Cognitive Flexibility In A Forensic Population

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Cognitive Flexibility In A Forensic Population

Abstract
Mental flexibility is a component of the executive function system that allows individuals to discover and employ alternative solutions to novel stimuli. It has been suggested that risk factors for criminality include poor cognitive flexibility leading to deficient problem-solving skill. Mental rigidity has also been correlated with a greater risk of involvement in persistent criminal activity. Studies with various offender populations have also suggested that social problem-solving skills are lacking in different offender groups. Subtests of the Delis Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) were employed to gather data from a group of convicted offenders. It was hypothesized that violent offenders would evidence executive function deficits and show an inferior performance, specifically on measures of cognitive flexibility, compared to nonviolent offenders. It was further hypothesized that the current forensic population as a whole would score differently on specific subtests in comparison to the normative sample. The violent offender group in this sample was found to have lower scale scores on the Sorting Test though the level of the difference was minor. In a comparison with the D-KEFS norming sample, the Sorting, Color Word Interference, and Trails tests also revealed small differences between the groups, and the Tower Test showed no such difference. Significant correlations were found between test performance, intelligence and education, and in comparison with the Brown ADD Scale. A MANOVA comparing test scores and number of convictions revealed no significant results.

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COGNITIVE FLEXIBILITY IN A FORENSIC POPULATION

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ABSTRACT

Mental flexibility is a component of the executive function system that allows individuals to discover and employ alternative solutions to novel stimuli. It has been suggested that risk factors for criminality include poor cognitive flexibility leading to deficient problem-solving skill. Mental rigidity has also been correlated with a greater risk of involvement in persistent criminal activity. Studies with various offender populations have also suggested that social problem-solving skills are lacking in different offender groups. Subtests of the Delis Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) were employed to gather data from a group of convicted offenders. It was hypothesized that violent offenders would evidence executive function deficits and show an inferior performance, specifically on measures of cognitive flexibility, compared to nonviolent offenders. It was further hypothesized that the current forensic population as a whole would score differently on specific subtests in comparison to the normative sample. The violent offender group in this sample was found to have lower scale scores on the Sorting Test though the level of the difference was minor. In a comparison with the D-KEFS norming sample, the Sorting, Color Word Interference, and Trails tests also revealed small differences between the groups, and the Tower Test showed no such difference. Significant correlations were found between test performance, intelligence and education, and in comparison with the Brown ADD Scale. A MANOVA comparing test scores and number of convictions revealed no significant results.
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Cognitive Flexibility in a Forensic Population

As the incidence of violent crime continues to be a significant social problem in the United States (U. S. Department of Justice, 2006), researchers persist in the search for causes of violent behavior. The purpose of the current work is to add to the ongoing research regarding risk factors for violence by exploring executive function deficits in offender populations. Specifically, neuropsychological measures including subtests of the Delis Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) were employed to gather data from a group of convicted offenders. It was hypothesized that violent offenders would evidence executive function deficits and show an inferior performance, specifically on measures of cognitive flexibility, compared to nonviolent offenders. It was further hypothesized that the current forensic population as a whole would score differently on these specific subtests in comparison to the normative sample. The paper will provide a focused literature review discussing the assessment of cognitive flexibility, as well as an overview of the use of neuropsychological testing as it relates to assessing violent behavior.
Review of the Literature on Cognitive Flexibility

Psychological assessments are used to evaluate cognitive, emotional, behavioral, and interpersonal functioning for the purposes of diagnosis, treatment planning, or consultation. Neuropsychological assessment is a subspecialty used to further delimit and define areas of brain function and deficit, and is used for a variety of purposes. Lezak, Howieson, and Loring (2004) identified the following uses of neuropsychological testing: diagnosis, patient care, treatment planning, research, and forensic evaluation.

Researchers have been linking brain dysfunction with criminal behavior for more than a century. Recent studies suggest that cognitive differences do exist between people who commit different types of crimes. Dodge and Newman (1981) found that aggressive individuals perceived fewer social cues and thus may fail to determine socially acceptable alternatives to their behavior. Howells (1986) also suggested that deficient problem solving skill resulted in individuals resorting to violent responses out of frustration and an inability to perceive alternate responses. The brain’s executive function system, governed by the frontal lobes, plays a large role in both problem solving and in inhibiting violent responses (Lezak et al. 2004).

Cognitive flexibility, a specific aspect of executive functioning, has been defined as the ability to shift attention and to attend to environmental cues, and is a component in problem solving ability (Lezak et al.). A lack of cognitive flexibility, or mental rigidity, appears to be a factor precluding individuals from discovering or employing alternative solutions to novel stimuli. It has been suggested that risk factors for criminality include
poor cognitive flexibility leading to deficient problem-solving skill. This deficiency has been correlated with a greater risk of involvement in persistent criminal activity (Andrews, 1995; Ross & Fabiano, 1985). When investigating the role of the executive functions in criminals, Bergeron and Valliant (2001) found differences between offenders and non-offenders in terms of executive functioning capability, with offenders exhibiting impaired ability in social competency, judgment, and perspective taking. Other studies of offenders and problem solving have shown varying results. Grier (1988) found no support for her hypothesis that a group of sex offenders had deficient problem solving ability; however, she posited education to be a possible mediator.

Several others have suggested a link between cognitive flexibility and criminality. Deu (1998) reported an interaction between cognitive flexibility and impulsivity in a study that explored using fantasy for planning violent crimes. His work supported previous studies that found violent offenders were more impulsive than nonviolent offenders. The study also suggested, however, that those with high impulsivity and high cognitive flexibility reported that they were at a greater likelihood of repeating a crime, as they were better able to devise ways of eluding detection. In other works a connection was found between problem solving, aggression, and cognitive flexibility deficits in relation to cue recognition (Dodge & Newman, 1981), the generation of non-aggressive solutions (Richard & Dodge, 1982), and ideas about possible consequences to aggressive behaviors (Guerra, 1989; Guerra & Slaby, 1989).

Other studies have suggested a relationship between intelligence and cognitive flexibility pertaining to the commission of different types of crimes. In their 2005 paper, Cantor, Blanchard, Robichaud, and Christensen found evidence to suggest an association
between low intelligence (resulting from prenatal or childhood brain injury), and commission of pedophilias. Earlier studies have suggested that difficulties with establishing a correlation between violent tendencies and personality was predicated on the intelligence of the offender, with higher intelligence levels being less associated with violent crime, and offenders with limited intelligence more likely to behave impulsively (DeWolfe, & Ryan, 1984; Heilbrun, 1979, 1982; Johansson & Kerr, 2005; Lynam, Moffit, & Stouthamer-Loeber, 1993). Nayak & Milner (1998) studied risk factors for child abuse in mothers with and without a history of abusing. When controlling for intelligence, their results showed group differences on measures of cognitive flexibility and problem-solving but when statistically controlling for depression and anxiety, no group differences were found.

In light of the research findings that show some relationship between poor cognitive flexibility, poor problem-solving, and risk to commit various types of crimes, several studies have focused on ameliorating these deficits and providing skills training as a way of increasing cognitive flexibility in social problem solving. In his review of problem solving skills training, McGuire (2001) found that cognitive rigidity resulted in a lack of consideration of alternatives or consequences. In writing about differences in rehabilitation programs, Ross, Fabiano, and Ewles (1988) found that certain offenders had greater difficulty with social problem-solving and using means-end reasoning. Those most likely to exhibit such deficits were adolescents, chronic offenders, those abusing alcohol, sex offenders, and violent offenders. These deficits were unrelated to general intelligence levels. Despite the deficits, what was found to be most useful in rehabilitation attempts was to engage the offenders in alternative ways of thinking about
problems or to improve their creativity in problem solving. In their follow up study of the technique training, Slaby and Guerra (1990) also found that by encouraging the discovery of alternative responses, aggressive responses could be reduced.

If cognitive flexibility is correlated to poor problem solving and deficient alternative response generation, enhancing the ability to think flexibly should lead to a decrease in aggressive responses. Studies of rehabilitation programs have shown a change in social problem solving ability in the participants, with one such study showing maintenance of the skills, at least up to a fifteen month follow up (McMurran, Fyffe, McCarthy, Duggan, & Latham, 2001). A lack of consistent results in this field of study, however, indicates a need for continued examination of the link between cognitive flexibility, violence, and problem-solving skills training.

The following section will examine testing results as they relate to the role of cognitive flexibility and other aspects of executive functioning in the commission of crimes, especially violent crimes. A focused literature review will help to operationally define the construct of cognitive flexibility within the larger concept of executive functioning. Next, the history of neuropsychological testing in offenders, specifically in violent offenders, will be presented. The review will conclude with a discussion of factors that may confound the relationship between executive functioning, cognitive flexibility, and violence.

Executive Function and Cognitive Flexibility Defined

Behavior has been conceptualized as a combination of cognitions, emotions, and the expression of behavior, known as executive functioning (Lezak, Howieson, & Loring, 2004). The executive functions are what allow for self-directed behavior, and in
conjunction with cognitions, these functions include planning for and carrying out tasks. Damage to specific areas of the brain usually influence specific functioning (i.e. movement or language disorders), while damage to the area involved in the executive functions (i.e. the frontal lobes) leads to more global deficits. Lezak et al. has described executive function impairment to include signs of decreased self-control, emotional deficits, increased irritability, impulsivity, and difficulty with shifting attention. Deficits in attentional set-shifting, with the inclusion of increased mental rigidity, are incorporated by the current study under the concept of cognitive flexibility.

