The Relationship Between Executive Dysfunction and Criminality in Forensic Psychiatric and Correctional Populations

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Abstract

Crime has immense social and economic impact. Understanding and treating the underlying factors of criminal behavior is essential to creating an overall safer society. Deficits in executive functioning — inhibition, cognitive shifting, and working memory — have been implicated as a factor contributing to criminal behavior. **Method:** Manuscript 1 examines the relationship between executive dysfunction and severity and frequency of criminal behavior of forensic psychiatric patients, individuals who committed crime under the influence of a severe mental disorder. Manuscript 2 compares the executive functioning of two unique criminal populations — forensic psychiatric patients and correctional offenders. **Results:** Poorer executive functioning is related to more in-custody aggression and a violent index offence. Forensic psychiatric patients display pervasive executive dysfunction and abnormal executive function profiles; they also have significantly poorer executive function performance than correctional offenders. **Conclusions:** Executive functions are a potential treatment target and could influence risk and release decisions.

**Keywords**

Forensic Psychiatric Patients, Correction Offenders, Executive Functions, Violence, Aggression, Crime, Inhibition, Cognitive Shifting, Working Memory, Mental Disorders
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Table of Contents

Abstract .................................................................................................................................................. ii
Acknowledgements .............................................................................................................................. iii
Table of Contents ................................................................................................................................ iv
List of Tables ......................................................................................................................................... viii
List of Figures ..................................................................................................................................... x
List of Appendices ............................................................................................................................... xi
List of Abbreviations ............................................................................................................................ xii
Chapter 1 ............................................................................................................................................... 1
  1.1 Overview of Thesis ....................................................................................................................... 1
  1.2 Criminal Justice System .............................................................................................................. 1
  1.3 Factors that Contribute to Criminal Behavior ........................................................................... 3
  1.4 Definitions of Violence and Aggression ..................................................................................... 4
  1.5 Executive Functioning ................................................................................................................ 5
  1.6 Executive Functioning and Criminality ..................................................................................... 7
  1.7 Current Thesis ............................................................................................................................. 8
  1.8 Ethical Considerations ............................................................................................................... 8
  1.9 References .................................................................................................................................. 10
Chapter 2 ............................................................................................................................................... 15
  2.1 Postdicting Severity and Frequency of Aggression and Violence in a Forensic Psychiatric Population .................................................................................................................. 16
  2.2 Executive Functioning ................................................................................................................ 17
  2.3 Violence and Aggression ............................................................................................................ 19
Chapter 3 .............................................................................................................. 75

3.1 Executive Dysfunction in Forensic Psychiatric and Correctional Populations ...... 76

3.1.1 Factors Leading to Criminality ................................................................. 76

3.1.2 Executive Functioning .............................................................................. 77

3.1.3 Executive Functioning and Criminal Behavior ......................................... 78

3.1.4 Modifiability of Executive Functions ....................................................... 79

3.1.5 Mental Health Issues in Correctional Offenders and Comparisons with
Forensic Psychiatric Patients ............................................................................ 80

3.1.6 Current Study ............................................................................................ 81

3.2 Method .......................................................................................................... 82

3.2.1 Participants ............................................................................................... 82

3.2.2 Materials .................................................................................................. 84

3.2.3 Procedure .................................................................................................. 88

3.3 Data Analyses ............................................................................................... 89

3.4 Results ........................................................................................................... 92

3.4.1 Preliminary Analyses ............................................................................... 92

3.4.2 Independent Samples T-Tests .................................................................... 93

3.4.3 Clinically Significant Executive Functioning Impairment and Normative
Sample Comparison ............................................................................................ 98

3.5 Discussion .................................................................................................... 104

3.5.1 Inhibition .................................................................................................. 104

3.5.2 Shifting ..................................................................................................... 106

3.5.3 Working Memory ....................................................................................... 107
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.4 Implications</td>
<td>109</td>
</tr>
<tr>
<td>3.5.5 Limitations and Future Directions</td>
<td>111</td>
</tr>
<tr>
<td>3.5.6 Conclusions</td>
<td>113</td>
</tr>
<tr>
<td>3.6 References</td>
<td>114</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>126</td>
</tr>
<tr>
<td>4.1 General Discussion</td>
<td>126</td>
</tr>
<tr>
<td>4.2 Executive Functioning and Criminality</td>
<td>126</td>
</tr>
<tr>
<td>4.3 Executive Dysfunction in Criminal Populations</td>
<td>128</td>
</tr>
<tr>
<td>4.4 Comparison of Executive Functioning in Forensic Psychiatric Patients and Criminal Offenders</td>
<td>129</td>
</tr>
<tr>
<td>4.5 Theoretical Considerations</td>
<td>130</td>
</tr>
<tr>
<td>4.6 Limitations and Future Directions</td>
<td>132</td>
</tr>
<tr>
<td>4.7 Implications</td>
<td>134</td>
</tr>
<tr>
<td>4.8 Conclusion</td>
<td>135</td>
</tr>
<tr>
<td>4.9 References</td>
<td>136</td>
</tr>
<tr>
<td>Appendices</td>
<td>142</td>
</tr>
<tr>
<td>Curriculum Vitae</td>
<td>153</td>
</tr>
</tbody>
</table>
List of Tables

Table 2.1: Demographic Information ................................................................. 25
Table 2.2: Developmental History ................................................................. 26
Table 2.3: Psychiatric Diagnoses ................................................................. 27
Table 2.4: Offending Characteristics ............................................................. 28
Table 2.5: Index Offences .............................................................................. 32
Table 2.6: List of Component Scores and Abbreviations .............................. 35
Table 2.7: Variable Scoring .......................................................................... 39
Table 2.8: Means, Standard Deviations, and Ranges of Outcome Variables .... 41
Table 2.9: Means, Standard Deviations, and Ranges of KBIT-2 Scores ........... 42
Table 2.10: Means, Standard Deviations, Ranges, and Percentile Ranks of DKEFS Scores .............................................................................. 43
Table 2.11: Correlations among DKEFS scores .............................................. 44
Table 2.12: Correlation Coefficients Between Predictor and Outcome Variables .... 45
Table 2.13: Summary of Hierarchical Regression Analysis for Variables predicting Total Aggression Score .............................................................................. 47
Table 2.14: Summary of Hierarchical Regression Analysis for Variables Predicting Total Violent Convictions ................................................................. 48
Table 2.15: Summary of Hierarchical Regression Analysis for Variables Predicting In-Custody Rule Infractions ................................................................. 49
Table 2.16: Logistic Regression Predicting Violent/Nonviolent Index Offence .... 50
Table 2.17: Means, Standard Deviations and Ranges of Violent Versus Nonviolent Index Offences .............................................................................. 51
Table 3.18: Proportional Representation of Forensic, Correctional, and Normed Samples. ..........................................................................................................................84

Table 3.19: Variable Names and Construct Measured. ..........................................................88

Table 3.20: Variable Scoring. ................................................................................................91

Table 3.21: Differences Between Forensic Psychiatric Patients and Correctional Offenders on DKEFS Scores. ..................................................................................95

Table 3.22: Percentage of Groups 2 Standard Deviations Below the Mean and Comparisons Between Groups.........................................................................................101
List of Figures

Figure 3.1: Differences Between Forensic Psychiatric Patients and Correctional Offenders on Executive Function Components ................................................................. 98

Figure 3.2: Percentage of Forensic Psychiatric Patients and Correctional Offenders Who Score 2 Standard Deviations Below the Mean. ............................................. 103
List of Appendices

Appendix 1: HSREB Full Board Approval Notice ............................................. 142
Appendix 2: Lawson Final Approval Notice ..................................................... 143
Appendix 3: Data Collection Form ................................................................. 144
Appendix 4: Letter of Information and Consent .............................................. 147
Appendix 5: Sample List of Medications ....................................................... 151
**List of Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWIT</td>
<td>Color-Word Interference Test</td>
</tr>
<tr>
<td>CWIT\textsubscript{IC}</td>
<td>Color-Word Interference Test — Inhibition Condition</td>
</tr>
<tr>
<td>CWIT\textsubscript{ISC}</td>
<td>Color-Word Interference Test — Inhibition/Switching Condition</td>
</tr>
<tr>
<td>DKEFS</td>
<td>Delis-Kaplan Executive Function System</td>
</tr>
<tr>
<td>DKEFS\textsubscript{INH}</td>
<td>Delis Kaplan Executive Function System – Inhibition</td>
</tr>
<tr>
<td>DKEFS\textsubscript{SHIF}</td>
<td>Delis Kaplan Executive Function System – Shifting</td>
</tr>
<tr>
<td>DKEFS\textsubscript{WM}</td>
<td>Delis Kaplan Executive Function System – Working Memory</td>
</tr>
<tr>
<td>EF</td>
<td>Executive Function</td>
</tr>
<tr>
<td>ICC</td>
<td>Intraclass Correlation Coefficient</td>
</tr>
<tr>
<td>IQ</td>
<td>Intelligence Quotient</td>
</tr>
<tr>
<td>KBIT-2</td>
<td>Kaufman Brief Intelligence Test, Second Edition</td>
</tr>
<tr>
<td>NCRMD</td>
<td>Not Criminally Responsible on Account of Mental Disorder</td>
</tr>
<tr>
<td>OAS</td>
<td>Overt Aggression Scale</td>
</tr>
<tr>
<td>OAS-M</td>
<td>Overt Aggression Scale—Modified</td>
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<tr>
<td>ST</td>
<td>Sorting Test</td>
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<tr>
<td>TT</td>
<td>Tower Test</td>
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<tr>
<td>TT\textsubscript{AS}</td>
<td>Tower Test — Achievement Score</td>
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<tr>
<td>VF</td>
<td>Verbal Fluency Test</td>
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<tr>
<td>VF\textsubscript{SA}</td>
<td>Verbal Fluency Test — Switching Accuracy</td>
</tr>
</tbody>
</table>
Chapter 1

1.1 Overview of Thesis

This thesis follows the integrated article format outlined by the School of Graduate and Postdoctoral Studies at Western University. The thesis will be split into two main chapters, which will follow a general introduction and a section discussing ethical considerations unique to conducting research with protected populations. Chapters 2 and 3 are stand-alone manuscripts that both look at executive function (EF) deficits — or executive dysfunction — in criminal populations. Chapter 2 (manuscript 1) looks at the utility of EF deficits in postdicting violence and aggression in a forensic psychiatric population. Chapter 3 (manuscript 2) compares EF deficits in a forensic psychiatric and a correctional population, and compares these populations with a normative population. Chapter 3 of this thesis includes previously-collected data. Megan Hancock, PhD., generously provided her masters thesis data in order to make a comparison between two different criminal populations possible. Megan Hancock’s master’s thesis data (2009) includes all EF and intelligence scores of 80 correctional offenders.

Having an in-depth overview of the forensic psychiatric population in Chapter 2 will give the reader a more holistic understanding of why EF is important to look at in criminal populations and properly set up a comparison between two criminal populations in Chapter 3. This thesis will end with a general discussion.

1.2 Criminal Justice System

Criminal responsibility in Canada is made up of two components: the guilty act \( (actus\ reus) \) and the guilty mind \( (mens\ rea) \). In addition to perpetrating a criminal act, an individual must have the capacity to understand that the act was wrong in order to be held criminally responsible. If both the guilty act and the guilty mind are present, an individual
is deemed criminally responsible and is placed within the correctional system (Criminal Code of Canada, 1985). On the other hand, when a severe mental disorder impedes one’s ability to understand the nature and consequences of a criminal act, the guilty mind is no longer present. In this case, an offender is deemed Not Criminally Responsible on Account of a Mental Disorder (NCRMD) and is placed in the forensic psychiatric system. Section 672.54 of the Criminal Code of Canada mandates that individuals deemed NCRMD be given the “least onerous and least restrictive sentence,” which means that absolute discharge must be given once an offender is deemed no longer a risk to society. By law, discharge is guided by the balance of public protection, mental condition of the accused, and the rights of the offender (Corrections and Conditional Release Act, 1992). The goal of the forensic psychiatric system is to successfully rehabilitate and reintegrate offenders back into society (Bettridge & Barbaree, 2008), which requires special attention to a variety of risk factors that are linked to criminal behavior (Seto, Harris, & Rice, 2004). Despite this emphasis, individuals with mental disorders are disproportionately at risk for perpetrating and being victims of crime.

The deinstitutionalization movement was a major factor contributing to the increase of individuals with mental disorders in the criminal justice system. The discovery of antipsychotic medication and the push for community mental health services led to the psychiatric deinstitutionalization movement in the 1960s. Deinstitutionalization resulted in an 80% decrease in psychiatric patients; however, at the same time, days in psychiatric hospitals increased (Sealy, 2012). Furthermore, changes to civil law resulted in more difficulties involuntary treating and hospitalizing individuals with mental disorders (Crocker & Côté, 2009). These factors have resulted in the criminal justice system increasingly becoming a first contact point for mental health services for
individuals with mental disorders (Crocker & Côté, 2009). Furthermore, although fewer than 1% of criminal cases end with an NCRMD verdict (Bettidge & Barbaree, 2008), there has been a 102% increase in NCRMD verdicts in Canada between 1992 and 2004 (Latimer & Lawrence, 2006) and the length of hospitalization has increased substantially (Livingston, Wilson, Tien, & Bond, 2003). From an economic perspective, holding an individual deemed NCRMD in a medium-security hospital is incredibly costly, costing over $700 a day or over $274,000 a year per person (Jacobs et al., 2014). The increasing burden of mental disorders on the Canadian criminal justice system is not only seen in the forensic psychiatric system. In a correctional setting, the number of offenders with mental disorders has almost doubled in the last decade (Schneider, Forestall, & MacGarvie, 2002) despite decreasing crime rates (Statistics Canada, 2012).

Forensic psychiatric patients make up a small but significant population, in terms of both economic and societal impact. Given the immense social and economic cost of mental disorders and crime, understanding the factors that contribute to criminality are essential for determining offenders’ risk, creating effective rehabilitation programs, and promoting an overall safer society.

1.3 Factors that Contribute to Criminal Behavior

An offender suffering from a mental disorder receives special consideration in most legal systems around the world. In Canada, regulations regarding offenders with mental disorders suggest that mental disorders, at least partially, lead to criminal behavior in some cases (Anckarsäter, Radovic, Svennerlind, Höglund, & Radovic, 2009); otherwise, mental disorders would have no place in criminal proceedings and disposition decisions. However, the relationship between mental disorders and crime is contentious. Over 85% of those deemed NCRMD have prior criminal convictions in which they were
found guilty (Crocker, Braithwaite, Côté, Nicholl, & Seto, 2011). Potentially, the presence of a mental disorder was a factor in previous convictions. The relationship between mental disorders and crime is highly contested and criminal risk factors beyond mental disorder need to be considered.

Beyond mental disorders, a variety of demographic factors have a well-established link with criminality. Demographic factors, such as being male, younger, in a low socioeconomic status/lower education, and racial status, are risk factors of criminality. For example, in one study conducted in Indiana, most individuals with severe mental disorders who committed homicide between 1990 and 2002 grew up in dysfunctional families, had severe substance dependence, had extensive criminal histories, and received little to no treatment for their mental disorders (Matejkowski, Cullen, & Solomon, 2008). The relative contribution of mental disorders to violence and crime in society appears to be minimal; violence is significantly correlated with a variety of demographic factors, including gender and socioeconomic status, while mental disorders appear to contribute relatively little to violence (Norko & Baranoski, 2005). Furthermore, no psychiatric symptom (e.g., anxiety, depression, psychosis) — other than anger — had a temporal association with violence in psychiatric patients over a six month period (Skeem et al., 2006). Therefore, many factors are important to consider when looking at why those with mental disorders commit crimes. Recently, researchers have attempted to link deficits in higher order cognitive functioning — or EF — to violence and aggression.

1.4 Definitions of Violence and Aggression

Since both violence and aggression will be measured in the current study, a definition of both will be discussed below. For the remainder of the current study, original terminology of cited research will be used (i.e., violence or aggression).
For the purposes of the current study and because research is being conducted in a controlled setting, a broader definition of aggression will be used, incorporating both physical and/or psychological elements. Aggression will therefore be defined as any form of behavior that injures someone or something physically or psychologically (Berkowitz, 1993).

While all violence is considered aggressive, the opposite is not true. In other words, aggressive acts are not always violent. A uniform definition of violence has not been established; however, violence is more generally used in criminal settings (Citrome & Volavka, 2003). Rippon (2000) suggests violence be narrowed to acts of aggression that are more heinous in nature and result in physical harm. In the present studies, violence will therefore be defined as a physical act that results in the physical injury of another human being (Anderson & Bushman, 2002).

Although intent is an essential aspect in some definitions of both violence and aggression, the presence of a mental disorder may distort the capacity of intent. Eichelman and Hartwig (1990) suggest that a more behavioral definition of violence and aggression is appropriate. Therefore, more behavioral definitions of violence and aggression will be considered in this study.

1.5 Executive Functioning

EF is an umbrella term that describes a series of higher-order cognitive functions, and has been widely defined to include concepts such as inhibition, planning and reasoning, attention, flexibility, shifting, and problem solving (e.g., Miyake et al., 2000). These higher-order functions are necessary for an individual to conduct appropriate everyday activities and are viewed as being primarily controlled by the frontal lobe (Miyake et al., 2000). In a seminal study, Miyake et al. (2000) conducted a latent factor
analysis of nine commonly-used tests of EF and found three factors to make up EF:
inhibition, cognitive shifting, and working memory. Although these constructs overlap to
varying degrees (Diamond, 2013), Miyake et al. (2000) found that a three-factor model
produced a significantly better fit than a one- or two-factor model of EF. Despite the
definition of EF being debated, Miyake’s model is one of the most widely used and cited
models of EF (Miyake et al., 2000). Below, the three components and the association
between EF and intelligence will be described.

**Inhibition.** Inhibition is the ability to control more automatic responses, and run
cognitive processes that are counterintuitive (Diamond, 2013). Miyake et al. (2000)
define inhibition as the ability to inhibit responses that are more dominant or automatic
when needed. In forensic psychiatric and correctional populations, inhibition may be
essential in suppressing aggressive impulses.

**Shifting.** Shifting, which is sometimes called cognitive shifting or switching, is
the ability to take different perspectives, or shift back and forth between numerous tasks
or mental sets (Garon, Bryson, & Smith, 2008). An inability to shift from task to task in
forensic psychiatric and correctional populations may result in an escalation of aggressive
or violent behavior.

**Working Memory.** Working memory is the process of holding information in the
mind that is no longer perceptually present (Baddeley & Hitch, 1994; Smith & Jonides,
1999), and updating and monitoring incoming information for how relevant it is for a
certain task, then replacing irrelevant information with more important information to the
task at hand (Morris & Jones, 1990). Working memory is distinguished from short-term
memory; the brain develops differently for both working memory and short-term
memory. Additionally, brain-imaging techniques show that both working and short-term
memory utilize separate brain areas (for more information see D’Esposito, Postle, Ballard & Lease, 1999; Eldreth et al., 2006; and Smith & Jonides, 1999).

Working memory is looked at in the current studies as being potentially instrumental in aggression and violence in forensic psychiatric and correctional populations.

**Executive Functioning and Intelligence.** Although there is overlap between EF and intelligence (e.g., Luciano et al., 2001; Carpenter, Just, & Shell, 1990; Miyake et al., 2000), some individuals with deficits in everyday, higher-order functioning (or EF) show normal intelligence on tradition tests of intelligence (e.g., Damasio, 1994; Sternberg, 1988), suggesting intelligence and EF are separate constructs. Intelligence Quotient (IQ) is measured in the current study in order to test for the unique contribution of EF in predicting violence and aggression.

**1.6 Executive Functioning and Criminality**

The relationship between antisocial behaviors and both cognitive function and intelligence has received considerable attention in the past decade. Groups that display antisocial behavior — both violent and nonviolent — receive lower intelligence scores compared to groups that do not display antisocial behavior (Heilbrun, Heilbrun, & Heilbrun, 1978; Henry & Moffitt, 1997). Recently, researchers have attempted to link deficits in EF to violence and aggression.

In a meta-analytic review of 39 studies with 4,589 participants, Morgan and Lilienfeld (2000) found that antisocial groups — including groups with violent and aggressive histories — scored .62 standard deviations (SDs) lower than non-antisocial groups on EF measures. A more recent meta-analysis of 125 studies involving 14,786 participants also found that antisocial groups displayed more executive dysfunction than
control groups (Ogilvie, Stewart, Chan, & Shum, 2011); the largest effect size was found for criminality with criminal groups performing .61 SDs lower than controls. (Note: Both meta-analyses controlled for age, sex, ethnicity, and intelligence.) Despite a clear link between EF deficits and antisocial behavior, there is little known about which facets of EF are impaired in antisocial groups. Furthermore, no research was found that looks at the relationship between EF deficits and antisocial behavior in a forensic psychiatric population.

1.7 Current Thesis

This thesis looks at the role of EF in predicting violence and aggression in a forensic psychiatric population. Furthermore, the relationship between EF deficits and aggression and violence will be further explicated by looking at different facets of EF. This thesis has two main manuscripts: Chapter 2 and Chapter 3. Chapter 2 will look at the role of EF in postdicting severity and frequency of violence and aggression in a forensic psychiatric population. Postdiction is a common technique used in forensics research to estimate an event subsequent to its occurrence (Yamada, Kawabe, & Miyazaki, 2015). Chapter 2 will also look at the EF profiles of forensic psychiatric patients. Chapter 3 will compare EF in a forensic psychiatric population with data previously collected from a correctional population (Hancock, Tapscott, & Hoaken, 2010) and population norms. Chapter 4 will be a general discussion of both chapters.

