever, Sometimes, Often, and Very Often) (Burney). Raw scores are converted to T-scores (\(M=50; SD=10\)). The scales used in the current study are the Reactive Anger scale and the Anger Control scales which measure an adolescent’s ability to control their anger and manage their behavior (Burney 2001).

Normative data for the AARS is based on a sample of 1,116 middle school students (60% Caucasian and 51% female) and 1,213 adolescents in high school students (53% Caucasian and 60% female; Burney, 2001). The overall reliability of the AARS is good, with alpha coefficients ranging from .80 to .94 (Burney, 2001). The validity of the measure is supported by factor analysis and correlation with other measures of anger (Burney, 2001).

Procedure

As part of the standard assessment battery for the evaluation program, demographic data were gathered and WISC-IV (Wechsler, 2003) tests were conducted by psychometricians, while a parent for each participant completed the CBCL (Achenbach & Rescorla, 2001) and CPRS-RL (Conners, 1997). The children also completed the AARS (Burney, 2001). All measures were hand-scored by the psychometricians and the scores were entered into a computer database by a data entry clerk. Permission to access the database was provided by the facility (see Appendix A); the Xavier University Institutional Review Board (IRB) also approved the study (see Appendix B).

Results

The first aim of the study was to compare the primary WISC-IV scores (FSIQ, VCI, PRI, WMI, and PSI) of the juvenile offenders to the standardization sample. The
means and standard deviations of these scores are provided in Table 3. The results of the one-sample t-tests that compared the WISC-IV FSIQ, VCI, PRI, WMI, and PSI scores to the standardization sample (\(M=100, SD=15\)) indicated that mean scores for the offender sample were all significantly lower than the standardization sample mean.

In light of the large number of African American juvenile offenders in the current sample, we also investigated whether the FSIQ and index scores of the African American juvenile offenders (\(n = 461\)) were significantly lower than that of the African American subgroup sample norms. Comparing the African American subgroup of the WISC-IV standardization sample’s mean FSIQ and index scores (Wechsler, 2003; Sattler & Dumont, 2004) against the mean scores of the African American participants from the current sample using one sample t-tests indicated that WISC-IV FSIQ and index scores were lower for the African American juvenile offender sample than the African American subgroup standardization sample. The means, standard deviations, and one-sample t-test results are presented in Table 4.

In order to evaluate the heterogeneity of cognitive functioning of juvenile offenders, subgroups were created using cluster analysis of the current sample using the WISC-IV index scores. To determine the number of clusters within the sample, a hierarchical cluster analysis, two-step cluster analysis, was first used. Then K-means cluster analysis, a non-hierarchical cluster analysis method, was performed to determine cluster membership based on the number of clusters derived from the two-step cluster analysis. This method has been recommended by Hair and Black (2002) and used by Spare-Werner (2010) and Mun, Windle, and Schainker (2008). A two-step cluster analysis is helpful in clarifying clusters within large samples (>400 cases). However, it is
more susceptible to interference from irrelevant information or outliers and does not provide specific cluster membership information. The K-means cluster analysis was utilized to minimize the effect of interference and provide information about cluster membership. A three cluster solution was determined to best fit the data based on verbal comprehension index, perceptual reasoning index, working memory index, and processing speed index scores. In addition, the three cluster solution created meaningful groups that evenly distributed the cases in each cluster. Table 5 provides descriptive statistics for each cluster including mean and standard deviation of the WISC-IV FSIQ, index scores, and scores on the AARS, CBCL, and CPRS.

Cluster 1 (n=278, 46.49% of the total sample) was labeled the “Below Average” cluster because all the index scores were below average, using the categories described by Wechsler (2003; See table 5). Cluster 2 (n=174, 29.91% of the total sample) was labeled the “Low Processing Speed” cluster because all the index scores are within the average range with the exception of the processing speed index score, which is in the Low Average range based on the established categorization (Wechsler; See table 5). However, this score is not statistically significantly lower than the other scores. We labeled Cluster 3 (n=146, 24.41% of the total sample) the “Very Low Functioning” cluster because it is characterized by index scores that are well below average (Wechsler; See table 5), or approximately between the 1 and 4th percentiles.

A multivariate analysis of variance (MANOVA) with a Bonferroni correction and post-hoc tests between clusters was conducted to validate that each cluster is unique. The MANOVA indicated significant differences between the clusters, Wilk’s lambda, \( F = 174.37, p < .001 \) (See table 6). Post hoc analyses using the Dunnett’s C test revealed that
all index scores differed significantly between all the clusters combinations. These results support a three-cluster solution (See table 7).

To further validate the solution, a MANOVA was conducted with select scores from the CPRS-L (Cognitive Problems, Hyperactive Behavior, and ADHD Index), CBCL (Attention Problems, ADHDP, and Aggressive Behavior), and AARS (Reactive Anger and Anger Control) (see Table 6 for means and standard deviations by cluster). A significant difference between the clusters was found (Wilks’ lambda, $F = 2.45, p = .001$). Post hoc analyses indicated significant differences for the Attention Problems, Attention Deficit/Hyperactivity, and Anger Control scales (see table 7). A post hoc analysis using Dunnett’s C test revealed that the Very Low Functioning cluster had significantly higher mean scores on the Attention Problems scale of the CBCL and the Attention Deficit/Hyperactivity scale of the CBCL compared to the Below Average and Low Processing Speed clusters, which did not differ from each other. Finally, on the Anger Control scale the Below Average cluster had a mean score that was significantly lower than that of the Low Processing Speed cluster, which indicates significantly poorer anger management.

