A Neuropsychological Assessment of Adult Sex Offenders

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Abstract

There is widespread concern within at least Western cultures of the potential damage that sex offenders may cause to society. The government statistics highlight a frightening pattern of sexual abuse in Australia, with the trend implicating that sexual assault is on the rise and that children are the predominant victims (ABS, 2003b). Specifically, 17,850 reports of sexual assault were recorded in 2002, a 6% increase since 2001. Further to this, there is still no universal agreement as to the extent to which treatment effectively reduces sexual recidivism. Therefore, there is an urgent need for research into this problem behaviour.

Research examining the causes of sexual offending has examined a biological hypothesis that sex offenders have functional brain impairment. However, the results of neuropsychological assessments of various sex offender populations are inconsistent and inconclusive. The aim of this study was to investigate the brain function of males convicted and incarcerated for sexual offences against children using neuropsychological assessment. Specifically, it was hypothesised that the sex offenders would show functional impairment in their frontal and temporal lobes. A battery of neuropsychological tests was compiled to assess the functions of these regions including four WAIS-III subtests (Arithmetic, Vocabulary, Block Design and Picture Arrangement), Rey Auditory Verbal Learning Test (RAVLT), Rey Complex Figure (RCF), Wisconsin Card Sorting Test (WCST) and the FAS Test. These tests were administered to 25 incarcerated male sex offenders, 25 incarcerated male non-sex offenders and 25 men with no criminal history. Although attempts were made to match these groups on age, level of education and level of intelligence, statistical analyses revealed that there were significant differences between the groups on these variables. These differences were statistically controlled using analyses of covariance (ANCOVAs) and factorial analyses of variance (ANOVA).

The results indicated that the sex offenders performed significantly worse than the controls on all neuropsychological tests. However, statistically significant differences were only found between the sex offenders and control group on the immediate recall trials of the RAVLT and RCF. These observed differences did not change when age, level of education and level of intelligence were statistically controlled. It was concluded that there is insufficient evidence from this study to support the hypothesis that sex offenders have functional impairment in their frontal and temporal lobes. However, given the relevance of potential brain impairment to both the biological and social-cognitive perspectives of sexual offending, future research in this field is warranted.

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Cheers everyone!

Declaration

"This thesis contains no material which has been accepted for the award of any other degree or diploma, except where due reference is made in the text of the thesis. To the best of my knowledge, this thesis contains no material previously published or written by another person except where due reference is made in the text of this thesis."

Signed: _____

Date: 5/02/06

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Chapter 1

Overview of dissertation

1.1 Introduction

The focus of this dissertation is the neuropsychological assessment of adult sex offenders. The main purpose of neuropsychological assessment is to draw inferences about the functional characteristics of the brain based on a variety of standardised tests (Benton, 1994). Thus, the focus of this study is on the brain function of adult sex offenders. Section 1 of this chapter relates to the problem statement and is divided into subsections. Firstly, the incidence of sexual offending in Australia is discussed, identifying this as a problem that needs urgent attention. Secondly, the link between sexual behaviour and the brain is briefly addressed, followed by a short presentation on past research. Together these sub-sections highlight the need that the brain organization of sex offenders should be scientifically examined for impairment. Thirdly, the differences between brain structure and function are discussed in terms of the differences between neuropsychological measures and brain imaging techniques. Section 2 presents the aim and scope of the study. Section 3 presents an overview of the dissertation, identifying the overall structure and providing a brief description of the chapters to follow.

1.2 Problem statement

There is widespread concern within at least Western cultures of the potential damage that sex offenders may cause to society. Regardless of whether the actual incidence of sexual assault and child molestation is increasing, the media coverage of such incidents heightens awareness and contributes to society's fear of repeat sexual offending. While this fear and concern for the welfare of other's is pivotal in motivating sex offender research, what is more compelling is that after decades of anecdotal observations, empirical research and numerous theories, there is still no universal agreement as to the extent to which treatment effectively reduces sexual recidivism. A recent meta-analysis exploring the effectiveness of psychological treatment in various sex offender groups summarised the data from 43 studies (Hanson et al., 2002). The resultant sexual recidivism rate, averaged across all studies, was lower for treated groups (12.3%) compared with untreated groups (16.8%). Specifically, it was reported that current treatment programs which included cognitive-behavioural (n=13) and systemic approaches (n=2) reduced

sexual recidivism rates from 17.4% to 9.9%. (Hanson et al.). Although these results are supported by a large sample size (n=9454), the authors acknowledge that further research is required to confirm these conclusions and that more information is needed to determine which treatment types benefit which types of sex offenders (Hanson et al.). Although this research indicates that the current approach to the treatment of sex offenders appears effective, there are still a number of unanswered questions. Therefore, there is an urgent need for effective research into this problem behaviour.

1.2.1 Incidence

The Australian Bureau of Statistics (ABS) defines sexual assault as "physical assault of a sexual nature directed toward another person, where that person; does not give consent; gives consent as a result of intimidation or fraud; is legally deemed incapable of giving consent because of youth or temporary/permanent capacity" (ABS, 2003a, p. 4).

The collective statistics of recorded crime in Australia highlight a frightening pattern of sexual abuse in the country, with the trend implicating that sexual assault is on the rise and that children are the predominant victims (ABS, 2003b). Specifically, 17,850 reports of sexual assault were recorded in 2002, a 6% increase in the number of these assaults since 2001. It was further reported that the sexual victimisation rate increased from 69 to 91 per 100,000 population between 1993 and 2002, a rate which has been highlighted as the highest level since the inception of data collection in 1993 (ABS, 2003b).

The ABS (2003b) data also implicates that the victims of sexual assault are predominantly young. Although the ABS (2003b) identified that individuals aged 24 or less were the predominant victims of sexual assault (72%), they reported that it was children aged 10-14 and teenagers aged 15-19 that were three times more likely to be recorded as victims of sexual assault than the total population.

These statistics highlight that the problem of sexual offending is not only prominent in Australia, but actually on the increase. As such, there is an urgent need for research into this area.

1.2.2 Relationship between sexual behaviour and the brain

The relationship between sexual behaviour and the brain has long been established. While the specific neural mechanisms remain unknown, extensive animal research has consistently documented the alteration of the normal sexual response following stimulation of the frontal and temporal lobes (Dua & MacLean 1964; MacLean, Denniston & Dua, 1963; MacLean & Ploog, 1962; Vaughan & Fisher, 1962). The available experimental research involving humans is limited. However, the association between brain dysfunction and what was then termed "sexual disorders" dates back to 1886 with the publication of Krafft-Ebbing's book "Psychopathia Sexualis". This book detailed a variety of sexual disorders and speculated as to their origins, many of which were associated with brain damage. It was during this time that the term "pedophilia" was introduced and defined as a product of "acquired mental weakness" possibly due to conditions affecting the brain such as dementia, chronic alcoholism, epilepsy and head injuries. While these observations were not scientifically proven at the time, evidence has since accumulated to establish the association between abnormal sexual behaviour and brain dysfunction in humans (Hucker et al., 1986). Several studies documenting observations in patients have reported altered sexual behaviour following the onset of temporal lobe seizures (Davies & Morgenstern, 1960; Epstein, 1960. 1961; Hunter, Logue & McMenemy, 1963; Kolarsky, Freund, Machek & Polak, 1967) and frontal lobe damage (Cummings, 1985; Walsh, 1994).

1.2.3 Past research

At a theoretical level, sexual offending is more or less synonymous with the topic of abnormal sexual behaviour (Lanyon, 1991), therefore, it is reasonable to hypothesise that men convicted of sexual offences may have some form of brain dysfunction. However, many of the studies reporting the association between abnormal sexual behaviour and brain dysfunction were conducted with neurology clinic patients in whom the observed change in sexual behaviour was the consequence of a neurological disorder (Langevin, Wortzman, Wright & Handy, 1989). As such, the evidence of brain dysfunction was imminent or self-fulfilling. It is only in the past 25 years that sexual offenders, without known neurological damage, have been examined to determine whether they exhibit similar brain dysfunction to these neurological patients.

Although this research spans decades, the available empirical research still remains limited. Observational studies were apparent in the late 1970's, followed by a burst of studies by a group

of researchers in the mid-late 1980's. Unfortunately, since the early-mid 1990's research in this area appears to have waned. During this time some very progressive work was undertaken and research examined a number of sexual offender groups for neuropsychological functioning and structural brain damage. However, the results to date are inconsistent and inconclusive. This represents a serious gap in the knowledge required for the development of effective treatment programs.

1.2.4 Differences between brain function and structure

Neuropsychological assessment and computerised tomography (CT) have been the predominant techniques used in past research. However, they aim to measure different aspects of the brain: function and structure, respectively. Brain structure refers to the physical external (cerebral hemispheres, brain stem and cerebellum) and internal (white matter, basal ganglia and lateral ventricles) anatomical features of the brain (Walsh, 1994). Therefore, structural brain measures aim to identify tangible abnormalities in these features, such as, brain size, length, width, area, density and symmetry (Wright, Nobrega, Langevin & Wortzman, 1990). Abnormalities in these areas are often referred to as gross brain pathology or gross brain differences.

In addition to these structural elements the brain is also organised into functional levels that integrate in a number of ways to control for a large number of behaviours (Kolb & Whishaw, 1990). This functional organisation is extensive and complex and is beyond the scope of this dissertation. However, in general the cortex is divided into four arbitrary lobes (frontal, temporal, parietal and occipital), each of which are associated with a number of behavioural (e.g. motor skills) and cognitive (e.g. memory, learning, intelligence) functions (Walsh, 1994; Kolb & Whishaw). These abilities are thus the focus of brain function measures, rather than anatomical brain structures. As it is well established that lesions, damage or disruptions to these regions are associated with impaired functions, variations from what is considered normal functioning are considered indicative of some form of impairment in the associated brain region (Walsh; Kolb & Whishaw). However, this does not infer a structural abnormality. As such, individuals who deviate from what is considered normal are often referred to as having brain dysfunction, brain impairment or cognitive impairment.

The differences between the constructs of brain function and structure indicate that the findings from functional and structural measures may not correlate since the brain may be functionally

impaired but structurally normal. Conversely, a structurally impaired brain may still function within normal limits (Mills & Raine, 1994). Given this, it is possible that sex offenders have structurally normal brains with impaired functioning or vice versa. This may account for some of the perceived inconsistencies between the results of these measures in the research. Such as, in Langevin, Wortzman et al. (1989) where functional impairment in sex offenders was indicated by an impaired performance on the Halstead Reitan Neuropsychological Battery (HRNB) but no structural differences were found in their computerised tomography (CT) scans.

Further to this, these techniques may also be uncorrelated due to their own associated limitations. Although CT is a highly reliable and valid measure, it may lack the specificity necessary to identify dysfunction in the temporal structures. For example, CT scans may have poorer spatial resolution of smaller brain structures due to interference of the bony structures at the base of the skull (Langevin, Wortzman et al., 1989; Mills & Raine, 1994).

Research has further indicated that newer technology is also limited. While most positron emission tomography (PET) scanners cover the whole horizontal dimension of the brain, they miss parts of the vertical dimension including the top frontal and parietal areas close to the central sulcus and the lower regions of the temporal pole and ventral cerebellum (Cabeza & Nyberg, 1997). Further to this, the low temporal resolution renders the PET technique unable to detect small changes (Hardcastle & Stewart, 2002; Sergent, 1994).

The nature of the sex offenders' deficit is unknown. Therefore, a procedure that has the ability to detect subtle changes is warranted. As such, reliance on technology that has the potential to miss subtle changes may produce false results in this study. As such, the study reported in this dissertation uses neuropsychological assessment. Neuropsychology is defined as the study of the relationship between brain function and observable behaviour. The main purpose of neuropsychological assessment is to draw inferences about the functional characteristics of the brain based on a variety of standardised tests (Benton, 1995). Thus, the focus of this study is on the cognitive function rather than the structural gross brain differences of sex offenders.

1.3 The aim and scope

Therefore, the aim of this study is to investigate the brain function of males convicted and incarcerated for sexual offences against children using neuropsychological assessment.

1.4 Overview of the study

To achieve the above aim Chapter 2 discusses the definition of sex offenders and the various theoretical attempts to explain such behaviour. Chapter 3 outlines evidence linking sexual behaviour to the frontal and temporal lobes and highlights the relevance for research in to the brain function of sex offenders. This chapter also provides an overview of the past research utilising both functional and structural techniques to assess the brains of sex offenders and discusses various methodological limitations. Chapter **4** outlines the research design to be used in this investigation, including the hypotheses to be tested, definition of participant groups and the neuropsychological tests to be used. Chapters 5 and 6 provide the results of the statistical analyses used to assess the data and offers interpretations of the results in terms of the participants' cognitive functions. Chapter 7 summarises and concludes the study, discussing the findings in relation to current methodological limitations, potential theoretical and clinical implications and recommendations for future research.

Chapter 2

Theories of sexual offending

2.1 Introduction

This chapter is divided into two sections. The first section discusses the concept of a child sex offender in terms of the legal and clinical definitions, followed by the presentation of the conventional research definition currently used by researchers in this field of study (Barbaree & Seto, 1997). Sub-groups of these offenders are also defined. The second section discusses the theories of sexual offending, particularly in reference to individuals who sexually offend against children. Although there is still no universally accepted etiological theory of sexual offending, several theories have been identified over the years. Three levels of theories are presented and discussed in turn: comprehensive, single-factor and descriptive. The chapter concludes with identifying a next step in sex offender research, highlighting that a focus on the brain function of this population is warranted.

2.2 Defining child sexual offenders

In Victoria, the Crimes Act (Vic) 1958 details a range of categories of sexual offences against both children and adults. For a full review of these definitions refer to the Crimes Act (Vic) 1958, sections 8, 8A, 8B, 8C, 8D, 8E and 8EA. Specifically, section 8C defines sexual offences against children. In short, this Act identifies a sexual offence as any sexual contact with an individual without hislher consent and all adult sexual interactions with children, including both physical and non-physical contact. Although a child is legally defined as an individual under the age of 18 years, the legal age of consent is 16 years. As such, a child sex offender in Australia may be legally defined as an individual who has had either physical or non-physical sexual contact with an individual under the age of 16. However, it is also considered illegal for an adult to engage in sexual penetration or an indecent act with a 16 or 17 year old child in hislher care, supervision or authority.

The defining feature of this legal definition is the actual behaviour. However, until recently the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association [APA], 1994) identified that the act of a sexual offence against a child was not enough for a

diagnosis of pedophilia. According to the criteria, pedophilia was only diagnosed if the individual suffered "recurrent, intense sexually arousing fantasies, sexual urges or behaviours involving sexual activity with a prepubescent child or children (generally age 13 years or younger)" (APA, p. 528) and these fantasies, urges or behaviour caused "clinically significant distress or impairment in social, occupational or other important areas of functioning" (p. 528). As such, it was considered that only a proportion of the individuals committing these offences suffered from the mental disorder pedophilia.

These criteria led to many clinicians and researchers questioning the reliability and validity of the diagnosis. Firstly, concerns were raised about the lack of clarity around the terms "intense", "recurrent", "behaviour" and "clinically significant distress" (Marshall, 1997; O'Donohue, Regev & Hagstrom, 2000). It was argued that without precise criteria defining these terms, the diagnosis was open to interpretation and, thus, potential false positive and false negative diagnoses (O'Donohue et al.). Secondly, it was identified that this diagnosis excluded many child sex offenders as they may have only committed one offence or were not distressed about their behaviour (Marshall; O'Donohue et al.). Thirdly, questions were raised about the arbitrary time frame and age of victims, arguing that there was no basis or justification for choosing these numbers (Marshall; O'Donohue et al.).

In the latest revision of this manual, DSM-IV-TR (APA, 2000), it is no longer considered necessary for an individual to display "clinically significant distress" to qualify for the diagnosis of pedophilia. Rather, most individuals who commit sexual offences will be diagnosed with pedophilia provided the behaviour is "recurrent" over a period of at least six months and the child is "generally" under the age of 13. While this definition alleviates the concern that "clinically significant" distress was necessary for a diagnosis, many of the concerns clinicians and researchers had regarding the DSM-IV criteria, still remain. Specifically, this criteria still lacks the clarity of terms, thus, the diagnosis remains open to interpretation. Furthermore, the arbitrary timeframe and age of victim remain in the criteria and, as such, individuals committing only one sexual offence or offending against children between the ages of 14-16 are not likely to be diagnosed as pedophiles.

These unresolved problems associated with this definition have led many clinicians and researchers to abandon the clinical diagnosis of pedophilia, in preference for their own criteria (Marshall, 1997). As such, there is still no consensus on the defining features or diagnostic

criteria of child sex offenders. However, many professionals often use the construct of child molester, generally defined as an individual who has committed a sexual offence against a child, (Marshall; O'Donohue et al., 2000), irrespective of whether the behaviour is persistent (Marshall). In this construct, the governing laws and legal age of consent define the terms "sexual offence" and "child". The conventional research definition of a child molester further stipulates that the offender is at least aged 16 years and five years older than the victim (Barbaree & Seto, 1997).