1.8 Ethical Considerations

This study was conducted in an environment with a protected population. Therefore, unique challenges arise, particularly regarding consent. The study was designed to pose minimal risk to patients. Potentially, a participant could become frustrated with the length and cognitive demand of the testing session. Safety measures
were put in place in order to ensure the best interests of patients and examiners including:

A) Only individuals who had the capacity to consent were approached, B) Capacity to consent was determined in collaboration with on-site psychologists and social workers to be anyone who has financial decision-making abilities (financial consent), and C) Consent was determined on a continual basis. The letter of information was explained, and patients were notified that their results would be kept completely confidential and that their participation would have no impact on their review board or treatment decisions.

No deception was involved in the study, and patients were informed that their personal files would be looked at. All patients were informed that they could take breaks at any point in completing the study. No compensation was provided for participation in the study; however, patients were informed that their participation could help develop rehabilitation programs in the future.

In terms of examiners, safety measures were put in place for examiners to prevent adverse outcomes. All examiners informed nursing staff of their whereabouts with patients, testing was completed in a windowed room that staff members could see into, rooms were monitored at all times by security cameras, and examiners were equipped with panic buttons. No adverse incidents occurred with patients or examiners in relation to this study.

The current study was approved by a full board Western Research Ethics Board Review (Appendix 1) and by Lawson Health Research Institute, a research body that oversees research conducted at St. Joseph’s Health Care, including the Southwest Centre for Forensic Mental Health Care (Appendix 2).
1.9 References


*Criminal Code of Canada*, R. S. C. 1985, c.46, s. 672(34).


the relationship at the weekly level. *Journal of Consulting and Clinical Psychology, 74*, 967-979.


Chapter 2

Postdicting Severity and Frequency of Aggression and Violence in a Forensic Psychiatric Population

Erin J. Shumlich
2.1 Postdicting Severity and Frequency of Aggression and Violence in a Forensic Psychiatric Population

Mental disorders are a component of criminal responsibility in almost every legal system around the world. In Canada, someone who commits a crime under the influence of a severe mental disorder is deemed Not Criminally Responsible on Account of Mental Disorder (NCRMD). This suggests that mental disorders, at least partially, contribute to criminal propensity; however, the relationship between mental disorders and crime is tenuous. For example, Skeem et al. (2006), in a study of psychiatric patients at a high risk of perpetrating violence, found that no psychiatric symptom — including psychosis — was related to crime over time, except for anger. Furthermore, they found gender, socioeconomic status, and ethnicity accounted for a significant proportion of the variance of antisocial behavior (Skeem et al., 2006).

Although forensic psychiatric patients make up fewer than 1% of criminal cases in Canada (Bettidge & Barbaree, 2008), forensic psychiatric patients constitute the most aggressive psychiatric in-patient group (Bowers et al., 2011). The three most common mental disorders in forensic psychiatric hospitals (schizophrenia, antisocial personality disorder, and borderline personality disorder) are associated with poor outcomes (e.g., reduction of symptoms), increased aggression, self-harm behavior, and pessimism in the health-care community that manifest as personal and professional biases against individuals with these mental disorders (Howard, McCarthy, Huband, & Duggan, 2013; Reid, 2009; Salekin, 2002; Dingfelder, 2004; van Dongen, Buck, & Van Marle, 2014).

Researchers have attempted to understand the complex psychosocial risk factors that lead those with a mental disorder to commit crime (e.g., Bettidge & Barbaree, 2008). Predictors of violence and aggression amongst individuals with mental disorders include:
homelessness, demographic factors, dysfunctional family life, substance abuse, and level of mental health treatment (Matejkowksi, Cullen, Solomon, 2008; Fisher, Silver, & Wolff, 2006; Markowitz, Bellair, Liska, & Liu, 2001). Clearly, there are myriad factors that contribute to criminal propensity. Recently, executive function (EF) has been proposed as an important explanatory component in understanding criminality.

2.2 Executive Functioning

Looking beyond mental disorders and psychosocial factors, researchers have begun examining how different aspects of cognition relate to general aggression and violence. Cognitive functioning came to the forefront when researchers noticed that aggressive patients who exhibited frontal lobe damage had difficulty engaging in higher-order tasks like organization, set-shifting, and goal-directed behavior (Damasio, Grabowski, Frank, Galaburda, Damasio, 1994). Cognitive functioning has since been implicated in violence and antisocial behaviors (Morgan & Lilienfeld, 2000; Ogilvie, Steward, Chan, & Shum, 2011).

Higher-order cognitive functioning related to the frontal lobe is known as EF (Marsh & Martinovich, 2006). Researchers have suggested that EF is the mediating factor of frontal lobe damage and aggression (Bufkin and Luttrell, 2005; Marsh and Martinovich, 2006). Although EF is an essential consideration of forensics research, methodological issues arise due to the atheoretical approach often taken by researchers and the lack of ubiquitous definition of EF in the literature.

Despite being a widely discussed construct, the definition of EF and the components that make it up are elusive. In a seminal study, Miyake et al. (2000) conducted a latent factor analysis and discovered a three-factor model of EF, which consisted of inhibition, cognitive shifting, and working memory. Miyake et al. define
inhibition as the “ability to deliberately inhibit dominant, automatic, or prepotent responses when necessary” (p. 57). Shifting (also called cognitive shifting or switching) is the ability to mentally move back and forth between multiple tasks while working memory is the “updating and monitoring” of memory components. Miyake et al.’s (2000) is one of the most widely used and cited models of EF.

Despite differences in the definition of EF, there appears to be a clear relationship between EF and aggression and violence. In a meta-analytic review of 125 studies involving 14,786 participants and controlling for age, sex, and ethnicity, antisocial groups — including violent and aggressive groups — displayed more EF deficits than control groups; the largest effect size was found for criminal groups, which performed .61 standard deviations (SDs) below controls on various measures of EF (e.g., the general population; Ogilvie et al., 2011). However, it is unclear which aspects of EF are related to aggression and violence and there may be variation as a function of the nature of the offense.

Studies that have examined differences in the nature of offending have typically examined violent versus nonviolent offending. In a sample of 77 adult male offenders in a correctional facility, Hancock, Tapscott, and Hoaken (2010) found that executive dysfunction postdicted severity and frequency of violent offending, but not of nonviolent offending. Postdiction is the process that makes use of information to retrospectively interpret an event (Yamada, Kawabe, & Miyazaki, 2015). This is consistent with substantial research suggesting executive dysfunction is more pronounced in those who perpetrate violent compared to those who perpetrate nonviolent offenses (Baker & Ireland, 2007; Barker et al., 2007; Miura, 2009). However, this finding is equivocal.
Other researchers have found no EF differences between violent and nonviolent offenders (Greenfield & Valliant, 2007; Hoaken, Allaby, & Earle, 2007).

Brower and Price (2001) conducted a literature review attempting to establish a pattern of executive dysfunction in predicting violent and criminal behavior. Their review supported an association between cognitive dysfunction in general and antisocial behavior but found that there were no reliable findings showing that executive dysfunction predicted violent crime. The equivocal findings could be due to the different criminal populations examined; while executive dysfunction may predict violence in a medium-security correctional population (Hancock et al., 2010), it may not predict violence in other criminal populations (e.g., maximum-security correctional offenders; Greenfield & Valliant, 2007). Violent, aggressive, and nonviolent acts are defined widely across the literature, which could also explain these contrasting findings. Therefore, more research is needed to further explicate the relationship between executive dysfunction and violence in specific criminal populations.

2.3 Violence and Aggression

There is also a lack of uniform definition of violence and aggression throughout the literature. Violence and aggression are often used interchangeably; however, using these terms interchangeably is not recommended (Citrome & Volavka, 2003). Aggression is defined as behavior that injures someone or something physically or psychologically (Berkowitz, 1993). Violence is narrowed to acts of aggression that are more heinous in nature and result in physical harm (Anderson and Bushman, 2002). Thus, violence is defined as a physical act that results in the physical injury of another human being (Anderson and Bushman, 2002).
Intent is usually incorporated into definitions of aggression and violence; however, the nature of forensic psychiatric populations makes intent difficult to gauge. Although intent is an essential aspect in some definitions of violence and aggression, mental disorders make intent difficult to determine. Therefore, more behavioral definitions of violence and aggression are appropriate (Eichelman & Hartwig, 1990).

### 2.4 Mental disorders, Executive Dysfunction, and Criminality

The presence of a mental disorder complicates the relationship between executive dysfunction and criminality. Research has found executive dysfunction is common amongst individuals suffering from a variety of mental disorders which often occur in forensic psychiatric patients (Howard et al., 2013; van Dongen, et al., 2014; Dingfelder, 2004), including substance use disorders (Baler & Volkow, 2006), depression (Tavares et al., 2007), obsessive compulsive disorder (Penades et al., 2007), and, importantly, schizophrenia and related disorders (Barch, 2005). In individuals with schizophrenia, large cognitive impairments of 1-2 SDs below control groups have been noted across a broad range of cognitive areas (Heinrichs & Zakzanis, 1998). Additionally, researchers have suggested that working memory deficits can cause some positive schizophrenia symptoms such as disorganized speech (Melinder & Barch, 2003). Therefore, executive dysfunction may be a key characteristic of forensic psychiatric patients.

The most common diagnosis in forensic psychiatric settings is schizophrenia. Because of this, virtually all forensic psychiatric patients are prescribed medication, most often antipsychotics, as part of the treatment regimen (Crocker et al., 2015; Barch, 2005). Antipsychotic medications have varying effects on cognition. First-generation antipsychotics have adverse effects on cognition, specifically working memory (Blyler & Gold, 2000), while there is some evidence that newer antipsychotic medications improve
cognitive functioning (Hill, Bishop, Palumbo, & Sweeney, 2010). On the other hand, individuals with schizophrenia who have taken medication and those who have never taken medication show similar levels of executive dysfunction (Barch, Carter, MacDonald, Braver, & Cohen, 2003; Saykin et al., 1994). Although executive dysfunction is the most well established factors of pervasive functional disability in individuals with schizophrenia (Hill et al. 2010), the effects of antipsychotics on cognition and the role of cognitive dysfunction in the development and maintenance of schizophrenia are difficult to determine. Medications can decrease executive dysfunction, but even amongst individuals taking antipsychotics, executive dysfunction is still related to aggression (Krakowski & Czobor, 2012). Since every patient in the current study is on numerous medications, and patients’ medications and medication doses change regularly, the effects of medication were not considered.

Individuals with schizophrenia are four times more likely to behave aggressively than individuals without schizophrenia, especially when experiencing positive psychotic symptoms (Angermeyer, 2000; McNiel, Eisner, & Binder 2000). The prevalence of mental disorders that are historically intractable (e.g., schizophrenia; Fatemi, 2010), comorbidity with substance use disorder (Howard et al., 2013), and lack of resources to provide forensic psychiatric patients individualized care (Dickens, Piccirillo, & Alderman, 2013; Nicholls, Brink, Greaves, Lussier, & Verdun-Jones, 2009) make it difficult for forensic psychiatric hospitals to fulfill their mandate of treating and transitioning individuals into the community (Bettridge & Barbaree, 2008). Having a better understanding of the factors that contribute to in-custody acts of aggression is essential to provide the basis for effective and efficient care in forensic psychiatric hospitals.
2.5 Current Study

Given the complicated relationship between mental disorders, criminality, and EF, research on executive dysfunction in a forensic psychiatric population is needed in order to have a better understanding of the underlying factors that contribute to violence and aggression in this population. Therefore, the goals of this study are: A) to determine whether executive dysfunction is postdictive of frequency and severity of offending, and B) to determine whether there are differences in EF for violent and nonviolent offenders.

This study is the first that we know of to look at how EF deficits relate to criminality in a forensic psychiatric population. Based on the state of the literature, the following hypotheses were made: A) Robust EF deficits have been found in criminal populations, therefore it was predicted that forensic psychiatric patients will be deficit in EF, B) All three components of EF appear to be important for appropriate social behavior. Therefore, it was hypothesized that all three components of EF will be related to violence and aggression in forensic psychiatric patients, and C) Executive dysfunction appears to be related to aggressive and violent behavior but not to nonaggressive antisocial behavior. Therefore, it is hypothesized that levels of executive dysfunction will be higher amongst violent and aggressive patients than nonviolent and nonaggressive patients.

Deficits in EF manifest in numerous ways, including difficulty planning and problem solving, distractibility, impulsivity, aggressiveness and poor judgment of behavioral consequences (Mesulam, 2002). Therefore, understanding how EF deficits contribute to criminal behavior is essential for determining risk and informing release decisions and rehabilitation programs.
2.6 Method

2.6.1 Participants

The sample for the present study consisted of 42 adult male forensic psychiatric patients from the Southwest Centre for Forensic Mental Health Care, a medium-security forensic psychiatric hospital in St. Thomas, Ontario. Inclusion criteria were: (a) normal or corrected-to-normal vision, (b) fluency in English, and (c) the capacity to consent. Patients could be withdrawn from the study for the following reasons: 1) if they became unable to provide informed consent; 2) if they became verbally or physically aggressive towards the examiner, other patients, or staff members at the time of data collection; or 3) if they are deemed a risk to themselves or others. No patients were withdrawn from the study due to these reasons.

Patients’ age ranged from 19.2–63.1 years old (M = 41.6, SD = 13.4). Thirty-three patients were White/Caucasian (78.6%), seven were Aboriginal/First Nations (16.7%), and two were Black (4.8%). The majority of patients were single/never married (78.6%); the rest were separated/divorced (21.4%). Patients completed between 5 to 16 years of education (M = 11.3; SD = 2.3). The majority of patients had no history of NCRMD designations (N = 33; 78.6%); seven patients had one previous NCRMD designation (16.7%); one patient had two previous designations (2.4%); and one patient had three previous designations (2.4%) Demographic information can be found in Table 2.1.

Patients’ developmental history can be found in Table 2.2. Eight patients had a history of childhood sexual trauma (19%), two had a history of physical trauma (4.8%), and five had a history of both sexual and physical trauma (11.9%). Five patients had a previous brain injury (11.9%), and four had childhood Attention Deficit Hyperactivity Disorder (9.5%).
The primary diagnoses were the following: schizophrenia (50%), other psychotic disorders (31%), bipolar and related disorders (14.3%), and autism spectrum disorder (4.8%). Most (90.5%) patients had comorbid disorders with 83.3% of individuals also having a comorbid substance use disorder. See Table 2.3 for patients’ psychiatric diagnoses.

Most patients (83.3%) also had a previous psychiatric hospitalization; number of previous hospitalizations ranged from 0–35 (M = 7.4; SD = 7.8). The mean age at the first offence was 22.8 (SD = 7.7). An index offence(s) is the illegal criminal action that results in the determination of NCRMD status. Patients had between 1–13 index offence charges (M = 3.3; SD = 2.5). Sample offending characteristics can be found in Table 2.4.
Table 2.1: Demographic Information.

<table>
<thead>
<tr>
<th>Demographic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
</tr>
<tr>
<td>White</td>
<td>33</td>
<td>78.6</td>
</tr>
<tr>
<td>Aboriginal</td>
<td>7</td>
<td>16.7</td>
</tr>
<tr>
<td>Black</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single/Never Married</td>
<td>33</td>
<td>78.6</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>9</td>
<td>21.4</td>
</tr>
<tr>
<td><strong>Educational Attainment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than High School</td>
<td>18</td>
<td>42.9</td>
</tr>
<tr>
<td>High School/GED</td>
<td>19</td>
<td>45.2</td>
</tr>
<tr>
<td>Vocational Diploma</td>
<td>3</td>
<td>7.1</td>
</tr>
<tr>
<td>Bachelors Degree</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Previous Not Criminally Responsible on</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Account of Mental Disorder Designations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>33</td>
<td>78.6</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>16.7</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2.4</td>
</tr>
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</table>
Table 2.2: Developmental History.

<table>
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<tr>
<th>Characteristic</th>
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<tr>
<td>History of Childhood Trauma</td>
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<td></td>
</tr>
<tr>
<td>Sexual</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>Physical</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Both</td>
<td>5</td>
<td>11.9</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>57.1</td>
</tr>
<tr>
<td>Unknown</td>
<td>3</td>
<td>7.1</td>
</tr>
<tr>
<td>Head Injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td>11.9</td>
</tr>
<tr>
<td>No</td>
<td>35</td>
<td>83.3</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Childhood Attention Deficit Hyperactivity Disorder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>9.5</td>
</tr>
<tr>
<td>No</td>
<td>34</td>
<td>80.9</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
<td>9.5</td>
</tr>
</tbody>
</table>
Table 2.3: Psychiatric Diagnoses.

<table>
<thead>
<tr>
<th>Primary Diagnosis</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizophrenia</td>
<td>21</td>
<td>50</td>
</tr>
<tr>
<td>Other Psychotic Disorders</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td>Bipolar and Related Disorders</td>
<td>6</td>
<td>14.3</td>
</tr>
<tr>
<td>Autism Spectrum Disorder</td>
<td>2</td>
<td>4.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comorbid Psychological Disorder</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4</td>
<td>9.5</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
<td>33.3</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>54.8</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Substance Abuse Disorder</td>
<td>35</td>
<td>83.3</td>
</tr>
<tr>
<td>Bipolar and Related Disorders</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Personality Disorders</td>
<td>17</td>
<td>40.5</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>21.4</td>
</tr>
</tbody>
</table>
Table 2.4: Offending Characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>M</th>
<th>(SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of First Offence</td>
<td>22.8</td>
<td>(7.7)</td>
<td>13–44</td>
</tr>
<tr>
<td>Years Since Not Criminally Responsible on Account of Mental Disorder</td>
<td>6.1</td>
<td>(5.3)</td>
<td>0.3–20.4</td>
</tr>
<tr>
<td>Designation for Index Offence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Index Offences</td>
<td>3.3</td>
<td>(2.5)</td>
<td>1-13</td>
</tr>
<tr>
<td>Number of Previous Hospitalizations</td>
<td>7.4</td>
<td>(7.8)</td>
<td>0-35</td>
</tr>
</tbody>
</table>

2.6.2 Materials

Delis-Kaplan Executive Function System (DKEFS). EF was assessed using the DKEFS (Delis, Kaplan, & Kramer, 2001). Due to time constraints, four out of nine subtests were administered. These subtests were chosen to be the most conceptually relevant to the three facets of EF (inhibition, shifting, and working memory). Using a subset of the nine DKEFS subtests does not affect the psychometric properties of the DKEFS, as each subtest is designed to stand alone (Baron, 2004). The DKEFS is considered to be one of the most comprehensive and psychometrically valid measures of EF (Baron, 2004; Homack, Lee, & Riccio, 2005). The four subtests used for the current study — Verbal Fluency, Color-Word Interference, Sorting, and Tower tests — tap into unique components of EF (i.e., inhibition, shifting, and working memory). Administration of the four DKEFS subtests took about 1-1.5 hours. Each of the four subtests will be described followed by a description of the scoring and psychometric properties of the DKEFS. Higher scores generally reflect better performance; however, scores closer to 10 reflect better performance for the Tower Test — Move Accuracy Ratio score.
**Color-Word Interference Test (CWIT).** The CWIT is an adaptation of the Stroop Test (Stroop, 1935) and consists of four conditions. The first two conditions require patients to name color blocks and read color words to establish a baseline for higher-level tasks. CWIT inhibition (condition 3) and CWIT inhibition/switching (condition 4) measure inhibition (Delis et al., 2001).

**Sorting Test (ST).** The ST assesses working memory and inhibition (Delis et al., 2001; Baron, 2004). The Sorting Test requires patients to sort six cards into two different groups, with three cards in each group as many times as they can. The groups have to be conceptually or perceptually similar in some way.

**Tower Test (TT).** The TT measures “planning, rule learning, and inhibition of impulsive and perseverative responding, and the ability to establish and maintain instructional set aspects of executive function,” which require working memory (Delis et al., 2001). The Tower Test was adapted from the Tower of Hanoi and Tower of London tests, in which patients make towers by moving five different shaped disks across three pegs.

**Verbal Fluency Test (VF).** The VF consists of the following three conditions: letter fluency, category fluency, and category switching. The letter fluency condition measures patients’ ability to generate words starting with a certain letter. The category fluency condition measures ability to retrieve lexical items. The category switching condition requires patients to say words that alternate between two semantic categories.

**DKEFS Psychometric Properties.** The DKEFS has a large normative sample of 1,750 individuals age 8 to 89 who are representative of the population of the United States (Delis et al., 2001; Baron, 2004). Each subtest offers between 6 and 34 interpretable scores, including primary measures, optional measures, and contrast
measures. The DKEFS offers primary and optional scores for each subtest; only the primary scores were considered in subsequent analyses.

Raw scores were converted to scaled scores (M = 10, SD = 3) based on age-based norms. The DKEFS manual provides internal consistency scores, which vary for each subtest: CWIT (.6–.9), ST (.6–.8), TT (.5–.8), and VF (.4–.9). Test-rest reliabilities, measured using data from 101 examinees, also varied from $r = .8$ (VF – Letter Fluency) to $r = .6$ (CWIT — Shifting Condition; Delis et al., 2001). Evidence of convergent validity with other well-known neuropsychological tests of EF is well established (e.g., Wisconsin Card Sorting Task; Delis et al., 2001; Homack et al., 2005).

**Kaufman Brief Intelligence Test, Second Edition (KBIT-2).** Intelligence was measured using the KBIT-2 (Kaufman & Kaufman, 2004), which provides three scores: a verbal, a nonverbal, and a composite score. The KBIT-2 takes about 30 minutes to administer. The KBIT-2 has a large normative sample of 2,120 individuals age 4 to 90 who were representative of the population of the United States (Kaufman & Kaufman, 2004). The internal consistency (split-half reliability) for the Verbal Score (.86 to .96), Nonverbal Score (.78–.93), and composite IQ (.89–.96) are moderate to high (Kaufman & Kaufman, 2004). The KBIT-2 has good construct validity, correlating moderately to highly on well-established measures of intelligence and academic achievement (e.g., Weschler Intelligence scale, Achievement tests; Kaufman & Kaufman, 2004).