One-way ANOVAs were conducted to determine if the clusters differed in age and number of charges. These data are provided in Tables 8 and 9. Although there was no significant difference between the clusters based on age, the clusters differed in the number of charges, with the Very Low Functioning group having a significantly higher number of misdemeanor charges compared to the Low Processing Speed group. A chi-squared analysis indicated that the clusters differed significantly in their distribution of race, $\chi^2 = 29.18, df = 2, p < .001$. As can be seen in Table 10, the proportion of African
American juveniles was highest in the Very Low Functioning group (89.1%), and lowest in the Low Processing Speed group (64.4%). These results suggested a greater proportion of African American participants in the clusters with lower overall cognitive functioning.

Discussion

Greater understanding of the neurocognitive functioning of juvenile offenders can lead to greater understanding of their emotional and behavioral functioning (Palacios & Semrud-Clikeman, 2005). Specifically, behavioral disorders such as Conduct Disorder, ADHD, and Oppositional Defiant Disorder have been documented to have neurocognitive foundations, and these disorders are documented to occur at much higher rates among juvenile offender than other groups (Moffitt, 1993; Palacios & Semrud-Clikeman). Furthermore, some studies (e.g., Carroll et al., 2006) have found that the criminal behavior of juvenile offenders who have been diagnosed with ADHD is more severe and frequent than those juvenile offenders without ADHD. The current study, therefore, sought to identify patterns in neurocognitive functioning that may inform prevention and treatment programs.

The results of the current study support previous research on intelligence test performance of juvenile offenders. We found that the mean FSIQ score and index scores of juvenile offenders were significantly lower than that of the standardization sample for the WISC-IV and the mean scores from the African American standardization subsample. Similar results are well documented in other research studies (Altus & Clark; Cornell & Wilson, 1992; Law & Faison, 1996; Teichner & Golden, 2002; Wechsler, 1944). The relationship between criminal behavior and low cognitive functioning is complex, but
individuals with lower cognitive functioning are more likely to have lower achievement in school, poor school attendance, increased impulsivity, and poor affiliation with school (Knoll & Sickmund; Piquero, Moffitt, & Lawton, 2005; Pope & Thomas, 2007), all of which are risk factors for antisocial and criminal behaviors. In addition, individuals with lower cognitive functioning are more likely to have poor behavioral control and judgment, which are also risk factors for antisocial behavior (Pope & Thomas).

The third aim of the study was to create subgroups within the sample of juvenile offenders based on WISC-IV index scores using cluster analysis. A three-cluster solution was identified and supported by MANOVA. Based on the pattern of index scores for each cluster, we labeled “Below Average”, “Low Processing Speed”, and “Very Low Functioning” clusters. These results suggest diversity in neurocognitive functioning among juvenile offenders that can be masked by using only mean scores for a sample; these subtypes are also supported by previous research findings (Raine et al., 2005; Spare-Werner, 2011; Teichner et al., 2000).

With regard to the clusters we found, the “Below Average” cluster was characterized by scores that are within the Below Average range on the WISC-IV. This cluster reflects the commonly found mean IQ score performance of juvenile offenders (Elliott & Eirsky, 2002; Fabian, 2010; Golden et al., 1996; Moffitt, 1990; Teichner & Golden, 2000) and is the largest cluster identified for this sample. An individual with below average functioning can expect to have a minimal level of difficulty in everyday functioning. The level of functioning is most likely to affect scholastic aptitude, motivation, and interest in achievement (Sattler, 2001). In addition, a child with below average intellectual functioning is likely to experience the world with a more concrete
understanding (Sattler). The juvenile offenders in this group are likely to experience less affiliation with school and struggle with more abstract reasoning risk factors for antisocial behavior (Piquero, Moffitt, & Lawton, 2005). This cluster also had significantly more juvenile offenders who were African American than would be expected. It is likely that those juvenile offenders who are African American have more risk factors for criminal behavior and lower cognitive functioning. In addition, the WISC-IV has been noted in literature to be biased towards minorities including African Americans (Sattler, 2001).