Lezak et al. (2004) have written that frontal lobe damage has been found to lead to poor cognitive flexibility. This deficiency leads to a lack of ability to problem solve in novel situations, especially where rapid decision making is essential. Perseveration on a current course of action, or the lack of ability to shift attention, could have both personal, and societal consequences when lack of cognitive flexibility leads to dysfunctional problem solving actions that violate others’ rights. In a forensic context, the following questions arise: Are there differences in the abilities measured by tests of cognitive flexibility in persons with violent crime histories? Are the tests of cognitive flexibility specific enough to gauge these differences? What are the possible uses of these tests in detecting those with difficulty in set-shift ability; and, are there treatment possibilities to enhance problem solving ability in those with such deficits? These were the questions that prompted the current study and an examination of the previous research into these questions will follow.
Crime and Behavior

While the causes of criminal behavior have been the focus of much research in psychology as well as other fields of study, the use of neuropsychological assessment in this field is still evolving. However, a body of research does exist that attempts to define the risk factors for commission of crime, especially violent crime. The current work adds to the body of literature seeking answers to these difficult questions.

A variety of studies have contributed to the body of evidence for the association between violence and neurological deficits in several populations (see Brower & Price, 2001; Cohen, Brumm, Zawacki, 2003; Filley, Price, Nell, et al., 2001; Kandel & Freed, 1989; Kelly, Richardson, Hunter, & Knapp, 2002; Krakowski, 1997; Krakowski, Czobor, Carpenter, et al., 1997; Seguin, Pihl, Harden, et al., 1995; Valliant, Gristey, Pottier, & Kosmyna, 1999; Pincus, 1993). Experimental animal studies have contributed much of the current understanding of the neurological correlates of violent behavior by creating lesions to elicit aggressive behaviors, while studies using human populations have depended on brain imaging techniques, electroencephalograms (EEG), and neuropsychological test performance. Such tests are less specific than what is needed to develop a full understanding of a basis for violent behavior given the complex interplay of individual and environmental factors that combine to elicit violence (Krakowski, 1997). However, results of these studies indicated that criminal offenders were deficient in effective problem solving (see Bergvall, Wessely, Forsman, & Hansen, 2001; Deu, 1998; Grier, 1988; Hatashita-Wong, Smith, Silverstein et al., 2002; Hollin, 2001; Ingram, Marchioni, Hill, et al., 1985; Jacobs & Anderson, 2002; Keltikangas-Jarvinen, 2002;
Young, Justice, & Erdberg, 1999, among others), and identified a need for continued exploration of neuropsychological factors in offender populations.

In an editorial discussing violence as a major public health problem, Pincus (1993) explores the role of neurology in violence assessment. He writes that behaviors are a result of brain activity and goes on to presume that abnormal behaviors result from abnormality in some area of the brain. From this writing it can be interpreted that Pincus includes violence as an abnormal behavior and that neurological examination is a useful adjunct to the study of violent behavior. He also maintains that psychological factors play as much of a role as biological factors, citing that death row felons often carry both neurological and psychiatric diagnoses.

Just how extensive does brain damage need to be before the executive functions are affected? This question was explored in a review of frontal lobe damage and antisocial behavior by Kandel and Freed (1989). The studies reviewed established that although hard neurological signs may not be evident, minimal brain dysfunction can still influence behavior. Again it is questioned whether tests of frontal lobe impairment are specific enough to determine site of impairment or are merely reflective of more diffuse damage. These authors concluded that definitive studies that provide more than correlational evidence for a connection between violence and frontal lobe dysfunction had yet to be conducted.

The need for further study of what variables contribute to the making of a violent offender is well warranted, as those with increased propensity for violent behavior could then potentially be identified before human and societal damage occurs and their own lives are forever altered (Brantley & Ochberg, 2003). It is with this aim that such studies
continue to search for causes and potential treatments. Hollin's (2001) editorial reiterates this point in outlining the studies of offender populations that have been shown to be deficient in social problem solving. He argues that increasing options for successful behaviors has been an area that psychologists have influenced in an attempt to affect individual and societal change, and that this has extended to offender populations. The next section of this paper will further examine executive function research as it relates to violent crime.

There are currently no definitive means of assessing propensity for violence. No gene for violence has been identified nor should this be an expectation as rarely are there only single factors involved in any situation or condition (Filley et al. 2001). Brain dysfunction does not automatically lead to violent behavior; many individuals with brain lesions do not commit violent offenses. This argument can lead to the criticism that brain damage should not be used as a defense in the adjudication of violent crime (Restak, 1993). It may, however, be accurate to surmise that certain populations are more prone to committing violent offenses. Animal and human lesion studies, as well as imaging techniques have implicated the frontal lobes as well as the limbic system to be involved in aggression and behavior control (see Filley et al., 2001, for a review; also Krakowski, 1997; Mercer, Selby, & McClung, 2005); however, there are difficulties making conclusions about violent behavior based on these types of studies.

In a comparison study of a group of nonviolent individuals with a group of violent individuals who were given a diagnosis of antisocial personality disorder (APD), imaging studies indicated an 11% decreased volume of grey matter in the violent group. The authors suggested that decreased frontal gray matter volume was related to antisocial and
violent behaviors (Raine, Lencz, Bihrle, LaCasse, & Colletti, 2000). As previously stated, brain damage cannot solely account for violent behavior, but concomitant cognitive deficits may lead an individual to have the perception of decreased choice in situations, or the inability to access other options. Raine et al. supported the need for further work in this area before definitive statements can be made about the relationship between grey matter, violence and APD.

In an attempt to address limitations found in prior works, Morgan and Lilienfeld (2000) provide a meta-analytic review of previous studies of the relation between tests of executive function and antisocial behavior. The authors focused on clarifying the relation between executive function and antisocial behavior by looking at the differences between the groups in terms of effect size. They used a larger number of studies than previously examined and a broader definition of antisocial behavior. The questions in the review also addressed differences between performance on other neuropsychological tests versus scores on tests of executive function. Inclusion criteria for the analysis stated that studies had to contain as dependent measures at least one of the following measures of executive function: Category Test of the Halstead – Reitan Neuropsychological Battery, Q score of Porteus Mazes Test, Stroop Interference Test, Part B of the Trail Making Test, perseverative error scores from the Wisconsin Card Sort Test, or the Verbal Fluency Test. A diagnosis of antisocial behavior was used as the independent variable. Studies also had to produce results such that effect sizes were accurately calculable.

A total of thirty-nine studies were analyzed resulting in a mean effect of .62. The authors report this as a “robust and statistically significant relation between antisocial behavior and executive function” (Morgan and Lilienfeld, 2000, p. 128). However, the
authors are quick to point out the heterogeneity of their sample in terms of effect size and the consequence to the overall mean. They interpret this to be a result of the heavy influence of the motor task of the Porteus Mazes claiming that the antisocial behavior group scored significantly more poorly than the non-antisocial group on that task. In general, the authors add their work to previous reviews stating that the results were inconsistent as far as definitively relating antisocial behaviors and specific executive functioning deficits rather than a more global neuropsychological deficit.

While advanced imaging methods provide a view into the neuroanatomy of individuals, neuropsychological testing can provide information regarding cognitive dysfunction from a different perspective, and cognitive flexibility specifically has been explored within several population groups (Valliant, Gristey, Pottier, & Kosmyna, 1999; Krakowski, et al. 1997; Cohen, et al. 2003; Stone & Thompson, 2001). In a study of frontal lobe impairment in sex offenders, Stone and Thompson (2001) posited that these offenses were a result of poor decision-making due to brain impairment. Their sample had a variety of risk factors including a history of experiencing violence, addictions, and probable brain trauma. Using tests that measure mental flexibility (Stroop Test, Wisconsin Card Sort, and Trails A & B), the authors compared offender performance to the tests' norm samples and reported significant differences between their sample and the norm group scores on tests of executive functioning. Although the authors do not provide data on specific scores, they give examples as illustrative of their findings. On the Stroop Color Word Test, the normative sample mean was 104.9 (SD=10.22) while the offender sample mean was 78.130 (SD=9.50). Normative scores on the Trails B task were 64.00 seconds with the offender sample mean score being 103.11. Mean normative scores on
the Wisconsin Card Sort were 5.60 (SD=1.08) with the offender sample at 4.34 (SD=2.1). While there is overlap in the offenders' samples, indicating that some offenders scored in the normative range, the authors state that a greater proportion of their sample scored several standard deviations below the norm. Without providing specific numbers, Stone and Thompson reported that the larger group of their sample scored below 98% of the norm group. The authors also imply that executive function impairments were evident, and that the offenders relied upon unsophisticated approaches to solving problems. These studies indicate that functional differences do exist and can be measured by neuropsychological testing, although issues of specificity of test results remains a difficulty.

One aspect of cognitive flexibility, abstract conceptualization or planning, is associated with greater problem solving skill. The capacity to plan has also been associated with greater ability to find alternative solutions to problems. In a study of premeditation of criminal behavior in sex offenders using the Weigl Color Test and the Stroop Color Word Interference Test, Deu (1998) found that violent offenders were more impulsive than non-violent offenders. He also suggests that offenders who scored better on measures of cognitive flexibility and were highly impulsive were more likely to report that they would repeat a crime. The author proposes that flexibility may also increase the ability to problem-solve ways to avoid detection and capture after committing a crime.

What others factors may be involved with flexibility? In their study of mothers at high risk for child abusing, Nayak and Milner (1998) considered head injury as a factor affecting mental flexibility. After statistically controlling for intelligence differences, the high risk group had lower scores on the Wisconsin Card Sort Test and other measures of
problem solving. The study group also had greater difficulty incorporating feedback to correct their responses. Bergvall, Nilsson, and Hansen (2003) explored differences in neuropsychological function in a group of violent offenders and found that those diagnosed with a personality disorder made more errors on set-shifting tasks. In the study comparing a control group with two groups of offenders, one of which was diagnosed with personality disorders, the researchers found that the personality disorder group made more set-shift errors and exhibited "poor character development" (p. 341), as compared with the other groups. The statistical analysis of the set-shift task (the intra-dimensional-extra-dimensional shift test [ID/ED] of the Cambridge Neuropsychological Test Automated Battery) revealed that the control group all completed the task while 30% of the personality disorder group and 17% of the non-personality disorder group failed to complete the task (F(2,36)=12.524, p=0.001).