**2.6.3 File Review**

The first six months after patients’ NCRMD designations were coded for aggressive and nonaggressive in-custody incidents; this time point was chosen in order to look at in-custody aggression at a consistent time point in patients’ stay in the hospital. There were no differences between aggression in the first and last three months of coding.
Therefore, it was determined that patients were relatively stable over time and that their level of aggression is consistent.

For each patient the following information was recorded: number of previous charges and convictions (violent and nonviolent were coded separately), number of previous psychiatric hospitalizations, age of first offence, psychiatric diagnoses, and the index offence(s). History of childhood trauma and brain injury were recorded as noted in patient files. See Appendix 3 for a full data collection form.

**Coding Index Offence.** Index offences were coded as violent or nonviolent. Violent index offences were further coded according to Cornell’s (1996) 7-point scale of violence (see Table 2.5): 1 (no assault/verbally assaultive; e.g., threatened with a weapon); 2 (assault without injury; e.g., slap, push); 3 (minor injury; e.g., bruises, scrapes); 4 (serious injury requiring substantial hospital treatment; e.g., broken limb, sexual assault); 5 (severe injury resulting in lasting impairment or life-threatening injury; e.g. stab wounds, coma); 6 (homicide); and 7 (extreme homicide; e.g., multiple homicide; homicide involving mutilation). Some patients committed multiple index offences; only the most severe offence was coded, as is suggested by previous research (e.g., Hancock et al., 2010).
Table 2.5: Index Offences.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonviolent</td>
<td>14</td>
<td>33.3</td>
</tr>
<tr>
<td>No assault/verbally assaultive</td>
<td>8</td>
<td>19.0</td>
</tr>
<tr>
<td>Assault without injury</td>
<td>7</td>
<td>16.7</td>
</tr>
<tr>
<td>Minor injury</td>
<td>4</td>
<td>9.5</td>
</tr>
<tr>
<td>Serious injury requiring substantial hospital treatment</td>
<td>4</td>
<td>9.5</td>
</tr>
<tr>
<td>Severe injury</td>
<td>4</td>
<td>9.5</td>
</tr>
<tr>
<td>Homicide</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Extreme homicide</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Coding In-Custody Aggression and Rule Infractions.** In-custody aggressive incidents were coded as: verbally aggressive, physically aggressive against others, physically aggressive against objects, or self-aggression, according to the Overt Aggression Scale-Modified (OAS-M). The OAS-M was developed by Coccaro, Harvey, Kupsaw-Lawrence, Herbert, & Bernstein (1991) for psychiatric patients as an adaptation of the Overt Aggression Scale (OAS) by Yudofsky et al. (1996). All in-custody rule infractions (e.g., rule breaking behaviors) were also recorded. Inter-rater reliability was measured using the intraclass correlation (ICC) for coding of in-custody aggressive and in-custody rule infractions. Two research assistants coded the in-custody aggressive and in-custody rule infractions. ICCs were calculated using the two-way random effects model for single measures (ICC₁) and average measures (ICC₂). The ICC₁ and ICC₂ were .96 and .98, respectively, which are considered excellent according to Cicchetti and
Sparrow’s (1981) guidelines. The OAS has been adapted to fit many different settings and needs, all with acceptable levels of reliability and validity (Cohen et al., 2010). The reliability of the OAS-M has been previously established (intraclass correlation coefficient ≥ 0.91; Coccaro et al., 1991; Coccaro & Kavoussi, 1997).

2.6.4 Procedure

Patients deemed NCRMD were approached for recruitment. A list of patients who had the ability to consent was given to researchers by the lead social worker at the hospital. A hospital psychologist determined which individuals would be a good fit for participation; this was determined by whether the individual was stable at the time of the study. The patient was provided with a copy of letter of information and consent (Appendix 4), and any questions or clarifications were dealt with. The patients were told that participation was voluntary and that participation would not influence review board decisions. After obtaining consent, an appointment for the 1.5–2 hour testing session was scheduled. Patients were given the option to break up testing time if they wished. Thirty-five patients completed their testing within one session; seven patients completed testing over two sessions.

Administration of the DKEFS and KBIT-2 was counterbalanced; additionally, all subtests were counterbalanced to prevent order effects. The individuals who completed the test administration also conducted the file review (i.e., the primary author and one research assistant). File reviews were conducted after completion of the test battery and all tests were scored after completing file review in order to prevent any experimenter bias and minimize any potential effects of experimenter knowledge of patients’ EF and intelligence scores.
The current study was approved by a full board Western Research Ethics Board Review (Appendix 1) and by Lawson Health Research Institute, a research body that oversees research conducted at St. Joseph’s Health Care, including the Southwest Centre for Forensic Mental Health Care (Appendix 2).

2.6.5 Construction of DKEFS component scores

The achievement scores in each subtest can be used as separate measures of fundamental cognitive skills that address certain domains of EF (Delis et al., 2001). CWIT — Inhibition and CWIT — Inhibition/witching conditions measure inhibition (Delis et al., 2001). Furthermore, an aggregated CWIT — Inhibition and CWIT — Inhibition/witching conditions score has been used previously as an inhibition component score (see Hancock, 2010 for the process of determining the DKEFS inhibition score). The VF — Switching Accuracy score was specifically designed to measure cognitive switching (Delis et al., 2001). Therefore, the switching accuracy component was used to measure cognitive switching. The TT requires numerous higher-order abilities, including planning, reasoning, etc. (Delis et al., 2001). Importantly, working memory is essential for these higher-order abilities. Various tower tests — Tower of Hanoi, Tower of London, and DKEFS Tower Tests — have also been used as a measure of working memory (e.g., Chan, Wan, Cao, & Chen, 2010; Delis et al., 2001; Gilhooly, Wynn, Phillips, Logie, & Della Sala, 2002; Goela, Pullara, & Grafman, 2001). Chan et al. (2010) found that working memory accounted for 23.5% of the variance on the Tower of Hanoi task. Therefore, this subscale score will be used as the working memory component of EF. The scores used in the current study to tap into the three components of EF (Miyake et al., 2000) are based solidly in theory. See Table 2.6 for an outline of the scores used.
Table 2.6: List of Component Scores.

<table>
<thead>
<tr>
<th>DKEFS component scores</th>
<th>Variable name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibition</td>
<td>Color-Word Interference Test – Inhibition</td>
</tr>
<tr>
<td></td>
<td>Color-Word Interference Test — Inhibition/Switching</td>
</tr>
<tr>
<td>Shifting</td>
<td>Verbal Fluency – Shifting Accuracy</td>
</tr>
<tr>
<td>Working Memory</td>
<td>Tower Test – Achievement Score</td>
</tr>
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</table>

2.7 Data Analyses

The outcome variables were frequency and severity of in-custody aggression (as measured by the OAS-M), in-custody rule infractions, previous violent convictions, and index offence violence. Count data present a challenge to forensic researchers (Ives, 2015) and numerous data analyses have been recommended to account for overdispersed count data. Ives (2015) suggests that a simpler analysis is preferred, when possible. As recommended, count data were log-transformed and ordinary least-squares linear models applied (e.g., Sokal & Rohlf, 1995; Zar, 1999; Crawley, 2003; see Ives, 2015 for a full review). In order to determine whether transformed count data are an appropriate approximation of a linear model, the necessary diagnostics were performed. The data passed the six assumptions required for conducting linear regression (see Casson & Farmer, 2014 for a full review). Therefore, an ordinary least squares multiple regression was used.
See Table 2.7 for a description of how DKEFS subtests are scored. Descriptive statistics are presented in standardized form (M = 10; SD = 3), when available. Subsequent analyses use z-scores based on the sample mean and standard deviation of raw data for the predictors and log-transformed outcome variables.

In order to determine the unique contribution patients’ EF has on violence and aggression, intelligence and years since NCRMD status need to be considered. EF appears to be an overlapping (e.g., Luciano et al., 2001; Carpenter, Just, & Shell, 1990; Miyake et al., 2000), but separate construct (e.g., Damasio, 1994; Sternberg, 1988) from intelligence. In terms of years since NCRMD status, yearly review board decisions to determine whether forensic psychiatric patients receive discharge reflect patients’ behavior (e.g., violent or aggressive acts and in-custody rule infractions), severity of index offence, and criminal histories (Crocker, Nicholls, Charette, & Seto, 2014). Therefore, composite intelligence score and years since NCRMD (i.e., years in custody) were entered in the first two blocks of the regression.

Three hierarchical multiple regressions were conducted with total aggression, number of violent convictions, and in-custody rule infractions as the dependent variables. Variables were entered in three blocks: (1) IQ (2) years since NCRMD (3) three EF factor scores. The proportion of variance accounted for by each set of variables is reported.

A sequential binary logistic analysis was also conducted. Previous research has categorized participants as violent or nonviolent. Rippon (2000) suggests violence is narrowed to acts of aggression that are more heinous in nature and result in physical harm. Therefore, only index offences that are scored 2 and above on Cornell’s 7-point scale of index severity (see Table 2.5 in Methods) were considered violent, excluding verbal aggression from the violent category. Due to the small sample size and lack of
range of violent index offence types, index offences were collapsed to a binary index
offence rating (i.e., violent and nonviolent).

Researchers suggest that effect size should also be considered in addition to
statistical significance, particularly with a small sample size (e.g., Glass, McGaw, &
Smith, 1981). There is no general rule to determine whether an effect size is large enough
to have clinical implications (Roberts & Ferguson, 2009). In fact, Gorard (1997) suggest
that if the cost-benefit is beneficial enough, then an effect size of 0.1 may be large.
Different cut-offs for determining minimum effect sizes have been suggested, including $r$
= .1 (Cohen, 1992), $r = .2$ (Lipsey, 1998), and .3 (Hinkle, Wiersma, & Jurs, 1988);
however, cutoffs should be guidelines and not applied rigidly (Roberts & Ferguson,
2009). In order to capture the range of clinically significant relationships, a $r = .1$ effect
size was used as an anchor of practical significance in the current study.

A large body of researchers suggest that effect sizes are necessary for all primary
outcomes (e.g., Wilkinson, 1999; Alhija & Levy, 2009; Dunst & Hamby, 2012; Fritz,
Morris, & Richler, 2012; Odgaard & Fowler, 2010) and that small effect sizes can be
extremely impactful for important outcomes (Trusty, Thompson, & Petrocelli, 2004). In
regression analyses, $R^2$ is a commonly used measure of effect size (French & Maller,
2007; Gomez-Benito, Hidalgo, & Padilla, 2009; Hidalgo & Lopez-Pina, 2004; Jodoin &
Gierl, 2001; Zumbo & Thomas, 1997). $\Delta R^2$ is a measure of quantifying the difference
between the $R^2$ value of the null model and the $R^2$ value of subsequent models.
Consequently, $\Delta R^2$ is a measure of effect size of the total model (Fidalgo, Alavi, &
Amirian, 2014).

Furthermore, a small sample size likely affected our ability to detect a true effect
size. A post-hoc power analysis (Faul, Erdfelder, Buchner, & Lang, 2009) for the
relationships between EF and violence and aggression \((d = .3)\) estimated the study power to be 0.51. An a priori power analysis suggested a sample size of 82 would be needed to have 80% power to detect an effect of the magnitude observed in the current study. Because of this, the discussion is focused on effect sizes rather than statistical significance.
Table 2.7: Variable Scoring.

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Scoring Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color-Word Interference Test</td>
<td>Four conditions present a list of colors, color words, and color words printed in different color ink</td>
</tr>
<tr>
<td>CWIT — Inhibition</td>
<td>The time it takes to read a list of words saying only the color of ink that the color word is printed in</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching</td>
<td>The time it takes to read a list of words saying the color of ink that the color word is printed in or reading the color word if it is in a box</td>
</tr>
<tr>
<td>Sorting Test</td>
<td>Sort 6 cards into 2 groups with 3 cards in each group that are the perceptually or semantically similar</td>
</tr>
<tr>
<td>ST — Correct Sorts</td>
<td>Number of correct sorts</td>
</tr>
<tr>
<td>ST — Description Score</td>
<td>0 = incorrect description; 1 = conceptually correct; 2 = conceptually and specifically correct</td>
</tr>
<tr>
<td>Tower Test</td>
<td>Assemble 9 different towers of increasing difficulty moving 5 disks across 3 pegs</td>
</tr>
<tr>
<td>TT — Achievement Score</td>
<td>Score 1–3 points depending on the number of moves required to complete the task; 0=incorrect tower</td>
</tr>
<tr>
<td>TT — Movement Accuracy Ratio</td>
<td>The number of total moves divided by the number of minimum moves required</td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td>In 60 seconds, say as many words as possible</td>
</tr>
<tr>
<td>VF — Letter Fluency</td>
<td>Number of words that start with a specific letter</td>
</tr>
<tr>
<td>VF — Category Fluency</td>
<td>Number of words in a specific category</td>
</tr>
<tr>
<td>VF — Category Switching</td>
<td>Number of words in two specific categories (switching back and forth between categories)</td>
</tr>
<tr>
<td>VF — Switching Accuracy</td>
<td>Number of correct switches between two specific categories</td>
</tr>
</tbody>
</table>

2.8 Results

2.8.1 Preliminary Analyses

Missing data. The data set had three missing data points: one patient had an unspecified number of previous hospitalizations; one patient had an unspecified number of previous charges and “numerous” previous violent offences; and one patient did not
complete the ST (discontinued testing). Sample means were used for each of the missing data points. Since fewer than 5% of data are missing in a random pattern, no serious problem is posed and any procedures for handling missing data yield similar results (Tabachnick & Fidell, 2007).

**Outliers.** No univariate outliers for outcome or predictor variables were identified by a standard score of above 3.29.

Multivariate outliers were examined using Cook’s $D$ statistics, which determine the influence an observation exerts on the regression coefficient (Tabachnick & Fidell, 2007). Cook’s $D$ was calculated from a regression containing $z$-score component scores from the DKEFS and outcome variables as predictors and the participant identification numbers as the dependent variable. Any score above 1.00 is considered an outlier (Tabachnick & Fidell, 2007); no outliers were found.

**Normality.** Predictors and outcome variables were examined for significant skewness or kurtosis. The following scores differed significantly from normal: CWIT — Inhibition, CWIT — Inhibition/Switching, number of in-custody rule infractions, number of previous violent offences, and OAS-M total. These variables were transformed according to Tabachnick and Fidell’s (2007) guidelines.

**Medications.** Given the potential of medications to interfere with executive cognitive performance, medication data were coded for a random sample of 10 patients’ medications. Since the sample is necessarily medicated and because patients’ medications change regularly (weekly in some cases), excluding patients due to medication intake and accounting for medication effects were unfeasible. See Appendix 5 for a sample list of medication.
2.8.2 Descriptive Statistics

Of the 42 patients, 61.9% had a history of at least one violent conviction. A criminal charge and a guilty verdict are necessary for a conviction; therefore, this rate excludes any NCRMD dispositions, including the index offence. Patients’ OAS-M scores ranged from 0–195 (M = 12.2; SD = 34.4). Patients had an average of 3.6 in-custody rule infractions (SD = 6.3). Patients had an average of 1.7 previous violent convictions (SD = 2.2). In terms of index offence rating, 47.6% had a violence index offence and 52.4% had a nonviolent index offence. See Table 2.8 for a description of the outcome variables. Table 2.9 presents KBIT-2 scores and Table 2.10 presents the DKEFS subscale scores.

Table 2.8: Means, Standard Deviations, and Ranges of Outcome Variables.

<table>
<thead>
<tr>
<th>Chart Review</th>
<th>M (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>chart review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-Custody Aggression Score¹</td>
<td>12.2 (34.4)</td>
<td>0–195</td>
</tr>
<tr>
<td>In-Custody Rule Infractions</td>
<td>3.6 (6.3)</td>
<td>0–34</td>
</tr>
<tr>
<td>Number of Violent Convictions</td>
<td>1.7 (2.2)</td>
<td>0–8</td>
</tr>
<tr>
<td>Index Offence Rating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Violent</td>
<td>20 (47.6%)</td>
<td></td>
</tr>
<tr>
<td>Nonviolent</td>
<td>22 (52.4%)</td>
<td></td>
</tr>
</tbody>
</table>

¹In-custody aggression score is measured by the Overt Aggression Scale–Modified
Table 2.9: Means, Standard Deviations, and Ranges of KBIT-2 Scores.

<table>
<thead>
<tr>
<th>KBIT-2 scales</th>
<th>M (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>86.2 (10.9)</td>
<td>51–115</td>
</tr>
<tr>
<td>Nonverbal</td>
<td>86.0 (20.5)</td>
<td>40–125</td>
</tr>
<tr>
<td>Total</td>
<td>85.0 (15.0)</td>
<td>54–116</td>
</tr>
</tbody>
</table>

*Note.* KBIT-2 scores have a mean of 100 and a standard deviation of 15.
Table 2.10: Means, Standard Deviations, Ranges, and Percentile Ranks of DKEFS Scores.

<table>
<thead>
<tr>
<th>DKEFS subscales</th>
<th>Standard Scores</th>
<th>Percentile Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)     Range</td>
<td>M (SD)     Range</td>
</tr>
<tr>
<td>Color Word Interference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition</td>
<td>6.4 (3.8)      1–14</td>
<td>24.6 (25.3)     0.1–90.9</td>
</tr>
<tr>
<td>Inhibition/Switching</td>
<td>6.6 (3.8)      1–13</td>
<td>25.6 (24.8)     0.1–84.1</td>
</tr>
<tr>
<td>Sorting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct Sorts</td>
<td>9.0 (3.5)      1–16</td>
<td>41.1 (30.5)     0.1–97.7</td>
</tr>
<tr>
<td>Description Score</td>
<td>8.0 (3.8)      2–16</td>
<td>32.3 (31.7)     1.4–97.7</td>
</tr>
<tr>
<td>Tower Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achievement Score</td>
<td>9.1 (3.0)      1–15</td>
<td>40.0 (28.9)     0.1–95.2</td>
</tr>
<tr>
<td>Move Accuracy</td>
<td>9.7 (2.7)      4–14</td>
<td>47.4 (28.4)     2.3–90.9</td>
</tr>
<tr>
<td>Ratio²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Letter Fluency</td>
<td>7.1 (3.1)      1–14</td>
<td>24.9 (23.9)     0.1–90.9</td>
</tr>
<tr>
<td>Category Fluency</td>
<td>8.0 (3.3)      1–16</td>
<td>32.8 (27.0)     0.1–97.7</td>
</tr>
<tr>
<td>Category Switching</td>
<td>6.6 (3.4)      1–14</td>
<td>21.0 (21.9)     0.1–63.1</td>
</tr>
<tr>
<td>Switching Accuracy</td>
<td>6.8 (3.3)      1–12</td>
<td>24.1 (24.4)     0.1–74.8</td>
</tr>
</tbody>
</table>

*Note.* Standard score mean is 10 and standard deviation is 3.

²Higher scores generally indicate better performance; however, scores closer to 10 on the Move Accuracy Ratio indicate better performance.
2.8.3 Preliminary Analysis

As described above, we had expected certain scores to correspond to certain components of EF. To determine if these scores appeared to be tapping similar constructs, we examined the correlations amongst DKEFS scores (Table 2.11). CWIT–Inhibition and CWIT–Inhibition/Shifting are significantly correlated ($r = .65, p < .01$); these scores are aggregated to make up an overall inhibition score. Significant negative correlations were found between VF–Switching Accuracy and CWIT–Inhibition ($r = -.44$) and CWIT–Inhibition/Shifting ($r = -.42$). VF–Switching Accuracy and TT–Total Achievement were also significantly correlated ($r = .41$); these scores were used to measure switching and working memory, respectively.

Table 2.11: Correlations among DKEFS scores.

<table>
<thead>
<tr>
<th></th>
<th>CWIT–Inhibition</th>
<th>CWIT–Inhibition/Shifting</th>
<th>VF–Switching Accuracy</th>
<th>TT–Achievement Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWIT–Inhibition</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWIT–Inhibition/Shifting</td>
<td>.65**</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF–Switching Accuracy</td>
<td>-.44**</td>
<td>-.42**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TT–Achievement Score</td>
<td>-.25</td>
<td>-.22</td>
<td>.41**</td>
<td>–</td>
</tr>
</tbody>
</table>

*Note.* *p < .05, two-tailed. **p < 0.01, two-tailed.

CWIT = Color Word Interference Test; VF = Verbal Fluency; TT = Tower Test
2.8.4 Correlation Among Predictor and Outcome Variables

Pearson’s zero-order correlations of the predictor and outcome variables are presented in Table 2.12. There are important relationships between the outcome and predictor variables.

Poorer inhibition ($r = -.11$), shifting ($r = -.10$), and working memory ($r = -.23$) are correlated with having perpetrated a violent index offence. Furthermore, as working memory decreases ($r = -.13$) and shifting increases ($r = .14$), in-custody aggressive scores increase. In-custody rule infractions are negatively related to inhibition ($r = -.19$) and positively related to shifting ($r = .18$). A higher number of previous violent convictions is related to higher patients’ inhibition ($r = .20$) scores. Furthermore, inhibition is positively correlated ($r = .21$) with years since NCRMD. Intelligence scores are negatively correlated with inhibition scores ($r = -.25$) and positively correlated with shifting ($r = .16$) and working memory scores ($r = .28$).

Table 2.12: Correlation Coefficients Between Predictor and Outcome Variables.