The “Low Processing Speed” group demonstrated a select low PSI score relative to the other WISC-IV index scores. The PSI measures attention span, persistence, scanning ability, short-term memory, and behavioral control (Sattler, 2001). With a deficit in these abilities an individual is likely to experience difficulty with maintaining attention, impulse control, and may struggle to complete tasks quickly and accurately (Sattler). It is likely that schoolwork, especially reading or other high attention demand tasks, will be more difficult for children with difficulties in these areas. Finding schoolwork to be challenging, frustrating or boring can contribute to experiencing less affiliation with school, which is a risk factor for juvenile offending (Piquero et al., 2005). The lower PSI scores raises concern of an executive functioning deficit, although this deficit was not demonstrated in the behavioral measures. It may be that this group’s average level cognitive functioning in other areas provides enough compensation to prevent the lower functioning in processing speed from impacting other areas of behavioral functioning. An interesting factor in this group is also the strength in cognitive functioning. The pattern of cognitive functioning found in this cluster has not
been captured in previous research where the mean intellectual functioning scores are documented as below average (Elliott & Eirsky, 2002; Fabian, 2010; Golden et al., 1996; Moffitt, 1990; Teichner & Golden, 2000). Spare-Werner, (2011) and Teichner et al. (2000) similarly found cognitive clusters that demonstrated average cognitive functioning without cognitive deficits. In addition, this group had a higher proportion of juvenile offenders who were Caucasian when compared to the other clusters. This group also had fewer misdemeanor charges compared to the Very Low Functioning cluster.

Finally, the "Very Low Functioning" group has much lower cognitive functioning than the other two groups, and at a level that suggests borderline intellectual functioning or mild mental retardation. The current data set did not include information about adaptive functioning that would be necessary to determine how many (if any) members of this cluster met diagnostic criteria for Mild Mental Retardation (APA, 2004). However, it is clear that an individual with this level of functioning would experience significant behavioral, academic, and adaptive challenges at school and in the community. These challenges and difficulties are likely to impact the level of affiliation with the community as discussed with the previous clusters (Hirschi, 2002; 2004). Further, this group demonstrated significantly higher behavioral problems on the Attention Problems and Attention Deficit/Hyperactivity scales, which supports the interpretation that they are at much higher risk for problematic behaviors that are related to the neurocognitive deficits of the group. As was the case with the low processing speed group, the very low functioning group's neurocognition is not adequately represented by the mean scores of the total sample. The group will likely need additional support to address their criminal behavior when considering treatment needs. This cluster also
displayed a disproportionate number of juvenile offenders who were African American and had a higher number of misdemeanor charges compared to the Low Processing Speed cluster. This cluster likely has several risk factors that can be associated with criminal behavior and lower cognitive functioning. Race has been noted to be one of these risk factors (Sattler, 2001).

When looking for patterns, some commonalities were apparent among the clusters. The mean PSI scores of each group is one of the lower scores among the index scores. Processing speed includes such skills as attentional control, cognitive flexibility, and impulse control (Sattler, 2001). All of these executive functions could impact decision making, the ability to control impulses, and foresee multiple consequences for their behavior. Olson, Hooper, Collins, and Luciana (2007) found that those children and adolescents with more neurocognitive impulsivity were more likely to display externalizing behavior such as aggression or other behaviors that constitute criminal offenses.

In addition, in all of the clusters, the VCI score is slightly below that of the PRI score, which is consistent with the longstanding VIQ<PIQ pattern of juvenile offenders (e.g., Teichner & Golden, 2000). While the difference is not as great as the difference between processing speed index scores and the other measures, it is important to note because other studies have indicated that difficulty verbalizing needs, thoughts, and feelings may be a risk factor for juvenile offending (Pope & Thomas, 2007). In addition, the deficit in verbal functioning would greatly impact scholastic affiliation which is another risk factor for juvenile offending (Pope & Thomas, 2007). This continues to be an area worth further investigation.
The clusters were all relatively close in their scores on the behavioral measures (see Figure 1). This suggests that while there is diversity in neurocognitive functioning, the clusters are relatively similar in behavioral functioning on measures of ADHD, impulsivity, and inattention. A visual analysis of means and standard deviations of each cluster based on the behavioral measures indicates that there are no behavioral measure scores within the clinically significant range (at least two standard deviations above/below the mean) (Achenbach & Rescorla, 2001; Burwery, 2001; Conners, 1997). This would indicate that there are no or very few reports of clinically significant behavioral problems on these measures.

Raine et al. (2005) found a four cluster solution that supported Moffitt's (1993) taxonomy based on an analysis of the Child Behavior Checklist (teacher and self-report) and past criminal behavior coded for seriousness of offense. The clusters, named control group, childhood limited, adolescent limited, and life-course persistent, were then compared on a variety of measures including neuropsychological measures (e.g., Wisconsin Card Sorting Task, Continuous Performance Task, and WISC-R subtests Vocabulary, Information, Block Design, and Picture Completion). Neurocognitive profiles of these clusters indicate significant differences such as the life course persistent cluster had lower overall intelligence and verbal skills compared to those within the adolescent limited cluster. In addition, the childhood limited group had the lowest IQ scores among all of the groups. It appears that these two groups are similar to the below average and very low functioning groups in the current study. The adolescent limited group appears to have neurocognitive profiles similar to that of the low processing speed group because it had few deficits. While this study appears to have similar general
findings, it created clusters based on the behaviors of juvenile offenders rather than neurocognition.

Spare-Werner (2011) noted a five cluster solution based on a female juvenile offender sample’s WISC-IV and Woodcock-Johnson 3rd edition scores. The clusters were labeled “Average,” “Low Average,” “Verbal Weakness,” “Extremely Low,” and “Low VCI/PRI.” While female juvenile offenders have been noted to have differing characteristics in many areas when compared to male juvenile offenders, it is important to note the diversity in neurocognitive profiles and the similarity that Spare-Werner found with the current results are noteworthy. Specifically, her study also identifies clusters that reflected average, low average and extremely low overall cognitive functioning.