Bergeron and Valliant (2001) attempted to differentiate between adults and young offenders based on results of executive function and personality measures. They found no age related differences, but did find that over all offenders were more socially immature than non-offenders. The two groups' scores differed on the Porteus Maze and Paragraph Completion Method, with the offender group scoring below the non-offender group, suggesting social judgment deficits in offenders. However, in this study the Wisconsin Card Sort Test results did not differentiate the groups.

When attempting to identify risk factors for violence in a group of male psychiatric inpatients, Young, Justice, and Erdberg (1999) used a variety of procedures to discriminate inmates with a history of violent behavior into those with high or low violent behaviors. Their methodology explored differences in demographics, psychiatric
diagnoses, substance use, violence history, and neurological damage. Their sample exhibited a high incidence of neurological events with 84% reporting head trauma. The criteria for placing an offender in the high violent group involved someone with two or more offenses or a single incidence of causing loss of life. Those with only one physical attack and other non-personal crimes were placed in the low violence group. Results showed significant differences between the groups. Neuropsychological testing scores revealed impairment in most individuals; however, what distinguished the high violence group versus the low violence group was their scores on overall cognitive functioning (Halstead Impairment Index $t(129) = -2.12, p=.03$) and abstract reasoning (Category Test $t(130) = -2.19, p=.03$), with the high violence group performing poorly in comparison with the low violence group. As race had been a predictor for placement in the high violence group, a hierarchical regression allowed for further analysis of the results. When controlling for race, only the Category Test as a measure of abstract reasoning was found to identify those with high violent behavior histories.

In their review of the Aspen Neurobehavioral Conference on neurological correlates of violence, Filley, Bruce, Litt, et al. (2001) included neuropsychological testing as one of several means of assessing for causes for the commission of violent acts. The authors concur with other opinions on the point that single factors cannot account for violent behaviors; however, they do state the opinion that neuropsychological deficits contribute to decreasing an individual’s perception of alternative options. The consensus statement from the conference concludes that examination into the effects of frontal lobe dysfunction will provide greater understanding into causes for violent behaviors. Increased understanding can then lead to better prevention and treatment efforts.
Other studies have also found relationships between aggressive behavior and frontal lobe damage (Brower & Price, 2001; Seguin, Boulerice, Harden et al., 1999). In one study using a large Canadian longitudinal sample, Seguin, Pihl, Harden, Tremblay, and Boulerice (1995) found that boys with a long history of physically aggressive behavior were impaired on tests of executive function even after controlling for social factors such as anxiety and adverse family circumstances such as low socio-economic status. Though they do not report assessing for previous head trauma, the authors concluded that those boys who showed a pattern of aggressive behavior performed more poorly on tests of executive function compared to the non-aggressive group (see also Moffitt, Lynam, & Silva, 1994). There is a long list of studies involving a search for means of testing for neurological deficits in offender populations. The evidence accumulated thus far seems to indicate that there are differences in people who commit violent offenses, however, the number and variety of confounding factors between individuals, groups, and the studies themselves continues to cloud the conclusions that can be drawn.

Confounding factors: Substance abuse, attention deficits, education levels, and intelligence

Behavior is rarely the result of a sole aspect of brain function, thus it would be unwise to imply that a single test would be able to definitely state the cause for violent behavior. By the time people enter into the justice system it is difficult to measure the varying extent to which heritable, environmental, and societal factors have influenced their behavior. Despite the inherent limitations in performing psychological research with human participants, continued examination of current brain function can increase the
knowledge base and encourage greater understanding of the effects of outside influences on the brain and behavior. Direct correlations between aggressive behavior and cognitive flexibility have been difficult to determine, in part due to possible confounding factors. A variety of causes have been indicated as confusing potential associations between aggressive behavior and cognitive flexibility including: substance abuse, attention deficits, education, and intelligence. Studies in the field continue to work towards eliminating possible confounds and results vary on the reliability of neuropsychological tests to parse out specific function deficits. The next section will include additional discussion of several confounding factors that may influence the results of the current study.

Substance Abuse

The effects of drugs and alcohol on executive function abilities are unclear, although chronic alcohol abuse has been shown to have numerous deleterious sequelae including brain shrinkage and abnormal EEG findings (see Lezak et al., 2003). In a study examining community and inpatient violent behaviors and neurological correlates, Krakowski et al. (1997) concluded that a history of drug abuse was associated with community violence as well as neurological deficits. In their study of 131 male inmates, Young, Justice, and Erdberg (1999) concluded that a history of drug use (other than alcohol or marijuana) differentiated those in the high versus low violence group. In their work providing support for the existing research on the effects of drug use on executive function and violent behavior, Mercer, Selby, and McClung (2005) concluded that the drug abuse group had lower scores on tests of executive functioning compared to the non-drug abuse group. In addition, the violent drug abuse group scored lower on measures of
executive function compared to all other groups. Again the point is made of the difficulty of ascertaining the effects of external factors on executive function; however, the authors pose the question of how much a risk-taking lifestyle is responsible for frontal lobe damage in the first place.

Attention

Attention deficits have been a focus of research in both children and adults and difficulties remain with assessment, diagnosis and treatment though the effects of attention problems can cause individuals great distress. The inability to concentrate without drifting from a task can limit the ability to reason through novel problems and can affect behaviour in multiple settings. In addition to Attention Deficit Hyperactivity Disorder (ADHD), a number of other conditions are associated with attentional deficits, from dementia to schizophrenia. In a longitudinal study investigating the relationship between executive function and physical aggression in adolescent boys, Seguin et al. (1999) controlled for general memory, and intelligence in their analyses and found that although ADHD was not correlated with executive function or aggression, they did find a relationship between aggression and executive function. In a study of attention and executive function with adolescent sex offenders, Kelly, Richardson, Hunter, and Knapp (2002) hypothesized that the offender group would have greater deficits than the control group. Although the researchers found no significant difference between the groups, the authors question the inherent differences between their subject groups stating that the controls exhibited poorer verbal than performance scores which had not been found in previous studies. While their control group may not have been representative, Kelly et al. encourage further research in the use of neuropsychological testing with specific offender
groups as the offender group did exhibit difficulties in the ability to focus attention. In a study of pre-school-aged children, Marks, Berwid, Santra et al. (2005) also failed to find support for a connection between ADHD and executive function. Other works, however, have found relationships between the constructs and will be discussed below.

Pham, Vanderstukken, Philippot, and Vanderlinden (2003) assessed for selective attention and executive function deficits to examine planning ability and cognitive flexibility in a group of criminal psychopaths. In this study, the authors used the Psychopathy Checklist-Revised (PCL-R; Hare, 1991) cutoff scores to determine placement into the psychopathic versus control groups. The PCL-R is widely used in the assessment of psychopaths as distinct from antisocial personality disordered individuals (ASP). Anti-social personality is generally diagnosed based on DSM-IV criteria which Widiger and Trull (1994) found to be less definitively diagnostic of psychopathy. Hare (1995) also found other self-reports, such as the Minnesota Multiphasic Personality Inventory (MMPI), to be less definitive in the categorization of psychopaths.

Psychopaths as a group based on PCL-R criteria have been found to have higher numbers of crimes than controls and to engage in a greater variability of criminal behavior. Results of the Pham et al. study confirmed their initial hypothesis that psychopaths may be more affected by distractibility but be no different than normal controls on measures of flexibility. They suggested that these psychopaths do not have global planning deficits or lack flexibility but may be more prone to attention deficits when distracted. Such studies indicate the continued need for greater understanding of the executive function system, as well as the link between aggression and neurologic impairment (Krakowski, 1997).
Intelligence

The construct of intelligence has been considered to be a protective factor for criminality, in that it reduces the likelihood for some of the correlates of criminal behavior such as poverty and substance abuse. This is, of course, a generality and intelligence level is no protection from addiction, personality disorders, or major mental illnesses. Studies have differed on conclusions regarding the relation of intelligence to criminality. Lipsitt, Buka, and Lipsitt (1990) studied correlations between IQ and delinquency in a longitudinal study with a large sample of juveniles (3,164 total subjects). The groups were categorized as single versus repeat delinquency offenders. The study group was comprised of males and females, and both Blacks and Whites were represented. All participants were assessed on measures of intelligence at ages four and seven. Statistically significant differences were found, with single offenders attaining higher intelligence scores than repeat offenders. This work corroborates earlier findings relating intelligence and delinquency (Blumstein, Cohen, & Farrington, 1988; and Farrington, 1986) but does not exclude the possibility of environmental circumstances playing a role in developing delinquent behavior. Vocabulary testing has a history of being used as a reliable gauge of general intellectual ability (Lezak et al., 2004), and along with executive function deficits, Cohen et al. (2003) found a significant difference between groups of males who committed domestic violence (batterer group) in comparison with a group of non-batterers on vocabulary and comprehension tests with the batterer group attaining lower scores. The current study employed the Wechsler Vocabulary and Block Design subtests to gain an estimate of Full Scale IQ in an effort to reduce some of the confounds from previous studies.
The aforementioned studies regarding the potential roles of substance abuse, attention deficit, and intelligence demonstrate the difficulty of differentiating the various correlates of violent behavior and provide support for the need for continued research in this area.