<table>
<thead>
<tr>
<th></th>
<th>In-Custody Aggression</th>
<th>In-custody Rule Infractions</th>
<th>Previous Violent Convictions</th>
<th>Index Offence Rating</th>
<th>Years Since NCRMD</th>
<th>Composite IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibition</td>
<td>.00</td>
<td>-.19</td>
<td>.20</td>
<td>-.11</td>
<td>.21</td>
<td>-.25</td>
</tr>
<tr>
<td>Shifting</td>
<td>.14</td>
<td>.18</td>
<td>-.07</td>
<td>-.10</td>
<td>.01</td>
<td>.16</td>
</tr>
<tr>
<td>Working Memory</td>
<td>-.13</td>
<td>-.04</td>
<td>-.09</td>
<td>-.23</td>
<td>-.09</td>
<td>.28</td>
</tr>
</tbody>
</table>

*For index offence rating, 0 = nonviolent; 1 = violent*
2.8.5 Executive Dysfunction and Abnormality

Since the base rates of the standardized DKEFS sample exhibiting j or more abnormally low scores has not been provided (Crawford, Garthwaite, Sutherland, & Borland, 2011), a Monte Carlo method is used to determine these rates, which is strongly determined by the magnitude of correlations between scores. Therefore, a Monte Carlo method was used to determine the proportion of the forensic psychiatric patients who exhibited a profile with a combination of scores that are 2 SDs lower than the general population (see Crawford, Garthwaite, and Gault [2007], who developed this method for a full procedure about how base rates were calculated). This method has been used to determine j or more abnormally low scores on the Weschler Adult Intelligence Test-III, the Wechsler Intelligence Scale for Children-IV, and other batteries (e.g., Crawford, Allum, & Kinion, 2008; Crawford, Anderson, Rankin, & Mac-Donald, 2010; Brooks & Iverson, 2010; Schretlen et al., 2008). A 2 SD cutoff is used to determine clinically significant deficits and abnormal EF profiles, since this cutoff better distinguishes clinical populations from nonclinical populations (e.g., Goldman et al., 2013; Gualtieri & Morgan, 2008). Ten patients (23.8%) exhibited a combination of EF scores 2 SDs below the normative population.

Additionally, Crawford et al. (2011) suggest a Mahalanobis distance index to determine the overall abnormality of individuals’ EF profile. This value is an estimate of the proportion of a normative sample that will exhibit a more abnormal combination of scores. Fifteen patients (35.7%) exhibited profiles 2 SDs more unusual than a normative population.
2.8.6 Regression Analyses Predicting Total Aggression, Violent Convictions, and Rule Infractions

**Total aggression.** The hierarchical linear regression model revealed that IQ, years since NCRMD verdict, and EF components were not significant predictors of total aggression scores (see Table 2.13); together these variables accounted for 3% of the variance.

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>t</th>
<th>sr²</th>
<th>ΔR²²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total IQ</td>
<td>-.04</td>
<td>-.20</td>
<td>.00</td>
<td>.01</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td>.00</td>
</tr>
<tr>
<td>Years Since NCRMD</td>
<td>.01</td>
<td>.05</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>Inhibition</td>
<td>.01</td>
<td>.06</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Shifting</td>
<td>.13</td>
<td>.67</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>-.17</td>
<td>-.94</td>
<td>.02</td>
<td></td>
</tr>
</tbody>
</table>

**Total Violent Convictions.** The hierarchical linear regression model revealed that EF components, IQ, and years since NCRMD verdict were not significant predictors of total violent convictions (see Table 2.14); they accounted for 14% of the variance.
Table 2.14: Summary of Hierarchical Regression Analysis for Variables Predicting Total Violent Convictions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>t</th>
<th>$r^2$</th>
<th>$\Delta R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>Total IQ</td>
<td>-.08</td>
<td>-.47</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td>.01</td>
</tr>
<tr>
<td>Years Since NCRMD</td>
<td>.12</td>
<td>.74</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td>.09</td>
</tr>
<tr>
<td>Inhibition</td>
<td>-.08</td>
<td>-.41</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Shifting</td>
<td>-.13</td>
<td>-.71</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>-.26</td>
<td>-1.49</td>
<td>.05</td>
<td></td>
</tr>
</tbody>
</table>

**In-Custody Rule Infractions.** The hierarchical linear regression model revealed that EF components, IQ, and years since NCRMD verdict were not significant predictors of in-custody rule infractions (see Table 2.15) and accounted for 10% of the variance.
Table 2.15: Summary of Hierarchical Regression Analysis for Variables Predicting In-Custody Rule Infractions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>t</th>
<th>sr²</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total IQ</td>
<td>.04</td>
<td>.22</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td>.02</td>
</tr>
<tr>
<td>Years Since NCRMD</td>
<td>.18</td>
<td>1.07</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td>.07</td>
</tr>
<tr>
<td>Inhibition</td>
<td>-.17</td>
<td>-.89</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Shifting</td>
<td>.15</td>
<td>.81</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>-.20</td>
<td>-1.10</td>
<td>.03</td>
<td></td>
</tr>
</tbody>
</table>

2.8.7 Post Hoc Analysis Index Offence Violence

Logistic Regression Violent or Nonviolent Index Offence. Previous convictions may not be the most appropriate method of determining the utility of EF in predicting and postdicting behavior since EF may change over time. Therefore, the most recent offence was used as an outcome variable. EF might be related to more temporally-related violent incidents. Furthermore, an institutional setting may limit the severity and frequency of aggressive incidents that may occur outside a custodial setting. Logistic regression statistics predicting a violent index offence are displayed in Table 2.16.

The logistic regression model using IQ was not statistically significant, and number of years since NCRMD did not add significantly to the model. The model explained 2% of the variance (Nagelkerke R²); the model with EF explained 22% of the variance (Nagelkerke R²). However, there were no statistically significant predictors.
Overall, 72.7% of the population were correctly classified as nonviolent and 60% were correctly classified as violent.

**Table 2.16: Logistic Regression Predicting Violent/Nonviolent Index Offence.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratios (95% CI)</th>
<th>Overall model fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total IQ</td>
<td>1.37 (.65, 2.88)</td>
<td>8.92</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years Since NCRMD</td>
<td>1.18 (.59, 2.36)</td>
<td>10.91</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibition</td>
<td>.41 (.15, 1.11)</td>
<td>6.15</td>
</tr>
<tr>
<td>Shifting</td>
<td>.66 (.28, 1.52)</td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>.54 (.24, 1.18)</td>
<td></td>
</tr>
</tbody>
</table>

*Notes.* The odds ratio is calculated using the formula, expotentiate\(^b\). Significance tests of each parameter are based on Wald \(\chi^2\). For index offence rating, 0 = nonviolent; 1 = violent

**Comparing EF Between Violent and Non-Violent Offenders.** An independent samples t-test was conducted to determine EF differences between those with a violent versus nonviolent index offence (see Table 2.17). No significant differences were found.
Table 2.17: Means, Standard Deviations and Ranges of Violent Versus Nonviolent Index Offences.

<table>
<thead>
<tr>
<th></th>
<th>Violent M (SD)</th>
<th>Nonviolent M (SD)</th>
<th>t</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibition^4</td>
<td>7.0 (2.7)</td>
<td>6.1 (3.6)</td>
<td>-1.6</td>
<td>-0.3</td>
</tr>
<tr>
<td>Shifting</td>
<td>6.5 (3.3)</td>
<td>7.0 (3.3)</td>
<td>-0.7</td>
<td>-0.2</td>
</tr>
<tr>
<td>Working Memory</td>
<td>8.8 (2.6)</td>
<td>9.4 (3.6)</td>
<td>-1.4</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

*Note. t = t-test; d = Cohen’s d.*

^4Equal variances not assumed

2.9 Discussion

2.9.1 Central Findings

This study investigated the relationship between violence and aggression and different components of EF amongst forensic psychiatric patients. Overall there was a relationship between some of the components of executive dysfunction and measures of violence and aggression. Higher in-custody aggression scores were related to poorer performance on working memory measures and higher performance on shifting measures. This is contrary to previous research that suggests offenders have severe deficits in shifting attention from one task to another (Bergvall, Wessely, Forsman, & Hansen, 2001). Deficits in shifting may result in a lack of ability to shift from socially unacceptable (e.g., violent and aggressive) behavior to more adaptive behavior. While there was no relationship between in-custody aggression and shifting scores, forensic psychiatric patients displayed poorer performance on shifting compared to the mean.

The relationship between working memory and in-custody aggression is in line with previous research that suggests working memory may be a key component to
aggression and violence (Séguin, Nagin, Assaad, & Tremblay, 2004). Importantly, both violent and nonviolent individuals who suffered from childhood trauma displayed reduced brain activity during working memory tasks compared to individuals who had not experienced childhood trauma (Raine et al., 2001). In the current study at least 35.7% of patients had experienced childhood trauma, which may adversely affect working memory scores (Raine et al., 2001) and other components of EF (Lee & Hoaken, 2007). Therefore, future research should determine the role of childhood trauma in executive dysfunction and violence and aggression.

EF did not significantly predict whether patients committed a violent or nonviolent index offence, and no differences in EF were found between patients with a history of violent versus nonviolent offenses. The present study was in line with previous research, which found no difference in EF between violent and nonviolent offenders (Fullam & Dolan, 2008; Greenfield & Valliant, 2007; Hoaken et al., 2007). On the other hand, Hancock et al. (2010) found that EF predicted offending for violent offenders but not for nonviolent offenders. These equivocal results are likely due to different criteria for determining violent and nonviolent offenders. For example, Fullam and Dolan (2008) — who found no EF differences for violent versus nonviolent offenders — defined violent patients as those who had committed one or more acts of “physical aggression to staff, in-patients or property” (p. 248) while in custody, whereas Hancock et al. (2010) defined violent patients as those who had at least one violent criminal offence. The current study distinguished patients by violent and nonviolent index offences; however, in-custody incidents and criminal histories were also considered.

Contrary to the hypothesis, higher inhibition scores were related to more previous violent convictions, which is inconsistent with previous research (Ogilvie et al., 2011;
Philipp-Wiegmann et al., 2011). There are two possible reasons for these differences. Firstly, this could reflect a true relationship between EF and criminal history; however, this seems unlikely given that disinhibition — and the related construct impulsivity — is characteristic of criminal offenders (e.g., Seager, 2005; James & Seager, 2006; Ogilvie et al., 2011; Philipp-Wiegmann et al., 2001) and individuals with mental disorders (see Kisa, Yildirim, & Göka, 2005 for a review). Second, a more compelling explanation is that EF in this study is not reflective of patients’ past EF. For example, one patient’s first offence was 42 years prior to EF testing; on average testing was 21.5 years after patients’ first offence. Furthermore, in-custody aggression scores were calculated during the first six months after patients were deemed NCRMD, which was on average 6.1 years prior to EF testing. Although postdictive designs are commonly utilized in forensics research, temporally-related comparisons are needed. There is evidence that EF is changeable, especially for individuals with schizophrenia (Wykes, Huddy, Cellard, McGurk, & Czobor, 2011). Specifically, inhibition can improve significantly in individuals with psychotic and related disorders following short-term cognitive remediation (Urben, Pihet, Jaugey, Halfon, & Holzer, 2012). In the current study, lower inhibition scores were related to longer time since NCRMD designation (i.e., time in-custody). Longer time in-custody should be related to longer time in rehabilitation programs and treatment regiments, including antipsychotic medication; thus, treatment may have a positive impact on EF (Hill et al., 2010).

2.9.2 Executive Functioning in the Prediction of Outcome Variables

EF did not significantly predict the outcome variables. EF predictors added negligible amounts of variance (0% to 5%) to the model. While a clear link between criminal behavior and executive dysfunction has been established (Morgan & Lilienfeld,
2000; Ogilvie et al., 2011), research looking at how EF predicts criminal behavior is lacking and overwhelmingly atheoretical. For example, Hancock et al. (2010) found that one score from the CWIT, one score on the ST, and two scores on the TT from the DKEFS significantly predicted aggression in a correctional population. However, since the DKEFS provides 6–34 scores on each subtest, it is unlikely that a single score will give insight into offenders’ EF. The DKEFS is a measure that attempts to describe a real-world construct. Deficits on the DKEFS are descriptive; however, a theory of EF is necessary in order to determine the utility of EF measures in predicting everyday deficits. Therefore, rather than determining individual scores that significantly predict violence and aggression, an a priori theoretical approach is essential. The current study took a theoretical approach to determining the relationship between criminal behavior and executive dysfunction by using Miyake et al.’s (2000) theory of EF to make a priori EF components using DKEFS scores. A theoretical approach is necessary to guide future research and determine how deficits on EF measures related to real-world functioning.

The presence or absence of criminal intent may also influence the relationship between executive dysfunction and crime. Determining intent for index offence and in-custody aggression in forensic psychiatric populations is virtually impossible to determine. Intent is a key feature that distinguishes forensic psychiatric patients from other criminal offenders — an NCRMD designation implies that intent was lacking. Previous research focuses overwhelmingly on offenders without mental disorders, commonly excluding individuals with mental disorders from participation in research. In line with this, the type of crime committed might be important to consider. Instrumental offenders who commit crime to obtain a goal and reactive offenders who commit crime in reaction to a perceived threat display unique profiles of executive dysfunction.
Future research should determine the nature of criminal behavior in criminal populations, which may distinguish the EF of forensic psychiatric patients from other criminal offenders.

2.9.3 Executive Functions of Forensic Psychiatric Patients Compared to Norms

Forensic psychiatric patients scored below the mean on the DKEFS and KBIT-2 and the majority had combined DKEFS scores that were significantly dysfunctional and profiles that were significantly different from normal. Overall, the executive dysfunction in forensic psychiatric patients is consistent with research that shows criminal populations display EF deficits (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011). The unique profiles of forensic psychiatric patients could be due to numerous reasons and account for the variability in EF scores. Scarpa and Raine (2007) suggest that neurocognitive deficits interact with a variety of psychosocial risk factors to increase risk of criminality. It may be that a combination of risk factors contribute to the development of executive dysfunction in this population; this includes mental disorder (e.g., Barch, 2005), criminal history (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011), medication (Blyler & Gold, 2000; Hill et al., 2010), presence or absence of a personality disorder (Fullam & Dolan, 2008), and previous treatment for improving daily functioning (Wykes, Huddy, Cellard, McGurk, & Czobor, 2011). Forensic psychiatric patients’ EF is likely due to a variety of factors, which complicates research in this area and may have influenced the results of this study.

The overall severity of psychopathology may be more indicative of EF impairments than the presence of a specific mental disorder (Stordal et al., 2005). Patients’ abnormal scores and variability in scores could be due to differing levels of
psychopathology severity. Working memory may be particularly prone to psychopathology severity; in individuals with genetic vulnerability to schizophrenia, working memory deficits help predict who will develop schizophrenia or a psychotic disorder variant (Cannon, Jones, & Murray, 2002). Additionally, working memory deficits precede positive schizophrenia symptoms like disorganized speech (Melinder & Barch, 2003). A longitudinal study is warranted to further explicate how these variables influence forensic psychiatric patients’ EF.

2.9.4 Construct Considerations

EF appears to have a clinically significant relationship with violence and aggression in forensic psychiatric patients. However, there are ecological and theoretical issues to consider. Researchers have noted concerns with the validity of the assessment of EF using traditional neuropsychological measures (Chan, Shum, Toulopoulou, & Chen, 2008). In response to this, researchers have attempted to implement more complex batteries of testing EF (e.g., Schwartz, Reed, Montgomery, Palmer, & Mayer, 1991) — for example, the DKEFS (Delis et al., 2001) — that attempt to isolate specific components of EF. However, the validity of measuring various EF elements depends on the ability to specify and conceptualize appropriate models of EF (Chan et al., 2008). Using a specific theoretical model of EF and a multifaceted battery is essential for a valid representation of EF. However, there is no “gold standard” for measuring EF and EF batteries like the DKEFS are increasingly in demand (Ogilvie et al., 2011). Therefore, the current study addresses these theoretical concerns by using a theoretical approach and an EF battery that taps into the different components of EF. Despite this, the DKEFS uses process scores and does not provide outcome scores of the difference factors of EF, which makes comparison across studies difficult.
2.9.5 Implications

This study makes unique contributions to the existing literature. First, cognitive dysfunction is one of the most well established causes of pervasive functional disability in individuals with schizophrenia and other related disorders (Hill et al., 2010). Importantly, specific attention needs to be paid to the unique needs of this population in order to fulfill the mandate of the forensic psychiatric system to rehabilitate and reintegrate offenders back into the community. A meta-analysis of cognitive remediation programs for schizophrenia show these programs are efficacious in improving EF (Wykes et al., 2011). Preliminary data show that cognitive remediation programs are also efficacious for patients with bipolar disorder (Deckersbach et al., 2010) and depression (Solé, Jiménez, Martinez-Aran, & Vieta, 2015). Given evidence for executive dysfunction in this population and that EF can be improved, rehabilitation programs should specifically target EF with an overall aim of increasing the quality of life and daily functioning of these patients (Ross & Hoaken, 2010).

Second, understanding the underlying factors that lead to criminality is essential in risk assessments and release decisions. Estimating the likelihood that someone will commit future crime is critical. Currently, EF measures are not used in, or validated for, risk assessment and release decisions. Risk assessments and release decisions are far from perfect and have room to improve (Crocker et al., 2014). Given the executive dysfunction displayed in criminal populations and the potential for EF to predict violence and aggression, further exploration about the utility of EF measures in predicting violence and aggression are warranted. EF measures are fairly straightforward to administer and use objective scores, which are potentially useful in risk and release decisions.
2.9.6 Limitations and Future Directions

There are four key limitations to the current study. First, the small sample size limited power. However, small sample sizes are common in this field of research due to difficulty accessing these populations and the low number of beds at most forensic psychiatric hospitals. This study should be replicated with a larger sample size.

Second, nurses’ notes were inconsistently reported. Notes were meant to be recorded in 1-hour intervals; however, this varied per patient. Patients who had good behavior were given more privileges and therefore spent more time away from direct observations.

Third, patients who agreed to participate may have been more highly functional than other patients and may not be representative of forensic psychiatric patients. Nevertheless, more than half of patients in custody deemed NCRMD participated in the study.

Fourth, although this study followed previous research that use postdictive designs (e.g., Hancock et al., 2010; Crocker et al., 2015), the temporal distance between testing time and criminal histories may have prevented the detection of a true relationship between EF and crime. Future research should determine in-custody incidents of violence and aggression in a time period that is around the time of testing EF.

2.9.7 Conclusion

This study was the first of its kind. Forensic psychiatric patients were characterized by abnormal EF profiles and pervasive EF deficits. Importantly, this research suggests that some components of EF are related to violence and aggression. EF was related to the nature of the index offence, suggesting EF may have utility in
postdiciting violent criminal offences. Despite limitations, this study has important implications and should be replicated and should bolster future research.
2.10 References


Chapter 3

Executive Dysfunction in Forensic Psychiatric and Correctional Populations

Erin J. Shumlich
3.1 Executive Dysfunction in Forensic Psychiatric and Correctional Populations

Crime is incredibly costly for society, the victim, and the perpetrator. The social and economic cost of criminal offences in Canada is estimated to be $31.4 billion per year (Department of Justice Canada, 2008). Furthermore, the economic burden of mental disorders in Canada — accounting for health care costs, disability, and reduced quality of life — is estimated to be over $5 billion annually (Mental Health Commission of Canada, 2012).

Depending on the nature of criminal activity, individuals who commit crime are diverted to either the correctional system or the forensic psychiatric system. Those who are found guilty of their criminal offence are placed in the correctional system, while those who commit crime under the influence of a severe mental disorder are placed in the forensic psychiatric system (Criminal Code of Canada, 1985). Understanding the unique factors that lead forensic psychiatric patients and correctional offenders to criminal behavior is essential in order to effectively rehabilitate offenders and create an overall safer society.

3.1.1 Factors Leading to Criminality

The factors that lead to criminality in forensic psychiatric and correctional offender populations may be similar. Firstly, the relationship between mental disorders and crime is highly contested. Skeem and colleagues (2006) found no temporal relationship between psychiatric symptoms and criminal behavior, with the exception of anger, in psychiatric patients identified to be at a high-risk for violence. In contrast, among those with mental disorders, age, socioeconomic status, and ethnicity contributed to a significant proportion of variance of violent and aggressive behaviors (Skeem et al., 2006). Genetic and socioeconomic factors, substance abuse, and a history of criminal
behavior have been consistently related to criminality (Cohen, Spodak, Silver, & Williams, 1988; Monahan et al., 2001; Quinsey, Harris, Rice, & Cormier, 1998). Although mental disorders per se have not been related to criminal behavior, recently, executive functioning (EF) deficits has been implicated as an important factor contributing to criminal behavior; executive dysfunction has also been shown to be a common amongst a number of psychiatric disorders (Baler & Volkow, 2006; Barch, 2005; Penades et al., 2007; Tavares et al., 2007).

### 3.1.2 Executive Functioning

The relationship between antisocial behaviors and both cognitive function and intelligence has received considerable attention in the past decade. Specifically, higher-order cognitive functions — or EF — have been implicated in criminal behavior (Morgan & Lilienfeld, 2000; Ogilvie Steward, Chan, & Shum, 2011) and are thought to be localized in the frontal lobe of the brain (Alvarez & Emory, 2006). EF is a commonly discussed construct but a consistent definition has yet to be demonstrated (Suchy, 2009).

Miyake et al. (2000) provide an operationally-defined and widely-used three-factor model of EF. Based on factor analysis, they suggest that EF is made up of (a) inhibition, (b) shifting, and (c) working memory. Inhibition is the ability to control automatic responses and engage in cognitive processes that are counterintuitive (Diamond, 2013; Miyake et al., 2000) and is essential for suppressing aggressive impulses. Shifting (also called cognitive shifting or switching) is the ability to take on numerous perspectives and switch back and forth between tasks (Garon, Bryson, & Smith, 2008). Deficits in shifting result in the inability to shift from inappropriate to appropriate behavior and therefore may escalate aggressive or violent behavior. Finally, working memory is holding and manipulating information that is no longer perceptually present (Baddeley & Hitch, 1994;
Smith & Jonides, 1999); deficits in working memory often manifest as difficulty regulating thought and behavior and difficulty with goal oriented behavior (Kane et al., 2007).