Finally, Teichner et al. (2000) created clusters based on Luria-Nebraska Neuropsychological Battery-III (measuring verbal skills, executive functioning, memory, and visual-spatial reasoning) and found a four cluster solution within a clinical sample of juvenile offenders which included a no deficit, verbal deficit, mild verbal deficit, and executive functioning deficit group. Similarities in findings were present in this study. A no deficit and executive functioning deficit were comparable to the Low Processing Speed group in the current study. However, the other groups were not similar to the current study’s results.

The current study identified fewer clusters than previous studies. Raine et al. (2005) and Teichner et al. (2000) found a four cluster solution, although each of these studies used samples or derived clusters in a manner that differed from this one in important ways. Raine et al. (2005) categorized juvenile offenders based on behavior and compared those clusters based on neurocognitive functioning and Teichner et al. (2000)
studied juvenile offenders from an outpatient drug and behavioral problem clinic. Spare-Werner (2011) found a five cluster solution among female juvenile offenders from the same juvenile assessment program that the current study is using. However, each of these studies did document either a verbal or executive functioning deficit in at least one cluster and these studies indicated neurocognitive strengths as well.

An important aspect of the results is that some clusters indicate relative strengths such as average overall functioning. The “Low Processing Speed” group, which is the second largest cluster, is functioning in general in the average range intellectually. This suggests generalizing all juvenile offenders as below average intellectually may be doing a disservice to those juvenile offenders who function at a higher level. Teichner et al. (2000) and Spare-Werner (2011) also used cluster analysis and found similar results with at least one cluster who demonstrated cognitive strengths. In the development of treatments, there has been support for the development of strengths (Church, Wharton, & Taylor, 2009). The results suggest that there are also neurocognitive strengths among juvenile offenders which can be built upon in treatment. Low self-esteem in relation to individual strengths of character as well as academic strengths have been associated with increased risk for antisocial behaviors. However, if the neurocognitive strengths were to be supported this can be an important factor to improve self-esteem and therefore improve interventions and improve school functioning (Church et al.).

Limitations

There are a few limitations to the current study given the type of sample and the methods used. The first limitation is that the sample currently being used is very specific. It is not clear where along the continuum of criminal behavior patterns the participants
fall. The sample is derived from an assessment program designed initially for first time offenders, but as the program continued other offenders with more long standing patterns of criminal behavior were evaluated through this program. In light of the change in how the program was used, it is unclear what pattern of criminal behavior the participants of the current study are displaying those who are first time offenders in adolescence may have fewer problematic behaviors than those who began offending in childhood (Piquero & White, 2003).

In addition, the mean age of the sample is 14.75 years-old, which is slightly younger than other samples of juvenile offenders (Abramowitz, Kosson, & Seidenberg, 2004; Carroll et al., 2006; Cornell & Wilson, 1992; Law & Faison, 1996; Mun, Windle, & Schainker, 2008; Nas, De Castro, & Koops, 2005; Sevecke et al., 2009; Teichner et al., 2000; & Vermeiren & De Clippele). The Moffitt Taxonomic theory (Moffitt, 1993) proposed that there are two general patterns of antisocial behavior development: life course persistent (LCP) and adolescent limited (AL). LCP antisocial behavior has a poor prognosis with an early onset and persistence of antisocial behavior throughout life. AL antisocial behavior involves more normative antisocial tendencies of adolescence (Moffitt, 1993). Moffitt contends that, as a result of a “maturity gap” (the gap between the legal and physical ability to engage in certain activities), some adolescents engage in illegal behavior that is indistinguishable from that of LCP offenders, except that it only occurs during adolescence. Based on the age of the individuals in this first offense program it is likely that part of the sample falls within the AL type of antisocial behavior. According to Piquero and White (2003) more academic struggles; living with a single mother; poor cognitive abilities; and being male were all predictive of LCP offending.
Therefore the level of behavioral severity may in fact be less severe, than if the sample consisted of younger first time offenders.

Furthermore, if the sample is biased towards juvenile offenders with the AL type of antisocial behavior, then the results likely do not reflect the full diversity of neurocognitive profiles of juvenile offenders. Moffitt (2007) also proposed different neurocognitive profiles for AL and LCP antisocial behavior of individuals. Specifically she suggested more verbal and executive functioning deficits among individuals with LCP antisocial behavior. This indicates that further research may be needed to investigate the neurocognitive profiles of LCP juvenile offenders. A longitudinal study may help improve our understanding of this limitation.

This sample also consists of a higher proportion of African American participants compared to the proportion of African American individuals in the general population. While this higher proportion compared to the general population is a trend that is common among individuals who have displayed criminal behavior, it also suggests that this study may not be easily generalized to certain ethnic or racial groups within the juvenile court system (Knoll & Sickmund, 2010). This study is specific to male, African American and Caucasian, adolescent juvenile offenders in a Midwestern medium sized city. A study with other populations could be helpful in understanding the whole of juvenile offending populations.