Purpose of the Present Study

To date, there have been limited studies using the specific subtests of the Delis-Kaplan Executive Function System with forensic populations. Exploring the construct of cognitive flexibility using some of the subtests with this population may give insight into deficiencies in problem solving ability that may enhance understanding of criminality. Select aspects of a large study with volunteers of the Washington County Community Corrections project will provide data for exploration of the hypotheses that violent offenders differ from nonviolent offenders on measures of cognitive flexibility, and that this forensic population differs on these measures as compared to the normative sample. Additional questions will address confounding variables related to attention deficits, intelligence, and education. Finally, the population will be grouped by number of offenses to compare group differences on the subtests.

The primary tools used for exploring neuropsychological deficits in this study will be selected subtests of the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). The D-KEFS is a relatively new grouping of standardized measures for the assessment of executive functions, including cognitive flexibility, which is comprised of tests that have been used in neuropsychological testing for several decades. The results will be summarized as they relate to future research and relevance to work rehabilitating individuals exhibiting violent behaviors.
RESEARCH QUESTIONS

1. Individuals incarcerated for violent offenses will have inferior scores on measures of cognitive flexibility compared to those with nonviolent offenses. This hypothesis will be explored with an independent samples t-test.

2. The current forensic population will perform differently on the D-KEFS measures of cognitive flexibility in comparison with the normative sample. This hypothesis will be explored with one sample t-tests.

3. There will be an indirect relationship between cognitive flexibility and symptoms of attention deficit, with higher scores on measures of cognitive flexibility being associated with lower scores on measures of attention deficit. This will be explored using a bivariate correlation analysis.

4. A positive relationship will be found between cognitive flexibility and level of education and intelligence in this population, with higher scores on cognitive flexibility measures being associated with higher intelligence scores and higher levels of education. This hypothesis will be explored using a correlation analysis.

5. Offenders with multiple convictions will have lower scores on measures of cognitive flexibility than offenders with few known convictions. This hypothesis will be explored with a between-groups multivariate analysis of variance.
METHOD

Participants

Participants of this study were obtained from the general population housed at the Washington County Community Corrections (WCCC) facility in Hillsboro, Oregon. The Community Corrections Department is the provider of adult corrections services in Washington County. The department's mission is to increase public safety by reducing recidivism. It operates using the following principle: to provide a continuum of "supervision, sanctions, and services" to promote behavioral change and respect for community diversity. There is an investment in employee training, research-based service delivery and partnership with the community (Washington County-Community Corrections, 2005). The Department operates several programs including the community-based residential correctional facility where the study population were housed, as well as the Custodial Home Supervision Program also known as house arrest.

The Community Corrections Center offers a secure, structured environment while teaching accountability and employment skills, as well as offering treatment and skill building. It is able to house up to 215 male and female offenders. Programs are offered in substance abuse treatment, mental health evaluation and treatment, cognitive skills training, and a variety of life-skills programs. The Residential staff monitors compliance with Court and Parole Board conditions as well as working with each offender to develop a plan for services to facilitate community reintegration. Offenders are routinely screened by urinalysis and security is monitored with both visual and auditory surveillance.
The populations served by the program are those sentenced directly to the Center and those finishing out a jail sentence (50%). Post-prison supervision, and probation violators who require more structure to address problem behaviors, occupy another 8% of the beds. Another 30% of the beds are used for Local Control offenders who are serving sentences of less than 1 year. The Local Control offender program is the result of Senate Bill 1145 and emphasizes substance abuse counseling, cognitive skills training, and transitional release programs. The Center also offers the remaining 12% of bed space to indigent offenders as well as some sex offenders until more appropriate housing can be found. All residents must abide by the conditions and rules of the Center and either work or pursue work skills, as well as participate in programs that will help their transition back into the community.

One hundred incarcerated adults volunteered to participate in this study. Participants ranged in age from 19-61 years (M = 32.36, SD=10.42). All participants volunteered for the study and were admitted to participate as long as they were able to converse in English. Of the total group 30% were female and 70% male. Ethnic group by self-report included 76% Caucasian, 10% Hispanic, 6% African American, 6% Native American, 1% Polynesian/Islander, and 1% Multi-ethnic. Self-reported education ranged from 6-16 years of schooling (M=11.77, SD=1.93). Marital status of the group included 67% single, 16% divorced, 12% married, 3% widowed. The remaining data (2%) were not available. All participants were treated in accordance with the ethical guidelines of the American Psychological Association (2002) and Pacific University’s Institutional Review Board. Individuals were given the incentive of a 4-hour community pass for their participation in the study.
History of criminal activity in Oregon and arrest information was gathered from WCCC records and Oregon State Law Enforcement Data Sheets (LEDS). For this dissertation, participants were classified based on history of personal versus property crimes (see Table 1).

Those convicted for personal crimes were identified as the Violent Group. Convictions for this group included such offenses as assault, use of weapons, sexual assault, murder, manslaughter, and impaired driving causing harm or death. Those who were convicted for property crimes, the Nonviolent Group, include those who were convicted of fraud, possession of stolen property, breaking and entering, drug-related offenses, or traffic offenses. Designation into the groups followed a 1999 study by Valliant, Gristey, Pottier, and Kosmyna, though other studies have created their own but similar categorical groupings. Arrest data were recorded directly from WCCC files with crime type assessed by examination of the particular Oregon Revised Statue. Participants were placed in the Violent Group if they had been convicted of such a crime even if they had other nonviolent offenses. Based on this separation the Violent Group comprised 42% of the sample and the Nonviolent group was 56% of the sample, with 2 sets of missing data.
Table 1

*Number of Participants Convicted by Crime Type*

<table>
<thead>
<tr>
<th>Property Convictions (n=56)</th>
<th>N</th>
<th>%</th>
<th>Personal Convictions (n=42)</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUII</td>
<td>52</td>
<td>92.8</td>
<td>Assault II, III, IV</td>
<td>26</td>
<td>61.9</td>
</tr>
<tr>
<td>Manu/Del Controlled Sub</td>
<td>42</td>
<td>75.0</td>
<td>Harassment</td>
<td>12</td>
<td>28.6</td>
</tr>
<tr>
<td>Burglary II</td>
<td>14</td>
<td>25.0</td>
<td>Rape I, III</td>
<td>10</td>
<td>23.8</td>
</tr>
<tr>
<td>Driving while suspended</td>
<td>10</td>
<td>17.9</td>
<td>Robbery I, II, III</td>
<td>11</td>
<td>26.2</td>
</tr>
<tr>
<td>Forger I</td>
<td>9</td>
<td>16.1</td>
<td>Reckless Driving</td>
<td>6</td>
<td>14.3</td>
</tr>
<tr>
<td>Identity theft</td>
<td>8</td>
<td>14.3</td>
<td>Menacing</td>
<td>3</td>
<td>7.1</td>
</tr>
<tr>
<td>Resisting arrest</td>
<td>6</td>
<td>10.7</td>
<td>Criminal Mistreatment I</td>
<td>3</td>
<td>7.1</td>
</tr>
<tr>
<td>Unauth. Use of Vehicle</td>
<td>6</td>
<td>10.7</td>
<td>Custodial Interference II</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Disorderly Conduct</td>
<td>5</td>
<td>8.9</td>
<td>Sexual Abuse</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Interference w/mk rpt</td>
<td>5</td>
<td>8.9</td>
<td>Endanger Welfare of Minor</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Attempt to elude police</td>
<td>5</td>
<td>8.9</td>
<td>Fail driver duty, prop. damage</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Criminal Trespass I, II</td>
<td>4</td>
<td>7.1</td>
<td>Reckless Endangerment</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Concealed Weapon</td>
<td>4</td>
<td>7.1</td>
<td>Child Neglect II</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Giving false info</td>
<td>4</td>
<td>7.1</td>
<td>Arson I</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Failure to rpt. SO</td>
<td>3</td>
<td>5.4</td>
<td>Manu/Del Sub 1000’ school</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Unlawful Entry/Vehicle</td>
<td>3</td>
<td>5.4</td>
<td>Fail driver duty, injury</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Giving false information</td>
<td>2</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crim. Poss of Forged Instr.</td>
<td>2</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theft of Services</td>
<td>2</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening letter</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal Mistreatment II</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interfering w/Pub. Trans.</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to present license</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unauthorized departure</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tampering with evidence</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fail of driver duties: animal injury</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escape II</td>
<td>1</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Percentages equal more than 100% as participants were often convicted of more than one type of crime.*
Measures

For the purposes of this dissertation tests from a larger battery were used as dependent variables to explore the research questions. The measures used included selected subtests from the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) that purport to assess for cognitive flexibility. Tests of memory, attention deficit and intelligence were also used as independent variables. A more detailed description of the measures follows.

*Delis-Kaplan Executive Function System (D-KEFS)*

Estimates of executive functioning and cognitive flexibility were derived from specific tests within the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). The D-KEFS is comprised of a collection of tests, with some adaptations, that have been in the domain of neuropsychological testing for several decades. For the majority of the subtests raw scores are converted to scaled scores with a mean of 10 and standard deviation of 3. They are a well normed collection of tests of executive function for the assessment of flexibility of thinking, inhibition, problem solving, impulse control, concept formation, abstract thinking, and creativity. The group of tests in the D-KEFS was standardized on a stratified national sample of 1750 people matched from the 2000 U.S. Census to be reflective of age, sex, ethnicity, years of education, and region. The tests are for use with children and adults from 8-89 years of age. As the current sample ranged in age from 19 to 61, the tests are appropriate in that respect for comparison.