These three processes overlap and rely on each other. For example, inhibition and working memory rarely, if ever, occur alone; in order to incorporate new information in working memory, habitual responses need to be inhibited (Diamond, 2006). However, Miyake et al. (2000) found that these three factors were clearly distinguishable and produced a significantly better fit than a one- or two-factor model.

3.1.3 Executive Functioning and Criminal Behavior

Deficits in intelligence and EF have implications for criminal behavior. Groups that display antisocial behavior — both violent and nonviolent — receive lower intelligence scores (Heilbrun and Heilbrun, 1985; Henry & Moffitt, 1997). A contemporary shift in research focuses on the link between EF deficits and violence and criminality. A meta-analytic review by Morgan and Lilienfeld (2000) looked at 39 studies that used six different well-validated measures of EF. Overall, antisocial groups had poorer EF scores than control groups (d = .62). A more recent meta-analysis of 125 studies involving 14,786 patients found that antisocial groups displayed more executive dysfunction (d= .61) than control groups (Ogilvie et al., 2011). Of note, both meta-analyses controlled for age, sex, ethnicity, and intelligence.

EF deficits are not only characteristic of criminal offenders, but also may be related to different kinds of criminal offenders. A study of adult male offenders in a correctional facility found that offenders with deficits in certain measures related to two key elements of EF — inhibition and shifting — had higher rates of previous violent offending (Hancock, Tapscott, & Hoaken, 2010). Executive dysfunction was postdictive
of violent offending but not of nonviolent offending, which is consistent with previous research (Baker & Ireland, 2007; Barker et al., 2007; Miura, 2009). In contrast, several studies have shown no EF differences between violent and nonviolent offenders (Fullam & Dolan, 2008; Greenfield & Valliant, 2007). Given that executive dysfunction is common in both psychiatric and general criminal populations, the extent of executive dysfunction amongst forensic psychiatric patients and a comparison of executive dysfunction amongst criminal populations are worth examining.

3.1.4 Modifiability of Executive Functions

The modifiability of EF make EF deficits an appealing rehabilitative target in criminal settings. EF remediation programs have been used with success in a variety of different populations, including antisocial groups (Brunton & Hartley, 2013). Cognitive remediation programs have also shown significant improvement in EF for individuals with mental disorders (Wykes, Huggy, Cellard, McGurk, & Czobor, 2011; Deckersbach et al., 2010; Solé, Jiménez, Martinez-Aran, & Vieta, 2015) and therefore have potential utility in criminal settings. Additionally, EF remediation programs seem to work in numerous modalities, including short-term, long-term, computer-based, and skills-based programs (e.g., Deckersbach et al., 2010; Flavia, Stampatori, Zanotti, Parrinello, & Capra, 2010; Levine et al., 2011; Wykes et al., 2011). The evidence that suggests EF can be improved make EF an appealing target for rehabilitation; however, in order to target EF in criminal populations, a better understanding of the nature of dysfunction unique to different criminal populations is essential.
3.1.5 Mental Health Issues in Correctional Offenders and Comparisons with Forensic Psychiatric Patients

There has been a drastic increase in severe mental disorders in correction populations in the last decade. Since 1997, rates of federal offenders with severe mental health concerns have increased an estimated 70%; this may in part be due to deinstitutionalization without adequate resources for community-based services (Mental Health Commission of Canada, 2012). Deinstitutionalization, which started in the 1960s is the process of replacing mental health services from psychiatric institutions to community mental health services (Markowitz, 2006), which puts them at a greater risk for criminal victimization and criminal perpetration (Teplin, McClelland, Abram, & Weiner, 2006). As many as 15.6% of Canadian inmates suffer from a severe mental disorder (Corrado, Cohen, Hart, & Roesch, 2000). Additionally, those with severe mental disorders are at a substantially higher risk of being incarcerated multiple times (Baillargeon et al., 2009a), and are more likely to have parole revoked and to recidivate than offenders without a mental disorder (Baillargeon et al., 2009b; Porporino & Motiuk, 1995). There are up to three times as many individuals with mental disorders in the criminal justice system than in the general public in Canada (Olley, Nicholls, and Brink, 2009). Additionally, a report by the Office of the Correctional Investigator (Sapers, 2013) found that 14.5% of male offenders presented with mental health problems at admission in a federal correctional setting. Furthermore, while crime rates have been decreasing in the last decade (Statistics Canada, 2012), the number of offenders with mental disorders has almost doubled (Schneider, Forestall, & MacGarvie, 2001).

A key priority of the Correctional Service of Canada (2015) is to transition individuals into the community and address mental health needs of inmates. Despite this,
recidivism rates remain high (e.g., Fazel & Wolf, 2015). The Canadian criminal justice system has had varying focus on retribution and rehabilitation throughout history. Although many politicians support tough on crime policies (Geddes, 2009; Prime Minister of Canada, 2011), a retribution model has been empirically ineffective (e.g. Cook & Roesch, 2012; Smith, Goggin, & Gendreau, 2002; Stalhskopf, Males, & Macallier, 2010). In contrast to the correctional system in general, the forensic psychiatric system emphasizes rehabilitation. Interestingly, 33–44% of individuals who have served time in a Canadian federal correctional setting recidivate within the first year (Bonta & Andrews, 2003; Crocker et al., 2015; Villeneuve & Quinsey, 1995) compared to 7.5–10.3% of individuals in a forensic setting (Crocker, Seto, Nicholls, & Côté, 2013). This difference might relate to differences in the emphasis on rehabilitation in forensic psychiatric settings. While mental health is an issue in correctional settings, there is an emphasis on rehabilitation and treatment in forensic psychiatric settings. Importantly, understanding EF differences between these populations can inform rehabilitation programs in each setting.

3.1.6 Current Study

There is evidence to suggest that EF is modifiable. Given that deficits in EF are directly linked with criminal behavior, understanding the nature of EF deficits in criminal populations is essential. A direct comparison of EF in these two populations could provide a more in-depth understanding of the underlying factors that lead individuals in unique criminal populations to commit crime and a comparison could inform rehabilitation programs and risk and release decisions. The objectives for the current study are: A) examine EF differences between a forensic psychiatric population and a
correctional population; and B) compare EF of forensic psychiatric and correctional populations with a normative sample.

Executive dysfunction is characteristic of individuals with mental disorders and a clear link between executive dysfunction and crime has been established. Thus, forensic psychiatric and correctional populations are expected to have poorer EF than a normative population.

Given the current state of the literature, specific hypotheses cannot be made regarding the nature of EF differences between correctional and forensic populations.

3.2 Method

3.2.1 Participants

Participants for the current study were 42 adult male forensic psychiatric patients and 80 adult male correctional offenders from a previous study (Hancock et al., 2010). Both the forensic and correctional facilities are medium-security and located in southwestern Ontario. Participants were included in the sample if they had English proficiency, normal-to-corrected vision, and were able to consent to participate. Exclusion criteria for correctional offenders included the presence of a mental disorder. No participants were excluded due to these reasons.

Forensic psychiatric patients ranged in age from 19–63 years old (M = 41.6; standard deviation [SD] = 13.4). The majority of patients were White (78.6%), 16.7% were Aboriginal/First Nation, and the remaining 4.8% were Black. Average educational attainment was 11.3 years (SD = 2.3). The primary psychiatric diagnoses were schizophrenia and other psychotic disorders (81%), bipolar and related disorders (14.3%), and autism (4.8%).
Correctional offenders ranged in age from 19–57 (M = 33.4; SD = 9.2). The majority of offenders were White (58.8%); other offenders were Aboriginal (17.5%), Black (17.5%), Arab/West Asian (2.5%), Hispanic (1.3%), and other (2.5%). Average education attainment was 11.4 years (SD = 1.9).

The normed sample was based on information provided in the Delis-Kaplan Executive Function System (DKEFS) manual based on 1,750 individuals aged 8–89 sampled to be equivalent to the 2000 United States (US) census in terms of ethnicity and education (Delis, Kaplan, & Kramer, 2001). Educational attainment and ethnicity for the normative sample are averaged across the age categories relevant to the current sample (i.e., the educational attainment and ethnicities are only considered for those that fall within the specified age categories). Normed sample ethnicity and educational attainment categories are based on those provided by the DKEFS.

Table 3.18 presents the demographic characteristics of the current sample and of the DKEFS normative sample.
Table 3.18: Proportional Representation of Forensic, Correctional, and Normed Samples.

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Forensic n (%) (N=42)</th>
<th>Correctional n (%) (N=80)</th>
<th>Normative n or % (N=1,750)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16–19</td>
<td>1(2.4)</td>
<td>1(1.3)</td>
<td>175</td>
</tr>
<tr>
<td>20–29</td>
<td>10(23.8)</td>
<td>30(42.9)</td>
<td>175</td>
</tr>
<tr>
<td>30–39</td>
<td>10(23.8)</td>
<td>26(33.8)</td>
<td>150</td>
</tr>
<tr>
<td>40–49</td>
<td>7(16.7)</td>
<td>17(22.1)</td>
<td>100</td>
</tr>
<tr>
<td>50–59</td>
<td>7(16.7)</td>
<td>3(3.9)</td>
<td>100</td>
</tr>
<tr>
<td>60–69</td>
<td>7(16.7)</td>
<td>0</td>
<td>125</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 8 years</td>
<td>5(11.9)</td>
<td>4(5.2)</td>
<td>5.6%</td>
</tr>
<tr>
<td>9–11 years</td>
<td>12(28.6)</td>
<td>32(41.6)</td>
<td>9.2%</td>
</tr>
<tr>
<td>12 years</td>
<td>14(33.3)</td>
<td>24(31.2)</td>
<td>32.4%</td>
</tr>
<tr>
<td>13–15 years</td>
<td>9(21.4)</td>
<td>15(19.5)</td>
<td>27.8%</td>
</tr>
<tr>
<td>≥ 16 years</td>
<td>2(4.8)</td>
<td>2(2.6)</td>
<td>25.0%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2(4.8)</td>
<td>14(17.5)</td>
<td>12.2%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0</td>
<td>1(1.3)</td>
<td>11.2%</td>
</tr>
<tr>
<td>White</td>
<td>33(78.6)</td>
<td>47(58.8)</td>
<td>71.7%</td>
</tr>
<tr>
<td>Aboriginal/First Nation</td>
<td>0</td>
<td>2(2.5)</td>
<td></td>
</tr>
<tr>
<td>Arab/West Asian</td>
<td>7(16.7)</td>
<td>14(17.5)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>2(2.5)</td>
<td></td>
</tr>
</tbody>
</table>

*DKEFS norms did not report Aboriginal/First Nation or Arab/West Asian ethnicities

3.2.2 Materials

**Kaufman Brief Intelligence Test, Second Edition (KBIT-2).** Intelligence was measured using the KBIT-2, which takes about 30 minutes to administer. The KBIT-2
was normed on a sample of over 2,100 individuals aged 4 to 90 that were
demographically representative of the United States as a whole. Verbal, nonverbal, and
composite IQ scores are provided. The KBIT-2 has good psychometric properties. The
KBIT-2 has good internal consistency for the Verbal Score (.86 to .96), Nonverbal Score
(.78-.93), and Composite Score (.89–.96), and is moderately to highly correlated with
other well-established measures of intelligence and academic achievement (Kaufman &
Kaufman, 2004). Forensic psychiatric patients’ and correctional offenders’ scores are
based on norm comparisons, with a mean of 100 and a SD of 15.

**Delis-Kaplan Executive Function System (DKEFS).** EF was assessed using four
subtests from the DKEFS: Verbal Fluency, Color-Word Interference, Sorting, and Tower
tests. These tests were chosen because they measure the three facets of EF: inhibition,
shifting, and working memory. The DKEFS consists of nine subtests; however, each
subtest is designed to stand alone (Delis et al., 2001). Although inhibition, shifting, and
working memory rarely, if ever, occur alone and each measure likely taps into multiple
aspects of EF (Diamond, 2006; Miyake et al., 2000), the four subtests provide scores that
most heavily tap into specific components of EF.

The Color-Word Interference Test (CWIT) is an adaptation of the Stroop Test
(Stroop, 1935) and consists of two baseline conditions and two higher-order conditions.
The first two conditions assess color naming and reading of color words. The CWIT —
Inhibition condition (condition 3) requires inhibition of reading words in order to name
the corresponding ink color. The CWIT — Inhibition/Switching condition (condition 4)
requires participants to shift back and forth between reading words and reading the color
that the word is printed in (Delis et al., 2001). The CWIT — Inhibition and the CWIT —
Inhibition/Switching conditions have been used in previous research to measure inhibition.
Corrected and uncorrected errors, and contrast scores are also reported. An example of a contrast score is CWIT — Inhibition minus Color Naming, which measures inhibition condition score minus the color naming baseline condition. Overall, the CWIT subtest measures inhibition (Delis et al., 2001; Hancock et al., 2010; Hancock, 2014).

The Sorting Test (ST) measures numerous abilities, including initiation, conceptual flexibility, concept formation, and problem solving skills (Delis et al., 2001; Baron, 2004), which require inhibition and working memory (Delis et al., 2001). Participants are asked to sort two decks, each with six cards; participants sort six cards into two groups with three cards in each group. This test requires participants to sort cards into semantic and visual categories (i.e., correct sorts) requiring working memory and provide descriptions of the categories (i.e., description score), inhibiting inappropriate responses. The ST — Description Score requires participants to inhibit their automatic responses to respond in an appropriate way and therefore measures inhibition (Baron, 2004; Delis et al., 2001; Homack, Lee, & Riccio, 2005). The ST — Correct Sorts measures the number of correct sorts a participant makes, requiring participants to manipulate information to come up with new ways to sort cards, tapping into working memory (Delis et al., 2001).

Finally, the Tower Test (TT) requires participants to assemble different towers by moving five disks across three pegs. The Tower Test is an adaptation of the Towers of Hanoi and Towers of London and requires a variety of executive abilities, including planning, working memory, and initiation (Delis et al., 2001); these higher-level abilities require working memory. Various tower tests have been used as a measure of working memory, including the DKEFS Tower Test (Chan, Wan, Cao, & Chen, 2010; Delis et al.,
The TT — Achievement Score is an overall score and assesses working memory; the TT — Movement Accuracy Ratio compares the number of moves taken versus the total number of moves required, which is a measurement of inhibiting unnecessary moves.

The Verbal Fluency Test (VF) consists of three conditions — letter fluency, category fluency, and category switching — that measure the ability to generate category and letter words, and switch between two semantic categories (Delis et al., 2001). Repetition errors (i.e., repeating words) and set-loss errors (i.e., saying words unrelated to the task) were also recorded. The VF — Letter Fluency, VF — Category Fluency, and error scores measure participants’ working memory (Delis et al., 2001; Hancock, 2014; Hancock et al., 2010). The VF — Category Switching task, which includes VF — Switching Accuracy and VF — Percent Switching Accuracy, was specifically developed to measure cognitive shifting (Delis et al., 2001).

The DKEFS was normed using 1,750 people aged 8 to 89 years and matched on US demographic characteristics. Raw scores were transformed into age-adjusted standard scores with a mean of 10 and SD of 3. See Table 3.19 for a list of variables used in the current study and the constructs they measure.
Table 3.19: Variable Names and Construct Measured.

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Construct Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWIT — Inhibition</td>
<td>Inhibition</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching</td>
<td>Inhibition</td>
</tr>
<tr>
<td>CWIT — Inhibition minus Color Naming</td>
<td>Inhibition</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Combined Naming and Reading</td>
<td>Inhibition</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Inhibition</td>
<td>Inhibition</td>
</tr>
<tr>
<td>CWIT — Inhibition Errors</td>
<td>Inhibition</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching Errors</td>
<td>Inhibition</td>
</tr>
<tr>
<td>ST — Correct Sorts</td>
<td>Working Memory</td>
</tr>
<tr>
<td>ST — Description Score</td>
<td>Inhibition</td>
</tr>
<tr>
<td>TT — Achievement Score</td>
<td>Working Memory</td>
</tr>
<tr>
<td>TT — Movement Accuracy Ratio</td>
<td>Inhibition</td>
</tr>
<tr>
<td>VF — Letter Fluency</td>
<td>Working Memory</td>
</tr>
<tr>
<td>VF — Category Fluency</td>
<td>Working Memory</td>
</tr>
<tr>
<td>VF — Category Switching</td>
<td>Cognitive Shifting</td>
</tr>
<tr>
<td>VF — Switching Accuracy</td>
<td>Cognitive Shifting</td>
</tr>
<tr>
<td>VF — Set Loss Errors</td>
<td>Working Memory</td>
</tr>
<tr>
<td>VF — Repetition Errors</td>
<td>Working Memory</td>
</tr>
<tr>
<td>VF — Percent Switching Accuracy</td>
<td>Cognitive Shifting</td>
</tr>
<tr>
<td>VF — Percent Set Loss Errors</td>
<td>Working Memory</td>
</tr>
<tr>
<td>VF — Percent Repetition Errors</td>
<td>Working Memory</td>
</tr>
</tbody>
</table>

*Note.* CWIT = Color Word Interference Test; ST = Sorting Test; TT = Tower Test; VF = Verbal Fluency.

### 3.2.3 Procedure

Only procedures for the testing of forensic psychiatric sample are reported. For a full procedure of the correctional sample, see Hancock et al. (2010). A list of patients who
had the ability to consent and who were psychiatrically stable was given to research staff by an on-staff social worker. Research staff provided a verbal overview of the study and a copy of the letter of information to patients. The patient was provided with a copy of the letter of information and consent form (Appendix 4), and any questions were answered. Most patients completed testing within one session; seven completed testing over two sessions.

Administration of the DKEFS and the KBIT-2 took approximately 1.5–2 hours. Both tests and subtests were counterbalanced. Participants were explicitly told that participation was voluntary and that the results would not impact any future release decisions. No compensation was given for participation.

The current study was approved by a full board Western Research Ethics Board Review (Appendix 1) and by Lawson Health Research Institute, a research body that oversees research conducted at St. Joseph’s Health Care, including the Southwest Centre for Forensic Mental Health Care (Appendix 2).

3.3 Data Analyses

To examine group differences in EF between correctional offenders and forensic psychiatric patients, independent samples t-tests were conducted. In addition, the percentage of samples having clinically significant impairments in EF was examined. Different clinical cutoff scores are commonly used to determine cognitive deficits, including scores 1, 1.5, and 2 SDs below the normed mean on neuropsychological measures (e.g., Goldman et al., 2013). However, a 2 SD cutoff better differentiated cognitive impairments of individuals with mental disorders and a range of neurocognitive disorders compared to controls (e.g., Goldman et al., 2013; Gualtieri & Morgan, 2008); therefore, a 2 SD cutoff will be used. Pearson chi square (χ²) analyses were conducted to
determine differences between forensic and psychiatric offenders on proportions of individuals with clinically significant EF deficits. Nonparametric one-sample chi square analyses were conducted to determine if the proportion of forensic and correctional offenders 2 SDs below the mean significantly differ from the distribution of the normative population that fall 2 SDs below the mean (i.e., 2.5%). A false discovery rate was applied to each of the analyses and adjusted appropriately (Benjamini & Hochberg, 1995).

In terms of DKEFS scores, since some standard scores are restricted in range, raw scores are used when appropriate. Data are presented in standard score and standard scores are used for chi square comparisons; t-tests were conducted with raw scores. Higher scores generally reflect better performance. However, high and low contrast scores (i.e., CWIT — Inhibition minus Color Naming, CWIT — Inhibition/Switching minus Color Naming and Reading and CWIT — Inhibition/Switching minus Inhibition) and TT — Move Accuracy Ratio are indicative of deficit functioning; in other words, scores closer to 10 indicate better performance. See Table 3.20 for a list of how DKEFS variables are scored.
Table 3.20: Variable Scoring.

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Scoring Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color-Word Interference Test</td>
<td>Four conditions present a list of colors, color words, and color words printed in different color ink</td>
</tr>
<tr>
<td>CWIT — Inhibition</td>
<td>The time it takes to read a list of words saying only the color of ink that the color word is printed in</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching</td>
<td>The time it takes to read a list of words saying the color of ink that the color word is printed in or reading the color word if it is in a box</td>
</tr>
<tr>
<td>CWIT — Inhibition minus Color Naming</td>
<td>The time taken in the inhibition condition minus the time taken in the color naming condition</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Combined Naming and Reading</td>
<td>The time taken in the inhibition/switching condition minus the time taken in the color naming and color reading conditions</td>
</tr>
<tr>
<td>CWIT — Inhibition minus Inhibition</td>
<td>The time taken in the inhibition/switching condition minus the time taken in the inhibition condition</td>
</tr>
<tr>
<td>CWIT — Inhibition Errors</td>
<td>The number of corrected and uncorrected errors made in the inhibition condition</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching Errors</td>
<td>The number of corrected and uncorrected errors made in the inhibition/switching condition</td>
</tr>
<tr>
<td>Sorting Test</td>
<td>Sort 6 cards into 2 groups with 3 cards in each group that are the perceptually or semantically similar</td>
</tr>
<tr>
<td>ST — Correct Sorts</td>
<td>Number of correct sorts</td>
</tr>
<tr>
<td>ST — Description Score</td>
<td>0 = incorrect description; 1 = conceptually correct; 2 = conceptually and specifically correct</td>
</tr>
<tr>
<td>Tower Test</td>
<td>Assemble 9 different towers of increasing difficulty moving 5 disks across three pegs</td>
</tr>
<tr>
<td>TT — Achievement Score</td>
<td>Score 1–3 points depending on the number of moves required to complete the task; 0=incorrect tower</td>
</tr>
<tr>
<td>TT — Movement Accuracy Ratio</td>
<td>The number of total moves divided by the number of minimum moves required</td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td>In 60 seconds, say as many words as possible</td>
</tr>
<tr>
<td>VF — Letter Fluency</td>
<td>Number of words that start with a specific letter</td>
</tr>
<tr>
<td>VF — Category Fluency</td>
<td>Number of words in a specific category</td>
</tr>
<tr>
<td>Variable name</td>
<td>Scoring Method</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>VF — Category Switching</td>
<td>Number of words in two specific categories (switching back and forth between categories)</td>
</tr>
<tr>
<td>VF — Switching Accuracy</td>
<td>Number of correct switches between two specific categories</td>
</tr>
<tr>
<td>VF — Set Loss Errors</td>
<td>Number of incorrect words</td>
</tr>
<tr>
<td>VF — Repetition Errors</td>
<td>Number of repeated words</td>
</tr>
<tr>
<td>VF — Percent Switching Accuracy</td>
<td>Number of correct switches between two categories divided by the number of words in two specific categories</td>
</tr>
<tr>
<td>VF — Percent Set Loss Errors</td>
<td>Number of incorrect words divided by the total number of words</td>
</tr>
<tr>
<td>VF — Percent Repetition Errors</td>
<td>Number of repeated words divided by the total number of words</td>
</tr>
</tbody>
</table>

*Note.* CWIT = Color Word Interference Test; ST = Sorting Test; TT = Tower Test; VF = Verbal Fluency.