Child molesters can further be categorised according to the nature of the offender's relationship with the victim and the victim's gender. Individuals who offend against their own children are referred to as incest offenders, whereas the term non-familial child molesters refers to individuals who offend against biologically unrelated children or children with which they have no legal family relationship. Further subdivisions of this latter group can be made depending on the victim's gender. Heterosexual molesters offend against children who are of a different gender to them, whereas homosexual molesters offend against children with the same gender as theirs (Barbaree & Seto, 1997).

2.3 Theories of sexual offending

To date there is still no universally accepted etiological theory of sexual offending which encapsulates its onset, development and maintenance. However, there is a consistent belief that the etiology of sexual offending involves multiple factors and that these may operate differently for different offenders (Lanyon, 1991). Two interacting categories of factors are thought to initiate sexual offending, predispositions and triggers. Predispositions (distal factors) are assumed to emerge from genetics and developmental experiences, are thought to be causal to sexual offending and aim to answer why questions (Ward & Hudson, 1998). On the other hand, triggering or contextual factors (proximal) are generally state variables that disinhibit control over antisocial behaviour and attempt to answer how sexual offending occurs (Lanyon, 1991; Ward & Hudson). While there is consistency in the belief that these factors exist, the approach to empirical research and theory development has been piecemeal, with researchers working independently. However, recently researchers have attempted to outline one comprehensive etiological theory of sexual offending that combines the strengths of the most influential child sexual abuse theories with a number of more current single factors thought to cause sexual offending (Ward & Siegert, 2002).

The levels of theories discussed here are in accordance with those outlined by Ward and Hudson (1998) and are based on a level of theory comprehensiveness rather than on an ontological level i.e. psychological, biological or social. It is argued that this distinction not only allows for classification of existing theories, but also provides a guide and structure for integrating future research (Ward & Hudson). The three levels are comprehensive, single-factor and descriptive theories. Each will be discussed in turn. However, a critical review of all existing theories is beyond the scope of this dissertation, which is focussed on the neuropsychological assessment of child sex offenders.

2.3.1 Comprehensive theories

This level of theorising is considered the most comprehensive and is associated with identifying multiple causal factors and their interactions. However, the sex offending literature is deficient in this area. Instead there are a number of multi-factor theoretical frameworks that organise research into a set of associated constructs, which can then guide empirical research (Ward & Hudson, 1998). Only recently has the first attempt been made to develop a comprehensive etiological theory of sexual offending. This theory, identified as the Pathways Model (Ward & Siegert, 2002), has "knitted" together the best elements of the three most influential theoretical frameworks to date. The aim being to develop an explanatory account of child sexual abuse and the causal mechanisms underpinning the considerable variation in the type, severity and range of problems child sex offenders present (Ward & Siegert). Prior to identifying the outline of this theory, a brief summary of the three multi-factor frameworks is presented; Marshall and Barbaree's (1990) Integrated Theory, Hall and Hirschman's (1991) Quadripartite Model and Finkelhor's (1984) Precondition Model.

Of the available frameworks, Marshall and Barbaree's (1990) theory of sexual aggression is perhaps one of the most comprehensive examples that focus on distal factors while still acknowledging the importance of proximal factors and their interaction. This model integrates four groups of factors consistently presented as causal mechanisms in sexual offending – developmental, biological, social-cultural and situational. It is hypothesised that adverse developmental experiences result in a number of vulnerabilities that when combined with transient situational factors may result in sexual offending behaviour. In this view the authors

posit that sex and aggression are mediated by the same neural substrates and hormonal steroids and thus creates for the male an unlearned drive for sexual aggression. They argue that the socialisation process is required to provide inhibitory mechanisms over this behaviour, such that, children and adolescents are required to learn to inhibit aggression in a sexual context. However, in the presence of poor parenting and inconsistent physical punishment the authors argue that socialisation processes required for the development of a positive attitude towards relationships and a sense of self-confidence may not occur. As such, the individual fails to develop the skills necessary to deal with pubertal changes. Thus, a number of resultant vulnerabilities are formed including poor social skills, negative attitudes and a lack of distinction between sexuality and aggression. It is further hypothesised that sexual assault may occur when these vulnerabilities interact with situational variables such as alcohol, anger, sexual arousal and availability of potential victim.

Although this theory is broad and flexible (Ward & Hudson, 1998) it is lacking in sufficient detail to identify how these factors interact and specifically translate into sexual offending behaviour. This, however, is a by-product of being a framework and not a theory and thus should not take away from its contribution to the literature.

The relationship between adverse developmental experiences and resultant vulnerabilities is similar in vein to the personality factor outlined in Hall and Hirschman's (1991) quadripartite model of sexual aggression and the motivational factor in Finkelhor's (1984) four-factor model of child molestation. However, unlike Marshall and Barbaree (1990), these frameworks tend to focus on the more proximal factors. As such, other possible distal factors are omitted, as are detailed descriptions of the processes by which the distal factors lead to sexual offending. Furthermore, these frameworks focus on different sexual offending populations and thus differ in what they consider to be the primary motivation of sexual offending.

Hall and Hirschman (1991) hypothesise that sexual arousal, negative emotions (affective dyscontrol) and cognitive distortions are state and situation dependent variables that interact with more enduring trait variables to increase the likelihood of sexual aggression. They further identify these enduring traits as personality problems, which may have arisen through adverse developmental experiences. Detailed descriptions of how these factors interrelate to produce sexual offending are lacking. Although Hall and Hirschman argue that each of the four factors is a motivational precursor, which serves to overcome the threshold that generally inhibits sexual

aggression. Furthermore, it is suggested that each motivational precursor will produce a different subtype of sexually aggressive act depending on the relative intensity of each factor.

On the other hand, Finkelhor (1984) argues that the primary motivation to offend for child abusers stems from a desire to satisfy an emotional and sexual need in the absence of alternative sources of sexual gratification, which are proposed as being a product of poor early experiences. In conjunction with this motivation, it is further argued that three other preconditions need to be met for an offence to occur including overcoming; (1) internal inhibitions; (2) external inhibitions; and (3) the child's resistance (Finkelhor). It is hypothesised that disinhibitors are utilised to overcome these three factors and may include alcohol use, psychosis and social-cultural factors (Finkelhor). The proximal factors (preconditions) referred to in this framework are more a description of what an individual is required to do in order to offend rather than an explanation of how the factors contribute to the offending process or interact with the motivation factor. However, the disinhibitors described here are similar to some of the situational factors outlined in Marshall and Barbaree's (1990) framework.

The Confluence Model of Sexual Aggression (Malamuth, Linz, Heavy, Barnes & Acker, 1995) and Prentky & Knight's (1991) typology of rapists also offer frameworks that attempt to understand the causes of sexual offending behaviour. However, as these frameworks are primarily focused on men who offend against adult women rather than children, they are not appropriate for this current discussion.

In general, these frameworks have served a useful purpose in collating a large amount of sex offending literature and providing an insight into the potential combination of etiological factors associated with sexual offending and has provided specific constructs that can be empirically tested. However, the lack of attention to distal factors and details of the mechanisms and processes translating these to sexual offending render it impossible to determine what causes this behaviour.

The Pathways Model is the first attempt to provide a comprehensive etiological theory of child sexual abuse. It builds on these frameworks by knitting together their best elements and combing them with a number of more current single-factors thought to be causal to sexual offending (Ward & Siegert, 2002).

In short, this theory recognises that there are ecological factors that increase an individual's vulnerability to sexually offend against children (Ward & Siegert, 2002) including family environment, developmental learning history and biological and cultural factors. According to the model these factors interact with a set of common clusters or psychological mechanisms including (1) problems with emotional regulation (2) social skills and intimacy deficits (3) distorted sexual scripts and (4) cognitive distortions (Ward & Siegert). The result of the interaction between these mechanisms and the etiological factors provides a building block of vulnerabilities from which emerges five potential pathways to sexual offending behaviour (1) Intimacy Deficits (2) Deviant Sexual Scripts (3) Emotional Dysregulation **(4)** Antisocial Cognitions and (5) Multiple Dysfunctional Mechanisms (Ward & Siegert).

In general, each of these causal pathways has a different primary mechanism at its core which is the driving force behind the sexual offending behaviour. This theory hypothesises that although each sexual offence involves all four psychological mechanisms, it is possible that only the primary mechanism is dysfunctional. It is speculated that the remaining mechanisms are typically normal and are, in a sense, "recruited" by the primary dysfunctional mechanism to generate an offence (Ward & Siegert, 2002). For example, emotional need rather than sexual deviancy is hypothesised to drive Pathway 3: Emotional Dysregulation. It is speculated that sex may be used as an emotional coping strategy in circumstances where individuals have difficulty controlling negative emotions or have problems calming themselves. In these times of emotional distress, where social supports are unable to be accessed or utilised, children may be used opportunistically to satisfy sexual needs or as a way of punishing their partners (Ward & Siegert). In this example, the individual's lack of emotional competency is the driving force behind the offending behaviour rather than sexual arousal. The mechanism of sexual arousal has been recruited in order to improve the individual's mood, while the social competency mechanisms were recruited to enable access to a child. However, these mechanisms are not in effect dysfunctional. Furthermore, the individual does not have any offence-supportive beliefs and in general believes that sex with children is wrong. However, during the offence the individual is able to disengage his normal self-regulation processes by focusing on the anticipated pleasure and subsequent improvement in mood. It is only after the offence that the individual feels guilt (Ward & Siegert). This example highlights that all four psychological mechanisms are involved in the offending behaviour. However, it is only the emotional component that is dysfunctional. The other mechanisms were simply recruited in order to carry out the offence.

While each pathway is based on this process, they each vary in the strength and range of problem clusters and the particular set of causes that generate them (Ward & Siegert, 2002). However, an in-depth discussion of each of these pathways is beyond the scope of this dissertation which is focused on the neuropsychological assessment of child sex offenders.

The Pathways Model is an extremely useful addition to the sex offender literature and enhances our understanding of the causal mechanisms underpinning the considerable variation in the type, severity and range of child sex offences (Ward & Siegert, 2002). However, the authors acknowledge that this theory has limitations and requires further refinement. Specifically, it is still unclear as to how the four sets of psychological mechanisms interact to produce sexual offending behaviour. Furthermore, it is noted that the idea of a primary mechanism recruiting other normally functioning mechanisms is metaphorical and that more detail is required to further explain this proposed process (Ward & Siegert).

2.3.2 Single-factor theories

This level of theory is more specific than that of the comprehensive level, focusing on only one factor thought to be causal to sexual offending. These theories aim to describe sexual offenders' deficits in detail and their role in the offending process. Essentially these single-factor theories provide the conceptual basis for the more comprehensive theories (Ward & Hudson, 1998). Numerous single factors have been identified as motivations to offend sexually, predominantly deviant sexual arousal, social incompetence and deficits in intimacy, empathy and cognitions and to lesser extent biological factors. Each of these are presented and discussed below.

2.3.2.1 Deviant sexual arousal

The earliest views of the relationship between deviant sexual arousal and sexual offending are encapsulated in the sexual preference hypothesis which identified that sexual offences and other deviant behaviour are motivated by a conditioned preference for deviant sex (Marshall, 1996). Several theorists have extended the sexual preference hypothesis to rape and violent sexual assault (Quinsey, Chaplin & Upfold, 1984). One stimulus control model is an example of this and is based on the premise that rapists prefer non-consensual sex, as it is optimally satisfying. This perspective argues that rape cues have excitatory control over rapists' arousal, such that, sexual

arousal is increased in the presence of rape cues including force, humiliation and non-consent (Barbaree & Marshall, 1991).

Although a large literature base exists to support this contention, equally compelling arguments exist to cast doubt. There is evidence that child molesters (Marshall, Barbaree & Christophe, 1986) and rapists (Abel, Barlow, Blanchard & Guild, 1977; Earls & Proulx, 1986; Lalumiere & Quinsey, 1994; Quinsey et al., 1984) have been distinguished from non-offenders in their sexual arousal to various sexual stimuli. However, research in this field is inconsistent with research finding no differences between rapists and non-rapists in their arousal to rape cues (Baxter, Barbaree & Marshall, 1986; Eccles, Marshall & Barbaree, 1994; Langevin et al., 1985). Furthermore, it has been convincingly argued that much of the research has been predominantly based on the use of a non-standardised phallometric test i.e. measurement of penile circumference changes during sexual and non-sexual imagery (Barbaree, 1990).

This discrepancy in the research led to the development of other models to account for the observed sexual arousal to rape stimuli. Contrarily to the excitatory notion, is the inhibition model which identifies that rape cues serve to inhibit the normal male from offending and as such rapists may not have the same strength of inhibition to the rape stimuli (Barbaree & Marshall, 1991). Similarly, the response compatibility perspective (Blader & Marshall, 1989) identifies differences in inhibitory mechanisms. This position argues that rape cues cannot stimulate an individual to rape as non-consent and violence occur as a product of rape not as an antecedent. These authors postulate that aggression and sexual arousal are mutually inhibitory mechanisms in the normal male. Such that, if an individual is sexually aroused, it precludes an aggressive response at the same time. However, in the rapist these two mechanisms function together and are thus seen as compatible. It is argued that this is the defining feature of rape. There is some evidence for this inhibitory model in the literature (Lohr, Adams & Davis, 1997), although much remains to be conducted.

Research does not support one model over the other as a number of models are supported by empirical data. Barbaree and Marshall (1991) argue that this may be a result of different models operating in men when they offend. It is further postulated that this variety of models may account for the heterogeneity in rapists. For example, sadistic rapists may show excitatory arousal to rape cues, whereas the disinhibition model may account for the opportunistic rapist (Barbaree & Marshall). However, further work is required to define the casal mechanisms

underpinning this deviant sexual arousal and its relationship to sexual offending in not only rapists but also other sexual offender populations.

2.3.2.2 Social incompetence

A number of theories and proposals concerning the social interactions of sex offenders have been postulated over the years. Historically, social incompetence has been viewed under the banner of social skills deficits, which explain'that men lack the behaviours necessary to interact appropriately with women in social and sexual situations. It has further been hypothesised that anxiety in social situations can inhibit the development or expression of appropriate social behaviours (Overholser & Beck, 1986). Many social constructs have been empirically tested including self-confidence, assertion and social anxiety. However, the results are weak, inconsistent and different for various offender populations. While there is some evidence that child molesters lack self-confidence in social situations (Segal & Marshall, 1995) and show greater fear of being negatively evaluated (Overholser & Beck), other studies with non-familial child molesters report no difference in confidence (Marshall, Barbaree & Fernandez, 1995). Contradictory findings have also been found in the rapist population, ranging from reports of no skill deficit (Hudson & Ward, 1997; Sternac & Quinsey, 1986) to reports that rapists were more anxious than other groups in role-plays that required assertion (Overholser & Beck). These contradictions may be due, in part, to inadequate controls groups, the heterogeneity of sex offenders or lack of consistent definition of the constructs being measured. However, Hudson and Ward (2000) suggest that these inconsistencies more likely reflect that research has not yet asked the right questions regarding the relationship between interpersonal functioning and sexual offending.

McFall's (1990) position on social competency may suggest that Hudson and Ward (2000) are correct as he persuasively argues that that it is not just a question of whether sex offenders have social skills, but whether they have the ability to comprehend and process the incoming social information and make appropriate responses. In his information processing approach to this area, social competence is defined as a three stage sequential process by which incoming information is transformed into behavioural outputs. Thus, observable competent social behaviour is the product of the ability to; (1) accurately assess the situation; (2) generate response options and select the best one; and (3) execute a response, monitor its intended impact and make any necessary changes. As such, McFall emphasises the importance of

evaluating social perception processes as well as overt social skills. This concept has proven useful in a few studies with rapists having greater difficulty in identifying women's negative interpersonal cues in videotaped heterosexual interactions (Lipton, McDonel & McFall, 1987) and in decoding women's emotions (Malamuth & Brown, 1994).

Hudson & Ward (2000) utilised McFall's (1990) definition and argued that deficiencies in social competence is central to the causes and maintenance of sexual offending. They identified a number of different pathways by which interpersonal competency deficits may influence sexual offending behaviour, yet acknowledged that further empirical evidence is required to determine the causal linkages. However, they do suggest that the key interpersonal domains likely to mediate sexual aggression are intimacy, empathy and cognitive processes. Each of these three concepts has been the focus of more recent single-factor theories.

There is evidence that sex offenders have difficulty establishing intimate adult relationships and lack the skills necessary to manage interpersonal relationships (Keenan & Ward, 2000). Attachment theory has been one of the most promising ways of construing intimacy and understanding how these deficits lead to sexual offending. Marshall's (1989) original theory identifies that insecure attachment bonds in childhood lead to the failure to learn the necessary interpersonal skills to form intimate adult relationships. The consequent emotional loneliness is hypothesised to produce hostile attitudes, interpersonal aggression and a vulnerability to seek intimacy through sex, increasing the chances of sexual promiscuity and deviancy.

In critiquing this theory it was later reported that not all insecurely attached individuals were emotionally lonely and that this theory did not account for different offender types (Ward, Hudson, Marshall, 1996). As such, this theory was reformulated and the most recent perspective argues that there are three insecure attachment styles that lead to intimacy deficits (Ward, et al.). Each style is associated with different perceptions of self and others and different emotions, beliefs, goals and strategies. Thus, the pursuit of intimacy through sexually inappropriate ways is different for each attachment style.