Another consideration with this study is the race and socioeconomic status of the normative samples for the AARS, CBCL, and Conners’ are not similar to the race and socioeconomic status of the current sample. The norms were established with samples that were predominantly Caucasian and from middle class socioeconomic status families
EXECUTIVE FUNCTIONING OF JUVENILE OFFENDERS

(Achenbach & Rescorla, 2001; Burney, 2001; & Conners, 1997). This difference in race and socioeconomic status should be considered when interpreting the results of the behavioral measures.

Poor academic functioning is documented as an important risk factor for children and adolescents (Knoll & Sickmund; Piquero, Moffitt, & Lawton, 2005; Pope & Thomas, 2007). Future research could investigate achievement test scores in addition to neurocognitive functioning. Measures of school affiliation may also improve our understanding of this relationship. This study may have been improved by the inclusion of measures of academic functioning as well as neurocognitive functioning.

There is long history of the study of intellectual test performance among juvenile offenders (Altus & Clark, 1949; Wechsler, 1944), although there has been less research utilizing the most recent edition of the WISC. This scale has created the opportunity to provide more detail about a child’s cognitive functioning through analysis of the index scores (Sattler, 2008). In addition, there has been little research on the diversity of neurocognition of juvenile offenders. The current study attempted to utilize the WISC-IV to generate a more detailed picture of juvenile offenders. Future research will need to continue this investigation with a variety of juvenile offender populations and perhaps include new tools in the measurement of neurocognitive functioning.
References


longitudinal test of Moffitt’s hypothesis. *Journal of Criminal Justice, 3*, 399-409. doi: 10.1016/s0047-2352(03)000461


Table 1

*Age and Race Distribution for Sample (n=599)*

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>2</td>
<td>.3</td>
</tr>
<tr>
<td>12</td>
<td>28</td>
<td>4.7</td>
</tr>
<tr>
<td>13</td>
<td>61</td>
<td>10.2</td>
</tr>
<tr>
<td>14</td>
<td>136</td>
<td>22.7</td>
</tr>
<tr>
<td>15</td>
<td>173</td>
<td>28.9</td>
</tr>
<tr>
<td>16</td>
<td>198</td>
<td>33.1</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>461</td>
<td>77.0</td>
</tr>
<tr>
<td>Caucasian</td>
<td>127</td>
<td>21.2</td>
</tr>
<tr>
<td>Unspecified/Other</td>
<td>11</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Note. "Unspecified/Other includes boys identified as multiracial, Asian, or undocumented race."
Table 2

*Mean number of Charges per juvenile offender (n=599)*

<table>
<thead>
<tr>
<th></th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Felony</td>
<td>1.55</td>
<td>1.40</td>
</tr>
<tr>
<td>Misdemeanor</td>
<td>4.50</td>
<td>4.03</td>
</tr>
<tr>
<td>Unruly</td>
<td>0.39</td>
<td>0.75</td>
</tr>
<tr>
<td>Unknown²</td>
<td>5.31</td>
<td>4.89</td>
</tr>
</tbody>
</table>

Note. ²: Unknown specifies that the charge was not documented
Table 3

*WISC-IV* Scores Compared to Standardization Sample (n=599)

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Scale IQ</td>
<td>80.86</td>
<td>12.48</td>
<td>-37.55</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>VCI</td>
<td>82.96</td>
<td>13.14</td>
<td>-31.72</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PRI</td>
<td>87.93</td>
<td>13.20</td>
<td>-22.38</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>WMI</td>
<td>87.50</td>
<td>14.84</td>
<td>-20.63</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PSI</td>
<td>80.45</td>
<td>12.87</td>
<td>-37.18</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Note. *WISC-IV* standardization sample has a Mean score of 100, SD of 15; VCI= Verbal Comprehension Index, PRI= Perceptual Reasoning Index, WMI= Working Memory Index, and PSI= Processing Speed Index.
Table 4

*African American Participants' WISC-IV Scores Compared to African American Standardization Sample (n=461)*

<table>
<thead>
<tr>
<th>Full Scale IQ</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>79.04</td>
<td>11.99</td>
<td>-22.71</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>VCI</td>
<td>80.84</td>
<td>12.49</td>
<td>-18.94</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PRI</td>
<td>86.18</td>
<td>12.77</td>
<td>-8.83</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>WMI</td>
<td>86.82</td>
<td>15.30</td>
<td>-13.05</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PSI</td>
<td>79.68</td>
<td>12.69</td>
<td>-25.92</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Note. Full Scale IQ compared against 91.72, VCI compared against 91.86, PRI compared against 91.43, WMI compared against 96.12, PSI compared against 95.00 (Sattler, 2010)
Table 5.