### 3.4 Results

#### 3.4.1 Preliminary Analyses

**Missing Data.** One data point was missing from the forensic psychiatric patient group data; therefore, a group mean substitution was utilized. Two offenders in the correctional sample did not complete certain subtests and therefore a group mean substitution was employed. Group substitution is thought to be appropriate for data with fewer than 5% of missing data in a random pattern (Tabachnick & Fidell, 2007).

**Outliers.** Data were screened for univariate outliers, looking at each group separately. Any standard score in excess of 3.29 ($p < .001$, two-tailed test) are potential outliers. Three scores in the forensic psychiatric sample and six in the correctional sample were identified as outliers. Because both sample sizes are relatively small, outliers have the potential to unduly influence the results (Aguinis, Gottfredson, & Joo, 2013).
Anguinis et al. (2013) suggest that respecifying the model is an appropriate approach to dealing with outliers that can unduly influence the results. Therefore, outliers that are an excess of 3.29 were re-coded to be exactly 3.29 SDs from the group mean.

**Normality.** An independent sample t-test requires normal distribution of the dependent variables within each group. DKEFS and KBIT-2 scores were tested for normality. The following scores were significantly kurtosis or skewed: VF — Set Loss Errors, VF — Category Fluency, VF — Category Switching, VF — Switching Accuracy, CWIT — Inhibition, and CWIT — Inhibition/Switching. Scores that were significantly skewed and kurtosis were transformed according to Tabachnick and Fidell’s (2007) guidelines.

**Demographic Differences.** Forensic psychiatric patients were significantly older in age (M = 41.6; SD = 13.4) than correctional offenders (M =33.4; SD = 9.2; t(56.7) = 3.8, *p* < .01). There was no difference on educational attainment (t(120) = -.7, ns). No differences on verbal IQ (t(120) = -1.8, ns) were found between forensic psychiatric patients (M = 86.1; SD = 11.3) and correctional offenders (M = 90.3; SD = 11.4); no differences on nonverbal IQ (t(78.2) = -2.0, ns) were found between forensic psychiatric patients (M = 86.3; SD = 20.9) and correctional offenders (M = 93.4; SD = 11.9). Forensic psychiatric patients had significantly lower total IQ scores (M = 85.2; SD = 15.4) than correctional offenders (M = 90.5; SD = 11.7; t(120) = -2.1, *p* < .05).

### 3.4.2 Independent Samples T-Tests

A series of independent samples t-tests were conducted to compare the forensic psychiatric and correctional populations; scores are presented in standard form and analyses were conducted using raw scores (See Table 3.21). Levene’s Test of Homogeneity of Variance was conducted to determine homogeneity of variance between
groups. Not using pooled variance and making degrees of freedom adjustment using the Welch-Satterthwaite method corrected scores that violated the assumption of homogeneity of variance.

Forensic psychiatric patients performed significantly more poorly than correctional offenders on 2 out of 9 measures of inhibition: CWIT — Inhibition ($t(49.2) = 4.4, p < .01$) and CWIT — Inhibition/Switching ($t(120) = 4.1, p < .01$). On the other hand, correctional offenders had significantly lower scores than forensic psychiatric patients on 1 out of 9 inhibition measures: the TT — Move Accuracy Ratio ($t(120) = -2.1, p < .05$).

In terms of cognitive shifting, forensic psychiatric patients performed significantly more poorly on 2 out of 3 measures: VF — Category Switching ($t(120) = -4.5, p < .01$) and VF — Switching Accuracy ($t(120) = -3.5, p < .01$).

In terms of working memory scores, forensic psychiatric patients performed significantly more poorly than correctional offenders on the 3 out of 8 measures: TT — Achievement Score ($t(59.1) = -2.2, p < .05$), VF — Letter Fluency ($t(120) = -3.1, p < .01$) and VF — Category Fluency ($t(120) = -3.4, p < .01$).
Table 3.21: Differences Between Forensic Psychiatric Patients and Correctional Offenders on DKEFS Scores.

<table>
<thead>
<tr>
<th></th>
<th>Forensic Psychiatric M (SD) Range</th>
<th>Correctional M (SD) Range</th>
<th>t</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhibition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWIT — Inhibition</td>
<td>6.5 (3.9) 1–14</td>
<td>9.0 (3.1) 2–14</td>
<td>4.4**</td>
<td>1.3</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching</td>
<td>6.9 (3.9) 1–14</td>
<td>8.7 (3.2) 1–15</td>
<td>4.1**</td>
<td>0.8</td>
</tr>
<tr>
<td>CWIT — Inhibition minus Color Naming1</td>
<td>10.4 (2.4) 4–16</td>
<td>9.7 (3.3) 1–19</td>
<td>1.2</td>
<td>0.2</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Color Naming and Reading1</td>
<td>9.8 (3.3) 1–16</td>
<td>9.1 (3.0) 3–16</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Inhibition1</td>
<td>10.4 (4.7) 1–19</td>
<td>9.6 (3.6) 1–19</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>CWIT — Inhibition Errors</td>
<td>7.4 (3.9) 1–12</td>
<td>7.5 (3.8) 1–12</td>
<td>-0.2</td>
<td>0</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching Errors</td>
<td>8.3 (2.9) 1–12</td>
<td>8.5 (3.1) 1–12</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>TT — Move Accuracy Ratio1</td>
<td>9.8 (2.6) 4–14</td>
<td>8.8 (2.6) 1–13</td>
<td>-2.1*</td>
<td>-0.4</td>
</tr>
<tr>
<td>ST — Description Score</td>
<td>8.1 (3.8) 2–16</td>
<td>7.4 (2.8) 1–13</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Shifting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Category Switching</td>
<td>7.0 (3.2) 1–16</td>
<td>9.3 (3.0) 2–15</td>
<td>-4.5**</td>
<td>-0.8</td>
</tr>
<tr>
<td>VF — Switching Accuracy</td>
<td>7.1 (3.1) 1–12</td>
<td>9.1 (3.0) 1–15</td>
<td>-3.5**</td>
<td>-0.7</td>
</tr>
<tr>
<td></td>
<td>Forensic Psychiatric</td>
<td>Correctional</td>
<td>$t$</td>
<td>$d$</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------</td>
<td>--------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Percent Switching</td>
<td>9.3 (3.6)</td>
<td>9.3 (3.0)</td>
<td>-0.3</td>
<td>-0.1</td>
</tr>
<tr>
<td>Accuracy</td>
<td>1–12</td>
<td>1–12</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Working Memory</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST — Correct Sorts</td>
<td>9.1 (3.5)</td>
<td>8.0 (2.9)</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>1–16</td>
<td>1–14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TT — Achievement Score</td>
<td>9.1 (4.0)</td>
<td>10.2 (2.1)</td>
<td>-2.2*</td>
<td>-0.6</td>
</tr>
<tr>
<td></td>
<td>1–15</td>
<td>7–15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Letter Fluency</td>
<td>7.4 (3.0)</td>
<td>9.2 (3.5)</td>
<td>-3.1**</td>
<td>-0.6</td>
</tr>
<tr>
<td></td>
<td>1–14</td>
<td>2–17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Category Fluency</td>
<td>8.3 (3.1)</td>
<td>10.3 (3.3)</td>
<td>-3.4**</td>
<td>-0.6</td>
</tr>
<tr>
<td></td>
<td>1–16</td>
<td>1–19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Set Loss Errors</td>
<td>9.8 (2.4)</td>
<td>10.2 (3.1)</td>
<td>1.5</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>3–13</td>
<td>1–13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Repetition Errors</td>
<td>9.7 (2.2)</td>
<td>9.0 (2.9)</td>
<td>-0.3</td>
<td>-0.1</td>
</tr>
<tr>
<td></td>
<td>3–13</td>
<td>1–12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Percent Set Loss Errors</td>
<td>8.6 (3.5)</td>
<td>9.7 (3.6)</td>
<td>1.9</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>1–13</td>
<td>1–13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Percent Repetition Errors</td>
<td>9.1 (2.8)</td>
<td>8.7 (3.7)</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>4–13</td>
<td>1–15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Notes. *$p < .05$, two-tailed. **$p < 0.01$, two-tailed. $t = t$-score; $d =$ Cohen’s $d$. *

CWIT = Color Word Interference Test; ST = Sorting Test; TT = Tower Test; VF = Verbal Fluency.

DKEFS standard scores have a mean of 10 and a standard deviation of 3. KBIT-2 scores have a mean of 100 and a standard deviation of 15.

1Higher scores generally indicate better performance; however, scores closer to 10 indicate better performance.
A series of independent t-tests were conducted to compare forensic psychiatric patients’ and correctional offenders’ performance on DKEFS scores that were broken down into component scores (See Figure 3.1). For a performance comparison on the components of EF, contrast scores and TT — Move Accuracy Ratio were excluded; only measures in which lower scores indicate poorer performance were included. Forensic psychiatric patients performed significantly more poorly (M = 7.5; SD = 9.0) than correctional offenders (M = 9.0; SD = 2.7) on shifting (t(120) = -2.7; p < .01). There were no differences in scores between forensic psychiatric patients (M = 7.3; SD = 2.5) and correctional offenders (M = 8.0; SD = 2.3) on inhibition (t(120) = -.4; ns), or between forensic psychiatric patients (M = 8.8; SD = 1.4) and correctional offenders (M = 9.2; SD = 2.0) on working memory (t(108.3) = -1.2; ns).
3.4.3 Clinically Significant Executive Functioning Impairment and Normative Sample Comparison

Table 3.22 presents the proportion of forensic psychiatric and correctional participants that perform 2 SDs below the mean.

Using a 2 SD cutoff for clinical significance, forensic psychiatric patients had a significantly higher proportion of deficits than correctional offenders in 2 out of 9 inhibition tasks (CWIT — Inhibition \( [\chi^2 = 10.4, p < .01] \); CWIT — Inhibition/Switching \( [\chi^2 = 6.1, p < .05] \)), 1 out of 3 cognitive shifting tasks (VF — Category Switching \( [\chi^2 = 9.7, p < .01] \)), and...
and 1 out of 8 working memory tasks (VF — Percent Repetition Errors [$\chi^2 = 6.5$, $p < .05$]).

The proportions of forensic psychiatric patients and correctional offenders scoring 2 SD below the mean are displayed in Figure 3.2.

**Forensic Psychiatric Patients Compared to the Norm.** A higher proportion of forensic psychiatric patients compared to the general population were 2 SDs below the mean in 7 out of 9 inhibition measures: CWIT — Inhibition ($\chi^2 = 190.1, p < .01$), CWIT — Inhibition/Switching ($\chi^2 = 139.5, p < .01$), CWIT — Inhibition/Switching minus Color Naming and Reading ($\chi^2 = 8.5, p < .01$), CWIT — Inhibition/Switching minus Inhibition ($\chi^2 = 139.5, p < .01$), CWIT — Inhibition Errors ($\chi^2 = 117.1, p < .01$), CWIT — Inhibition/Switching Errors ($\chi^2 = 23.9, p < .01$), and ST — Description Score ($\chi^2 = 78.2, p < .01$).

In terms of shifting, a higher proportion of forensic psychiatric patients compared to the general population were 2 SDs below the mean in all 3 shifting measures: VF — Category Switching ($\chi^2 = 117.1, p < .01$), VF — Switching Accuracy ($\chi^2 = 78.2, p < .01$), and VF — Percent Switching Accuracy ($\chi^2 = 23.9, p < .01$).

A higher percentage of forensic psychiatric patients scored 2 SDs below the mean compared to the general population in 4 out of 8 working memory measures: ST — Correct Sorts ($\chi^2 = 8.5, p < .01$), VF — Letter Fluency ($\chi^2 = 61.7, p < .01$), VF — Category Fluency ($\chi^2 = 47.2, p < .01$), and VF — Percent Set Loss Errors ($\chi^2 = 23.9, p < .01$).

**Correctional Offenders Compared to the Norm.** In terms of inhibition, a significantly higher proportion of correctional offenders scored 2 SDs below the mean compared to the general population in 8 out of 9 inhibition measures: CWIT — Inhibition
\( \chi^2 = 25.1, p < .01 \), CWIT — Inhibition/Switching \( \chi^2 = 32.8, p < .01 \), CWIT — Inhibition minus Color Naming \( \chi^2 = 18.5, p < .01 \), CWIT — Inhibition/Switching minus Color Naming and Reading \( \chi^2 = 18.5, p < .01 \), CWIT — Inhibition/Switching minus Inhibition \( \chi^2 = 51.3, p < .01 \), CWIT — Inhibition Errors \( \chi^2 = 185.1, p < .01 \), and CWIT — Inhibition/Switching Errors \( \chi^2 = 41.5, p < .01 \). ST — Description Score \( \chi^2 = 86.7, p < .01 \),

In terms of shifting, a significantly higher proportion of correctional offenders scored 2 SDs below the mean compared to a general population on 3 out of 3 measures: VF — Category Switching \( \chi^2 = 8.2, p < .01 \), VF — Switching Accuracy \( \chi^2 = 18.5, p < .01 \), and VF — Percent Switching Accuracy \( \chi^2 = 18.5, p < .01 \).

A significantly higher proportion of correctional offenders displaying deficits compared to the normed population on 6 out of 8 working memory measures: ST — Correct Sorts \( \chi^2 = 65.1, p < .01 \), VF — Letter Fluency \( \chi^2 = 32.8, p < .01 \), VF — Set Loss Errors \( \chi^2 = 18.5, p < .01 \), VF — Repetition Errors \( \chi = 25.1, p < .01 \), VF — Percent Set Loss Errors \( \chi^2 = 62.1, p < .01 \), and VF — Percent Repetition Errors \( \chi^2 = 86.7, p < .01 \).
Table 3.22: Percentage of Groups 2 Standard Deviations Below the Mean and Comparisons Between Groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>2 SD</th>
<th>Chi-Square (χ²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forensic %</td>
<td>Correctional %</td>
</tr>
<tr>
<td><strong>Inhibition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWIT — Inhibition</td>
<td>35.7</td>
<td>11.3</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching</td>
<td>31</td>
<td>12.5</td>
</tr>
<tr>
<td>CWIT — Inhibition minus Color Naming⁴</td>
<td>4.8</td>
<td>10</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Color Naming and Reading⁴</td>
<td>9.5</td>
<td>10</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching minus Inhibition⁴</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>CWIT — Inhibition Errors</td>
<td>28.6</td>
<td>26.3</td>
</tr>
<tr>
<td>CWIT — Inhibition/Switching Errors</td>
<td>14.3</td>
<td>13.8</td>
</tr>
<tr>
<td>TT — Move Accuracy Ratio⁴</td>
<td>2.4</td>
<td>5</td>
</tr>
<tr>
<td>ST — Description Score</td>
<td>23.8</td>
<td>18.8</td>
</tr>
<tr>
<td><strong>Shifting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VF — Category Switching</td>
<td>28.6</td>
<td>7.5</td>
</tr>
<tr>
<td>Variable</td>
<td>2 SD</td>
<td>Chi-Square (χ²)</td>
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<tr>
<td></td>
<td>Forensic %</td>
<td>Correctional %</td>
</tr>
<tr>
<td>VF — Switching Accuracy</td>
<td>23.8</td>
<td>10</td>
</tr>
<tr>
<td>VF — Percent Switching Accuracy</td>
<td>14.3</td>
<td>10</td>
</tr>
<tr>
<td><strong>Working Memory</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST — Correct Sorts</td>
<td>9.5</td>
<td>16.3</td>
</tr>
<tr>
<td>TT — Achievement Score</td>
<td>4.8</td>
<td>2.5</td>
</tr>
<tr>
<td>VF — Letter Fluency</td>
<td>21.4</td>
<td>12.5</td>
</tr>
<tr>
<td>VF — Category Fluency</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>VF — Set Loss Errors</td>
<td>7.1</td>
<td>10</td>
</tr>
<tr>
<td>VF — Repetition Errors</td>
<td>4.8</td>
<td>11.3</td>
</tr>
<tr>
<td>VF — Percent Set Loss Errors</td>
<td>14.3</td>
<td>16.3</td>
</tr>
<tr>
<td>VF — Percent Repetition Errors</td>
<td>2.4</td>
<td>18.8</td>
</tr>
</tbody>
</table>

*Notes. *p < .05, two-tailed. **p < 0.01, two-tailed.

*Note. CWIT = Color Word Interference Test; ST = Sorting Test; TT = Tower Test; VF = Verbal Fluency.

ᵃHigher scores generally indicate better performance; however, scores closer to 10 indicate better performance

ᵇNorm comparisons are based on the 2.5% of the population expected to fall 2 standard deviations below the mean
Figure 3.2: Percentage of Forensic Psychiatric Patients and Correctional Offenders Who Score 2 Standard Deviations Below the Mean.

Inhibition

Shifting

Working Memory

Variable Names
3.5 Discussion

Both forensic psychiatric patients and correctional offenders demonstrated a wide range of EF deficits compared to the normative population. Specifically, a significantly higher proportion of forensic psychiatric patients and correctional offenders performed 2 SDs below the mean compared to the normative population. This suggests that both criminal populations are characterized by executive dysfunction, which is consistent with previous research suggesting that criminal populations display significant executive dysfunction (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011). Forensic psychiatric patients display more severe deficits than correctional offenders in measures of inhibition, shifting, and working memory.

3.5.1 Inhibition

Forensic psychiatric patients performed more poorly overall on two CWIT tasks that measure inhibition (CWIT — Inhibition and CWIT — Inhibition/Switching) than correctional offenders and a higher number of forensic psychiatric patients had clinically significant impairment on these measures than correctional offenders. Severe deficits in inhibition are seen in individuals with schizophrenia — the most common mental disorder seen in forensic psychiatric patients (Crocker et al., 2013) — but not with other psychiatric disorders (Kohl, Heekeren, Klosterkötter, & Kuhn, 2013). More severe psychopathology is also related to more extensive EF deficits (Barch, 2005). Correctional offenders with mental disorders were excluded from participation. Therefore, in addition to criminality, general psychopathology is likely related to inhibition deficits in the forensic psychiatric population.

On the other hand, correctional offenders had significantly lower scores than forensic psychiatric patients on 1 out of 9 measures of inhibition (TT — Move Accuracy
Ratio); however, the proportion of both populations in the clinically significant range are not significantly different from each other and are not significantly different than what would be expected in the general population, suggesting that these populations do not display deficits in this measure. However, lower scores on TT — Move Accuracy Ratio are due to fewer number of moves compared to what is expected, suggesting that correctional offenders perform more poorly than forensic psychiatric patients on initiation, planning, and executing action (Delis et al., 2001).

Compared to the general population, a significantly higher proportion of forensic psychiatric patients and correctional offenders had clinically significant deficits on almost all measures of inhibition (i.e., 7 out of 9 measures for forensic psychiatric patients and 8 out of 9 measures for correctional offenders). For example, there were 33.2% (i.e., 35.7% vs. 2.5% for norms) more individuals from the forensic psychiatric sample and 8.8% more from the correctional offender sample that had clinically impaired (> 2 SDs) inhibition scores on the CWIT — Inhibition measures than would be expected in a normative sample. These results are consistent with previous research suggesting criminal populations display deficits on measures of inhibition (Seager, 2005; James & Seager, 2006; Ogilvie et al., 2011; Philipp-Wiegmann et al., 2001) and expand previous research by providing evidence for the extent and pervasiveness of clinically significant deficits in inhibition.

Deficits in inhibition may manifest as an inability to inhibit automatic or socially unacceptable responses to situations. Deficits in inhibition likely make complex social situation difficult, especially when these situations involve conflict (Broomhall, 2005).
3.5.2 Shifting

Overall, forensic psychiatric patients had lower scores than correctional offenders on 2 out of 3 shifting measures (VF — Category Switching and VF — Switching Accuracy); in line with this, forensic psychiatric patients’ overall shifting score was significantly lower than correctional offenders’ and a significantly higher proportion of forensic psychiatric patients fell within the clinically significant range (> 2 SDs) compared to correctional offenders. These results consistently show that forensic psychiatric patients are more deficit in shifting than correctional offenders. Individuals with schizophrenia (Ravizza, Moua, Long, & Carter, 2010) and a range of other mental disorders (e.g., major depressive disorder; Whitmer & Gotlib, 2012) display deficits in shifting task. Therefore the presence of severe mental disorders characteristic of forensic psychiatric populations — including the current sample — likely contribute to the more pervasive deficits in shifting in forensic psychiatric patients.