The test authors provide data on convergent and discriminant validity and these are considered to be adequate for most of the individual tests (for reviews see Homack,
Lee, & Riccio, 2005; Dugbartey & Ramsden, 2001). Reliability and validity analyses have been found to be comparable to the earlier tests from which the D-KEFS measures were derived. There has been criticism that the test manual does not directly provide extensive reliability data (Schmidt, 2003). In rebuttal to this critique, the authors of the instrument maintain that they chose to publish new data in peer reviewed journals, rather than in the manual, for greater dissemination of the results (Delis, Kramer, Kaplan, & Holdnack, 2004). Additional evaluation of the D-KEFS battery can be found in Lezak et al. (2004). One such critique is the lack of a theoretical rationale for including the selected measures, calling into question the usefulness of the modifications of the well-known tests included in the battery.

A number of validation studies have been conducted and provide information regarding the suitability of the D-KEFS for assessing executive function deficits in a wide variety of populations including the brain injured (focal frontal-lobe lesions, focal ventro-medial prefrontal damage, frontal-temporal dementia, mild cognitive impairment, subcortical ischemic disease, lateralized right-hemisphere damage), Parkinson’s disease, multiple sclerosis, chronic alcoholics, normal aging, autism, Asperger’s syndrome, schizophrenia, psychopathy, childhood stroke, attention deficit disorder, and fetal alcohol syndrome (see Delis et al. 2004 for complete reference list). Individual tests in the collection are purported to measure different aspects of executive functioning and are discussed individually.

**D-KEFS Trail Making Test**

The D-KEFS Trail Making Test is a version of the widely administered test of scanning and visual-motor tracking, divided attention, and cognitive flexibility known as
Trails A & B, long available in the public domain. The D-KEFS version consists of five tasks of increasing level of complexity with the fourth condition, called Condition 4: Number-Letter Switching, being the primary measure of mental flexibility. The authors of the test battery report that this condition of number-letter switching can be used to assess cognitive flexibility in a visual-motor sequencing task. The three initial conditions and the final condition allow for the assessment of errors that may result from motor or visual deficits, or errors in fundamental number or letter sequencing skills. The manual reports moderate to good internal consistency reliability, with Cronbach's alpha values from .57 to .81 depending on age group. Test-retest reliabilities have shown alpha levels of .77. The D-KEFS adaptation of the Trails test has correlated well with the original version and some consider it to be an improvement from other versions, though more empirical validation of this would help confirm advantages (Baron, 2004).

**D-KEFS Sorting Test**

The D-KEFS Sorting Test consists of increasing the demand for abstract thinking skill by pulling for recognition of rule concepts; this test that has been found to relate to cognitive flexibility also described as mental rigidity and perseveration. The D-KEFS Sorting Test was derived and modified from the California Sorting Test (Baron, 2004; Ramsden, 2001). Individuals are asked to free sort for 16 concepts across two sets of cards and then tested for sort recognition using the same cards. This subtest assesses for problem-solving ability, and both verbal and spatial concept formation. Lezak et al. (2004) cites the Card Sorting Test in general to be the “most studied of the tests” (p. 637). In a comparison with patients with multiple sclerosis, the Correct Free Sorts category of the D-KEFS correlated at a moderate level (.62) with the Categories Achieved score on
the Wisconsin Card Sort Test (WCST). In a pilot study (n=23) convergent validity with the WCST was reported to be in the moderate level. The manual cites split-half reliabilities on the Sort Recognition score to range from .62-.81.

*D-KEFS Color-Word Interference Test*

The Color-Word Interference test is a modification of the well-known Stroop test and assesses set shifting ability. Four conditions are given: color-naming, word reading, inhibition, and inhibition/switching. Condition 4: Inhibition/Switching, depicts some of the names of colors written in a different colored ink and the others presented within a box. Participants are asked to name the color of the ink if the word is not in a box and to read the word if it is enclosed in a box. It is this final condition of the subtest that measures the inhibition of automatic responding to generate an alternate response. The manual reports internal consistency alphas from .62-.86, split-half reliabilities ranging from .62-.86, and test-retest coefficients from .62-.76.

*D-KEFS Tower Test*

The D-KEFS Tower Test is a modified version of other Tower Tests in the public domain (e.g. Tower of London, Tower of Hanoi) and assess for planning ability. The test consists of asking participants to complete tower building tasks by recreating pictured constructions using an increasing number of disks placed on three spindles. Tests are timed and are of increasing complexity and require planning and flexibility to complete the task as quickly as possible. The manual reports on internal consistency with Cronbach’s alpha levels of .61 for the Total Achievement Score.
**Wechsler Abbreviated Scale of Intelligence (WASI)**

An estimation of intelligence (IQ) was derived from the Wechsler Abbreviated Scale of Intelligence (WASI; The Psychological Corporation, 1999) using the Vocabulary and Block Design tasks. The WASI is designed to be a brief intelligence assessment that yields Full Scale (FSIQ), Verbal IQ (VIQ), and Performance IQ (PIQ) estimates. It has proven to be a valid measure of assessing verbal and performance capacity and has been used in clinical situations and research studies where an estimate of intelligence is sought when time or other constraints forestall the administration of the full Wechsler Adult Intelligence Scales (WAIS). The verbal and performance estimate can be made using either two or four subtests for children and adults from ages 6 to 89. The WASI was standardized on a representative national sample of 2,245 children and adults. The manual provides reliability and validity information with reliabilities above .80 for measures of split-half reliability, internal consistency, stability, and test effects. Validity information correlating the WASI with other tests is also included, and the WASI is considered to be the recommended instrument for brief and accurate assessment of general intellectual functioning.

**Brown Attention-Deficit Disorder Scales**

An assessment of attention and concentration was achieved using scores from the Brown ADD Scales (Brown, 1996). The Brown ADD Scales are a screening tool for assessing attention deficit disorder in adolescents and adults suspected of having symptoms of ADD with a focus on the inattention aspect rather than hyperactivity or impulsivity. Discriminant validity is considered to be very good with a difference of two standard deviations between the clinical and non-clinical samples. Comparison with
subtests from the WISC-III or WAIS-R of attention and concentration further corroborate the utility of the Brown scales. Although a large representative sample is lacking and research on the underlying model is limited, the use of the Brown has been supported as a clinical screening tool as part of a larger battery to assess attention deficits.

*California Verbal Learning Test-II*

Memory deficits will be estimated with the use of the Long Delay Free Recall score of the California Verbal Learning Test (CVLT-II; Delis, Kramer, Kaplan, & Ober, 1983-2000). The CVLT-II is a word list task for the assessment of an individual’s ability to use semantic associations in word learning and has been used in the evaluation of memory. It includes a rote learning curve that is tested with free recall, delayed recall and recognition trials. Lezak et al. (2004) recommend including delayed recall tests in assessing memory, thus this variable will be included as an independent variable in the current analyses. The CVLT-II is considered to be a valid tool in the assessment of learned and recalled verbal information. The current version was standardized on a sample of 1,087 adults matched to the 1999 US census. Reliability and validity estimates are greater than .80 between age groups. Re-test samples yielded an uncorrected reliability estimate of .82.

**Procedure**

Study volunteers were scheduled for a testing appointment at the corrections facility with a third or fourth year clinical psychology doctoral student who conducted the testing. The graduate students were trained in administration of the assessment battery by either a Pacific University faculty member or the project’s research assistant. Student testers were given training on all measures and were required to complete two full
research protocols and receive feedback on areas of common mistakes before beginning data collection. The first several test administrations by each examiner were evaluated by research assistants in an attempt to maintain standardized testing procedures and scoring reliability.

Prior to testing the participants were read, and asked to sign, an informed consent informing them of their rights and the potential risks. Participants were tested on two separate occasions, with an individually administered group of cognitive tests given on one day and a series of self-report measures given in a group setting on a second day. The cognitive testing included the Wechsler Abbreviated Scale of Intelligence Vocabulary and Block Design, Rey-Osterrieth Complex Figure Test (Rey-O), Wechsler Individual Achievement Test, Word Reading and Spelling, California Verbal Learning Test-II, Wechsler Memory Scales Digit Span and Spatial Span (Forward & Backward), Delis-Kaplan Executive Function System (D-KEFS) Trails, Color-Word Interference, Card Sort, and Tower Tests; and the Woodcock-Johnson-III-Pair Cancellation. Lezak, et al. (2004) provides a description of the tests with a limited review of validity and reliability information. As attention deficit measures, the Integrated Visual Auditory (IVA) Continuous Performance Test (see Tinius, 2003 for review), and the Brown Attention Deficit Disorder Scale (Brown, 1996) were given as the final measures. See Appendix A for test references.

Cognitive testing was completed within approximately four hours per participant with variability based on effort and ability. Participants were offered the opportunity to take breaks at their choosing. During the memory trial delay periods, participants were only allowed rest breaks if enough time remained so that the delay period would not
exceed the standardized limits of that test. At completion of the cognitive testing, participants were scheduled a time to complete the psychological testing portion in a group format with self-report measures pertaining to experiences with alcohol, anxiety, and trauma.

Scoring

Test scores were obtained by the graduate student test administrators according to standardized test protocol. These were recorded with no identifying information relating the participant to the results. It should be noted that the participant’s residential counselors were given a general summary of the results indicating achievement level in a number of areas. The participants were informed of this and were given the option of discussing the results by meeting with their counselor.

Following the completion of data collection, two graduate students with advanced training in neuropsychological assessment performed a quality assurance review of the data including tests prone to subjective scoring (e.g. WASI Vocabulary and Rey-O). Data were then entered individually into two separate SPSS data bases and cross checked for consistency.
RESULTS

Demographic, Intelligence, and Attention Measures

A comparison was made of the two identified groups, the Violent and the Nonviolent participants. The overall assumption that violent offenders would perform more poorly on tests of cognitive flexibility was explored by comparing scores on the dependent measures. Descriptive statistics of the study groups by age, education, and scores on intelligence and attention measures are provided. A comparison of the Violent and Nonviolent groups on age, attention, and intellectual ability revealed that the groups were reasonably well matched based on an analysis with independent samples t-tests (see Table 2 for results).