Deficiencies in empathy have long been associated with sexual offenders, largely because it is appealing to believe that men who commit these crimes do so without feeling their victims' pain (Hudson & Ward, 2000). While there is a consensus on the existence of this deficit, the exact nature, empirical support and specific mechanisms linking this deficiency to sexual offending are

lacking. Nevertheless, it is hypothesised that a lack of empathy acts as a disinhibitory mechanism, by removing the constraints that would normally prevent an individual from hurting someone (Marshall & Meric, 1996). Furthermore, recent research has postulated an information processing framework to conceptualise empathy in sex offenders. This is a four stage process including; (1) emotion recognition; (2) perspective taking; (3) emotion replication; and (4) response decision (Marshall, Hudson, Jones & Femandez, 1995). However, how this links specifically to sexual offending is still unknown and it is suggested that research will need to focus on examining deficiencies in each stage of the process before this can be identified (Marshall, et al.).

The proposal that maladaptive beliefs and attitudes contribute to sexual offending is not new. Abel et al. (1989) pioneered research in this area and first identified the concept of cognitive distortions. He argued that these beliefs served to justify sexual contact with children and helped maintain this behaviour. However, it wasn't until recently that potential underlying causal mechanisms of these distortions were identified (Ward & Keenan, 1999). Ward and Keenan hypothesised that maladaptive implicit theories underpinned these distortions, defining these theories as an organisation of knowledge that facilitates an understanding of self, others and the world. These theories guide the processing of incoming information and, as such, information contradicting these basic theories is either rejected or distorted so that it becomes congruent. Five maladaptive theories about victims are thought to be relevant to sexual offending including; (1) children as sexual objects; (2) individuals have the right to assert their needs above those judged as less important; (3) the world and the people in it are dangerous; (4) the world is uncontrollable; and (5) sexual activity is beneficial and unlikely to harm. It is further predicted that these maladaptive theories originate from poor early developmental experiences. Such that, if an individual is exposed to sexual or physical abuse their resultant implicit theories may focus on trying to explain and understand these experiences (Ward & Keenan). As such, harmful behaviour may be construed as normal. While this model does provide a useful framework from which to view the relationship between cognitions and sexual offending, these authors acknowledge that currently our understanding of this concept is still poor.

These implicit theories form part of a larger theory of mind, which constitutes the ability to understand behaviour in terms of desires, thoughts, beliefs and emotions (Wellman, Cross & Watson, 2001). This knowledge of the mind is organised into specific implicit theories, which individuals rely on when making sense of their social worlds. It has been proposed that the

abovementioned deficits in intimacy, empathy and cognition indicate a lack of awareness of other peoples' desires, beliefs, perspectives and needs (Ward, Keenan & Hudson, 1999). As such, Keenan and Ward (2000) have suggested that sex offenders may suffer from a deficit in their theory of mind. They suggest that different developmental issues may lead to different kinds of theory of mind problems resulting in a number of observed deficiencies in sex offenders. Thus, the difficulties experienced are likely to vary among sex offenders depending on the causal mechanism involved. While Keenan and Ward have speculated as to potential causal pathways, they report that much research is needed before the pathways related to offending are identified. Despite this, it is argued that this framework offers a way of unifying seemingly disparate deficits in sex offenders.

Several other cognitive factors have been identified as being important to offending. For example, Ward, Hudson, Johnston & Marshall (1997) construe cognition in a social cognitive framework identifying that there are different cognitive variables including the content (cognitive products) and structures (schemata) of the cognitions and the processes (information processing) that generate them. While the links between the products were discussed above, the literature concerning these other variables is more related to how an offender processes information so they can offend. As such, these variables are more relevant to how offending occurs, rather than why and are thus included in more descriptive theories of offending.

2.3.2.3 Biologqical factors

Genetics, abnormal hormonal levels and brain dysfunction have all been linked to sexual offending. However, definitive findings and theories as to how these factors contribute to this behaviour are sparse. To date, there is no evidence of a genetic factor in pedophilia (Langevin, 1993), although case reports of pedophilic fathers and sons have been reported (Gaffner, Lurie & Berlin, 1984). Inconsistent findings are suggestive of brain dysfunction as measured by neuropsychological tests, computerised tomography (CT) and electroencephalography (EEG). A few theories have speculated as to how these factors may relate to sexual offending.

Some researchers have hypothesised this to be reflective of neuroendocrine abnormalities, such that abnormal hormonal levels may disrupt the sexual arousability of an individual. This is based on the belief that the endocrine system drives sexual behaviour (Langevin, 1993). There is some evidence for this in the literature with peripheral blood samples of pedophiles indicating abnormal

testosterone levels (Bain et al., 1988) and increased plasma testosterone levels in rapists (Berlin, 1989). Very limited research supports this position and as such it is not widely accepted. However, the use of anti-androgen medication in the treatment of sex offenders aims to reduce sexual arousal by decreasing testosterone levels (Maletzky & Field, 2003). Therefore, there does appear to be some current support for the belief that biologically driven sexual urges may contribute to the motivation of sexual offences.

An alternative position in this realm is the neurophysiological hypothesis proposed by Flor-Henry (1987). This theory is based on a belief that normal sexuality is determined by the presence of normal verbal sexual representations, which are dependant on intact dominant hemispheric systems and their ability to trigger the orgasmic response in the non-dominant hemisphere. As such, he proposed that the observed EEG differences in pedophiles were reflective of a pathological neural organisation in the dominant hemisphere thus giving rise to abnormal sexual representations, which in turn lead to, disrupted connections with the non-dominant hemisphere. Consequently, only these abnormal ideas are capable of eliciting an orgasmic response. Although evidence has accumulated to suggest dominant hemispheric dysfunction in sex offenders, methodological limitations hamper definitive conclusions.

Contrary to these theories is the hypothesis that brain dysfunction may not produce the sexual urges; rather it may function to weaken an individual's control of deviant sexual urges (McConaghy, 1993). Specifically how this operates remains unknown. However, it serves as a potentially useful hypothesis in understanding sexual offending and may be explored more in relation to the noted social deficiencies.

Despite the disparity in these hypotheses, the consistency lies in the fact that the researchers supporting these positions consider biological factors to only be a part of what is important to sexual offending (Langevin, 1993).

2.3.3 Descriptive theories

Theory at this level specifies the cognitive, behavioural, motivational and contextual factors associated with the commission of a sexual offence. It focuses on the more temporal and proximal causes or rather how an offence occurs (Ward & Hudson, 1998). There has been a

tendency to overlook this level of theory in the literature. However, recently Ward, Louden, Hudson and Marshall, (1995) postulated a comprehensive offence chain.

This model is cyclical in nature and identifies nine distinct steps that characterise the offence process. Stage 1 comprises background factors that serve to motivate or trigger the cycle including past and present circumstances and the individual's cognitive and affective perception of these events. This stage is followed by a period of distal and proximal planning in which contact with the potential victim is established. Contributing factors at this stage include alcohol intoxication, victim vulnerability, cognitive distortions and sexual arousal. Following the actual offence at stage six is an evaluation period where cognitive distortions may be utilised to overcome feelings of guilt and shame. Future resolutions are made, and the associated distortions or their absence, influence the ongoing background factors and serve to maintain the offending cycle.

Recent research has further contributed to this model by focusing on the cognitive processes involved in offending and their relationship to the stages of the offence chain. Such that, it is proposed that different cognitive processes occur at different stages of the chain. Ward, Fon, Hudson and McCormack (1998) identified seven categories of cognitive processes and suggested that interpretations, explanations and planning are relevant to the earlier stages whereas evaluations, denials and minimisations were associated with stages after the offence. Further work on these processes, cognitive content and their interactions will add greater detail to the knowledge of the offence chain.

At this point in time, this model substantially increases our understanding of the offending process and integrates many of the factors outlined in both level one and level two theories. It further postulates different pathways through which this offence process occurs. One pathway is associated with explicit planning, positive affect and a tendency to romanticise the relationship with the victim. On the other hand, the second pathway involves greater levels of negative emotions, lack of planning and a preoccupation with ones' own needs. It is speculated that offenders follow not only these paths but also a combination of the two, thus enabling the model to account for the heterogeneity of offenders as well as different offending styles or behaviours (Ward, et al., 1995).

2.4 Conclusion

Ideally we would like to have a global etiological theory of sexual offending which would integrate all three theoretical levels into a coherent structure, which includes both distal and proximal causal factors. Although the Pathways Model is a step in the right direction, its limitations still prevent us from understanding how the psychological mechanisms interact with each other to produce offending behaviour (War & Siegert, 2002). In Ward and Hudson's (1998) review of theory construction and development, they concluded that the next step is to identify explanatory gaps in the theory and the level of theory construction that would advance our understanding at this point in time. They further acknowledged that one such possibility for advancement would be more detailed single-factor theories that could tease out causal processes proposed in more general theoretical frameworks. Subsequent theorising may then focus on linking these single-factor theories into more comprehensive and descriptive models.

Many theories place great emphasis on the idea that deficits in the psychological make-up of sex offenders stem from developmental adversity in their childhood. Amongst the most notable of these factors are problematic relationships with their parents and physical and sexual abuse. While there is some empirical evidence that sex offenders experience these problems early in life, it is limited and prevalence estimates varies. Finkelhor (1984) argued that histories of sexual abuse amongst sex offenders only occur in special cases, whereas Fagan and Wexler (1988) reported the prevalence of sexual abuse as ranging from 9% to 47%. Although 47% may be perceived as large and thus supportive of the argument, it must be noted that an even larger percentage did not experience sexual abuse. In one of the most recent studies exploring sex offenders' perceptions of their early experiences, the findings identified that rapists reported poorer relationships with their fathers and child molesters described more sexual abuse. While this was identified as being consistent with previous research, what was inconsistent was the finding of no group differences in maternal relationships (McCormack, Hudson & Ward, 2002). Although these findings do indicate poor early experiences in sex offenders, the study did not use a control group of non-offending participants. As such, it is difficult to ascertain how the identified experiences in the sex offender population compare to frequencies of these experiences in the general population.

Anecdotal and empirical research indicates that a proportion of sex offenders experience poor early relationships. However, comprehensive studies have not been conducted and as such definitive conclusions regarding the relationship between developmental adversity and

subsequent offending cannot be made. Although it would appear logical that developmental adversity may increase the susceptibility to sexual offending, it cannot be the only contributing factor given that not all children who experience problematic childhoods become sex offenders. Furthermore, not all sex offenders report histories of poor childhoods. As such, other important vulnerability factors may be operating prior to the onset of this behaviour.

One concept that has repeatedly arisen in the most recent research is that of information processing and Ward et al. (1997) believe that systematic investigation of information processing in sexual offending will greatly enhance our knowledge and understanding. They further argue that research should draw upon cognitive science for ways of measuring cognitive structures and the impact of attention, recognition, memory, encoding and categorisation on information processing. However, what these authors don't focus on is the relationship between these processes and the functioning of the human brain. Such that, dysfunction in certain parts of the brain may interrupt the ability of an individual to perform these processes adequately. It has been suggested in the literature that sex offenders may have brain dysfunction in the temporal areas of the brain. Given that this part of the brain is involved in attention, memory, emotion and sexual behaviour it appears imperative to ascertain its contribution to sexual offending before identifying the relevance of other factors. The following chapter discusses this subject in detail.

Chapter 3

Functional brain impairment in sex offenders

3.1 Introduction

The previous chapter identified that a potential next step in sex offender research is to examine the contribution of brain function to sexual offending behaviour. This chapter provides an overview of the contribution of the temporal and frontal lobes to sexual behaviour. Firstly, extensive research from animal studies and temporal lobe epilepsy patients is discussed as evidence for the role of these brain regions in human sexual behaviour. Following this is section 2, which provides an overview of the research utilising both functional and structural techniques to assess the brains of sex offenders. Various methodological limitations are highlighted in section 3 including types of sex offender populations used, lack of normal control groups, use of same non-offender control group and the limitations associated with the choice of brain function and structural measures. The chapter then concludes that, although this line of research is worth pursuing, at this time there is no definitive answer as to the nature and extent of brain impairment in sex offenders.

3.2 The neural basis of sexual behaviour

Sexuality is an integral part of everybody's life. However, taboos in many cultures and moral censorship have impeded research on human sexual behaviour. It was only in the first half of the twentieth century that objective research on the human sexual response was conducted. Sexual behaviour comprises two intertwined elements; (1) libido which represents the affective and cognitive processes (subjective thoughts and feelings) motivating sexual activity; and (2) potency which is the physiological capacity to respond to sexual stimuli (Morrell, 1991). While the specific neural mechanisms involved in the modulation of sexual behaviour are yet to be uncovered, extensive animal research and clinical observations of patients with temporal lobe epilepsy has highlighted the temporal lobes, limbic structures and the frontal lobe as playing an important role (Morrell). This section discusses research identifying the frontal and temporal regions as playing a role in sexual behaviour.

3.2.1 The temporal lobes and sexual behaviour.

Considerable animal research has linked the temporal lobes with sexual behaviour. Biological manipulation of the temporal region and its substructures in rats (Elwers & Critchlow, 1960; Fernandez-Guasti, Escalante, Ahlenuis, Hillegaart & Larsson, 1992; Van Dis & Larsson, 1971; Vaughan & Fisher, 1962), cats (Green, Clemente & de Groot, 1957), dogs (Hart, 1974), monkeys (Dua & MacLean, 1964), possums (Bergquist, 1970) and chickens (Howard, Rogers & Boura, 1980) has demonstrated that sexual behaviour can either be elicited or abolished. Stimulation studies of deep temporal lobe structures (medial preoptic area, anterior hypothalamic nuclei and median forebrain bundle) in a variety of animals have elicited basic sexual functions (penile erection and seminal discharge) and an increase in sexual activity (Dua & MacLean 1964; MacLean, et al., 1963; MacLean & Ploog, 1962; Vaughan & Fisher, 1962). Contrarily, lesion studies predominantly of the amygdala and hippocampus have documented abolition or marked impairment in copulation (Hart, 1974; Heimer & Larsson, 1966; Szechtman, Caggiula & Wulkan, 1978).

Endocrine studies further support these structures as important in the regulation of sexual behaviour. Testosterone propionate implanted in the medial preoptic hypothalamic area restores copulation in castrated rats (Heimer & Larsson, 1966; Johnston & Davidson, 1972; Lisk, 1967). Injections of serotonin into the same region resulted in an inhibition of sexual behaviour of male rats as evidenced by an increase in the number of mounts (Fernandez-Gusti et al., 1992). Contrarily, injections of the cholinergic agonist carbachol into the substantia nigra altered sexual behaviour in male rats such that intromission frequency was reduced (Winn, 1991).

The most pervasive animal case demonstrating the relationship between the temporal lobes and sexual behaviour is that of Kluver and Bucy (1939). These researchers removed both temporal lobes including the uncus and the greater part of the hippocampus in macaque monkeys. Five significant behavioural changes were documented and collectively became known as the Kluver-Bucy syndrome; (1) marked decrease of anger and fear; (2) excessive tendency to attend to all stimuli; (3) incessant need to put everything to the mouth; (4) an inability to recognise objects; and (5) an increase in overt sexual activity. Of particular importance here, is the overt and uninhibited sexual behaviour that resulted in indiscriminate attempts to mount both animate and inanimate objects. It is thought that this behaviour may represent an inability to recognise an appropriate sexual partner (Ellison, 1982). It was reported that the limbic, medial-temporal portion of the temporal lobes was responsible for the observed behavioural changes. This

suggests that not only are these structures involved in the modulation of the physiological sexual response, but that they may also play a role in the more libidinous aspects of sexuality.

An equally striking change in sexual behaviour has frequently been observed in patients with temporal lobe epilepsy. Hyposexuality following the onset of seizures in these patients was first observed in 1954 (Ellison, 1982). Defined by the frequency of less than one episode of sexual behaviour per month (Cummings, 1985), this observation was characterised by a marked reduction in both libidinal (loss of interest in sexual activity and lack of sexual fantasies) and genital arousal (decrease in the number of erections). Since this time, numerous accounts of hyposexuality have been documented (Blumer 1970; Blumer & Walker, 1967; Demerdas, Shaalan, Midani, Kamel & Bahri, 1991; Fenwick, et al., 1985; Shukla, Srivastava & Katiyar, 1979; Taylor, 1969), and its association with the temporal seizure discharge has been consolidated by research reporting the termination of hyposexuality following surgery or the administration of drugs (Blumer, 1970; 1975). In these cases restoration of sexual desire and ability were reported.

This hyposexuality directly contrasts the observed hypersexuality demonstrated in animals, indicating that the state of activity in the temporal lobes influences the modulation of sexual behaviour. Specifically, it appears that continuous excessive activity of the temporal structures has an inhibitory effect, whereas, a lack of activity has an excitatory effect.

In addition to hyposexuality, patients with temporal lobe epilepsy have also exhibited a number of other abnormal sexual behaviours. Specifically, it is reported that these patients are particularly vulnerable to paraphillias (group of disorders in which unusual or bizarre imagery or acts are necessary for sexual excitement). Fetishism and transvestism are the most commonly documented in the literature as being related to these patients. However, voyeurism, sadism, masochism, frotteurism and genital self-mutilation have also been reported (Cummings, 1985).