*Mean and Standard Deviation of Each Cluster on Important Scales.*

<table>
<thead>
<tr>
<th></th>
<th>Below Average(n=278)</th>
<th>Processing Speed Deficit(n=174)</th>
<th>Very Low Functioning(n=146)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(M)</td>
<td>(M)</td>
</tr>
<tr>
<td></td>
<td>((SD))</td>
<td>((SD))</td>
<td>((SD))</td>
</tr>
<tr>
<td><strong>WISC-IV</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>79.55 (4.68)</td>
<td>95.73 (7.02)</td>
<td>65.73 (6.36)</td>
</tr>
<tr>
<td>Verbal Comprehension</td>
<td>80.26 (9.36)</td>
<td>96.46 (8.90)</td>
<td>72.11 (9.90)</td>
</tr>
<tr>
<td>Perceptual Reasoning</td>
<td>87.01 (8.64)</td>
<td>100.60 (9.05)</td>
<td>74.69 (10.25)</td>
</tr>
<tr>
<td>Working Memory</td>
<td>87.90 (10.70)</td>
<td>100.01 (10.74)</td>
<td>71.93 (10.80)</td>
</tr>
<tr>
<td>Processing Speed</td>
<td>81.58 (10.44)</td>
<td>88.65 (11.78)</td>
<td>68.61 (9.13)</td>
</tr>
<tr>
<td><strong>CBCL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention Problems</td>
<td>60.55 (9.71)</td>
<td>59.70 (8.43)</td>
<td>63.43 (11.21)</td>
</tr>
<tr>
<td>Aggressive Behavior</td>
<td>62.95 (12.22)</td>
<td>63.13 (12.27)</td>
<td>63.25 (12.64)</td>
</tr>
<tr>
<td>Externalizing Problems</td>
<td>63.88 (11.87)</td>
<td>63.85 (12.36)</td>
<td>63.79 (12.48)</td>
</tr>
<tr>
<td>Attention Deficit/Hyperactivity</td>
<td>59.21 (8.24)</td>
<td>59.01 (7.86)</td>
<td>61.60 (8.63)</td>
</tr>
<tr>
<td><strong>AARS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive Anger</td>
<td>46.86 (9.32)</td>
<td>48.57 (9.77)</td>
<td>46.71 (10.39)</td>
</tr>
<tr>
<td>Anger Control</td>
<td>48.43 (9.57)</td>
<td>50.94 (9.89)</td>
<td>48.99 (9.87)</td>
</tr>
<tr>
<td><strong>Conners’</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Problems/Inattention</td>
<td>55.52 (11.93)</td>
<td>55.49 (12.36)</td>
<td>57.64 (12.89)</td>
</tr>
<tr>
<td>Hyperactivity</td>
<td>64.12 (17.38)</td>
<td>61.78 (16.39)</td>
<td>65.44 (18.13)</td>
</tr>
<tr>
<td>ADHD Index</td>
<td>58.59 (13.80)</td>
<td>56.97 (14.28)</td>
<td>60.18 (14.78)</td>
</tr>
</tbody>
</table>
Table 6.

MANOVA Comparing Clusters on WISC-IV and MANOVA Comparing Clusters on Behavioral Measures.

<table>
<thead>
<tr>
<th>Scale/Measure</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WISC-IV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSIQ</td>
<td>1054.50</td>
<td>.001</td>
</tr>
<tr>
<td>Verbal Comprehension</td>
<td>291.08</td>
<td>.001</td>
</tr>
<tr>
<td>Perceptual Reasoning</td>
<td>320.61</td>
<td>.001</td>
</tr>
<tr>
<td>Working Memory</td>
<td>272.89</td>
<td>.001</td>
</tr>
<tr>
<td>Processing Speed</td>
<td>146.74</td>
<td>.001</td>
</tr>
<tr>
<td><strong>CBCL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention Problems</td>
<td>608.22</td>
<td>.001</td>
</tr>
<tr>
<td>Aggressive Behavior</td>
<td>4.62</td>
<td>.97</td>
</tr>
<tr>
<td>Externalizing Problems</td>
<td>0.42</td>
<td>1.00</td>
</tr>
<tr>
<td>Attention Deficit/Hyperactivity</td>
<td>4.99</td>
<td>.01</td>
</tr>
<tr>
<td><strong>AARS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive Anger</td>
<td>2.04</td>
<td>.13</td>
</tr>
<tr>
<td>Anger Control</td>
<td>3.67</td>
<td>.03</td>
</tr>
<tr>
<td><strong>Conners</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Problems/Inattention</td>
<td>1.67</td>
<td>.19</td>
</tr>
<tr>
<td>Hyperactivity</td>
<td>1.89</td>
<td>.15</td>
</tr>
<tr>
<td>ADHD Index</td>
<td>2.04</td>
<td>.13</td>
</tr>
</tbody>
</table>
Table 7.