Analyses of independent variables indicated that differences between the Violent and Nonviolent groups on the measures of attention and memory were not statistically significant giving greater reliability to the statement that differences between the two groups are at an increased probability to result from differences in another realm, such as executive functioning.
Table 2

Descriptive Characteristics by Group [M (SD)]

<table>
<thead>
<tr>
<th>Source</th>
<th>Violent (n=42)</th>
<th>Nonviolent (n=56)</th>
<th>sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>32.81 (9.33)</td>
<td>32.02 (11.35)</td>
<td>ns</td>
</tr>
<tr>
<td>Education</td>
<td>11.76 (1.88)</td>
<td>11.73 (1.92)</td>
<td>ns</td>
</tr>
<tr>
<td>FSIQ</td>
<td>94.12 (12.47)</td>
<td>96.95 (11.36)</td>
<td>ns</td>
</tr>
<tr>
<td>VIQ</td>
<td>89.60 (15.26)</td>
<td>93.70 (11.99)</td>
<td>ns</td>
</tr>
<tr>
<td>PIQ</td>
<td>102.02 (10.77)</td>
<td>101.14 (13.47)</td>
<td>ns</td>
</tr>
<tr>
<td>Brown ADD</td>
<td>59.63 (10.33)</td>
<td>61.06 (12.14)</td>
<td>ns</td>
</tr>
<tr>
<td>CVLT-II (Long-Delay Free Recall)</td>
<td>93.07 (14.04)</td>
<td>94.25 (12.04)</td>
<td>ns</td>
</tr>
</tbody>
</table>

1. Individuals incarcerated for violent offenses will have inferior scores on measures of cognitive flexibility compared to those with nonviolent offenses.

The first research question examined differences between the Violent (V) and Nonviolent (NV) groups on measures of cognitive flexibility using t tests. Scaled scores were used for the analysis and are depicted in the table of results. As with all scaled scores in the D-KEFS, lower scores indicate poorer performance on the task. Levene’s test for equality of variances revealed that the assumption of equality could not be assumed for the Sorting Test; however, this assumption was not violated for the remaining measures. Results for this research question were in the expected direction with some noted exceptions but largely failed to reach a meaningful difference. However, on one measure of executive function, the D-KEFS Sorting Test, scores for the Violent Group (M=8.21, SD=2.82) were statistically lower than for the Nonviolent group (M=9.44, SD=1.86), t(94) = -2.57, p = .017, suggesting that the V group responded less flexibly on this task and were less able to produce correct sorts than the NV group. On
two of the remaining tests, Color Word Interference and the Tower Test, the V group’s scores were lower than the NV group’s scores; however, these did not reach statistical significance indicating no significant difference between the groups on those measures (see Table 3). On the Trails Test the V group’s mean performance was slightly higher than the NV group. The D-KEFS subtests are all purported to measure some construct of executive functioning; however, results suggest that the tests may measure different abilities, although the level of difference was slight in this sample. Despite a moderate effect size for the difference on the Sorting Test, the D-KEFS mean scale score is reported to be a score of 10, but with a standard deviation of ± 3, further exploration of this hypothesis with a larger sample may reveal more meaningful results.

Table 3

*Note: p<.05

2. The current forensic population will perform differently on the D-KEFS measures of cognitive flexibility in comparison with the normative sample.

The second research question suggested that the scores on the dependent variables for the study population would be lower in comparison to the D-KEFS overall norm sample implying that the forensic population in this study had deficient levels of cognitive flexibility when compared to the mean of the norm sample population. Using one sample t-tests comparing norm group scaled scores with the study group overall
mean for each of the dependent measures provided partial confirmation of this supposition. Using a test value of 10 (the mean scale score of the dependent measures), Table 4 illustrates that the sample population's scores were significantly lower on three of the measures. Means, standard deviations, degrees of freedom, *t* scores, and significance level for each test are given in the table. That differences can be found in the results among the tests gives further support for the argument that the tests do not measure a unitary construct and deserve further scrutiny into the utility of employing one test over another. However, as with the preceding results, the difference from the Population Mean is slight again calling into question the utility of the results.

Table 4

*Comparison of Sample Mean Scaled Scores on D-KEFS Measures*

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean</th>
<th>SD</th>
<th><em>t</em></th>
<th>df</th>
<th>sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tower Test</td>
<td>10.25</td>
<td>2.39</td>
<td>1.02</td>
<td>96</td>
<td>.309</td>
</tr>
<tr>
<td>Sorting Test</td>
<td>8.95</td>
<td>2.42</td>
<td>-4.28</td>
<td>96</td>
<td>.000**</td>
</tr>
<tr>
<td>Color Word Inter.</td>
<td>9.20</td>
<td>2.90</td>
<td>-2.71</td>
<td>95</td>
<td>.008*</td>
</tr>
<tr>
<td>Trail Making Test</td>
<td>9.24</td>
<td>2.62</td>
<td>-2.85</td>
<td>95</td>
<td>.005*</td>
</tr>
</tbody>
</table>

*Note:* *p* < .01; **p** < .001

3. *There will be an inverse relationship between cognitive flexibility and symptoms of attention deficit, with higher scores on measures of cognitive flexibility being associated with lower scores on measures of attention deficit.*

The third research question considered the relationship between cognitive flexibility, attention, and memory deficits. Attention deficit estimates were obtained by using the scores on the Brown ADD Scales. Memory deficit estimates were obtained with the California Verbal Learning Test-2, Long Delay Free Recall task. The measures were
compared with a bivariate correlation analysis and are displayed in Tables 5 and 6 respectively.

In the comparison of the D-KEFS subtests and the Brown ADD Scale, one correlation was found to be statistically significant while the other measures were not correlated with attention deficits as measured in this study. The overall sample scores on the Color Word Interference test and Brown ADD Scale were negatively correlated (-.224), and the correlation was significant at the 0.05 level indicating that those participants who indicated greater difficulty with attention received lower scores on the Color Word Interference test. The Color Word Interference Switching task is purported to relate to inhibition and set shifting, thus it is not surprising that this association would be found. Further examination of the use of this test for attention problems may be warranted. The subtest or other Stroop-like tests may also be useful to examine the relationship between the set shifting and inhibition found in attention disorders as related to mental flexibility and violence. No other correlations were found to support the hypothesis that attention or memory would be related to the construct of cognitive flexibility as measured by the rest of the D-KEFS tasks used in this study (see Table 5 and Table 6).
### Table 5

*Correlations Between D-KEFS Measures and Brown ADD Scale Scores*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TowerScS</td>
<td>.157</td>
<td>.124</td>
</tr>
<tr>
<td>SortCorrScS</td>
<td>.157</td>
<td>.124</td>
</tr>
<tr>
<td>CWSwitchScS</td>
<td>.036</td>
<td>.250(*)</td>
</tr>
<tr>
<td>Trails4ScS</td>
<td>.136</td>
<td>.041</td>
</tr>
<tr>
<td>BrownT</td>
<td>-.118</td>
<td>.016</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).

### Table 6

*Correlations Between D-KEFS Measures and CVLT-II Long Delay Free Recall Scale*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pearson Correlation</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TowerScS</td>
<td>.157</td>
<td>.124</td>
</tr>
<tr>
<td>SortCorrScS</td>
<td>.036</td>
<td>.250(*)</td>
</tr>
<tr>
<td>CWSwitchScS</td>
<td>.729</td>
<td>.014</td>
</tr>
<tr>
<td>Trails4ScS</td>
<td>.136</td>
<td>.041</td>
</tr>
<tr>
<td>LDFreeSS</td>
<td>.181</td>
<td>.076</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
A secondary analysis was conducted comparing self-report of symptoms of attention deficit disorder with the Brown ADD Scale scores. An independent-samples t-test compared scores on the Brown ADD with self-reported past diagnosis of ADD. A significant difference in Brown scale scores was found for those who agreed to a past diagnosis (M=69.2; SD=12.1) and those who did not report such a diagnosis (M=58.2; SD=10.1; \( t(94) = 4.11, p < .001 \)). Agreement between a self-reported diagnosis of ADD and the Brown ADD Scale responses offers support for the use of the Brown ADD Scale for the purposes of screening for the presence of ADD in research projects where records of past testing may be difficult to obtain.

4. A positive relationship will be found between cognitive flexibility and intelligence and level of education in this population, with higher scores on cognitive flexibility measures being associated with higher intelligence scores and higher levels of education.

For the fourth research question, a correlation analysis was conducted between intelligence, as calculated by the WASI Full Scale IQ scores, and the D-KEFS subtests (see Table 7). Intelligence was found to have a moderate correlation to all but the Trail Making Test, which has been found to measure motor speed to a greater degree than mental flexibility.
Table 7

*Intercorrelations Between D-KEFS Subtests and Full Scale IQ*

<table>
<thead>
<tr>
<th>Subtests</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trail Making Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Color Word Int</td>
<td>.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sorting Test</td>
<td>.04</td>
<td>.25*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Tower Test</td>
<td>.14</td>
<td>.04</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td>5. FSIQ</td>
<td>.11</td>
<td>.29**</td>
<td>.52**</td>
<td>.28**</td>
</tr>
</tbody>
</table>

*Note.* *p < .05; **p < .01.