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA, 1994), fetishism and transvestism are both characterised by recurrent intense sexual fantasies, urges or behaviours involving non-human objects. Specifically for transvestism, dressing in women's clothing is the object of sexual arousal. The most striking case study highlighting the relationship between temporal lobe epilepsy and fetishism is that reported by Mitchell, Falconer and Hill (1954). In this case the patient reported that from the age of 8 years he experienced a feeling of

pleasure when he gazed at a safety pin. Later in life his wife described a sequence of his behaviours, which were initiated by staring at the safety pin for one minute. These included glassy-eyes, humming, sucking movements of his lips and immobility. He also occasionally walked backwards and crossed-dressed in her clothing. This fetish disappeared after he underwent surgery to remove the epileptic foci located in the left temporal lobe.

Davies and Morgenstern (1960) reported four cases in which transvestism was associated with temporal lobe epilepsy. Epstein (1960, 1961) reviewed five patients with fetishism and transvestism, two of which had clinical epilepsy and three having distinct EEG abnormalities in the temporal region. Hunter et al. (1963) reported a further case in which temporal lobectomy ceased fetishist and transvestite activity.

While these reports only document a few cases, further investigations using larger samples also support the relationship between temporal lobe dysfunction and paraphilias. Hoenig and Kenna (1979) reported that in their sample of 46 transsexuals, 48% exhibited EEG abnormalities half of which were located in the temporal region. In a more systematic study of 86 men with epilepsy, Kolarsky et al. (1967) documented that sexual deviations were apparent in 22% and that this was significantly related to patients with temporal lesions. Amongst the sexual deviations exhibited were voyeurism, exhibitionism, sadism, masochism, fetishism and transvestism (Cummings, 1985).

The outlined research consistently documents changes in sexual behaviour associated with temporal lobe epilepsy. However, conclusions regarding the precise prevalence of this relationship are unknown as the research is fraught with methodological and interpretive difficulties. Study designs have largely been uncontrolled and many confounding variables have included the effects of medication, lack of precise definition of seizure type, degree of seizure control and age (Morrell, 1991). In a more recent study comparing self-reported sexual function of epileptic patients with healthy controls and patients with diabetes no difference was reported (Jensen et al., 1990).

This study however, raises another main concern with research in this area, and that is the reliance on self-reported sexual behaviour. Retrospective self-reports rely heavily on long-term memory which may not be accurate or detailed in patients with temporal lobe epilepsy (Davidson, Kwan & Greenleaf, 1982), thus, leaving the data open to several interpretations.

Despite the need for standardised measures of sexual response and a control for anti-epileptic medication (Morrell, 1991), the research collectively highlights that the temporal lobes are in some way related to sexual behaviour. More recent research utilising more sophisticated techniques has supported this notion in both animals and humans. Kindling-like stimulation of the medial preoptic area induced sexual behaviour in non-copulating rats (Portillo, Basanez & Paredes, 2003) while antiandrogens affecting the receptors in this same region reduced sexual motivation and suppressed sexual behaviour (McGinnis, Montana & Lumia, 2002). In a study evaluating human cerebral centres of penile erection using functional magnetic resonance imaging (fMRI), the inferior frontal and temporal lobes and limbic structures (cingulate gyrus, corpus callosum, thalamus, caudate nucleus and globus pallidus) were activated in healthy subjects during an erotic film (Park et al., 2001).

In short, research continuously links sexual behaviour with the temporal lobe and its substructures and demonstrates that disruptions to these regions produce alterations in both libido and potency.

3.2.2 The frontal lobes and sexual behaviour

Research has highlighted that the frontal lobe is divided into several subregions, all of which produce distinct behavioural changes. While there is some controversy over the labelling of the various types of changes into specific syndromes, there is a general consensus that three distinct sets of changes occur with damage to the frontal lobes. The first set of changes is related to what may broadly be termed personality, the second set involves changes to intelligence and the third set are characterised by adynamia (lack of verbal or overt behaviour) (Walsh, 1994). It is reported that changes to sexual behaviour are encompassed in the first set of characteristics and are resultant from damage to the orbito-frontal region of the brain (Cummings, 1985).

The documentation of personality changes to patients with frontal damage dates back to the 1800's. The most pervasive case being that of Phineas T. Gage, a patient injured when an iron bar was blown through the front of his head. His injury primarily affected the area upwards from the medial orbital region to the precentral region (Kolb & Whishaw, 1990). Widely documented is the complete change in his behaviour, which was generally characterised by impulsivity, lack of concern and lack of inhibition (Walsh, 1994). Similar observations were made in patients with

damage to the orbito-frontal cortex. Their behaviour was characterised by a lowering of moral and ethical standards, euphoria, elation and obscene language (Starkstein & Robinson, 1991).

While early psychiatric case studies consistently reported personality alterations following damage to the frontal brain regions (Kolb & Whishaw, 1990), animal studies in the early 1900's continually produced negative results. Researchers were unable to detect any behavioural changes resulting from anterior lesions to the frontal cortex (Starkstein & Robinson, 1991) until 1948 when changes in monkeys following cingulotomy were observed. These observations highlighted that the monkeys appeared tamer, seemed to have lost their social conscience and were unable to predict the consequences of their actions (Starkstein & Robinson). Since this time few systematic studies have examined the effects of frontal lesions, although, extensive literature on psychosurgery supports the idea that the orbito-frontal region is associated with disinhibited and impulsive behaviour. The changes resulting from such a lesion can be summarised as exhibiting immature behaviour, lack of tact and restraint, coarse language, promiscuous sexual behaviour and a general lack of social graces (Blumer & Benson, 1975).

In contrast to patients with temporal lobe damage, the changes in sexual behaviour observed in patients with orbito-frontal damage appear related to a lack of inhibitions (libidinous aspects of sexual behaviour) rather than a change in their frequency of sexual activity or arousal (Kolb & Whishaw, 1990). Several case studies highlight the existence of abnormal sexual behaviour in reference to socially acceptable standards and the patients' past history of sexual practices. Amongst these documentations are the observations of an excessive and disinhibited interest in sex (Starkstein, Boston & Robinson, 1988), engaging in forceful sex with partner in the presence of relatives, masturbation in public and the commencement of homosexual relationships (Starkstein & Robinson, 1991). Other observations reported include sexual preoccupations, inappropriate sexual jokes and comments, openly soliciting sexual activity, walking around naked and attempts to fondle members of the opposite sex (Blumer & Benson, 1975; Cummings, 1985; Taylor, 1969).

While empirical data is lacking to support such observations, the accumulation of anecdotal evidence highlights the possible involvement of the frontal lobes in abnormal sexual behaviour.

3.3 **Past Research**

Limited literature is available on the brain structure and function of sex offenders. Neuropsychological assessment and computerised tomography (CT) have been the predominant measures used, with regional cerebral blood flow (rCBF) and electroencephalography (EEG) being used to a lesser extent by other researchers. Various offender populations have been examined which limit the comparability of studies and the generalisability of the results.

One group of researchers have dominated the field and at the end of a decade of research, this group of authors concluded "collectively the findings…suggest that pedophiles have structural abnormalities, reduced size and greater asymmetry and functional impairment in the left temporal-frontal areas" (Wright et al., 1990 p. 327). Despite the significant contribution these authors have made to sex offender research, this conclusion should be regarded as tentative given the inconsistency in the results and the methodological limitations confounding the research. The following sections identify inconsistencies in the research and discuss factors that complicate sex offender research, thus, preventing the identification of such a specific conclusion at this time.

Hucker et al. (1986) examined 41 men facing charges for sexual offences against children and compared them to 14 non-violent non-sex offenders. Using the Halstead-Reitan Neuropsychological Battery (HRNB) and Luria Nebraska Neuropsychological Battery (LNNB) they found that the pedophiles had significantly greater overall functional impairment. Further to this, CT scans identified that the pedophiles had significantly more CT abnormalities and in most cases dilatation of the anterior and temporal horns was evident. Despite differentiating the pedophiles into subgroups based on their sexual preference, insufficient numbers precluded them from drawing any subgroup conclusions. However, the authors concluded that as a group the pedophiles showed neuropsychological impairment, specifically they reported that the composite pattern from the functional and structural measures suggested more left temporal-parietal involvement.

In 1989, Langevin, Wortzman et al. attempted to replicate these findings using a larger sample of pedophiles (n=113) to ascertain potential subgroup differences. These results confirmed that the pedophiles showed more overall functional impairment compared to controls (n=31) as indicated by the Impairment Index of the HRNB, with some subgroup differences becoming evident. Contrarily, the CT results were not confirmed, such that, neither general abnormalities nor

temporal lobe abnormalities were found. Furthermore, additional neuropsychological tests including the Wechsler Memory Scale (WMS) and Space Relations Test (SRT) did not indicate any differences between the groups. No location specific functional or structural impairments were noted in this study, with the researchers concluding that while the suggestion of brain damage and dysfunction is suggested in sex offenders the results are far from consistent.

A further three studies conducted by other researchers using the LNNB demonstrated neuropsychological impairment to varying degrees in sex offender populations. However, only one study utilised a specific pedophilic group (Scott, Cole, McKay, Golden & Liggett, 1984). The other study used a very small sample (n=6) of mentally disordered sexual offenders (Graber, Hartmann, Coffman, Huey & Golden, 1982), which given their intellectual capacity may already have had some neurological impairment. The third study used a heterogenous group of sex offenders including rapists, pedophiles and exhibitionists (Galski, Thornton & Shumsky, 1990). Although these studies support the hypothesis of neuropsychological impairment in sex offenders, these studies used different sex offender populations compared to those employed by Hucker et al. (1986). As such, it is difficult to compare the results of these studies with that of Hucker et al's findings and ascertain which group of offenders exhibit this impairment.

Partial support for Hucker at al's (1986) findings emerged with Flor-Henry, Lang, Koles and Frenzel's (1991) report that "true" pedophiles differed significantly from controls in EEG power and coherence during verbal processing. This led to his conclusion that left hemisphere functions may be disrupted in pedophiles. However, given that Flor-Henry, Lang, Koles & Frenzel (1988) previously reported this same disruption in a group of exhibitionists, the impairment was not exclusive to the pedophilic group. Furthermore, lower regional cerebral blood flow (rCBF) was reported in both mentally disordered sexual offenders (n=6) (Graber et al., 1982) and a group of males incarcerated for sexual offences against children (Hendricks et al., 1988). While this is indicative of functional impairment, the very small sample sizes used and again the difference in populations render it difficult to generalise the results.

Langevin and colleagues continued their work with other sex offender populations to ascertain whether the impairment was exclusive to pedophiles or extended to other sex offender populations. Studies of men facing charges of incest (Langevin, Wortzman, Dickey & Handy, 1988), exhibitionism (Langevin, Lang, Wortzman, Frenzel & Wright, 1989) and assault against adult women (Hucker et al., 1988) failed to confirm Hucker et al's (1986) findings. Despite 13.3%

of incest offenders scoring in the impaired range on the HRNB, their performance did not differ significantly from a non-sex offender control group. Furthermore, there were few differences in their CT scans (Langevin et al., 1988). Exhibitionists also did not differ in their overall functioning as measured by the HRNB or in their CT scans (Langevin, Lang et al., 1989). Although the sadists (rapists) showed significantly more CT abnormalities in the right temporal horn, it was the non-sadists who were more functionally impaired as indicated by the LNNB (Hucker et al., 1988).

The inability of these researchers to replicate their earlier findings of impairment in pedophiles with several other sex offender groups supports their argument that structural and functional impairment may only exist in certain types of offenders. However, the research did not provide further evidence for the identification of location specific impairment or structural abnormality. These researchers duly noted this and in 1989 they reported, "the present investigations suggest that sex offenders show some brain damage and dysfunction but results are far from consistent" (Langevin, Wortzman et al., 1989, p. 178). They further reported in 1990 (Wright et al.) that "the findings of these studies suggest that not all sex offenders will show brain damage and neuropsychological dysfunction...It is also clear that gross pathology in sex offenders is relatively rare and that if there are differences in brain structures of sex offenders and controls, they are subtle" (Wright, et al., p. 321). However, after their 1990 study which found smaller brains in sex offenders and greater brain asymmetry in pedophiles, they reported the much more specific conclusion (noted earlier) that pedophiles had structural abnormalities and functional impairment in the left frontal and temporal brain areas (Wright, et al.). This conclusion appears premature because this study did not provide data on the functional impairment of pedophiles and the authors previously reported that research was inconsistent (Langevin, Wortzman et al.). Although their research, in general, indicated the existence of some form of brain dysfunction in pedophiles, their research only consisted of two studies on pedophiles one of which indicated global dysfunction, the other indicating temporal-parietal dysfunction. As such, there is insufficient evidence for conclusions regarding location specific dysfunction or structural abnormality in sex offenders.

3.3.1 Methodological limitations

A number of important methodological limitations not only prevent a definitive conclusion regarding the nature of functional and structural impairment in sex offenders, but they may also have masked potential impairments and differences between the groups. Specifically

confounding this research are the types of sex offender populations used, lack of normal control groups, use of same non-offender control group and the limitations associated with the choice of brain function and structural measures. Each of these will be discussed in turn.

3.3.1.1 Sex offender populations

There are many inherent problems with sex offender populations. Firstly, the lack of consistency in the definition of "sex offender" across the studies renders it difficult to ascertain the parameters of the group to which this dysfunction is attributed. That is, do all sex offenders exhibit this abnormality or is it based on victim type (children versus adults) or level of violence? While some studies have recognised this (Langevin et al., 1985; Langevin et al., 1988; Langevin, Wortzman et al., 1989), others have not (Scott et al., 1984). Thus, rendering the samples incompatible and reducing the ability to compare and contrast the results.

This lack of clarity in definition may be a product of the heterogeneity of the sex offender population. Not only are there are many different categories of "sex offenders" but many offenders commit more than one type of offence. This was highlighted in the Galski et al. (1990) study in which the researchers noted that many of the offenders in the study had records of both violent and non-violent sex offences. Further to this, Langevin et al. (1988) reported that 33% of men facing charges for sexual assault and/or incest had a previous conviction for non-sex offences.

Some researchers have recognised this heterogeneity and have employed the use of phallometric testing to identify the sexual preference of men facing charges of sexual assault against a minor or pedophilia (Hucker et al., 1986) and to determine distinct sub-groups of pedophiles (Langevin, Wortzman et al., 1989). This measurement involves the monitoring of penile volume changes while watching moving pictures of men, women, boys and girls (Hucker et al., 1986). Although this procedure has been identified as successful in differentiating pedophiles from normal males (Freund, 1965, 1967a, 1967b; Freund, McKnight, Langevin & Cibiri, 1972; Freund, Watson, Dickey & Rienzo, 1991), it remains a controversial tool. Firstly, not all research supports the usefulness of this technique (Baxter, Marshall, Barbaree, Davidson & Malcolm, 1984) with one study reporting that heterosexual pedophiles were also highly aroused by pictures of adult females (Marshall, et al., 1986). Secondly, it has been established that age or partner preference can be faked (Freund, Watson & Rienzo, 1988) and that a clear diagnosis is not

always established. In a study by Freund and Blanchard (1989) about 21% of patients were unable to be diagnosed due to insufficient responding, failure to show clear age preference and attempts to manipulate the response. Thirdly, the test does not ascertain what the subject is thinking during the recording. Such that, a normal male may produce positive responses to child stimuli, however, he may be thinking about the previously nude adult female. As such, a false diagnosis of pedophilia is recorded. Due to this, it has been recommended that the test be used with appropriate validity studies of the general population (Freund & Blanchard). This is a limitation of the discussed research, as the phallometric test was not administered to the non-sex offender control group.

In the fourth instance, phallometric testing is a measure of sexual preference and not behaviour. Therefore, positive results to child stimuli cannot be interpreted as evidence for sexual offences against children (Freund & Blanchard, 1989). This raises significant questions regarding the populations used by the group of researchers discussed in the literature as they generally used non-convicted samples. As such, it cannot be guaranteed that all the men in the sample had committed sexual offences against children. Thus, it would appear that the stated studies have measured the brain function of men with specific sexual preferences, rather than sex offenders. This places further limitations on their conclusions and argued position regarding brain impairment in sex offenders.

In addition to the use of phallometry, self-report and criminal histories have also been used to collect data for classification into sex offender group or pedophilic sub-group. However, the self-report measure appears to be unreliable with one study reporting that only 53% of their sample admitted to their current charges of sexual assault or incest (Langevin et al., 1988).

A second potential inherent problem with the sex offender population is that many confounding influences are part of a sex offending lifestyle. Specifically, many sex offenders may have a history of alcohol and/or drug abuse, which in itself can lead to brain pathology. Researchers in this field have acknowledged this and have incorporated assessment tools for substance abuse into their studies. However, the results of their assessments indicate that in their research this has not proven to be a problem. Although some of the sex offenders and controls had significant alcohol and drug abuse histories, statistical analyses did not report any differences on neuropsychological tests between those with and without substance abuse histories (Hucker et al., 1986; Hucker et al., 1988; Langevin et al., 1988; Langevin, Wortzman et al., 1989).

Collectively, the studies utilising these measures concluded that, in general, the neuropsychological differences between their groups were not attributable to substance abuse (Langevin et al., 1988).