A higher proportion of forensic psychiatric patients and correctional offenders displayed clinically significant deficits compared to the normative population in all three measures of cognitive shifting (VF — Category Switching, VF — Switching Accuracy, and VF — Percent Switching Accuracy). For example, 26.1% (i.e., 28.6% vs. 2.5% for norms) more individuals from the forensic psychiatric sample and 5% more from the correctional offender sample had clinically impaired (> 2 SDs) scores on VF — Category Switching. These results suggest that a significant number of individuals in both populations have difficulty shifting attention from task to task, which has numerous functional consequences. Despite the severe deficits in shifting seen in both criminal populations in this study, there is a paucity of research looking at the relationship between shifting and criminal behavior and the research that does exist is overwhelmingly
atheoretical. For example, Hancock et al. (2010), who also used the DKEFS as a measure of EF, found that VF — Category Switching significantly predicted severity of violence in a sample of correctional offenders; however, results of the other scores related to cognitive shifting were not provided. A theoretical framework of EF can facilitate an accurate, specific, and sensitive assessment of all components of EF, including shifting. The results of the current study suggest that shifting is an important component of EF deficits in criminal populations and warrants future research.

Inability to shift relates to ruminative thinking (e.g. Whitmer & Gotlib 2012) and could result in the escalation of violent and aggressive behavior due to the inability to shift from an inappropriate behavior to appropriate behavior. The results of the current study provide a basis for future research looking at the role of shifting in criminal behavior.

3.5.3 Working Memory

Forensic psychiatric patients have significantly lower scores overall than correctional offenders on 3 out of 8 working memory measures: TT — Achievement Score, VF — Letter Fluency, and VF — Category Fluency. A higher proportion of forensic psychiatric patients had clinically significant impairments than correctional offenders on 1 out of 8 working memory measures: VF — Percent Repetition Errors. Working memory has been implicated in the development and maintenance of schizophrenia (Barch, 2005). Furthermore, antipsychotics, which are used to treat schizophrenia have been shown to negatively affect working memory (Blyler & Gold, 2000). Therefore, more severe working memory deficits in forensic psychiatric patients may be due to these factors.
On the ST — Correct Sorts measure of working memory, 7% (i.e., 9.5% vs. 2.5% for norms) more individuals from the forensic psychiatric sample and 13.8% more from the correctional offender sample had clinically impaired (> 2 SDs) performance compared to the normative sample. The DKEFS Sorting Task has been compared and used in conjunction with other card sorting tasks that tap into similar facets of EF, including the Wisconsin Card Sorting Test (Parmenter, Wienstock-Guttman, Garg, Munschauer, & Benedict, 2007). Our results are consistent with previous research suggesting that individuals with both a criminal history (Kalinian & Wisniewski, 2007) and mental disorder (Everett, Lavoie, Gagnon, & Gosselin, 2001; Goldberg, Weinberger, Berman, Plisan, & Podd, 1987; Gooding, Kwapil, & Tallent, 1999) perform more poorly on card sorting tasks.

Interestingly, the proportion of both offender populations in the clinical range on the TT — Achievement Score was not significantly different from the normed population. The relationship between the performance on tower tests — including the Tower of Hanoi and Tower of London, from which the DKEFS Tower Test was adapted (Delis et al., 2001) — and criminal populations is equivocal. These results are contrary to previous research showing criminal populations are deficit in different tower tests (e.g., Bagshaw, Gray, & Snowden, 2014), but similar to other studies that found individuals with high psychopathic tendencies score higher on computerized tower task measures (Salnaitis, Baker, Holland & Welsh, 2011). However, these results should be interpreted with caution since there is evidence to suggest that different tower tests tap into different components of EF and therefore may not be directly comparable (Larochette, Benn, & Harrison, 2009; Unterrainer, Rahm, Halsband, & Kaller, 2005). Therefore, in addition to assessing working memory, the TT — Achievement Score may also reflect other
concepts related to EF, including overall planning, perceptual skills, and matrix reasoning (Chan et al., 2010; Riccio, Wolfe, Romine, Davis, & Sullivan, 2004).

Significantly more forensic psychiatric patients and correctional offenders had clinical impairment in VF measures of working memory; forensic psychiatric patients were clinically impaired in 3 out of 6 and correctional offenders were clinically impaired in 5 out of 6 VF measures of working memory, in line with previous research that shows deficits in verbal fluency tasks in correctional offenders (Hancock, 2014).

3.5.4 Implications

Overall, these two criminal populations appear to have more executive dysfunction than the general populations in all components of EF. Further, forensic psychiatric patients were more impaired in EF than correctional offenders. In addition to showing executive dysfunction in two unique criminal populations, this research expands previous research (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011) by showing the proportion of two unique groups of criminal offenders with clinically significant executive dysfunction. Ogilvie et al. (2001) found that criminal groups display deficits between .55 to .69 SDs below the mean in neuropsychological measures of EF, in line with our results. In the first study to look at frontal lobe abnormalities in criminal populations, 56.9% of “habitually aggressive” offenders had electroencephalogram (EEG) abnormalities, compared to 11.8% of offenders who had committed only a single aggressive incident (Williams, 1969), and more recent research involving neuroimaging techniques (e.g., magnetic resonance imaging [MRI]) show that criminal offenders display reduction in prefrontal gray matter compared with controls (e.g., Raine et al., 2005). These results consistently show that offenders have overall EF impairment; however, tests of neuropsychological functioning focus on group means without
determining the proportion of individuals with clinically significant deficits. For example, on one inhibition measure in our study, 28.6% of forensic psychiatric patients and 26.3% of correctional offenders displayed clinically significant dysfunction. The pervasive executive dysfunction in these populations can provide justification for rehabilitation programs that specifically target improving EF.

Executive dysfunction has real-world consequences, since EF is essential for day-to-day living. For example, individuals with executive dysfunction may be unable to adapt to new situations and behave in appropriate ways. In general, executive dysfunction manifests in numerous ways, including socially inappropriate behavior, difficulty planning and problem solving, distractibility, impulsivity, aggressiveness, poor judgment of behavioral consequences, and poor memory of consequences (Mesulam, 2002; Rabinovici, Stephens, & Possin, 2015). It is clear to see how these functional consequences of executive dysfunction may lead to criminal behavior. Given the immense social and economic impact of crime, understanding the factors that contribute to violence and aggression in two unique criminal populations is essential in order to successfully rehabilitate and reintegrate offenders back into society.

This research has some important implications. Firstly, the goal of the forensic psychiatric system is to rehabilitate and reintegrate offenders back into society, thus EF difficulties may be particularly important to treat. By understanding the unique factors associated with crime, there is the potential to develop rehabilitation programs that specifically target the functional needs of offenders. Executive dysfunction is one of the leading causes of functional disability in individuals with schizophrenia (Hill, Bishop, Palumbo, & Sweeney, 2010) and other mental disorders (Murray, Iacoviello, Neumeister, Charney, Iosifescu, 2011; Broyd et al., 2009) and increasingly more criminal
offenders suffer from mental disorders (Schneider et al., 2001). Therefore, the need for rehabilitation programs that target offenders’ specific needs cannot be understated. EF has the potential to improve, particularly for individuals with mental disorders (Wykes et al., 2011; Deckersbach et al., 2010; Solé et al., 2015), which make EF an appealing treatment target. This research offers a basis for developing rehabilitation programs that specifically target the needs of different criminal populations.

Secondly, EF could be utilized in risk assessments. Predicting the likelihood that someone will engage in future criminal behavior is essential. Previous research suggests that certain patterns of EF deficits predicted which correctional offenders would recidivate (Seruca & Silva, 2015). Given the pervasive executive dysfunction displayed in two unique criminal populations and the functional consequences of executive dysfunction in everyday life, executive dysfunction likely contributes to criminal behavior. The current research provides fodder for future investigation into the role of executive dysfunction in violence and aggression, which may have implications in risk and release decisions. This research is the first that we know of to look at the important criminogenic risk factors in a forensic psychiatric population.

3.5.5 Limitations and Future Directions

This research is not without its limitations. Research in the areas of criminal populations and EF has a range of methodological issues, including poorly operationalized definitions of EF, violence, and aggression.

Small sample sizes are also common in forensics research, which likely affect the ability to detect true relationships between variables.

Neuropsychological measures of EF have been criticized for lacking ecological validity (Chan, Shum, Touloupolou, & Chen, 2008). Although the DKEFS and other
newer measures of EF have been developed to tap into various aspects of EF (e.g., Schwartz, Reed, Montgomery, Palmer, & Mayer, 1991), the ecological validity of newer measures of EF remains unclear. Performance-based tests demand relatively simple responses that may not be reflective of real-life events (Chan et al., 2008). Therefore, it is possible that someone could perform well on these tests, yet have difficulty performing higher-order functions in daily life that demand more cognitive resources. A limitation of using the DKEFS is the lack of component scores provided for different aspects of EF. While process scores — like those provided in the DKEFS — provide important information about different processes involved in executing EF, process scores do not provide information about overall EF. The current study determined which process scores provided information about the three components of EF (inhibition, cognitive shifting, and working memory); however, the process scores that make up these components should be validated in future research. Future research should focus on determining the ecological validity of these measures and use multiple measures of EF, including measures that look at everyday functioning of individuals with EF deficits to corroborate results.

The current study provides avenues for future research. Firstly, both forensic psychiatric patients and correctional offenders display a wide range of EF deficits. Given the evidence to suggest that EF can be improved, future research should determine the impact of EF rehabilitation programs that specifically target offenders’ unique needs.

Deficits in EF are characteristic of criminal offenders and individuals with severe mental disorders, particularly for those with more severe psychopathology. Given the significantly higher proportion of forensic psychiatric patients that have clinically significant EF deficits compared to correctional populations, it is likely that a
combination of these factors lead to more severe deficits. Future research should compare the forensic psychiatric population with a civil psychiatric population in order to determine unique executive dysfunction in individuals with mental disorders who commit crime.

3.5.6 Conclusions

This research is the first of its kind to look to compare criminogenic risk factors of forensic psychiatric patients and correctional offenders. Both offender populations were characterized by pervasive EF deficits, which have implications for everyday functioning and criminal behavior. Despite the above limitations, this research has important implications and warrants replication and future research looking at the role of EF in criminality. Given the immense social and economic impact of crime and mental disorders, understanding the unique factors that lead to criminal behavior in different criminal populations is essential for informing rehabilitation programs and risk and release decisions.
3.6 References


Clinical Psychology, 1, 321–53.


the Research and Statistics Division, Justice Canada, March 2013.


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Chapter 4

4.1 General Discussion

The purpose of these studies was to investigate the role of EF in criminal populations. Chapter 2 attempted to explicate the relationship between EF deficits and violence and aggression. Chapter 3 looked at EF deficits in two unique criminal populations. These results as they pertain to study objectives will briefly be summarized and a discussion of limitations, implications, and conclusions will follow.

4.2 Executive Functioning and Criminality

The first goal of the thesis was to explicate the relationship between EF and criminality in a forensic psychiatric population. We wanted to determine if EF was related to violence and aggression and, furthermore, if EF is a useful construct in predicting criminal offending. The results indicated that some components of EF are related to violence and aggression; however, our prediction models incorporating the three components of EF did not significantly predict violence, aggression, or in-custody rule infractions.

In terms of the correlation analyses, the results suggested that there may be an important relationship between EF and temporally-related measures of violence and aggression. Specifically, a poorer working memory score was related to higher in-custody aggression. A violent index offence was related to poorer performance on all three components of EF (inhibition, shifting, and working memory).

In terms of the regression analyses, EF did not significantly predict in-custody aggression, index offence type, patients’ violent criminal histories, or in-custody rule infractions. While EF deficits have been established in criminal populations (Ogilvie, Stewart, Chan, & Shum, 2011), research supporting the role that EF plays in predicting
violence and aggression is rare. More frequently cited are a list of factors that moderate the relationship between aggression and EF, including alcohol use (Giancola, 2004), anger/hostility (Sprague, Verona, Kalkhoff, & Kilmer, 2011), information-processing (Hoaken, Shaughnessy, & Pihl, 2003), brain injury (Weber, Ring, Jansari, & Edwards, 2010), childhood trauma (Raine et al., 2001), and psychopathology severity (Barch, 2005; Stordal et al., 2005). With the exception of alcohol use, which is limited in a controlled setting, the above listed factors likely influenced the results of the current study, such that EF did not significantly predict any of our outcome variables. Future research should consider how these factors moderate and mediate the relationship between EF and violence and aggression.

There is a lack of relationship between EF measures and violent criminal histories in both the correlation and regression analyses. Distinguishing violent and nonviolent offenders based on criminal histories, some research shows more severe EF deficits in violent offenders (Hancock, Tapscott, & Hoaken, 2010), whiles others found no EF differences between offenders (Greenfield & Valliant, 2007; Hoaken, Allaby, & Earle, 2007). EF measures may not be the most appropriate representation of EF throughout patients’ criminal histories, since EF has the potential to change over time, particularly in those with mental disorders through cognitive rehabilitation programs (Wykes, Huddy, Cellard, McGurk, & Czobor, 2011; Urben, Pihet, Jaugey, Halfon, & Holzer, 2012) or through medication regimens (Blyer & Gold, 2000; Hill, Bishop, Palumbo, & Sweeney, 2010).

Overall, the results provide some evidence that EF is related to violence and aggression and that future research is warranted. Longitudinal or accelerated multicohort
research may be important to determine how rehabilitation, medication, and other factors moderate or mediate the relationship between EF and criminality.

4.3 Executive Dysfunction in Criminal Populations

The second goal of this thesis was to determine the level of EF deficits experienced in forensic psychiatric and correctional criminal populations.

Firstly, Chapter 2 looked at the EF profiles of forensic psychiatric patients. The results showed that a large portion of forensic psychiatric patients exhibited combined EF profiles that were 2 SDs below what would be expected in the general population (23.8% at 2 SDs below the mean). The profiles of EF deficits are in line with previous research suggesting that criminal populations (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011) and civil psychiatric populations (Hill et al., 2010) display EF deficits. Interestingly, a large proportion of forensic psychiatric patients exhibited an EF profile more unusual than the general population (35.7% at 2 SDs more unusual). The abnormal profiles suggest that forensic psychiatric patients have abnormal patterns of EF deficits (e.g., display proficiency on certain subscales, but deficiency in others). Since certain subscales tap into different components of EF, the multifaceted nature of EF is important to consider. While inhibition, cognitive shifting, and working memory overlap (Miyake et al., 2000), these constructs are unique, suggesting that EF components are important to consider. Therefore, differentiating the specific constructs of EF is essential for researchers and may account for some of the variability in the forensic psychiatric patients’ EF scores.

Secondly, in Chapter 3, severe EF deficits were seen in both forensic psychiatric patients and correctional offenders, which is consistent with previous research (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011). Compared to the normative population, both...
criminal groups displayed a significantly higher proportion of individuals 2 SDs below the mean compared to a normed population in a range of DKEFS scores, including scores related to the inhibition, cognitive shifting, and working memory components of EF. Impairments in EF generally manifest as “socially inappropriate behavior, inability to plan and problem solve, distractibility, aggressiveness, impulsive behavior, poor judgment of behavioral consequences, and poor memory” (Mesulam, 2002, p. 1068), which have serious implications for criminal behavior.

Overall, the results suggest that both forensic psychiatric patients and correctional offenders display severe deficits in all components of EF.

4.4 Comparison of Executive Functioning in Forensic Psychiatric Patients and Criminal Offenders

The final goal of this thesis was to compare the EF of forensic psychiatric patients and criminal offenders. Forensic psychiatric patients exhibited significantly lower EF scores than correctional offenders in numerous areas. Forensic psychiatric patients scored lower on measures of inhibition (Delis et al., 2001). Inhibition is necessary to control automatic responses and engage in cognitive processes that are counterintuitive when needed (Diamond, 2006; Miyake et al., 2001). This suggests that forensic psychiatric patients have more difficulty in complex social situations, particularly in situations that may involve negative stimuli (Broomhall, 2005). There is evidence that inhibition can improve significantly with short-term cognitive rehabilitation programs in individuals with psychotic disorders (Urben et al., 2012).

Forensic psychiatric patients also displayed more severe EF deficits on measures related to shifting than correctional offenders. Deficits in cognitive shifting suggest that forensic psychiatric patients have difficulty shifting back and forth from numerous tasks...
(Whitmer & Gotlib, 2012), which may result in an escalation in aggressive or violent behavior. A wide range of mental disorders, including schizophrenia and other psychotic disorders (Ravizza, Moua, Long, & Carter, 2010) are related to deficits in shifting (Whitmer & Gotlib, 2012). Preliminary research shows that EF rehabilitation programs are effective, particularly for those with mental disorders (Wykes et al., 2011); therefore, severe shifting deficits in forensic psychiatric patients could inform rehabilitation programs to focus on specifically improving shifting.

Finally, forensic psychiatric patients had significantly lower scores than correctional offenders on tests related to working memory (e.g., Tower Test). Working memory impairments seem to be particularly characteristic of individuals with schizophrenia and other psychotic variants (Eisenberg & Berman, 2010; Raffard & Bayard, 2012) and therefore working memory is a particularly important potential focus of rehabilitation programs for forensic psychiatric patients.

Overall, these greater deficits in forensic psychiatric patients could be due to a few reasons. In addition to criminal behavior (Morgan & Lilienfeld, 2000; Ogilvie et al., 2011), numerous other factors that adversely affect EF are characteristic of forensic psychiatric patients, including mental disorder (e.g., Barch, 2005) and antipsychotic medication (Blyer & Gold, 2000). Likely, a culmination of these factors adversely impact forensic psychiatric patients’ EF. Additionally, factors like presence or absence of personality factors (Fullam & Dolan, 2008) and treatment history (Wykes et al., 2011) can affect EF and should be considered in future research.

4.5 Theoretical Considerations

The relationship between deficits on neuropsychological measures of EF and real-world EF tasks is complicated. Neuropsychological measures are necessarily designed to
tap into simple tasks that look at a particular aspect of EF, whereas real-world tasks that
involve EF are complex and involve numerous processes (Ogilvie et al., 2011). Therefore,
it is plausible that someone who does not display deficits in neuropsychological measures
may still encounter difficulty in day-to-day tasks that require complex executive control.
The lack of ecological validity of traditional neuropsychological measures has been
largely criticized (Goldstein, 1996; Sbordone, 1996). In response, complex batteries of
tests are being developed in order to assess all components of EF, like the DKEFS (Delis
et al., 2001; Ogilvie et al., 2011).

Further complicating things is the lack of ubiquitous definition of EF, which may
lead to atheoretical approaches in research. Most measures of EF were developed and
based on theoretical models of EF (Chan, Shum, Touloupiou, & Chen, 2008). Using a
theoretical framework to approaching EF research can facilitate an accurate, specific, and
sensitive assessment of EF. Research using the DKEFS often cites different component
scores (e.g., Hancock et al., 2010). Since each subtest of the DKEFS provides between 6
and 34 interpretable scores (Delis et al., 2001), researchers need to carefully consider
which components make up the construct of EF.

Additionally, EF research typically is concentrated in the experimental realm,
which has been heavily criticized (Chan et al., 2008). Although clinical populations
commonly display EF difficulties on neuropsychological measures, the manifestation of
these difficulties in real-world scenarios has not been acknowledged. This functionality
needs to be addressed, particularly when discussing rehabilitation and reintegration of
offender populations. Burgeoning research shows that EF remediation programs are
effective at improving EF (e.g., in mental disorders; Deckersbach et al., 2010; Solé et al.,
2015; Wykes et al., 2011). However, the outcomes of rehabilitation programs should not
be only measured by test score improvement, but by reduction in everyday difficulties related to EF.

The lack of a common definition of violence and aggression highlighted in this thesis may account for differences in the relationship between EF deficits and violence and aggression across the literature. Given the heterogeneity of offenders in both criminal populations, the etiology and psychosocial predictors of crime is difficult to determine in these populations. Furthermore, violence and aggression are typically considered in reference to intent. While intent may be easier to distinguish in a correctional population, the presence of a mental disorder in a forensic psychiatric population makes intent almost impossible to distinguish. Therefore, the definition of violence and aggression in the current studies were behavioral, which — while appropriate (Eichelman & Hartwig, 1990) — are different than the definitions used in some previous research. In order to account for the varying definitions of violence and aggression, the current study looked at violence and aggression in numerous contexts (i.e., historical violence, index offence, and in-custody aggression).

4.6 Limitations and Future Directions

Despite the potential of EF in determining violence and aggression in criminal populations, a few limitations need to be addressed.

Factors Influencing EF. Numerous factors may affect EF and the relationship between EF and violence and aggression in both criminal populations, including psychotropic medication (e.g., Blyler & Gold, 2000), age of first offence (Nieuwbeerta, 2001), personality disorders (Fullam & Dolan), and intelligence (Heilbrun & Heilbrun, 1985; Henry & Moffitt, 1997). Personality factors may be an important contributor to violence and aggression above mental disorder or neuropsychological function (Fullam &
Dolan, 2008). Furthermore, those higher in psychopathy have more profound EF dysfunction than non-psychopathic offenders (Hildebrand, De Ruiter & Nijman, 2004; Bagshaw, Gray, & Snowden, 2014). In the current study, we carefully determined two important covariates — years since NCRMD verdict and intelligence. Previous research suggests that EF is an overlapping (e.g., Luciano et al., 2001; Carpenter, Just, & Shell, 1990; Miyake et al., 2001), but separate construct (e.g., Ardila, Pineda, & Rosselli, 2000; Damasio, 1994) from intelligence. Yearly review board decisions to determine whether forensic psychiatric patients receive discharge reflects patients’ behavior (e.g., violent or aggressive acts and in-custody rule infractions), severity of index offence, and criminal histories (Crocker, Nicholls, Charette, & Seto, 2014). Therefore, the number of years patients spent in custody (years since NCRMD status) was considered in the current study; however, the results of the current study showed that neither intelligence or number of years since NCRMD significantly added to the prediction of our outcome variables. Future research looking at EF and criminality should carefully consider the above listed factors.