Additionally, intercorrelations were run between the dependent measures and reported level of education (Table 8). The mean for level of education by grade as reported by the participants was $M = 11.8$, $SD = 1.84$ (n=94). Education was found to be correlated with performance on several of the measures. On the Color Word Interference and Sorting Tests level of education had a positive relationship with performance. This finding may indicate that the domains tested by these subtests were related to degree of learning and thus may be influenced by educational experiences.
Table 8

*Intercorrelations between D-KEFS Subtests and Education Level*

<table>
<thead>
<tr>
<th>Subtests</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trail Making Test</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Color Word Int.</td>
<td>.20</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sorting Test</td>
<td>.05</td>
<td>.22*</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>4. Tower Test</td>
<td>.14</td>
<td>.06</td>
<td>.16</td>
<td>--</td>
</tr>
<tr>
<td>5. Education</td>
<td>.16</td>
<td>.31**</td>
<td>.41**</td>
<td>.17</td>
</tr>
</tbody>
</table>

*Note.* *p* < .05; **p** < .01.

5. Offenders with multiple convictions will have lower scores on measures of cognitive flexibility than offenders with few known convictions.

The final research question explored differences in scores on the D-KEFS subtests for those with differing numbers of convictions (groups categorized as follows: 1-5, 6-10, and 11+ convictions). A one-way multivariate analysis of variance (MANOVA) was conducted to assess for differences between the three groups and the measures of cognitive flexibility (see Table 9). No significant differences were found. Wilks Lambda = .92, F (8,174) = .925. The $\eta^2$ (eta) was weak at .04. Table 9 contains the means and standard deviations on the dependent measures for the three groups. Table 10 shows correlations between measures.
Table 9

Multivariate Analysis of Variance for Number of Convictions and D-KEFS Subtests

<table>
<thead>
<tr>
<th># of Convictions</th>
<th>Trails M</th>
<th>Tower M</th>
<th>Sorting M</th>
<th>Color Word M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
<td>SD</td>
</tr>
<tr>
<td>1-5 (n=27)</td>
<td>9.15</td>
<td>10.26</td>
<td>9.37</td>
<td>8.89</td>
</tr>
<tr>
<td></td>
<td>2.81</td>
<td>2.38</td>
<td>1.95</td>
<td>2.55</td>
</tr>
<tr>
<td>6-10 (n=26)</td>
<td>9.89</td>
<td>10.31</td>
<td>9.27</td>
<td>9.08</td>
</tr>
<tr>
<td></td>
<td>1.93</td>
<td>2.62</td>
<td>1.91</td>
<td>3.03</td>
</tr>
<tr>
<td>11+ (n=40)</td>
<td>9.13</td>
<td>10.33</td>
<td>8.40</td>
<td>9.55</td>
</tr>
<tr>
<td></td>
<td>2.80</td>
<td>2.17</td>
<td>2.81</td>
<td>3.04</td>
</tr>
</tbody>
</table>

Table 10

Correlations between Number of Convictions and D-KEFS Subtests

<table>
<thead>
<tr>
<th></th>
<th>Trails</th>
<th>Tower</th>
<th>Sorting</th>
<th>Color Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convictions</td>
<td>-.024</td>
<td>-.008</td>
<td>-.155</td>
<td>.110</td>
</tr>
</tbody>
</table>
DISCUSSION

The rationale for the current study was to examine the utility of using several of the D-KEFS measures of executive function to assess the relationship between violent behavior and cognitive flexibility in a forensic population. The assumptions underlying the study were that individuals with less cognitive flexibility are more likely to have a history of violent crimes and that decreased ability in this domain could be a precursor for the propensity to commit a violent offense. It was found that only one of the measures, the D-KEFS Sorting Test, was of value in differentiating those who had committed violent versus nonviolent crimes in the study population.

Summary of research hypotheses and main findings

This study used a relatively new grouping of tests to examine whether violent criminals could be distinguished from non-violent criminals on the basis of their performance on measures of cognitive flexibility. The first hypothesis of a difference between individuals incarcerated for violent offenses and scores on measures of cognitive flexibility was partially supported. Results for the D-KEFS Sorting Test indicated that there was a significant difference between those convicted of violent and nonviolent offenses with violent offenders performing at a level below that of nonviolent offenders on this measure. These results are congruent with similar studies previously cited in the literature using similar tests of set-shifting ability from which the D-KEFS Sorting Test was adopted such as the Wisconsin Card Sort Test and California Card Sort. However, none of the other measures of cognitive flexibility distinguished between the two groups.
and as previously mentioned, despite a moderate effect size, the difference between the groups was only slight calling into question the meaning of the results.

The second hypothesis of difference between the study population as a whole on the D-KEFS measures of cognitive flexibility in comparison with the test’s norming sample was also partially supported. As expected given the results discussed in previous studies, the D-KEFS Sorting Test, Number of Correct Sorts, proved to be the best indicator of differences in cognitive flexibility between the samples. A significant difference at the $p < .001$ level was found between the groups on this aspect of the Sorting Test. Differences at the $p < .01$ level were found for the Color Word Interference Test as well as the Trail Making Test. No such differences were found for the Tower Test.

The third hypothesis that there a relationship does exist between cognitive flexibility and symptoms of attention deficit disorder was not supported using the current study methods. However, one of the D-KEFS subtests, the Color Word Interference Switching task, revealed a correlation in the hypothesized direction when compared with scores on measures of attention. This suggests that problems with sustaining attention may have an effect on this particular subtest as there are multiple stimuli as well as time constraints involved in the taking of the test. The possibility exists that this test could be explored further for use as another indicator for testing for attention or distraction problems.

The fourth hypothesis that a relationship exists between cognitive flexibility and IQ and level of education was partially supported. The D-KEFS Sorting, Color Word Interference, and Tower tests revealed a positive relationship with statistically significant
results correlating higher intelligence scores with higher scores on measures of cognitive flexibility offering support for the hypothesis that intelligence can be related to greater cognitive flexibility. The hypothesis was not supported for the Trial Making Test. On the Color Word Interference and Sorting Tests level of education also had a positive relationship with performance though the other tests showed only a small correlation to level of education.

The final hypothesis of individuals with multiple convictions scoring differently on measures of cognitive flexibility than those with fewer convictions was not supported though means scores on the Sorting Test were in the expected direction. The participants were grouped by the number of identified convictions with the supposition being that the greater the number of convictions the poorer the individuals would score on the outcome measures.

Summary of Findings

The results of the current study partially confirmed the main hypothesis that the individuals in the sample who had been convicted of violent crimes did score more poorly on one measure related to cognitive flexibility, the D-KEFS Sorting Test. However, other measures of cognitive flexibility did not differ between the violent and nonviolent offender groups. Intelligence was also related to cognitive flexibility. An examination of the number of convictions did not show a relation to any of the measures. In a comparison of the normative sample to the current forensic population, the D-KEFS Sorting Test was also the best indicator of a difference between the groups.
A comparison with the literature

At times the desire to make sense of the world may extend to a need to place people in categories. However, human behavior is rarely the result of any one cause. Human behaviors are more often the result of characteristics that fall on a continuum or dimension, rather than into distinct categories. The use of neurological evidence to explain criminal behavior is a tempting but insufficient means of assessing for violent behavior. As Restak (1993) has warned, a neurological defense can be “nothing more than a hyped-up pseudoscientific version of the insanity defense” (p. 869) that has been rejected by many a jury. Brain impairments can lead to a variety of deficiencies, and Restak goes on to define brain damage as a deviation from the normal structure, while brain deficits lead to behavioral abnormalities or impairments in intelligence, emotion, or “the capacity to act freely” (p.869). While some with brain injury or abnormalities do commit violent crimes, many others do not. Similarly, there are many people who commit violent offenses who have no evidence of brain abnormality. It is possible that measures of cognitive functioning are not yet sensitive enough to determine distinct differences in brain function. The present study gives additional support for the use of tests of cognitive flexibility, especially card sorting tests, in the assessment of propensity for limits to cognitive flexibility or effective problem solving ability. A focused literature review revealed that in tests of cognitive flexibility using card sort tasks, violent offender populations tend to score more poorly than do control groups (e.g. Stone & Thompson, 2001; Mercer, Selby, & McClung, 2005; & Krakowski, et al., 1997). The results of the current study corroborate these earlier findings.
Other studies have looked at populations with some association with difficulty with impulse control. In their study of cognitive function and problem-solving ability in social situations with individuals with schizophrenia, Hatashita-Wong et al. (2002) found that although the Wisconsin Card Sort Test was significantly related to the category assessing for cognitive flexibility, Trails B did not correlate with their measure of social problem solving.

The Trail Making tests also have a long history of being used to assess for brain damage and are considered one of the most popular tests for neurological screening as it is brief, inexpensive, and portable (Horton & Roberts, 2005), taking less than five minutes to administer. In their study seeking evidence for risk factors for violent behavior in a forensic population, Young, Justice, and Erdberg (1999) used Trails A & B as part of a larger battery. Similar to the current study, no significant results were found to differentiate high and low violence individuals on the Trails test. Stone and Thompson (2001), did find significant differences between their sample of sex offenders with the Trails B norm group calling into question differences between their sample of sex offenders and subsets of other violent offenders. This study also differentiated the groups based on their results on the Stroop test. When comparing groups who scored differently on measures of psychopathy, Hart, Forth, and Hare (1990) found that the High psychopathy group in one sample scored more poorly on Trails B (p < .06) but in another sample, no such difference was found. Pham et al. (2003) also examined differences between executive function and criminal psychopaths. In their study the following tests of executive function were used: a modified Wisconsin Card Sort, the Stroop Color Word Interference, Trail Making, and Tower of London. In this study the groups were
differentiated based on PCL-R scores. No differences were found for this grouping on the Card Sort, Stroop, or Trails; however, the Tower results indicated that the psychopathic group were impaired in inhibition ability in planning tasks.