3.3.1.2 Control groups

Research has largely relied on non-sex offending control groups comprising other non-sex offending criminals rather than participants without offence histories. This renders it difficult to ascertain whether the observed differences are unique to sex offenders or whether they occur at the same frequency in the general population. It has been noted that the use of this control group may be partially responsible for the lack of group differences as non-sex offenders may also have high rates of brain dysfunction (Mills & Raine, 1994).

Few studies have utilised normal control groups. Flor-Henry et al's (1991) control group matched on age, sex and education is perhaps one of the better examples. However, the lack of inclusion of a non-sex offending control group in this study renders it is difficult to identify whether the observed EEG differences are exclusive to pedophiles or more broadly associated with criminal behaviour. Hendricks et al. (1990) also failed to use a non-sex offending control group, thus, adding to the limits of their findings of structural and regional cerebral blood flow differences in child molesters. However, more importantly was the inclusion of females in a control group for comparison with an all male sex offender group. While the authors argue that this inclusion did not impact on the results, these findings must be accepted with caution given that men and women may have different brain organisation (Kolb & Whishaw, 1990).

Although some interesting findings have emerged from the literature, over half the research in this area has been conducted by the same group of researchers with a common control group (Mills & Raine, 1994). In Hucker et al's (1988) study on sexually aggressive men, a control group comprising 36 non-violent non-sex offenders was utilised. However, of this group only 20 had been tested at the time of the study. The remaining 16 participants had been tested some three years earlier in a previous study (Langevin et al., 1985). This same control group, or part thereof, was used in a further three studies (Hucker et al., 1986; Langevin, Wortzman et al., 1989; Wright et al., 1990). Given this, it cannot be assumed that the results of the control group have consistently been replicated. Therefore, it is possible that if new control groups had been used with each study, the observed differences may have been different. This raises questions

regarding the generalisability of the observed differences between the controls and sex offenders, to the general population.

3.3.1.3 Limitations of measures used

Neuropsychological assessment and CT scans have been the predominant techniques used in this research. However, as discussed in Chapter 1 these techniques aim to measure different aspects of the brain: function and structure, respectively. As such, the findings of the functional and structural measures may not correlate since the brain may be functionally impaired but structurally normal. Conversely, a structurally impaired brain may still function within normal limits (Mills et al., 1994). Given this, it is possible that sex offenders have structurally normal brains with impaired functioning or vice versa. This may account for some of the perceived inconsistencies between the results of these measures in the research. Such as, in Langevin, Wortzman et al. (1989) where functional impairment in sex offenders was indicated by an impaired Halstead-Reitan Neuropsychological Battery Index (HRNB) index but no structural differences were found in their CT scans. Further to this, these techniques may also be uncorrelated due to their own associated limitations. The limitations of each technique are discussed below.

The Luria-Nebraska (LNNB) and Halstead-Reitan (HRNB) Neuropsychological batteries have been the predominant tests used to assess neuropsychological functioning in sex offenders. However, both of these measures have been subject to considerable debate in terms of their reliability and validity. The LNNB is not widely accepted and has been criticised on a number of dimensions including its theoretical basis, heterogeneity of subtests, sampling limitations and its sensitivity to detecting brain dysfunction (Purisch, 2001). However, Purisch argues that this bias is based on incorrect knowledge. Contrarily, the HRNB is widely accepted and although it has been extensively criticised by Lezak (1995) for many of the same reasons as the LNNB, many neuropsychologists still use, at least parts of, the HRNB (Russell, 1998). Russell in his critique of Lezak's review identifies that her criticisms of the HRNB are unfounded and based on a misunderstanding of the basis of the tool.

Common to both these measures is the criticism that they don't equally address all areas of neuropsychological skills, which are referred to as sampling limitations (Purisch, 2001). Resulting from this is the inability of these batteries to specify localised brain dysfunction. Even the

supporters of the LNNB agree with these limitations and Purisch has argued that while the LNNB may be sensitive to obvious signs of right hemisphere association, diffuse or prefrontal regions, he suggests that other tests would need to be used to provide insights into other areas.

Specifically, it has been argued that neither of these measures adequately assesses memory (Kolb & Whishaw, 1990; Purisch, 2001). Given that memory is one of the predominant functions of the temporal lobes, specific conclusions regarding the functioning of these lobes based on these measures alone are unsubstantiated. This raises questions as to the utility of such measures in the neuropsychological assessment of sex offenders hypothesised to have temporal dysfunction. As such, the observed neuropsychological differences between sex offenders and non-sex offenders may not have been adequately assessed.

Hucker et al. (1988) recognised the use of the LNNB as a limitation in their study, acknowledging that its ability to localise brain pathology is poor, and identifying that group differences based on these results were weak. They modified their conclusions accordingly stating that differences between groups were more indicative of global impairment. As such, their conclusions hold merit. However, some studies failed to take these limitations into account and reported location specific deficits in sex offenders (Galski et al., 1990; Graber et al., 1982). These studies concluded that sex offenders had impairment located to right parietal-occipital areas and left frontal areas (Galski et al.) and frontal and temporal lobes (Graber et al.). However, given that the LNNB does not have the power to discriminate such specific deficits, these conclusions must be regarded with caution.

Hucker et al. (1986), Langevin et al. (1988) and Langevin, Lang et al. (1989) did not specifically report the limitations of the HRNB in their research. However, Langevin, Wortman et al's (1989) inclusion of an additional memory test (Wechsler Memory Scale) and a spatial ability test (Space Relations Test) indicate that they were perhaps aware of these limitations and attempting to make adjustments. Although these tests did not prove fruitful in identifying differences between pedophilic subgroups, they did improve the methodological quality of the study. Given this improved methodology, the finding of no difference between sex offender groups (pedophiles, incest offenders and sexual aggressives) on either of these measures carries more merit than does the results from previous studies. As such, this raises questions as to the previously documented findings indicating right hemisphere deficits in sadists (Langevin et al., 1985) and temporal dysfunction in pedophiles (Hucker et al., 1986). However, potential differences may

have been masked, as these groups were not compared to either a non-sex offending or non-offending control group.

Research in the sex offending area has also focused on the use of computerised tomography (CT) and electroencephalography (EEG) to examine brain structure and activity respectively. Although these measures are highly reliable and valid, they may lack the specificity necessary to identify dysfunction in the temporal structures. For example, CT scans may have poorer spatial resolution of smaller brain structures due to interference of the bony structures at the base of the skull, (Mills & Raine, 1994; Langevin, Wortzman et al., 1989), whereas the surface recording of brain activity (such as EEG) may not be indicative of deep temporal activity. As such, group differences may have been masked in previous studies employing these measures.

3.4 Conclusion

Collectively the past research at best indicates the possible existence of brain impairment in sex offenders. However, it does not provide sufficient evidence for conclusively identifying the parameters of the group to which this dysfunction is attributed, or the location specific functional impairment. Thus, there still exists an important gap in the research that needs to be addressed. Specifically, which group of sex offenders have functional brain impairment and to what extent? The following chapter outlines a research design that aims to answer this question.

Chapter 4

Research design

4.1 Introduction

The previous chapter identified that an important gap still exists in the research with respect to sex offenders. Specifically, it is still unknown whether sex offenders have a brain impairment and if so to what extent and what is the quality of this impairment. This chapter is divided into five sections and outlines a research design that aims to answer this question. Section 1 identifies the research hypothesis. Section 2 provides an overview of the participant groups to be used in the study, including incarcerated male sex offenders, incarcerated male non-sex offenders and a group of community men with no offence history. Section 3 identifies neuropsychology and neuroimaging as the methods available for assessing brain function. An overview of these methods is presented and the disadvantages of neuroimaging that lead to the decision to use neuropsychological assessment in this study are discussed. Section 4 presents an overview of the neuropsychological tests to be utilised. Section 5 provides an overview of the present study, identifying the demographic details of the participant groups and describing the procedure for the collection of data.

4.2 Hypothesis

The previous chapters highlighted that many of the etiological theories of sexual offending identify cognitions and emotions as casual elements of this behaviour. The most recent conceptions of both of these elements in the sex offending literature is from an information processing perspective, with researchers arguing that subsequent studies should focus on objectively measuring information processing (Ward et al., 1997). Given that our ability to process information is dependent on the functioning of our brains, it would seem that one such objective method would be the assessment of brain function. This approach is also consistent with the biological perspective of sexual offending which generically hypothesises that sex offenders have some form of brain dysfunction. As such, pursuing this line of research may highlight potential links between the biological and social-cognitive perspectives of sexual offending.

The lack of a consistent definition of sex offenders in previous research has produced some difficulties in studying the biological basis of pedophilia and indeed it is difficult to ascertain from previous research, with any precision, the precise group of sex offenders to which a brain dysfunction has been attributed. However, it has been postulated that pedophiles have brain dysfunction in the frontal and temporal regions of the brain. As these brain regions are involved in the regulation of many elements thought to be relevant to sexual offending including emotions, information processing and sexual behaviour, it is logical to hypothesise that sex offenders may exhibit dysfunction in these areas. Although previous empirical research does not consistently support this, emerging evidence indicates that impairment in this neural area is possible. As such, the lack of support for the hypothesis appears to be a product of fundamental methodological limitations that have prevented this hypothesis from being addressed adequately, rather than a lack of support from valid empirical studies that have shown no association with pedophilia and temporal lobe activity. However, the hypothesis that pedophiles as opposed to other child sex offenders have this dysfunction has not been validated, with research indicating no differences between incest offenders and pedophiles (Langevin et al., 1988). As such, it is possible that the dysfunction is attributed to all individuals who sexually offend against children. Given this, it is possible to tentatively argue that males convicted of sexual offences against children will have some form of functional impairment in their frontal and temporal brain regions. This will be the area of research undertaken in this dissertation.

4.3 Definition of participant groups

Many problems associated with sex offender research were highlighted in the previous chapters, particularly with reference to the definition of the sex offender group and the use of inadequate control groups. It was identified that the current diagnosis of pedophilia contained in the DSM-IV-TR (APA, 2000) was problematic and not readily used by researchers or clinicians in the area (Marshall, 1997). It was further reported that, although there is no consensus as to the definition of child sex offender, many professionals often use the conventional research definition of child molester. This construct is generally defined as any individual who has committed a sexual offence against a child, (Marshall, 1997; O'Donohue et al., 2000), whereby the governing laws and legal age of consent define the terms "sexual offence" and "child". Further to this, a child molester is considered as such irrespective of whether the behaviour is persistent (Marshall). However, the offender must be at least 16 years old and five years older than the victim (Barbaree & Seto, 1997). Given this, the research contained in this dissertation focuses on men

convicted for sexual offences against children. Therefore, the term pedophilia will not be used in this study. This group will be referred to as the sex offenders.

In Australia, the recruitment of sex offenders is limited to the criminal justice system, either through the prison system or the community treatment programs. One criticism of the use of incarcerated sex offenders is that their characteristics may be reflective of the effects of imprisonment (Araji & Finkelhor, 1985). While this may be a consideration in research evaluating state variables such as cognitions, emotions and personality, it is unlikely to effect stable trait factors such as brain function. Nevertheless, the inclusion of an incarcerated non-sex offending group of individuals will help control for any potential effects of incarceration on the sex offenders. Given this, recruitment of the sex offenders in this study is through the Victorian prison system.

A major limitation of the previous research was the lack of appropriate control groups, resulting in difficulty ascertaining whether sex offenders differed from other non-sex offenders and the general population. As such, this study utilises two control groups to control for offence type, effects of imprisonment, age, level of education and level of intelligence. A group of incarcerated men convicted of offences of a non-sexual basis will be used and recruited through the Victorian prison system. A second group comprising individuals with no offence history will be recruited through the community. In this study, these groups are respectively referred to as non-sex offenders and controls.

One of concerns in this type of research has been the substance abuse history of both sex offenders and non-sex offenders (Langevin, Wortzman et al., 1989). However, none of the reported studies assessing the impact of this on either group of offenders' neuropsychological performance have found significant results. Therefore, the present study does not assess substance abuse history.

4.4 Method of assessing brain function

Neuropsychology is defined as the study of the relationship between brain function and observable behaviour. The main purpose of the neuropsychological assessment is to draw inferences about the functional characteristics of the brain based on a variety of standardised tests (Benton, 1994). Although this is the most commonly used method of assessing brain function, technological advances have seen the development of new metholodologies for

exploring brain-behaviour relationships. Specifically, functional neuroimaging techniques, such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) are increasingly being introduced into both clinical practice and research. These techniques measure brain activity by means of regional cerebral blood flow (rCBF) during cognitive tasks. Although these advances increase the capability for visualising the brain and uncovering brain regions associated with cognitive tasks, a number of disadvantages also exist in relation to the underlying assumptions, interpretation of activation patterns and technical aspects (Sergent, 1994). This section is divided into two parts. The first discusses neuroimaging and the disadvantages that preclude its use in this study. Secondly, neuropsychology is briefly discussed, highlighting the various methods and approaches available and identifying the method that will be used in this study.

4.4.1 Neuroimaging

Technological advances have led to the development of new methodologies to assess brain-behaviour relationships. Among the most advanced technologies are functional neuroimaging techniques including positron emission tomography (PET) and functional magnetic resonance imaging (fMRI). These techniques measure brain activity by means of regional cerebral blood flow (rCBF) during cognitive tasks. One of the more common methods to draw inferences regarding cognitive function from these activation patterns is the subtraction method. This method requires that two tasks (experimental and control) differing along only one dimension be completed. The activation pattern in the control condition is subtracted from that of the experimental task and the resultant regions where activity levels differ significantly across the two conditions are thought to be relevant to the cognitive process involved in the experimental task (Posner & DiGirolamo, 2000; Sergent, 1994).

Two comprehensive reviews of PET and fMRI studies of normal participants concluded that many of the activation patterns are consistent with results of previous research highlighting the effects of brain damage in humans and animals. They argued that the reasonably consistent patterns across the studies attest to the value of imaging cognitive function (Cabeza & Nyberg, 1997, 2000). However, a number of practical and methodological limitations associated with these procedures render that these conclusions be regarded with caution.

A number of questions have been raised about some of the fundamental assumptions underlying these procedures and the ability to infer functional information from activation patterns. One of the main assumptions governing interpretation is that patterns of cerebral activity provide a reliable basis from which to infer functional information (Sergent, 1994). However, it has been argued that to date there is no proof that activation patterns are causally related to cognitive processes (Bub, 2000). This creates interpretive difficulties and Bub identifies that many researchers make sense of the data by relying on previous assumptions and theories regarding the relationship between cognitive function and brain anatomy rather than on the task comparison itself. He further argues that these interpretations are thus invalid, as functional imaging is not based on the same methodological principles from which those previous assumptions and theories were made.

It is further assumed that increases in rCBF reflect excitatory processes and the higher the increase, the higher the contribution of that area to the task. However, it is argued by Sergent (1994) that the polarity of the activation cannot be detected by this approach and that the relationship between rCBF and extent of contribution is not linear. Such that, the more habituated or practiced a task is, the less activation recorded (Sergent). As such, these assumptions require further validation prior to the utility of neuroimaging as a test of neuropsychological and neurophysiological theories of higher cognitive function (Bub, 2000).

A number of basic methodological limitations also impact on the accuracy and usefulness of the interpretations. As outlined above the subtraction method is used to draw inferences regarding the relationship between cognitive function and activation patterns. However, this methodology has been questioned as there is no way of determining whether the observed differences are related to cognitive processes underlying the experimental task or something else occurring either concurrently or coincidentally (Benton, 1994; Bub, 2000; Fiez, 2001; Hardcastle & Stewart, 2002; Poldrack, 2000). It is possible that unrelated areas to the task may be activated or related areas may be subtracted out if they coincide with the areas involved in the control task. Further to this, different activation patterns may occur for an experimental task if varying control tasks are used (Sergent, 1994).

Additionally, it is often difficult to obtain tasks that differ on only one cognitive process, thus resulting in many studies utilising a very simple control task such as resting with eyes closed. Consequently, this does not subtract out sensory, motor or linguistic processes from the

experimental task. Furthermore, it is very difficult to ascertain an experimental task that requires only one eegnitive process (Cabeza & Nyberg, 1997). As sueh, these procedures are unable to detect with reasonable accuracy the regions essential for performing a task (Cabeza & Nyberg, 2000). Given this, it has been suggested that neuropsychological tests be utilised in conjunction with functional imaging to ascertain this information (Cabeza & Nyberg, 2000)

On the more technical side, limitations in temporal and spatial resolution and volume scanned have also been reported. While most PET scanners cover the whole horizontal dimension of the brain, they miss parts of the vertical dimension including the top frontal and parietal areas close to the central sulcus and the lower regions of the temporal pole and ventral cerebellum (Cabeza & Nyberg, 1997). Further to this, the low temporal resolution renders the PET technique unable to deteet small ehanges (Hardcastle & Stewart, 2002; Sergent, 1994). Given that the nature of the sex offenders' deficit is unknown, a procedure that has the ability to detect both gross and subtle changes is warranted. As such, reliance on technology that has the potential to miss subtle changes may produce false results in this study.

Given the inherent problems in drawing functional conclusions from activation patterns, it appears that at this point in time neuroimaging does not provide us with sufficiently more adequate information than does neuropsychological assessment. While functional imaging certainly has a place in the future and does provide us with new information, the inherent problems, expense and impracticality of assessing incarcerated prisoners do not warrant its use in this study. As such, this study utilises neuropsychological assessment to assess the brain function of sex offenders.