**Sample Size.** The small sample size of both forensic psychiatric patients and criminal offenders limited the ability to detect effects smaller than $d = .3$; however, small sample sizes are common in forensics research due to difficulty accessing these populations and the small sample size. Future research should replicate this study with larger sample sizes.

**Methodological Issues.** The generalizability of this study is limited by sample characteristics. This research pertains to two specific criminal populations and suggests EF characteristics differ between criminal populations. Therefore, these results may not generalize across criminal offenders. It is also possible that individuals who volunteered to participate in this study were unique in some way (e.g., less disordered, more
motivated) compared to those who did not volunteer, which may bias the sample and underestimate the true effect in both populations. Patients who did not volunteer or who were not eligible may have had lower EF and higher aggression and violence; therefore, the results of the current study may be weaker than what would be seen in forensic psychiatric patients as a whole.

Furthermore, since our sample consisted of only men, these results may not generalize to female criminal offenders. The little research that looked at EF in aggressive females found conflicting results. While some research found a relationship between EF and aggression (Daoust, Loper, Magaletta, & Diamond, 2006; Giancola, Mezzich, & Tarter, 1998), others found no relationship (Komarovskaya, Loper, & Wamen, 2007). Therefore, future research should examine sex differences in EF and aggression.

4.7 Implications

Currently, EF measures are not used or validated for risk assessment and release decisions. Risk assessments and release decisions are far from perfect and have room to improve (Crocker, Nicholls, Charette, & Seto, 2014). Given the EF deficits displayed in criminal populations and the potential for EF to predict violence and aggression, further exploration about the utility of EF in predicting violence and aggression is warranted. EF measures are easy to use and objective, which makes them potentially useful in risk and release decisions. EF improvement through rehabilitation programs can be used to inform risk and release decisions.

This research provides some evidence that EF is an important component of violence, aggression, and functional disability in criminal populations. An important next step would be to determine the utility of targeting EF in rehabilitation programs. There is evidence that rehabilitation programs effectively improve EF (e.g., Wykes et al., 2011;
Rath, Simon, Langenbahn, Sherr, & Diller, 2003; Worthington, 2005). These programs have the potential to be adapted and implemented in a criminal setting. It is possible that interventions targeting EF in forensic psychiatric populations could result in decreased recidivism and better integration into the community following discharge.

4.8 Conclusion

This research is novel and contributes to the existing literature in several ways. Firstly, Chapter 2 further explicated the relationship between the different aspects of EF and criminality in an understudied and often ignored population of criminal offenders. Secondly, both manuscripts (Chapters 2 and 3) demonstrated that forensic psychiatric patients and correctional offenders display severe EF deficits compared to normative groups, consistent with research that suggests EF deficits are ubiquitous across offender populations. Finally, this study uniquely had access to the EF scores of two different criminal populations, which allowed for a direct comparison between forensic psychiatric patients and correctional offenders. This comparison is useful to determine unique differences of EF functioning in two criminal populations. The results of this research suggest that there are important EF differences in criminal populations that need to be considered in future research.

Further, the results suggest that EF may be important in understanding the complex and multifaceted underlying factors that contribute to violence and aggression in criminal populations. Therefore, special attention needs to be paid to rehabilitating EF in order to reduce future offences and effectively transition individuals back into the community. Given the immense social and economic impact of violence and crime, understanding the factors that contribute to violence and crime is of the upmost importance.
4.9 References


Appendices

Appendix 1: HSREB Full Board Approval Notice

Western University Health Science Research Ethics Board
HSREB Full Board Initial Approval Notice

Principal Investigator: Prof. Peter Heiken
Department & Institution: Social Science/Psychology, Western University

HSREB File Number: 105761
Study Title: Examining the Relationship Between Executive Cognitive Functioning and Violence in a Forensic Psychiatric Patient Population
Sponsor:

HSREB Initial Approval Date: January 28, 2015
HSREB Expiry Date: January 27, 2016

Documents Approved and/or Received for Information:

<table>
<thead>
<tr>
<th>Document Name</th>
<th>Comments</th>
<th>Version Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collection Form/Case Report Form</td>
<td></td>
<td>2015/01/06</td>
</tr>
<tr>
<td>Letter of Information &amp; Consent</td>
<td></td>
<td>2014/11/06</td>
</tr>
<tr>
<td>Western University Protocol</td>
<td></td>
<td>2014/11/06</td>
</tr>
<tr>
<td>Instruments</td>
<td>Pearson Delis-Kaplan Executive Function System</td>
<td>2015/01/22</td>
</tr>
</tbody>
</table>

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing and submitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCP2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer to Contact for Further Information

This is an official document. Please retain the original in your files.
Appendix 2: Lawson Final Approval Notice

LAWSON FINAL APPROVAL NOTICE

LAWSON APPROVAL NUMBER:  R-15-051

PROJECT TITLE:  Examining the relationship between executive cognitive functioning and violence in a forensic psychiatric patient population

PRINCIPAL INVESTIGATOR:  Dr. Peter Hoaken

LAWSON APPROVAL DATE:  February 17, 2015

Health Sciences REB#:  105761

Please be advised that the above project was reviewed by the Clinical Research Impact Committee and Lawson Administration and the project:

Was Approved

Please provide your Lawson Approval Number (R#) to the appropriate contact(s) in supporting departments (eg. Lab Services, Diagnostic Imaging, etc.) to inform them that your study is starting. The Lawson Approval Number must be provided each time services are requested.

Dr. David Hill
V.P. Research
Lawson Health Research Institute

cc: Administration
Appendix 3: Data Collection Form
DATA COLLECTION FORM

Previous NCR:
Diagnoses:

Subject ID: __ Date: _____________________________

Sex: M__________ Age: ______________________ years

Handedness: right / left (circle one) DOB: ____

Normal to corrected normal vision? Yes / No (circle one), specify:

________________________________________

________________________________________

Occupational history: ____

History of previous trauma:

Brain Injury:

Developmental issues:

History of drug abuse:

Education Level:

Highest grade completed: ____

Total number of years of schooling (not including kindergarten): _________

Marital Status: Which race do you most identify with:

Single (never married) ___ White/Caucasian ___

Married or cohabitating ___ Black ___ Aboriginal ___

Separated/divorced ___ Asian ___ Inuit ___

Widowed ____ Hispanic ___
TO BE OBTAINED THROUGH RADAR FILE REVIEW AFTER TESTING IS COMPLETE:

- Sentence Commencement Date: ____________________________
- Legal Status (Not Criminally Responsible):

  ____________________________________

- Previous Number of charges: _______________________________
- Previous number of hospitalizations: ______________________
- First disposition Date (Code of the date of the very FIRST charges):

  ____________________________________

- First charge type: ________________________________
- First disposition (absolute discharge; conditional discharge; suspended sentence; fine/restitution; community service; probation; conditional sentence; custody; other, specify): ________________________________
- Date entered hospital: ________________________________
- Index incident charge type: ______________________________
- Index incident date:

  ____________________________________

- Number of previous NCRMD: ______________________________
• Prior Sexual Offence (prior sexual offence; no prior sexual offence):

• Classification of index charge (Non-Violent; Violent, specify purely reactive, reactive-instrumental, instrumental-reactive, purely instrumental):

• Psychiatric diagnoses: _________________________________

• List any treatment for mental disorders that have been undergone in the past:

First six months in hospital:

• Aggressive incidents in forensic psychiatric hospital:

• Nonaggressive incidents in forensic psychiatric hospital:
Appendix 4: Letter of Information and Consent

LETTER OF INFORMATION AND CONSENT

Examining the Relationship Between Executive Cognitive Functioning and Violence in a Forensic Psychiatric Patient Population

Principal Investigator
Peter N. S. Hoaken, PhD., Associate Professor
Department of Psychology, Western University

Co-Investigators
Erin Shumlich, MSc Candidate, Clinical Psychology

Introduction
You are being invited to participate in a research study done by researchers from Western University. The purpose of this letter is to provide you with the information you require to have information about the study in order to make an informed decision about whether to participate in this research. You are being invited to participate in this research about how certain brain functions, like planning and restraint, relate to violence and aggression in a forensic psychiatric population because you are a forensic psychiatric inpatient.

Background/Purpose
A recent research idea about where aggression comes from suggests that brain functions, or cognitions, may be related to aggression. Cognitions include thinking differently, restraint, solving problems, planning, control, and creativity. The purpose of this study is to better understand what parts of cognition are related to aggression. Having a better understanding of how cognition and aggression relate can help the development of rehabilitation programs that better help forensic psychiatric patients. You are being asked to participate because you are a forensic psychiatric inpatient. Up to 50 people will participate in this study at the Southwest Centre for Forensic Mental Health Care and it will take up to 2 years to complete. Participation in this study will take approximately 1.5-2 hours of your time. You can ask for breaks as needed.

Study Design
You will be asked to complete a series of measures that look at cognitive ability. All measures will be recorded by the examiner or through paper and pencil responses, which will be recorded and stored on the primary investigator’s laptop in a password-protected and secure file. We would also like to look over your file information held by the Southwest Centre for Forensic Mental Health Care. Your files will be looked over to see any prior crimes and any aggressive incidences that have happened in this facility. You may be eligible to participate in this study if you are a male inpatient at the Southwest Centre for Forensic Mental Health AND if you (a) have normal or corrected-to-normal vision (that is, you may participate if you wear glasses or contact lenses), (b) are fluent in English, (c) can use the keyboard and mouse of a computer to click and type in answers to questions, and (d) can respond (verbally or in writing) to verbal and/or written questions.
Participants may be withdrawn from the study for the following reasons: 1) if they become unable to provide informed consent; 2) if they become physically aggressive towards the examiner, other patients, or staff members during the time of data collection; or 3) if they are deemed a risk to themselves, or others.

**Procedures**
You have been invited to participate through the cooperation of the Southwest Centre for Forensic Mental Health Care and Dr. Rod Balsom. You will be given a copy of the Letter of Information and provided as much time as needed to go over the form. The researcher will then go over the form with you and answer any questions you may have. You will sign a consent form prior to participating in the current study. Once the consent form is signed, you will complete five measures of cognitive ability. A researcher will sit down with you and take you through these five measures. These five measures require you to read words aloud, make judgments about pictures, and solve different problems. The researcher will record and time your responses as you go through the measures. You may ask questions about the procedure at any time.

**Voluntary Participation**
Participation in this study is voluntary. You may decide not to be in this study, or to be in the study now and then change your mind later. You should only agree to participate if you feel you have been given enough information about the study. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time. Participation in this study, refusing to answer questions, or withdrawal at any time will not have any effect your length of stay in the facility or decisions of release.

**Withdrawal from Study**
You may withdraw from the study at any time. If you decide to withdraw from the study, you have the right to request that the information that has been collected not be used in the study and discarded right away. Let your researcher know if you would like to withdraw and for your information not to be used in the study. If you decide to withdraw from the study, the information that was collected before you leave the study will still be used unless you request that it not be used. No new information will be collected without your permission.

**Risks**
There are no known risks to participating in this study, but you may become tired while completing the tasks. If this occurs please tell the researcher and we will help you with what you need.

**Benefits**
There are no direct benefits to you for participating in this study; however, your participation in this study may help forensic psychiatric patients in the future.

**Reminders and Responsibilities**
If you are already participating in another study at this time, you should tell the interviewer right away to decide if it is appropriate for you to participate in this study.
**Confidentiality**
Any information that you provide us with or that is obtained from your file is valuable, and we will respect your privacy by keeping this information confidential, that is, no one will have access to your information outside of the research team that is approved to do so. To protect your confidentiality, at no point will any personally identifying information be released; rather, a participant code will be assigned. Your data will be attached to a participant code so no one can tie your data to you. All data will be placed in a locked cabinet, in a securely locked room, in the Psychology Department at Western University, where only the Principal Investigator and other approved personnel can view it. All electronic data on a computer will be automatically secured on a laptop that only the Principal Investigator and other approved researchers can view. If the results of the study are published, names will not be used and no information about your identity will be released or published. Five years after the study has finished and the findings published, we will destroy the data you have provided us. Please note that if you would like to receive a copy of the overall results of the study please bring this to the attention of the interviewer, and this will be provided to you when it becomes available (please be aware this may take several months). Information collected for the study will not be recorded in your medical record. All information collected during this study, including your personal health information, will be kept confidential and will not be shared with anyone outside the study unless required by law. Also, please be aware that the Research Ethics Board at Western University may contact you directly to ask about your participation in the study.

**Compensation**
No money will be provided for participation in this study.

**Rights as a Participant**
You do not waive any legal right by signing this consent form. Participating in this study or signing this consent form will not affect your legal rights.

**Questions about the Study**
If you have any further questions about any aspect of this study, you may contact Dr. Peter Hoaken. If you have questions about the conduct of this study or your rights as a research subject, you may contact the Office of Research Ethics, The University of Western Ontario.

**Consent**
Project Title: Examining the Relationship Between Executive Cognitive Functioning and Violence in a Forensic Psychiatric Patient Population
By signing below, you are agreeing that:
1. You have read the Letter of Information (or it has been read to you)
2. The nature of the study has been explained to you
3. All questions regarding the study have been answered to your satisfaction
4. You agree to participate.
Please note that you do not waive any legal rights by signing this document. You will be provided with a copy of this letter.

Participant’s Full Name: ______________________________

Participant's Signature: _______________________________

Date: ______________________

Full Name of Person Obtaining Informed Consent: _______________________

Signature of Person Obtaining Informed Consent: _______________________

Date: ______________________
### Appendix 5: Sample List of Medications

<table>
<thead>
<tr>
<th>Participant</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>clonazepam (1 mg, ORAL, daily); clozapine (200mg, ORAL, daily); topiramate (50 mg, ORAL, daily)</td>
</tr>
<tr>
<td>2</td>
<td>benztropine (2mg, tab, ORAL, 2x daily); cholecalciferol (Vitamin D3) (800 units, tab, ORAL, daily); folic acid (2mg, tab, ORAL, daily); levothyroxine (t5 mcg, tab, ORAL, daily); lithium (600mg, syrup, ORAL); lithium (750mg, syrup, ORAL, with supper); olanzapine (Zyprexa Zydis) (20 mg, DIS tab, ORAL, bedtime) (10 mg, DIS tab, ORAL, daily); zuclopenthixol (Clopixol Depot, depot injection)</td>
</tr>
<tr>
<td>3</td>
<td>benztropine (1mg, ORAL 2x daily); benztropine (2mg, ORAL, q2 weeks); Consta (Injection only every 2 weeks); lithium (Carbolith, 900 mg, ORAL, daily); Melatonin (3mg, ORAL, daily); nicotine (Nicorette, 2mg, ORAL, q1 hour); paliperidone (Invega Sustenna, administer 150mg/1.5mL intramuscularly every 4 weeks); quetiapine (100mg, tab, ORAL, daily); risperidone (Risperdal Consta, 62.5mg, depot injection); sertraline (100mg, cap, ORAL, daily)</td>
</tr>
<tr>
<td>4</td>
<td>acetaminophen (650 mg, tab, ORAL, 3x daily); atorvastatin (10mg, tab, ORAL, daily); calcium carbonate (Tums 500mg, ORAL); cholecalciferol (400 units, tab, ORAL, BID); fluticasone-salmeterol (fluticasone-salmeterol 500 mcg-50mcg inhalation powder; 2x daily); lithium (600mg, cap, ORAL, daily); pyridoxine (200mg, tab, ORAL, 2x daily); quetiapine (400mg, tab, ORAL, 2x daily); senna (Senokot, 17.2 mg, tab, ORAL, daily); tiotropium (Spiriva, 18 mcg, inhalation powder, INHALE, daily)</td>
</tr>
<tr>
<td>5</td>
<td>clindamycin topical (clindamycin 1% topical solution, 2x daily); clozapine (400 mg, tab, ORAL, daily); fluticasone-salmeterol (Advair Diskus, 250 mcg-50mcg inhalation powder, 2x daily); methylphenidate (Concerta; 54mg, ORAL, daily); pantoprazole (40 mg, EC tab, ORAL, daily); polyethylene glycol 3350 (PEG3350; 17g, powder, ORAL, daily; NOTE: only administered once on 2015/11/17 @ 1322)</td>
</tr>
<tr>
<td>6</td>
<td>gabapentin (300mg, cap, ORAL, 2x daily); gabapentin (600 mg, tab, ORAL, 2x daily); ibuprofen (600mg, tab, ORAL, 3x daily); olanzapine (7.5 mg, tab, ORAL, daily); pantoprazole (40 mg, EC tab, ORAL, daily)</td>
</tr>
<tr>
<td>7</td>
<td>aripiprazole (400mg, depot injection); nitrofurantoin (Macrobid; 100mg, MCR CRS cap, ORAL, 2x daily); olanzapine (Zyprexa Zydis; 10 mg, ORAL, 2x daily); olanzapine (Zyprexa Zydis; 10 mg, ORAL, daily)</td>
</tr>
<tr>
<td>8</td>
<td>aripiprazole (10 mg = 1 tab, ORAL, daily); aripiprazole (300mg, depot injection)</td>
</tr>
</tbody>
</table>
depot injection, intramuscularly, every 4 weeks); duloxetine (Cymbalta; 60mg, ORAL, daily); quetiapine (100mg, ORAL, 2x daily);

<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>cholecalciferol (Vitamin D3; 1000 units, ORAL, daily); levothyroxine (75 mcg, ORAL, daily); lorazepam (1mg, ORAL, daily); Wild Salmon plus Fish Oil 1000mg capsule (patient's own supply, ORAL, daily); olanzapine (15mg, tab, ORAL, daily)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>benztpine (1mg, tab, ORAL, 2x daily); levothyroxine (50 mcg, ORAL, daily); lithium (600mg, ORAL, daily); lithium (750 mg, ORAL, daily); multivitamin (1 tab, ORAL, daily); olanzapine (Zyprexa Zardis; 20 mg, ORAL, daily); quetiapine (200 mg, ORAL, daily); risperidone (Risperdal Consta;50 mg, depot injection); risperidone (Risperdal M-Tab; 6 mg, ORAL, daily); senna (8.6 mg, ORAL, daily); tolterodine (4mg, ORAL, daily); zopiclone (3.75 mg, ORAL, daily)</td>
</tr>
</tbody>
</table>
Erin Shumlich
Curriculum Vitae

EDUCATION

In Progress  Masters of Science, Clinical Psychology
University of Western Ontario, London, ON
Advisors: Graham Reid, Ph.D., C.Psych; Peter Hoaken, Ph.D., C.Psych
Thesis: The Relationship Between Executive Dysfunction and Criminality in Forensic Psychiatric and Correctional Populations

2014  Bachelor of Science, Psychology Honours, First Class
Bachelor of Arts, English, First Class
University of Calgary, Calgary, AB
Faculty of Arts Dean’s List

ACADEMIC AWARDS AND ACHIEVEMENTS

• University of Western Ontario Graduate Research Scholarship (2015–2016) — $12,865

• University of Western Ontario, Faculty of Social Science — Graduate Research Award (2015–2016) — $750

• University of Western Ontario – Social Sciences and Humanities Research Council of Canada (SSHRC) — Master’s Scholarship (2015–2016) — $17,500

• University of Western Ontario Graduate Research Scholarship (2014–2015) — $12,865

• University of Regina – Social Sciences and Humanities Research Council of Canada (SSHRC) — Master’s Scholarship (2014) — $17,500 (declined)

• University of Windsor – Social Sciences and Humanities Research Council of Canada (SSHRC) — Master’s Scholarship (2014) — $17,500 (declined)

• Program for Undergraduate Research Experience (PURE) award (2014), University of Calgary — $3,000

• University of Calgary, Faculty of Arts Research Award (2013) — $1,000
  • Awarded for work on psychology honours project “Examining the Effects of Race on Mock Juror Decisions”

PUBLICATIONS AND PRESENTATIONS
Publications:

Conference Proceedings:

Other Academic Contributions:
- Shumlich, E. J., Gould, K., Balsom, R., & Hoaken, P. H. (2015 September). The Relationship Between Cognitive Functioning and Aggression in Forensic Psychiatric...

- Received an award for the “Best Oral Presentation” from the Research and Education Unit at Parkwood Institute


SUPERVISION AND REVIEWER EXPERIENCE

Honours Thesis Supervision
- Belal Zia (Co-supervised this student in 2015–2016; University of Western Ontario)
- Amy Beaudry (Co-supervised this student in 2015–2016; University of Western Ontario)
- Kelsey Gould (Co-supervised this student in 2014–2015; University of Western Ontario)

Ad-Hoc Reviewer
- Journal of Family Psychology

PROFESSIONAL SERVICE AND RELATED WORK EXPERIENCE

Teaching Assistantships:
- Abnormal Psychology (2016)

Student Liaison, London Regional Psychological Association (LRPA, 2015–Present)
- Attend meetings, vote on issues, plan events
- Provide students information regarding upcoming events and opportunities around London
- Get incoming students involved with community affairs through opportunities with LRPA

Co-President, Advocacy Through Action (AtA, 2015–Present)
- Plan and organize a yearly event to bring the community together to discuss psychological well being
- Organize clinical psychology student talks to be presented in the community and provide psychological resources for community members

Committee Member, Psychology Graduate Affairs Committee (2015–Present)
- Attend meetings, provide a voice for psychology graduate students for ongoing student affairs
Co-Organizer, Canadian Association for Girls in Science (2015–Present)

- Co-organized an event to promote psychological sciences that was attended by over 20 young girls

PROFESSIONAL MEMBERSHIPS

- London Regional Psychological Association (Student Member, 2014–Present)
- Canadian Psychological Association (Student Member, 2015–Present)