Despite the decades of research attempting to correlate violent criminality with performance on tests of neuropsychological functioning, no definitive corroborating conclusions have been forthcoming. Reasons for this include lack of standardized study design, methodology, and operational definitions. With such differences in study methods, Rasmussen, Almvik, and Levander (2001) find little reason to expect greater agreement between studies. However, the results of their study examining relations between neuropsychological tests, personality, criminality, and violence, the authors report finding differences between violent and non-violent criminals on the verbal factor of the neuropsychological measures. The authors also employed the Brown ADD Scale (BADD) to assess adult ADHD. The BADD results were also related to the verbal factors. Rasmussen et al. suggest that there is a “dose-response relationship” (p. 40), rather than a dichotomous one, to levels of ADHD as they affect verbal ability and impulse control. The present study did not find a relationship between BADD scores and history of violent crime, however, the association did exist between impulse control, or inhibition, as measured by the Color Word Switching Inhibition Test.

Clinical Implications

A variety of factors contribute to criminal behavior and researchers have been trying to understand the basis of criminality for decades. The goal of this dissertation has been to examine the role of cognitive flexibility in offenders with a history of violent behavior. The major hypothesis driving this work has been to examine a link between
limits in flexible thought processes and violent offending. As outlined in a previous section of this paper, cognitive flexibility is considered part of the executive function of the frontal lobes. Another area where research has been ongoing regarding flexibility in social problem solving is in the understanding and treatment of cognitive functions in populations found to have executive function deficits such as schizophrenic patients, especially those with negative symptoms. These studies may further contribute to our understanding of the role of cognitive flexibility and violent behavior.

Many studies have found that schizophrenic patients exhibit neurocognitive deficits in areas of executive function, attention, and memory. In one such study, Hatashita-Wong et al. (2002) looked at the relationship between social skills deficits and cognitive functioning in schizophrenia and found that cognitive flexibility as well as verbal memory contributed to information encoding and evaluation of alternative responses in social situations. Lezak (2004) cites studies finding that overall, schizophrenic patients perform more poorly than control groups on a range of cognitive tests especially those involving the frontal lobes. While the cause of the poor performance cannot be definitively stated, cognitive retraining studies with this group are encouraging (McGurk, Mueser, & Pascaris, 2005; Hogarty et al. 2004). In addition to adding to our understanding of the problem, these skills training programs may lead to greater understanding of problem solving training for individuals without a diagnosis of schizophrenia.

With offender populations, similar studies of deficient social problem solving have been undertaken. Research on developmental delays of offenders has found that many have deficiencies in realizing the consequences of their behavior and fail to use
cause and effect reasoning skills. Ross, Fabiano, and Ewles (1988) describe some of these deficiencies not as a failure of general, but of social intelligence. These deficits include rigidity of responses, impulsively using a response without considering alternatives, and a failure to anticipate an outcome. With less adept interpersonal problem solving skills, such individuals do not learn to deal with conflicts in a pro-social manner. Nonviolent offenders were not found to have the same level of social problems. According to cognitive social learning theory, effective problem solving is not an automatic response but a learned skill and as such can be acquired (McGuire, 2001; Hollin, 2001).

A variety of problem solving skills training programs have been implemented in correctional settings (Blud & Travers, 2001; Falshaw, Friendship, Travers, & Nugent, 2004; Fleck, Thompson, & Narroway, 2001; McMurran, Fyffe, McCarthy, Duggan, & Latham, 2001). Outcome studies of these programs have shown that results are largely positive. However, follow up studies on recidivism rates for some of these programs showed no significant difference between those who had received problem solving training and those who had not. Falshaw et al. suggest that more targeted assessment of individuals may increase the effectiveness of programs for specific offender types. In a similar study with adolescents aimed at decreasing aggressive behaviors, Guerra and Slaby (1990) found that cognitive mediation training had increased participants’ problem solving skills, as well as reduced aggression, impulsivity, and rigidity of behavior. One of the initial challenges in designing efficient treatments is determining the target audience or those who would most benefit. Testing for deficits in cognitive flexibility could allow for directing treatments towards those who would most gain from a program geared towards increasing effective problem solving and decreasing violent responding.
Limitations

Threats to validity undermine most research and this is likely to be the case with the current work. Some of the validity concerns include a selection bias and lack of a control group. Other considerations are the generalizability of the results, as well as questions regarding the operational definition of the construct under consideration.

With regard to selection bias, the sample population was comprised of a group of individuals in a somewhat unique program that may not be typical of many correctional settings. The exact inclusion criteria for individuals to be allowed to serve their time in this, rather than a typical correctional facility, were not known other than that they were serving the last year of their sentence or they were involved with the intense substance abuse program. It is possible that selection bias may have occurred on the part of the facility to exclude certain types of criminals or populations, thereby influencing the generalizability of the current results.

The participants' scores in this study were compared to the D-KEFS normative group scores; however, no control group was utilized, calling into question the reliability of using these measures for assessment of cognitive flexibility in other forensic populations. The D-KEFS Sorting Test was the only measure that differentiated between the Violent and Non-violent groups in this analysis. However, only a small difference was found and further examination of this question may give stronger support for the hypothesis. The sorting tests have been found to relate mental flexibility to the capacity to use feedback to shift mental set and control behavior. The correlations found in this and other studies give some support to the conclusion that cognitive flexibility was related to the particular ability of executive control between the two groups. In their
review, Goldberg and Bougakov (2005) agree that although there is no single test adequate to measure the totality of executive functioning, specific tests do provide reliable estimates of particular characteristics of executive control. They cite the use of Wisconsin Card Sorting Test from which the D-KEFS was adopted, as useful to assess mental flexibility.

Due to the rather extensive nature of the battery of tests, it is possible that some individuals did not give their best effort on all tasks. There can be a fatigue effect and some of the dependent variables were given at the end of the testing session (i.e. Brown ADD Scale, D-KEFS Tower Test). It is also possible that these individuals were not at all invested in doing well and thus did not give their best effort for unknown reasons. Other researchers have proposed that there is a need for identifying conditions that may influence executive function testing results to mitigate this problem in future studies (Seguin et al. 1999).

Other possible confounds to be considered include the use of self-reported information. The current population self-reported their drug and alcohol history. A majority admitted to using alcohol (70%), marijuana (45%), methamphetamine (54%), hallucinogens (4%), opiates (9%), and other stimulants (30%), but there are difficulties interpreting this information. The extent of use is unknown and is a limitation of the current data when considering the effects of substance abuse on brain performance. As forensic populations tend to have a long history of substance use, it is unknown what effect these substances have on their cognitive flexibility. Statistical tests comparing scores on the measures of cognitive flexibility by admittance of use of substances revealed no significant results. Although the participants were regularly monitored for
substance use while incarcerated, the date of last use was unknown. Re-testing of these individuals after a period of extended sobriety may reveal different results. Furthermore, with limited information on the participants' juvenile criminal history as well as other instances of violence, the grouping variable used in this study also contributes to speculation about the reliability of stating that lack of cognitive flexibility is a major precursor to violent behavior. Another area to expand upon in future studies relates to the extent and type of brain injury that participants may have experienced in the past. Although some questions were posed regarding loss of consciousness, it would be interesting to compare the same groups with greater knowledge of extent of brain injury.

A limitation with the data collected on the Sorting Test regards the use of limited aspects of that test. The D-KEFS Sorting Test, as well as the Wisconsin version, allow for the collection of various aspects of sorting ability. In this study, only the number of correct sorts was compared. Future studies may wish to examine the date for other results such as number of perseverative errors found. Finally, as with many studies, a larger sample would have contributed to the power of the results.

Directions for future research

The D-KEFS is a relatively new test of executive function ability that does not have an extensive history of use with forensic populations. While the current study results did give some support for the use of the D-KEFS Sorting Test task for assessing cognitive flexibility, additional comparisons of the D-KEFS Sorting Test task with the Wisconsin Card Sort could offer further support for use of the D-KEFS version with forensic populations to assess for this construct. Studies with greater numbers of participants as well as comparisons with different types of offender groups and different
measures of violence could provide further support for using cognitive flexibility as an assessment for deficient problem solving ability leading to violent behavior. As has been mentioned throughout, other forms of assessing for differences in executive function are also addressing violent responding. Future research assessing violence will likely take advantage of advances in neuroimaging as well as continue to work toward reducing methodological problems.
SUMMARY

The present study examined the use of the Delis-Kaplan Executive Function System for assessing cognitive flexibility and differences between those convicted of violent and nonviolent offenses. The violent group in the study population did show a significant difference on the measure best known for assessing this construct, the Sorting Test, however, the results were too small to say with confidence that individual performances were meaningfully different based on crime type. Scores on the other measures did not produce statistically significant differences. The major assumption was that a decreased ability to be mentally flexible could be a precursor for the commission of a violent crime out of an inability to effectively find an alternative solution to a confrontation. The ability to be mentally flexible can provide greater options for behavior, and the ability to discover alternatives was explored in the consideration of problem solving skills training programs. Problem solving skills training may be of use in increasing cognitive flexibility and such programs could show increased efficacy by targeting those individuals who are in greatest need of increasing their problem solving ability. Increasing effectiveness of evaluation for possible precursors to violent behavior may increase lead to improvements in identifying at risk individuals, as well as lead to improved rehabilitation efforts for violent offenders. The utility of such an outcome would be of great benefit to both the individuals and to society at large.
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APPENDIX A

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. AUDIT: The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Care.


Hayes, S. C., Strosahl, K., Wilson, K. G., Bissett, R. T. The Acceptance and Action Questionnaire (AAQ) as a measure of experiential avoidance.