4.4.2 Neuropsychological assessment

Neuropsychology is defined as the study of the relationship between brain function and observable behavieur-. The main purpose of the neumpsyeholegieal assessment is to draw inferences about the functional characteristics of the brain based on a variety of standardised tests (Benton, 1994). Currently there are a number of distinct tools, approaches and models of neuropsychological assessment. It has been reported that the main division in these methods is between the hypothesis testing method and pattern analysis (Russell, 1998). However, in Australia the reliance has been on the hypothesis testing method with the debate concerning the stringency with which this method should be applied in clinical settings. In its simplest form this method selects and utilises standardised tests in order to answer questions on which hypotheses

are based (Lezak, 1995). In Bowden's (1995) controversial paper he strongly asserted a need for a more disciplined approach to this method in Australian neuropsychology, arguing for the necessity to devise hypotheses independent of the referral question and a strict reliance on standardised tests, normative data and complete and lengthy assessment protocols. At the other end of the spectrum was the argument posed by Caine (1995) who similarly stressed the importance of clearly defining the questions and hypotheses but argued that these questions are vastly different and therefore different methodologies need to be employed to adequately address them. Caine asserted that methodologies only become problematic when they are inappropriate to the question being asked.

While a more stringent and specialised approach may be more critical in a clinical setting, the methodological plurality suggested by Caine (1995) may be more appropriate for the diversity of research questions. Nevertheless, the method suggested by Caine to assess the type of question posed in this study is not vastly different from the method proposed by Bowden (1995). As such, this study aims to measure and compare the performance of sex offenders and matched control groups using standardised neuropsychological tests.

4.5 Neuropsychological tests

The aim of this dissertation is to examine the global brain function of sex offenders and specifically the functions of the frontal and temporal lobes. As such, it is imperative that the tests utilised in this study have the capacity to assess global ability as well as functions related to the frontal and temporal lobes. The previous chapter identified that a gap in sex offender research lay in the choice of neuropsychological tests. Although the LNNB and HRNB are reported as being valid and reliable measures of global brain function by some researchers (Purisch, 2001; Russell, 1998), the controversy surrounding these measures render their utility in this study questionable. Specifically, these lengthy assessments are not considered standard practice in Australia for both ethical and economical reasons (McDonald, 1995). Therefore, the literature was reviewed to find a suitable test for global functioning and to determine the most appropriate neuropsychological tests to assess the frontal and temporal lobe functions.

4.5.1 Global tests

The Wechsler Adult Intelligence Scales are the most widely used individually administered measures of adult intelligence (Ehrenreich, 1996). However, one of the major disadvantages of this measure is the time required for administration, which is typically one-two hours (Ehrenreich). As such, there have been many attempts to develop shorter versions of this instrument without compromising validity.

The legitimacy of the short form originally caused debate amongst professionals (Silverstein, 1990a); however, a consensus has been reached over the years. It is now generally accepted that short forms of the revised edition of the Wechsler Adult Intelligence Scale (WAIS-R) can be legitimately used for research or screening purposes, provided the predominant use is a global estimation of intelligence (Ehrenreich, 1996; Silverstein; Thompson, Howard & Anderson, 1986). It is further reported that these short forms are routinely used by clinicians and are one of the preferred methods of obtaining a brief measure of intelligence (Boone, 1992). Given that this research only requires an estimation of global intelligence, it appears appropriate to use one of these short forms.

The development of these short forms has been based on either the reduction in the number of subtests administered or the omission of items from various subtests (Benedict, Schretlen & Bobholz, 1992; Thompson, 1995). However, the short forms that eliminate subtests are reported to be more reliable (Boone, 1991; Silverstein, 1990b) and are therefore used more often than the other types of short forms (Thompson et al., 1986). As such, short forms created on the deletion of subtest items were not considered for this research.

A number of short forms have been developed through the omission of subtests, many of which are based on the inclusion of either two or four subtests. However, the four subtest short form appears to be more popular (Kaufman, Ishikuma & Kaufman-Packer, 1991), with Silverstein's (1982, 1985) tetrad being the most commonly cited (Benedict, 1992). This tetrad includes Vocabulary, Arithmetic, Block Design and Picture Arrangement. Silverstein (1982) developed tables for the conversion of the sums of these four subtest scaled scores to estimated Full Scale IQ scores using the WAIS-R standardisation sample. The validity and reliability co-efficients of this tetrad have been reported at .95 and .94 respectively (Silverstein, 1982), in conjunction with a reduced administration time of approximately 30 to 43 minutes (Kaufman et al., 1991;

Thompson et al., 1986). It is further reported that this short form was superior to five other short forms in predicting Full Scale IQ in psychiatric inpatients (Boone, 1990).

Despite the excellent psychometric properties of Silverstein's (1982, 1985) tetrad, it has been criticised from a clerical point of view. Such that, the administration and scoring time of the tetrad were perceived as unnecessarily long (Kaufman et al., 1991). This led to the development of an "amazingly short" triad (Kaufman et al.) and Boone (1992) argued that this triad of Information, Picture Completion and Digit Span was psychometrically, clinically and clerically superior to Silverstein's tetrad. Although Grossman, Mednitsky, Dennis, Scharff and Kaufman (1993) supported the finding of shorter administration time and easier scoring, a cross-validation study of this triad in a psychiatric population did not support superior psychometric properties (McCusker, 1994). Rather, McCusker concluded that based on psychometric properties alone, the tetrad was superior to the triad. Further to this, an assessment of the accuracy of different subtest combinations in predicting Verbal IQ, Performance IQ and Full Scale IQ revealed that short forms comprising four subtests yielded greater predictive accuracy of these IQ scores than short forms with less than four subtests (Miller, Streiner & Goldberg, 1996).

In summary, it appears that research reports excellent psychometric properties for both the triad (Boone, 1992; Kaufman et al., 1991) and the tetrad (McCusker, 1994; Silverstein, 1982, 1985). Given that a conclusion as to which of these short forms possesses greater predictive ability has not been reached, it is difficult to ascertain from this feature alone which short form to use. However, it is argued that predictive accuracy should not be the principle basis on which to select a short form (Ehrenreich, 1996; Miller et al., 1996). Rather time requirements and the relevance of particular subtests to provide the required information should be taken into consideration.

Based on these recommendations, both time and the nature of the subtests were considered prior to choosing the short form used in this study. Given that four other neuropsychological tests are to be administered in conjunction with this short form, it is imperative that administration time of the short form be considered. However, while time is an important factor in this study, what is more important is the need to include the Vocabulary subtest. This subtest is reported to be relatively insensitive to brain impairment, thus potentially making this a useful indicator of premorbid intelligence to which other subtests can be compared (Miller et al., 1996). As it is hypothesised that sex offenders will have some type of brain impairment, the inclusion of this subtest may aid in the interpretation of the neuropsychological tests in view of premorbid

intelligence. Given that the Kaufman et al. (1991) triad does not include this subtest, the Silverstein (1982, 1985) tetrad has been chosen in this study as an estimated measure of global intelligence. The following sub-sections briefly define the four WAIS-III subtests to be used in this study: Vocabulary, Arithmetic, Block Design and Picture Arrangement.

4.5.1.1 Vocabulary

This task requires the participants to describe the meanings of several words. A number of functions can be assessed from performance on this test including, remote and long-term memory, verbal comprehension, abstract thinking and verbal conceptualisation skills (Lezak, 1995; Psychological Corporation, 1997a, 1997b). Consistently high split-half reliabilities are reported (Psychological Corporation, 1997b).

4.5.1.2 Arithmetic

The Arithmetic subtest requires participants to complete a number of orally presented mathematical problems. Performance on this test measures a variety of functions including, working memory, mental manipulation of information, conversion of verbal problems to correct mathematical principles and capacity to perform mental computations (Lezak, 1995; Psychological Corporation, 1997a, 1997b). Test-retest correlations of .80 to .90 are reported, with spilt-half reliabilities averaging .84 (Psychological Corporation, 1997b).

4.5.1.3 Block Design

This test requires participants to construct replicas of block designs presented on a two-dimensional plane. This test assesses a number of functions including, visual-spatial organisation, perceptual organisation, recognition of part whole relations and visual-motor coordination (Lezak, 1995; Psychological Corporation, 1997a, 1997b). Split-half reliabilities are consistently reported across all age groups, averaging .87 (Psychological Corporation, 1997b).

4.5.1.4 Picture Arrangement

In this test participants are presented with a series of cards, which are out of order. They are required to organise the cards, so that the pictures depict a story that makes sense. Performance on this test reflects participants' visual perception ability, social knowledge,

sequential thinking and comprehension of whole situations (Psychological Corporation, 1997a, 1997b). Split half reliabilities are reported to average .74 (Psychological Corporation, 1997b).

4.5.2 Temporal lobe tests

It is well established that the temporal lobes play a role in auditory and visual perception, memory, language, emotion and motivation. It is further accepted that damage to these areas produce a range of symptoms including not only impairment in the above functions, but also altered personality and sexual behaviour (Kolb & Whishaw, 1990; Walsh, 1994). However, it is not possible to capture all these processes in a standard assessment. As such, standardised neuropsychological tests for temporal lobe damage assess auditory and visual processing capacity, non-verbal and verbal memory and learning ability (Kolb & Whishaw). For this study, two well established neuropsychological tests have been chosen as representative of these functions: Rey Auditory Verbal Learning Test (RAVLT) and the Rey Complex Figure (RCF). The following two sub-sections contain definitions and a brief overview of the psychometric properties of each of these tests.

4.5.2.1 Rev Auditory Verbal Learnina Test

The Rey Auditory Verbal Learning Test (RAVLT) requires participants to learn and recall a list of 15 words, which are presented aurally over five consecutive trials. A second list of 15 words is aurally presented after Trial 5, followed by a free recall trial of the original list. Free recall and recognition of the original list is requested after a 30 minute time delay (Lezak, 1995). A number of functions can be assessed utilising the scores from these trials including immediate memory span, new learning, susceptibility to interference and short term and longer term retention (Spreen & Strauss, 1991).

The test has modest test-retest reliability, with correlations of about .55 over a one-year period (Spreen & Strauss, 1991). Factor analytic studies of Trials1, 5, 6, 7 and 8 produced three factors: acquisition, storage and retrieval (Lezak, 1995). There is some evidence that age, gender and intellectual capacity impact on participants' performance on the RAVLT. Specifically, performance has been shown to decline with age and recall has been reported to be better at higher IQ levels (Spreen & Strauss).

It is hypothesised that if sex offenders have temporal lobe impairment they will perform significantly worse in comparison to the controls on all RAVLT indices, including recalling fewer words on all immediate and delay recall trials and the recognition trial.

4.5.2.2 Rev Complex Fiaure

The Rey Complex Figure (RCF) requires participants to copy a geometric figure onto a plain piece of paper, and then reproduce it from memory following a 30 minute time delay. No prior warning of the memory component is given to the participants. This test assesses two functions; visual-constructional ability as measured by the accuracy of the original copy; and non-verbal memory, which is reflected in the amount and accuracy of the drawing retained in the recall trial (Spreen & Strauss, 1991).

A number of scoring systems are used to assess the accuracy the figure. However, despite this, inter-scorer reliability for the RCF remains high, with reports of correlations as high as .95 (Bennett-Levey, 1984) and .91 (Delaney, Prevey, Cramer & Mattson, 1992). It is reported that age and IQ contribute to performance on both the copy and recall trials. RCF scores are reported to increase with age, although, adult levels of the copy score are achieved by age 13 (Spreen & Strauss, 1991). In relation to recall scores, it has been suggested that decline begins around age 30 years, continuing steadily until around age 70 where a large drop in scores is apparent (Lezak, 1995). Modest correlations with measures of general intelligence have been noted (Spreen & Strauss)

It is hypothesised that if sex offenders have temporal lobe impairment they will perform significantly worse than the controls on the delayed recall trial, thus, recalling a smaller portion of the copy after a time delay.

4.5.3 Frontal lobe tests

Research has highlighted that the frontal lobe is divided into several subregions, all of which produce distinct behavioural changes. While there is some controversy over the labelling of the various types of changes into specific syndromes, there is a general consensus that three distinct sets of changes occur with damage to the frontal lobes. The first set of changes is related to what may broadly be termed personality, the second set involves changes to intelligence and the

third set are characterised by adynamia (lack of verbal or overt behaviour) (Walsh, 1994). Given the large number of associated symptoms with frontal lobe damage, few standard neuropsychological tests are useful for assessing impairment in this region (Kolb & Whishaw, 1990). However, it is reported that it is highly unlikely for individuals with frontal lobe damage to perform within normal limits on tests of response inhibition or verbal fluency (Kolb & Whishaw). As such, two well established neuropsychological tests representative of these functions have been chosen for this study: the Wisconsin Card Sorting Test (WCST) and FAS Test. The following two sub-sections contain definitions and a brief overview of the psychometric properties of each of these tests.

4.5.3.1 Wisconsin Card Sorting Test

The Wisconsin Card Sorting Test (WCST) requires participants to sort a deck of cards into four piles based on the examiner's feedback (correct or incorrect). The sorting principle (colour, form/shape and number) changes each time the participant has completed 10 correct placements in a row. The test begins with colour as the sorting principle and continues until the participant has completed six runs of 10 correct placements or the pack is exhausted before six successful runs (Lezak, 1995). A number of functions can be assessed based on the participant's performance including problem-solving, strategic planning, use of environmental feedback to shift set and inhibition of impulsive responding (Demakis, 2003).

Although the WCST performance can be scored in numerous ways, Categories Achieved and Perseverative Errors are the most widely used scores considered to be indicative of frontal lobe impairment (Lezak, 1995). Respectively, these are defined as the number of correct runs of 10 correct placements and the number of times the participant sorts to a previously correct principle or persists in sorting to an initial error (Lezak). These scores reflect the participants' ability to plan and organise, form concepts and change their responses based on examiner's feedback (Lezak; Kolb & Whishaw, 1990).

This test has excellent inter-scorer reliabilities with correlation co-efficients of .93, .92 and .88 for Perseverative Responses, Perseverative Errors and Nonperseverative errors, respectively (Heaton, Chellune, Talley, Kay & Curtiss, 1993). The validity of the WCST as a measure of executive function has been demonstrated in numerous studies examining the WCST performance of neurologically impaired populations. For a full review of these studies refer to the

WCST Manual (Heaton et al.). In general, age and education are reported to have some effect on performance, however, it is reported that age effects are inconsequential prior to the age of 70, whereas education effects are small (Lezak, 1995).

It is hypothesised that if sex offenders have frontal lobe impairment they will perform significantly worse than the controls on the WCST, specifically, achieving fewer correct categories and producing more perseverative errors.

4.5.3.2 FAS Test

The FAS test comprises three trials in which the participants are required to spontaneously produce as many words as they can in one minute, excluding proper nouns, numbers and the same word with a different suffix (Lezak, 1995; Spreen & Strauss, 1991). The first trial requires production of words beginning with F. The successive two trials request the production of words starting with A and S, respectively (Lezak). This test assesses verbal fluency, which is reflected in the combined sum of all admissible words across the three trials (Spreen & Strauss).

The test has near perfect inter-scorer reliability, with one-year retest reliability in older adults being reported as high as .70 and re-test reliability as .88 (Spreen & Strauss, 1991). Factor analytic studies in adults reported that this test predominantly loaded on a "verbal knowledge" factor (Spreen & Strauss). However, further studies report that letter fluency loaded on a factor, which also included an oral spelling test, digit span and mental calculations. This factor was labelled "abstract mental operation" (Lezak, 1995).

It has been reported that although age, education and gender play a role in verbal fluency, the inconsistency in the studies reporting the effects of these factors, renders it difficult to ascertain the nature and extent of these effects on FAS test performance (Loonstra, Tarlow & Sellers, 2001). Specifically, it is argued that it is unclear how many differences in performance are attributable to these factors, and how many are attributed to verbal intelligence (Loonstra et al.).

It is hypothesised that if sex offenders have frontal lobe impairment they will perform significantly worse than the controls on the FAS test, specifically, producing fewer words across all trials.

4.6 The Present Study

Seventy five male participants were recruited for this study: 25 incarcerated sex offenders; 25 incarcerated non-sex offenders; and 25 males with no offence history. The offence histories and demographic profiles of the three groups are discussed in the following section.

4.6.1 Offence History

The offence histories were obtained from the offenders' prison files. The information was gathered after the neuropsychological assessment had taken place. The sex offenders were convicted for sexual offences against both female and male children including indecent assault, gross indecency, sexual penetration against a child under 16 and incest. No offenders that were convicted of sexual offences against adults were included in the study. The non-sex offenders were convicted for a range of drug and property offences as well as murder and armed robbery. None of these offenders had been convicted of a sexual offence.

The offence histories of the control group were gathered through self-report prior to the neuropsychological assessment. The self-reports indicated that none of these participants had previous convictions.

4.6.2 Demographics

Age and level of education were self-reported prior to the neuropsychological assessment. Level of education was recorded as the number of years in which participants attended school and university, excluding prep. For example, if a participant completed Year 12, the level of education was recorded as 12 years.