*Post Hoc Comparisons of Clusters.*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Scale Being Compared</th>
<th>Cluster Comparison</th>
<th>Mean Difference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>WISC-IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>BA vs. LPS</td>
<td>-16.18</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>13.81</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>30.00</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Verbal Comprehension</td>
<td>BA vs. LPS</td>
<td>-16.20</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>8.15</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>24.35</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Perceptual Reasoning</td>
<td>BA vs. LPS</td>
<td>-13.60</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>12.32</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>25.92</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>BA vs. LPS</td>
<td>-12.12</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>15.96</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>28.08</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Processing Speed</td>
<td>BA vs. LPS</td>
<td>-7.07</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>12.98</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>20.04</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>CBCL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention Problems</td>
<td>BA vs. LPS</td>
<td>0.85</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>-2.88</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>-3.74</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Aggressive Behavior</td>
<td>BA vs. LPS</td>
<td>-0.18</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>-0.30</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>-0.11</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Externalizing Problems</td>
<td>BA vs. LPS</td>
<td>0.03</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>0.09</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>0.06</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Attention/Deficit</td>
<td>BA vs. LPS</td>
<td>0.20</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Hyperactivity</td>
<td>BA vs. VLF</td>
<td>-2.39</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>-2.59</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>AARS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive Anger</td>
<td>BA vs. LPS</td>
<td>-1.71</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>0.14</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>1.86</td>
<td>.27</td>
<td></td>
</tr>
<tr>
<td>Anger Control</td>
<td>BA vs. LPS</td>
<td>-2.51</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BA vs. VLF</td>
<td>-0.56</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>1.96</td>
<td>.22</td>
<td></td>
</tr>
<tr>
<td>Conners'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive</td>
<td>BA vs. LPS</td>
<td>0.03</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Problems/Inattention</td>
<td>BA vs. VLF</td>
<td>-2.13</td>
<td>.27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPS vs. VLF</td>
<td>-2.16</td>
<td>.36</td>
<td></td>
</tr>
<tr>
<td>Hyperactivity</td>
<td>BA vs. LPS</td>
<td>2.34</td>
<td>.49</td>
<td></td>
</tr>
<tr>
<td>ADHD Index</td>
<td>BA vs. VLF</td>
<td>LPS vs. VLF</td>
<td>BA vs. LPS</td>
<td>BA vs. VLF</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>-------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>-1.32</td>
<td>-3.66</td>
<td>1.62</td>
<td>-1.59</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>.18</td>
<td>.72</td>
<td>.82</td>
</tr>
</tbody>
</table>

*Note. BA = Below Average. LPS = Low processing speed. VLF = Very Low Functioning.*
Table 8.

*Age and Number of Offences by Cluster.*

|                      | Below Average | | Low Processing Speed | | Very Low Functioning |
|----------------------|---------------|-------------------------------------------------|--------------------|-------------------------------------------------|
|                      | $M$ (SD)      | $M$ (SD)                                       | $M$ (SD)           | $M$ (SD)                                       |
| Age                  | 14.72 (1.17)  | 14.67 (1.20)                                   | 14.89 (1.15)       |
| Felony               | 1.61 (1.46)   | 1.47 (1.44)                                    | 1.52 (1.26)        |
| Misdemeanor          | 4.38 (3.67)   | 4.08 (3.96)                                    | 5.20 (4.65)        |
| Unruly               | 0.38 (0.71)   | 0.39 (0.77)                                    | 0.40 (0.83)        |
Table 9.

*Age and Charge Differences Between Clusters.*

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.51</td>
<td>.22</td>
</tr>
<tr>
<td>Type of Charge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Felony</td>
<td>0.58</td>
<td>.56</td>
</tr>
<tr>
<td>Misdemeanor</td>
<td>3.33</td>
<td>.04a</td>
</tr>
<tr>
<td>Unruly</td>
<td>0.02</td>
<td>.98</td>
</tr>
</tbody>
</table>

*Note.* ^a^The Very Low Functioning cluster had significantly more misdemeanors than the Low Processing Speed cluster.
Table 10.

*Racial Differences Between Clusters.*

<table>
<thead>
<tr>
<th></th>
<th>African American</th>
<th>Caucasian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Below Average</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count (percent)</td>
<td>221 (79.5)</td>
<td>57 (20.5)</td>
<td>278 (77.5)</td>
</tr>
<tr>
<td><strong>Low Processing Speed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count (Percent)</td>
<td>112 (64.4)</td>
<td>62 (35.6)</td>
<td>174 (29.0)</td>
</tr>
<tr>
<td><strong>Very Low Functioning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count (Percent)</td>
<td>131 (89.1)</td>
<td>16 (11.5)</td>
<td>147 (24.5)</td>
</tr>
</tbody>
</table>
Figure 1. Mean cluster scores on the behavioral measures from the CBCL, AARS, and Conners'. BA = Below Average. LPS = Low processing speed. VLF = Very Low Functioning. AP = Attention Problems. AB = Aggressive Behavior. EP = Externalizing Problems. ADH = Attention Deficit/Hyperactivity. RA = Reactive Anger. AC = Anger Control. CP = Cognitive Problems/Inattention. H = Hyperactivity. ADHD-I = ADHD Index.
Appendix A

Approval Letter from Hillcrest Training School
Hamilton County
Juvenile Court
800 BROADWAY
CINCINNATI, OHIO 45202-1332
(513) 946-9200

September 16, 2011

Morell Mullins, Ph.D.
Xavier University Institutional Review Board
3800 Victory Parkway
Cincinnati, Ohio 45207

Dear Dr. Mullins:

This letter is to document that I have granted permission to Ms. Samantha Himes, psychology doctoral student at Xavier University, to use a de-identified database of information generated through the Multidimensional Assessment Program (MAP), which is operated by the Hamilton County Juvenile Court. It is my understanding that Dr. Kathleen Hart, a Court employee, will facilitate Ms. Himes access to this database, will assure that the database does not include identifying information, and will otherwise oversee Ms. Himes's research project in a manner that protects the security of the information contained in that database.