A series of one-way analyses of variance (ANOVA) were conducted to identify whether the groups differed significantly in their mean age and level of education. Prior to analyses the distributions of the variables were assessed against the assumptions of ANOVA. No serious departures from normality were noted. However, using a significance criterion of .05, Levene's test of equality of variance indicated significant differences in the variance of both age ($p = .044$) and education ($p = .001$). Although this is indicative of an assumption violation, the ratios of largest cell to smallest cell variance (F_{max}) for each variable did not exceed 10. With equal

sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

The results indicated that the mean age differed significantly between the groups, F (2,72) = 14.64, p = .000. Planned contrasts revealed that, on average, the sex offenders, M = 46.52, SD = 12.28, were significantly older than both the non-sex offenders, M = 32.12, SD = 8.50, t (42.69) ¤ 4.82, p = ,000 and control group, M = 35.40, SD = 8.29, t (42.11) = 3.75, p = ,001. The control group and non-sex offenders did not differ significantly in mean age, t (47.97) = 1.38, p = .174.

The ANOVAs further indicated that the mean level of education significantly differed between the groups, F (2,72) ¤ 5.28, p = .007. The sex offenders, M = 10.12, SD = 2.48, and control group, M = 10.88, SD ¤ 1.09, both had a higher mean level of education than the non-sex offenders, M = 9.18, SD = 1.73. However, planned contrasts revealed that the only significant difference was between the mean level of education of the non-sex offenders and control group, t (40.58) = 4.16, p = ,000. Despite this, on average, all three groups left school prior to completing Year 12.

4.6.3 Level of intelligence

Level of intelligence (or Full scale IQ) was estimated from the results of the participants' performance on the four WAIS-III subtests: Vocabulary, Arithmetic, Block Design and Picture Arrangement. A series of one-way analyses of variance were conducted to determine if the groups differed, on average, in their performance on these tests and the resultant estimated full scale IQ. Prior to analysis the distributions of all variables were assessed against the assumptions of ANOVA. No serious violations of these assumptions were noted. A statistical significance criterion of .O1 was used for all analyses.

The scores of the four tests were calculated in accordance with the WAIS-III scoring criteria. As such, a score of 10 is indicative of an average performance. Silverstein's (1982) conversion tables were used to estimate Full Scale IQ. The means and standard deviations for these tests and estimated IQ for each of the three groups are presented in Table 1.

Table 1

Means and standard deviations for the *WAIS-III* variables and estimated full scale IQ

	Sex offenders[a]		Non-sex offenders[a]		Controls[a]	
WAIS-III Variable	M	SD	M	SD	M	SD
Arithmetic**	9.64	3.55	8.76	2.67	11.44	2.84
Vocabulary**	9.64	2.75	7.76	2.42	10.28	2.13
Block Design	11.60	2.10	9.84	2.79	11.68	2.51
Picture Arrangement	10.92	3.20	8.60	2.06	10.12	2.86
Est. Full Scale IQ**	108.60	17.46	93.56	11.59	107.32	11.77

[a] $n = 25$

** $p<0.01$

Table 1 indicates that the controls and sex offenders had similar performances, scoring in the average range for all subtests. However, the controls appear more consistent in their performance across the subtests than the sex offenders, who have higher mean performance subtest scores than the verbal subtests. The mean scores of the non-sex offenders differ from both groups, scoring in the below average range for all subtests.

A series of one-way ANOVAs indicated significant differences in the mean scores of Arithmetic, $F(2,72) = 5.04$, $p = .009$, and Vocabulary, $F(2,72) = 7.16$, $p = .001$. There was also a trend towards significance in the mean scores of Block Design, $F(2,72) = 4.38$, $p = .016$, and Picture Arrangement, $F(2,72) = 4.59$, $p = .013$.

Planned contrasts confirmed that there was little difference in the performance of the controls and sex offenders, with no significant differences being found between their mean scores. The differences were predominantly between the mean scores of the non-sex offenders and the other two groups. There was a tendency for the non-sex offenders, on average, to score significantly lower than the controls on the verbal subtests: Vocabulary, $t(72) = -3.64$, $p = .001$; and Arithmetic, $t(72) = -3.11$, $p = .003$. However, the difference in mean Block Design scores approached significance, $t(72) = -2.62$, $p = .011$. Although the non-sex offenders also had lower mean scores than the sex offenders on all subtests, significant differences were only found amongst the mean scores of Vocabulary, $t(72) = 2.72$, $p = .008$, and Picture Arrangement, $t(72) = 2.98$, $p = .004$.

Table 1 further indicates that the sex offenders had the highest mean estimated full scale IQ score. However, this doesn't appear to differ substantially from the mean IQ of the control group. Although the mean IQ of the non-sex offenders appears to differ from both the sex offenders and controls, this score is still considered in the average range of intelligence.

Despite all three groups having average mean IQ scores, an ANOVA revealed that these mean scores differed amongst the groups, $F(2,72) = 9.03$, $p = .000$. However planned contrasts confirmed that the difference in mean IQ between the sex offenders and controls was not significant, $t(72) = .326$, $p = .745$. The contrasts identified that the difference lay between the mean IQ scores of the non-sex offenders and the other two groups: controls, $f(72) = 3.51$, $p = .001$; and sex offenders, $t(72) = 3.82$, $p = .000$.

This section identifies that the mean age, level of education and level of intelligence differed significantly between the three groups. Therefore, it is possible that these variables may confound the results. Such that, potential group differences in the mean scores of the test variables may be attributable to group differences in age, level of education and intelligence. Given this, each of the three variables will be assessed for suitability as a covariate in analyses of covariance (ANCOVAs). These results are reported in section 2 of the following chapter.

4.6.4 Procedure

Prior to the conduction of this research, ethics approval was sought from both Swinburne University and the Victorian Department of Justice. On being granted approval, prison staff approached prisoners (both sex offenders and non-sex offenders) seeking their interest in the study. A verbal overview of the study was then given to the prisoners by the primary researcher. Particular attention was paid to explaining confidentiality in terms of provision of their names and feedback on their performance. Prisoners interested in participating were then given an Information Sheet outlining the requirements of their participation (refer Appendix 1). Prior to the conduction of the neuropsychological assessment, all participants signed a consent form (refer Appendix 2) and were asked their age and level of education. The assessments were conducted in the interview rooms of the prison. The duration of each assessment was generally two hours. On completion of the assessment, details of offence histories were obtained from prison files. A written report was given to participants requesting feedback on their performance.

A similar procedure was followed for assessment of the control group, with the exception of the location of the assessment. Prison staff that volunteered for the study was assessed in the prison interview rooms, whereas other community members were assessed in their homes.

Chapter 5

Cognitive performance of sex offenders, non-sex offenders and controls

5.1 Introduction

In Chapter 4 it was hypothesised that the sex offenders will show a deficit in the functioning of the frontal-temporal lobes. As such, it was predicted that the pattern of neuropsychological test results would indicate that the sex offenders' mean scores on all four test variables will be significantly lower than the controls. Specifically, it was hypothesised that the sex offenders, relative to the controls, would recall fewer words in the immediate and delay recall trials of the Rey Auditory Verbal Learning Test (RAVLT), produce a poorer reproduction of the Rey Complex Figure (RCF) after a time delay, recall fewer words in the FAS test (FAS) and complete fewer categories and produce more perseverative errors in the Wisconsin Card Sorting Test (WCST). This chapter presents the statistical analyses computed to test these hypotheses and discusses the results in relation to functional abilities and potential support for the hypothesised frontal-temporal deficit in sex offenders. This chapter has four sections.

Section 1 presents the results of the one-way analyses of variance (ANOVA) computed to compare whether the performances of the three groups on these test variables differed significantly. Section 2 outlines a series of analyses utilised to assess the effects of age, level of education and level of intelligence on the participants' performance. Each of the three variables was assessed for their suitability for use as covariates in analyses of covariance (ANCOVAs). However, in the instances where the use was inappropriate, the variables were categorised into discrete variables and used in factorial ANOVAs. After summation of these results, Section 3 is presented. This section presents the results of an exploratory principal components analysis conducted to determine if there were any factors underlying those variables shown to be significantly different between the groups. The results of a subsequent discriminant function analysis are then presented in Section 4 highlighting the predictability of group membership based on the underlying factors. Given the communality of all the cognitive/neuropsychological measures it is not appropriate to consider all analyses using the different tests as independent. Therefore a conservative *p* value of .01 was utilised rather than the more stringent bon-feron correction, which assumes that all variables in different analyses are independent, which is an

assumption that cannot be supported because of the high inter-correlation between the cognitive measures.

Section 1
One-way analyses of variance

5.2 Introduction

A series of one-way analyses of variance (ANOVAs) were conducted to determine if the performances of the three groups on the four test variables differed significantly. Prior to analyses all variables were assessed against the assumptions of normality and homogeneity of variance. This section presents the assessment of assumption violations for all variables followed by the results of the one-way ANOVAs. The results of each test are discussed in four separate sub-sections followed by a summary discussion of the collective pattern of results.

5.2.1 Assumptions

Prior to analysis all variables were examined for accuracy of data entry, missing values and fit between their distributions and the assumptions of one-way analysis of variance. The variables were examined separately for each of the three groups. No missing values were detected.

5.2.1.1 Normality

The distributions of the variables were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the Rey Auditory Verbal Learning Test (RAVLT), Rey Complex Figure (RCF) and FAS test variable distributions. However, only the FAS A words skewness statistic for the sex offender group exceeded two standard errors of skewness.. Despite this, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent. As the assumption of normality applies to the sampling distribution of means and not raw scores, the central limit theorem assures that with sample sizes greater than 20, univariate ANOVA is robust to violations of normal variable distributions (Tabachnick & Fidell, 2001). With the sample size in each group being 25, the normality of sampling distributions of means is anticipated.

The distribution statistics for the WCST variables exceeded two standard errors of skewness and kurtosis. Inspection of histograms and box plots revealed serious departure from the normal distribution. Transformation of the variables was considered. However, the direction and severity of skewness differed between the groups, rendering transformation inappropriate. Although the sample size is theorised to be large enough for the analysis to be robust against these violations, given the seriousness of the violations these variables were omitted from the univariate analysis. They were later analysed using non-parametric statistics.

5.2.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of four variables; RAVLT errors (p=.002), RAVLT Total Score (p=.043), RCF Copy Score (p=.004) and FAS S words (p=.037). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 10. With equal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

5.3 Results of one-way analyses of variance

A series of one-way analyses of variance with three planned contrasts comparing all pairs of group means was performed for each of the RAVLT, RCF and FAS test variables. Specifically the contrasts compared: (1) sex offenders and control group; (2) non-sex offenders and control group; (3) sex offenders and non-sex offenders. The results for each set of test variables are discussed in turn.

5.3.1.1 Rev Auditory Verbal Learning Test

Recall scores were tallied on Trials 1 to 5, the distractor trial (Trial 6), the post distractor trial (Trial 7), the delayed recall trial (Trial 8) and recognition trial. The total number of words recalled over Trials 1 to 5 and the total number of errors produced were also calculated. Errors included repeated words and extra-list inclusions. The means and standard deviations for each of these variables across each of the three groups are presented in Table 2.

Scores for rate of learning (Trial 1 and Trial 5), rate of forgetting (Trial 7 and Delayed Recall Trial), proactive interference (Trial 1 and Trial 6), retroactive interference (Trial 5 and Trial 7) and retrieval (Delayed Recall and Recognition List A; Trial 6 and Recognition List B) were calculated as the difference between the trials in the above parentheses. Negative scores indicate a loss in the number of words recalled; positive scores indicate a gain in the number of words recalled. The means and standard deviations for these difference scores are also presented in Table 2.

Table 2

Means and standard deviations for the *RA*VLT variables

	Sex offenders[a]		Non-sex offenders[a]		Controls[a]	
RAVLT Variable	M	SD	M	SD	M	SD
Trial 1**	5.92	1.41	5.96	1.67	7.16	1.52
Trial 5	10.76	2.57	10.72	2.26	12.32	2.01
Trial 7	9.08	3.13	9.32	2.95	10.44	2.60
Total Score**	43.68	9.93	44.12	10.27	51.72	6.68
Total Errors**	3.96	3.00	7.48	5.89	8.60	6.26
Trial 6**	4.52	1.83	4.16	1.40	5.84	1.57
Delayed Recall	9.00	2.83	8.56	3.04	10.48	2.74
Recognition List A	13.84	1.40	13.64	2.14	14.24	0.83
Recognition List B	6.64	3.45	6.00	3.31	6.72	2.51
Rate of Learning	4.84	2.43	4.76	2.01	5.16	2.29
Rate of Forgetting	-0.08	1.57	-0.76	1.42	0.04	1.69
Retrieval List A	4.84	2.37	5.08	2.69	3.76	2.52
Retrieval List B	2.12	2.98	1.84	3.33	0.88	2.77
Proactive Interference	-1.40	2.22	-1.80	1.78	-1.32	2.14
Retroactive Interference	-1.68	2.12	-1.40	1.78	-1.88	1.96

[a] $n = 25$

** $p<0.01$

Table 2 shows that the control group recalled more words, on average, than both offending groups on the immediate recall trials. However, despite the offending groups recalling fewer words at Trials 1 and 5, their rate of learning across the trials was similar to that of the controls,

with all groups learning approximately five words on average. After a 30 minute delay period the controls recalled more words than the offending groups, on average. However, the rate of forgetting scores indicates that all groups experienced little forgetting during the delay.

Table 2 also indicates that there was little difference in the mean recognition scores for both List A and List B across the groups. All groups had positive mean retrieval scores, indicating greater facilitation of recall with recognition testing. However, the mean retrieval scores of both list A and B were greater for the offenders compared to the controls, indicating that the offenders benefited more from retrieval cues in the recognition trial than did the controls.

The mean proactive and retroactive interference scores were similar across the groups, indicating that all groups recalled fewer words after the presentation of an interference list. However, each group only lost between one and two words, suggesting that minimal interference was experienced. The controls produced more total errors on average, thus, indicating that they experienced more interference in the form of repetitions and extra-list inclusions than the other two groups.

One way analyses of variance confirmed that there was a significant difference between the mean number of words recalled in the immediate recall trials; Trial 1, $F(2,72) = 5.25$, $p = .007$; Total Score, $F(2,72) = 6.16$, $p < .003$; Trial 6, $F(2,72) = 7.53$, $p = .001$ and the total number of errors produced, $F(2,72) = 5.30$, $p < .007$. However, the difference between the mean number of words recalled after a delay period failed to reach significance, $F(2,72) = 3.06$, $p = .053$.

Planned contrasts further confirmed that the significant differences were between the mean scores of the control group and the offending groups. The controls recalled significantly more words than the sex offenders on Trial 1($t(72) = -2.85$, $p = .006$) and Trial 6 ($t(72) = -2.90$, $p = .005$), recalled more words overall ($t(42.03) < -3.36$, $p = .002$) and made significantly more errors ($t(34.50) = -3.34$, $p = .002$). Although a similar pattern was found between the mean scores of the control group and non-sex offenders on Trial 1($t(72) < 2.76$, $p < .007$), Trial 6 ($t(72) = 3.69$, $p = .000$) and Total Score ($t(41.23) < 3.10$, $p = .003$), the two groups did not differ significantly in the mean number of errors produced ($t(47.82) < 0.651$, $p = 0.518$).

Although the planned comparisons are highly significant, the effect sizes of the overall ANOVA for each of these significant variables is small; Trial 1, $n^2=.13$; Trial 6, $n^2=.17$; Total Score, $n^2=.15$

and Total Errors, n^2=.13. As such, only between 13%-17% of the variability in these scores is attributable to offence history. This indicates that despite differences amongst the groups, the relationship between these RAVLT variables and offence history is small to moderate at best.

Mixed model analyses of variance with one between group factor and one within-subject factor were conducted to compare group differences in rate of learning (Trial 1 and Trial 5), rate of forgetting (Trial 7 and Delayed Recall Trial), proactive interference (Trial 1 and Trial 6), retroactive interference (Trial 5 and Trial 7) and retrieval (Delayed Recall and Recognition List A; Trial 6 and Recognition List B). No significant interactions were found among the groups for any of these variables, F (2,72) = 0.22, p = .801; F (2, 72) □ 1.89, p □ .159; F (2,72) □ 0.40, p □ ,677; *F* (2,72) = 0.38, p = .686; F (2,72) = 1.93, p □ .153; F (2,72) = 1.15, *p* = .323, respectively. This indicates that the groups did not differ in their rate of learning, rate of forgetting, retrieval abilities or interference effects. As such, the observation that offenders benefited more from retrieval cues in the recognition trial than the controls is not statistically supported.

In summary, although the sex offenders scored lower on all RAVLT variables, the lack of significant differences found between the groups in rate of learning, forgetting and retrieval indicate that the sex offenders may not have impaired encoding, consolidation or retrieval abilities for verbal material in comparison to the controls. As such, the hypothesis of a temporal lobe deficit in sex offenders is unsupported. However, the findings do indicate that sex offenders differed from controls in their immediate recall of verbal information. While this suggests that the offenders were slow to process new information, given that the rate of learning was similar across the groups, it appears that this difference is not attributable to encoding difficulties. As such, it is possible that the differences in immediate recall may reflect a diminished working memory capacity in the sex offenders. Working memory is the limited capacity system for the temporary storage and processing of information and is considered to depend on the intact functioning of the prefrontal lobe (Hartman, Bolton & Fehnel, 2001). As such, this finding partially supports the potential existence of a frontal lobe rather than a temporal lobe deficit in sex offenders, although clearly the evidence for this position is not particularly compelling.