Please feel free to contact me if you need any additional information in this matter.

Sincerely,

Frank Yux
Court Administrator
Appendix B

Approval Letter from Xavier University IRB
October 27, 2011

Samantha Himes
2737 Alberts Ct. Apt. 4
Cincinnati, OH 45209

Dear Ms. Himes:

Re: Protocol #1121, An Examination of the Executive Functioning of Juvenile Offenders

The IRB has reviewed the materials regarding your study, referenced above, and has determined that it meets the criteria for the Exempt from Review category under Federal Regulation 45CFR46. Your protocol is approved as exempt research, and therefore requires no further oversight by the IRB.

If you wish to modify your study, it will be necessary to obtain IRB approval prior to implementing the modification. If any adverse events occur, please notify the IRB immediately.

Please contact our office if you have any questions. We wish you success with your project!

Sincerely,

[Signature]

Morell E. Mullins, Jr., Ph.D.
Chair, Institutional Review Board
Xavier University

C: Kathy Hart, advisor
EXECUTIVE FUNCTIONING OF JUVENILE OFFENDERS

Title: An Examination of the Executive Functioning of Juvenile Offenders

Problem. The number of cases managed by the juvenile court system is on the rise. In 2007 there were 44% more juvenile court delinquency cases than in 1985 (Knoll & Sickmund, 2010). When examining the development of criminal behavior, theorists have identified a variety of risk factors including neurocognitive impairment (Piquero, Moffitt, & Lawton, 2005). In addition, it is clear that while juvenile offenders’ mean test scores of intellectual functioning tend to fall in the Low Average range (Altus & Clark; Cornell & Wilson, 1992; Law & Faison, 1996; Teichner & Golden, 2002; Wechsler, 1944) new evidence suggests that there may be more neurocognitive diversity among juvenile offenders. With the most recent edition of the WISC, better clarification of executive functioning has been gained (Wechsler, 2003). The current study will document this neurocognitive diversity to better describe the cognitive skills of juvenile offenders with special attention to executive functioning.

Method. Data were generated by the routine psychological assessment of 599 boys through a juvenile court assessment program. The program involved a two week multidisciplinary evaluation that included administration of the WISC-IV. This assessment was then used to inform the court about how to best manage treatment. The program served primarily early offenders with a mean age of 14.75 (SD=1.18) in the current sample. The majority of participants were African American (77%) and had an average of at least one felony charge and four misdemeanor charges.

The current study utilized an anonymous dataset comprised of the psychological test scores of the youths who underwent the assessment. The sample was analyzed to assure that it was similar to that of other juvenile offender samples. A mixed model cluster analysis, using WISC-IV index scores, was utilized to find a cluster solution which would represent the neurocognitive functioning of the sample.

Findings. Independent t-tests were used to identify that the mean sample WISC-IV index and full scale IQ scores were significantly lower than the standardization sample for the WISC-IV. In addition, the mean scores from the African American juvenile offenders were significantly lower than that of the mean scores from the African American standardization sample. A three cluster solution was found based on the WISC-IV index scores. The clusters were labeled as the “Below Average” cluster characterized by index scores that are within the Below Average range on the WISC-IV, the “Low processing speed” group which demonstrated a select low on the PSI relative to the other WISC-IV index scores which were in the Average range, and the “Very Low Functioning” group which has much lower index scores than the other two groups.

To further validate the clusters, a MANOVA was conducted with select scores from the CPRS:L (Cognitive Problems, Hyperactive Behavior, and ADHD Index), CBCL (Attention Problems, ADHD, and Aggressive Behavior), and AARS (Reactive Anger and Anger Control) (see Table 6 for means and standard deviations by cluster). A significant difference between the clusters was found (Wilks’ lambda, F = 2.448, p = 0.001). Post hoc analyses indicated significant differences for the Attention Problems,
Attention Deficit/Hyperactivity, and Anger Control scales (see table 7). A post hoc analysis using Dunnett’s C test revealed that the Very Low Functioning cluster had a significantly higher mean score on the Attention Problems scale of the CBCL and the Attention Deficit/Hyperactivity scale of the CBCL compared to the Below Average and Low processing speed clusters, which did not differ from each other. Finally, on the Anger Control scale the Below Average cluster had a mean score that was significantly lower than that of the Low processing speed cluster, which indicates significantly poorer anger management. In addition, an ANOVA indicates that the Very Low functioning cluster has significantly more misdemeanor charges. A chi-squared analysis also indicated racial differences between the clusters in which the Below Average and Very Low Functioning clusters had a disproportionate number of African American participants.

Implications. The findings of the current study support research which indicates neurocognitive diversity among juvenile offenders (Raine et al., 2005; Spare-Werner, 2011; Teichner et al., 2000). Greater understanding of the neurocognitive functioning of juvenile offenders can lead to greater understanding of their emotional and behavioral functioning (Palacios & Semrud-Clikeman, 2005). Therefore this information can inform interventions for juvenile offenders. Future research can build upon and broaden the current study’s findings by including other samples of juvenile offenders and documenting neurocognition using other measures. The diversity of this population should be taken into account when investigating their needs.