5.3.1.2 Rev Complex Fiaure

Copy and recall scores were calculated using the Taylor scoring criteria for the Rey Complex figure. In general, the figure is broken down into 18 elements. Each element is awarded

between 0.5 and 2 points depending on the accuracy of the details and their placement. The highest possible score for each trial is 36 (Spreen & Strauss, 1991). Each of the 18 elements was tallied to form an RCF Copy Score and RCF Delay Score. The organisational quality of the copy trial was also assessed using the Hamby, Wilkins and Barry (1993) criteria. Emphasis is placed on the configural elements: the base rectangle and the horizontal and vertical midlines. Ratings are made on a 5 point Likert-type scale, with higher scores reflecting better organisation. The means and standard deviations for each RCF variable across each of the three groups are presented in Table 3.

Table 3

Means and standard deviations for the RCF variables

	Sex offenders[a]		Non-sex offenders[a]		Controls[a]	
RCF Variable	M	SD	M	SD	M	SD
RCF Copy Score**	29.32	2.92	30.48	3.64	32.36	1.53
RCF Delay Score	17.52	6.56	15.96	6.42	20.28	5.97
Organisational Quality	1.68	0.95	1.56	0.82	1.88	1.05

[a] $n = 25$

** $p<0.01$

Table 3 indicates that the control group had higher mean copy and recall scores than the other two groups, indicating that the controls produced a better copy of the design and recalled a larger portion of the design after a time delay. However, the difference in mean recall scores appears to be greater between the controls and non-sex offenders. The table also shows that although the sex offenders and non-sex offenders produced poorer copies of the design, the sex offenders recalled a larger portion of the design after a time delay.

One-way analyses of variance indicated that these mean copy scores were significantly different between the groups, $F(2,72) = 7.318$, $p = .001$. However, the differences in the mean delayed recall scores were not significant, $F(2,72) = 2.99$, $p = .056$. Planned contrasts further identified that the only significant difference in the mean copy scores were between the sex offenders and control group, $t(36.28) = -4.61$, $p = .000$. Despite this highly significant difference, the effect size, $n^2 = .17$ indicates that the relationship between RCF copy score and offence history is small to moderate, with only 17% of the variance in copy score being explained by offence history.

Table 3 indicates that the three groups did not differ in their organisational quality scores, indicating that all groups had poor organisational quality and made two or more configural errors during the copy trial. However, closer inspection of the types of configural errors made indicate very different patterns of errors for the controls compared with the two offender groups. In general, the configural elements are the outer rectangle and the vertical and horizontal midlines. Configural mistakes are made if all sides of the rectangle are not drawn together or are drawn as segments; sides of the rectangle are not joined; the midlines are drawn as segments or are 10% away from the centre; details are completed before the rectangle or midline.

Qualitative analysis of the sex offenders' copy trial indicate that 76% of the group had configural mistakes relating to the rectangle, 44% drew the midlines as segments and 100% drew details before the midlines. The non-sex offenders had a similar pattern of configural errors, 68%, 56% and 96% respectively. This suggests that both offender groups had difficulty not only perceiving the larger configural units but also had difficulty planning and organising unstructured material. Contrarily, the controls configural mistakes largely related to poor planning and organisation rather than the misperception of the rectangle and midlines, with 36% of the group making configural mistakes relating to the rectangle, 36% drawing the midlines as segments and 56% drawing details before the midlines.

The sex offenders' pattern of performance indicates that while they produced a poor copy of the figure in comparison to the controls, over time they were able to consolidate the information and reproduce a copy not statistically different to that of the control group. Given this, the difference between the sex offenders and controls may not be attributable to a memory deficit and as such, does not support the hypothesis of a temporal lobe deficit in sex offenders. However, this pattern may suggest that the sex offenders were unable to initially process as much information at a time compared to the controls. As evidenced in the qualitative analysis of their configural errors, the sex offenders' perception of the figure may have been altered and they subsequently perceived the design in smaller units rather than in the larger configural units. This potentially led to an increase in the likelihood of distortions and misplacements in the copy design. As such, the poor copy scores may be more reflective of a diminished working memory capacity in the sex offenders rather than an impaired visual-constructional ability. This indicates a potential frontal lobe deficit in sex offenders and partially supports the hypothesis of a frontal-temporal deficit in

this population. However, given the lack of differences between the performance of the two offender groups, this deficit may not be specific to sex offenders.

5.3.1.3 FAS test

The number of words produced for each of the F, A and S word trials were tallied. The total number of words and total number of errors produced across the trials were also calculated. Errors included proper nouns, repetitions, wrong words and variations. The means and standard deviations for each FAS variable across each of the three groups are presented in Table 4.

Table 4

Means and standard deviations for the FAS variables

	Sex offenders[a]		Non-sex offenders[a]		Controls[a]	
FAS Variable	M	SD	M	SD	M	SD
F words	12.36	4.67	11.00	3.79	12.00	3.69
A words	9.36	3.97	8.68	3.20	11.20	3.90
S words	12.28	5.10	11.72	4.67	15.40	3.62
FAS Total Score	34.00	12.42	31.00	10.53	38.52	9.38
FAS Total Errors	1.96	1.81	1.68	1.44	3.08	2.12

[a] $n = 25$

Table 4 indicates that, on average, the control group produced more A and S words than the offender groups but produced a similar number of F words. One-way analyses of variance indicated that there were no significant differences between the mean number of A, $F(2,72) = 3.10$, $p = .051$ and F words produced, $F(2,72) = .749$, $p = .477$. However, planned contrasts revealed that the difference in mean number of A words produced by the controls and non-sex offenders approached significance, $t(72) = 2.41$, $p = .019$.

One-way analyses of variance also revealed that the difference in mean number of S words identified by the groups approached significance, $F(2,72) = 4.85$, $p = .011$. Planned contrasts indicated that the control group produced significantly more S words than the non-sex offenders, $t(45.18) = 3.116$, $p = .003$, and that there was a trend towards significance between the mean S words scores of the sex offenders and controls, $t(43.29) = -2.50$, $p = .016$.

Table 4 also shows that, on average, the control group produced more words overall than the other two groups and made more errors. However, the large standard deviations for Total Score indicate that there is a lot of variability amongst the scores in each group. Although one way analyses of variance indicated that these mean differences in total words produced were not significantly different, $F(2,72) = 3.04$, $p = .054$, planned contrasts showed that the difference in mean number of words produced by the control group and non-sex offenders approached significance, $t(72) = 2.45$, $p = .017$. The difference in mean number of errors produced also failed to reach significance, $F(2,72) = 4.18$, $p = .019$. However, planned contrasts indicated that, on average, the control group produced significantly more errors than the non-sex offenders, $t(72) = 2.73$, $p = .008$.

The observed pattern of results indicates that the sex offenders did produce fewer words than the control group. However, the finding of no statistical difference between the sex offenders and the control group in word production indicates that the sex offenders may not have impaired verbal fluency. Given that depressed fluency scores are indicative of frontal lobe deficits, this finding does not support the hypothesis of a frontal-temporal deficit in sex offenders.

5.3.1.4 Wisconsin Card Sorting Test

Due to the violations of normality assumptions, one-way analyses of variance were unable to be performed on these variables. As such, the equivalent non-parametric test for k independent samples, Kruskal-Wallis, was produced for each of these variables. The means and standard deviations for each WCST variable across each of the three groups are presented in Table 5.

Table 5

Means and standard deviations for the WCST variables

	Sex offenders[a]		Non-sex offenders[a]		Controls[a]	
WCST Variable	M	SD	M	SD	M	SD
No, categories completed	3.84	2.29	3.40	2.27	4.80	1.96
No. of trials	113.40	19.97	115.84	20.58	107.88	21.83
Conceptuallevelresponses	55.36	21.25	57.32	19.11	63.36	18.66
Perseverative errors	24.56	18.96	22.08	12.71	16.40	10.14
Non-perseverative errors	19.36	14.82	22.12	13.98	16.16	13.91

a n = 25

Table 5 indicates that, on average, the control group completed more categories in fewer trials, produced more conceptual level responses and made fewer errors than both the offending groups. However, the largest differences appear to be between the mean scores of the controls and sex offenders, with the sex offenders, on average, making substantially more perseverative errors and producing fewer conceptual level responses. This indicates that the sex offenders had more difficulty than the controls in forming concepts, planning an appropriate problem-solving strategy and changing their inappropriate responses based on feedback. Additionally, the discrepancy between the mean number of perseverative errors and non-perseverative errors is much larger for the sex offender group than the other two groups. This suggests that the sex offenders' perseverative errors are reflective of inflexibility in thinking, rather than guessing. There was little difference in the mean scores of the sex offenders and non-sex offenders. However, the large standard deviations indicate that there was great variability within the scores of each group.

Despite these observed mean score differences, the Kruskal-Wallis test indicated that the groups did not differ significantly in the mean number of perseverative errors, X^2 (2) = 3.54, p = .170 or conceptual level responses, X^2 (2) = 2.87, p = .239. The Kruskal-Wallis test further indicated that no significant group differences were observed between the mean scores of number of categories, X^2 (2) = 4.90, p = .086, number of trials, X^2 (2) = 2.92, p = .232 and non-perseverative errors, X^2 (2) = 4.11, p = .128.

Although the sex offenders' performance appears poorer than that of the control group, the finding of no statistical differences between the sex offenders and controls on these variables renders it difficult to conclude that this performance is indicative of frontal lobe impairment in the sex offender group.

5.4 Summary

In summary, it appears that the control group performed better than the other two groups on all four neuropsychological tests, with few differences being observed between the two offending groups. In general, the pattern of results indicate that the sex offenders, in comparison to the controls, recalled fewer words in the immediate and delayed recall trials of the RAVLT, produced poorer copies of the Rey Complex Figure, reproduced a lower percentage of the figure after a

delay, produced less words in the FAS test and completed fewer categories and produced more perseverative errors in the WCST.

This overall observed pattern of results appears reflective of a frontal-temporal lobe deficit in sex offenders. However, this observation is only partially supported by the results of the statistical analyses. Although the sex offenders scored lower than the controls on the delayed recall trials of both the RAVLT and RCF, the differences were not significant. As such, it cannot be assumed that there is support for a temporal lobe deficit in sex offenders in this study.

Additionally, the sex offenders and controls significantly differed in their mean scores of the immediate recall trials of the RAVLT and RCF copy trial. Thus, suggesting a possible diminished working memory capacity and hence supporting a frontal lobe deficit. However, no significant differences were found between the mean FAS and WCST scores of the sex offenders and controls, thus, contradicting the evidence of frontal lobe impairment. As such, it is difficult to ascertain the extent of support for the hypothesised frontal-temporal deficit in sex offenders. Although, in general, the results do not support a temporal lobe deficit, they may offer partial support for the existence of frontal lobe impairment in the sex offender population. However, given that there were little differences between the performances of the sex offender and non-sex offender groups, it cannot be assumed that this potential frontal lobe impairment is specific to sex offenders. This possibility will be analysed further in Chapter 6.

Section 2

Effects of age, level of education and level of intelligence

5.5 Introduction

In the previous chapter, it was identified that mean age, level of education and level of intelligence differed significantly between the three groups. Therefore, it is possible that these variables may have confounded the results of the previous section. Such that, the observed group differences in the mean scores of the test variables may be attributable to group differences in age, level of education and intelligence. Given this, each of the three variables was assessed for the suitability of use as a covariate. In some instances the use was inappropriate. In these situations the variables were categorised into discrete variables and used in a factorial ANOVA. In these cases the interaction is the only effect of interest. The results of these analyses are discussed in the following sections. To reduce the possibility of Type I errors due to the large number of analyses, a statistical criterion of .01 will be used. Given the severity with which the WCST variables violate the normality assumption they were omitted from all the following analyses.

Age

5.6 Analysis of covariance

One assumption of ANCOVA is that the covariate is unrelated to the independent variable, which is offence category in this case. However, a correlation analysis using Pearson's r indicated that there was a significant moderate relationship between the two variables, $r = 0.396$, p ¤ ,000. As such, the use of age as a covariate is inappropriate. Given this, age was converted into a categorical independent variable to use in a factorial ANOVA.

5.7 Factorial analysis of variance

Age was categorised into three categories: 20-29 years, 30-39 years and 40+ years. When crossed with offence category, nine groups were produced. The sample size for each group is depicted in Table 6.

Table 6

Sample sizes for age by offence

Offence Category	Age Group		
	20-29 years	30-39 years	40+ years
Sex offenders	2	6	17
Non-sex offenders	12	9	4
Controls	6	11	8

N = 75

5.7.1 Assumptions

Prior to the analysis all variables were examined against the assumptions of factorial ANOVA, such that the distributions of each variable in each sample were assessed for normality and homogeneity of variance.

5.7.1.1 Normality

The distributions of the variables in each group were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. However, distribution statistics were unable to be calculated for the RAVLT Total Errors variable in the sex offender group aged 20-29 years. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. The only skewness statistics exceeding two standard errors of skewness were the RAVLT Trial 1 and FAS Total Errors variables in the sex offender group aged 40+ years. However, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent.

5.7.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of three variables: RAVLT Total Score (p = .042), RAVLT Total Errors (p = ,002) and RCF Copy Score (p = .007). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 3. With

unequal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

5.7.2 Results of factorial ANOVA

A **3 x** 3 factorial ANOVA was performed to determine the effects of age and offence history on the participants' performance on the RAVLT, RCF and FAS variables. No significant interactions were found between offence and age for any of the variables, indicating that the relationship between age and all test variables did not differ among the groups. As such, it appears that age had little impact on the participant's performance.

Level of education

5.8 Analysis of covariance

Prior to an ANCOVA using education as the covariate, a correlation analysis using Pearson's r was run to determine the relationship between education level and offence history. The results indicated the presence of a very weak, non-significant correlation between these two variables (r □ 0.160, *p* □ .171). As such, the covariate (level of education) is unrelated to the independent variable (offence history). Given this, ANCOVA is considered an appropriate method to assess the effects of level of education on the participants' performance on the neuropsychological tests.

5.8.1 Assumptions

Prior to analysis, level of education was further assessed against the criteria for covariates. A .01 criterion of statistical significance was employed for all tests.

5.8.1.1 Linearity

Scatter plots of the dependent variables versus the covariate were produced and examined for linearity. No serious departures of linearity were noted. However, the first run of a full-factorial SPSS ANCOVA using Type III sums of squares indicated that there were no significant linear relationships between level of education and these variables. As such, level of education is not considered a suitable covariate. Given this, education was converted into a categorical independent variable for use in a factorial ANOVA

5.9 Factorial analysis of variance

Initially level of education was converted into three categories: 9 years and under, 10-11 years and 12 years and over. However, when crossed with offence category this produced only one participant in the control group with 9 years and under of education. This renders factorial ANOVA an inappropriate method. As such, level of education was re-categorised into two groups: 10 years and under; 11 years and over. When crossed with offence category six groups were produced. The sample size for each group is depicted in Table 7.

Table 7

Sample sizes for level of education by offence

	Level of Education	
Offence Category	9 years and under	11+ years
Sex offenders	16	9
Non-sex offenders	19	6
Controls	10	15

N = 75

5.9.1 Assumptions

Prior to the analysis all variables were examined against the assumptions of factorial ANOVA, such that the distributions of each variable in each sample were assessed for normality and homogeneity of variance.

5.9.1.1 Normality

The distributions of the variables in each group were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. The only skewness statistics exceeding two standard errors of skewness were the RAVLT Trial 1 for sex offenders with fewer than 10 years of education and RCF Copy for non-sex offenders with 11+ years of education. However, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent.

5.9.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of two variables: RAVLT Total Errors ($p = .023$) and RCF Copy Score ($p = .004$). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 3. With unequal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

5.9.2 Results of factorial ANOVA

A 2 x 3 factorial ANOVA was performed to determine the effects of level of education and offence history on the participants' performance on the RAVLT, RCF and FAS variables. No significant interactions were found between offence and level of education for any of the variables. Thus, indicating that the relationship between level of education and all test variables did not differ among the groups. As such, it appears that level of education had little impact on the participant's performance.

Level of intelligence

5.10 Analysis of covariance

Prior to an ANCOVA using estimated full scale IQ (IQ) as the covariate, a correlation analysis using Pearson's r was run to determine the relationship between IQ and offence history. The results indicated the presence of a very weak, non-significant correlation between these two variables ($r = -.034$, $p = .770$). As such, the covariate (IQ) is unrelated to the independent variable (offence history). Given this, ANCOVA is considered an appropriate method to assess the effects of level of intelligence on the participants' performance on the neuropsychological tests.

5.10.1 Assumptions

Prior to analysis IQ was further assessed against the criteria for covariates. A .01 criterion of statistical significance was employed for all tests.

5.10.1.1 Linearity

Scatter plots of the dependent variables versus the covariate were produced and examined for linearity. No serious departures of linearity were noted. However, the first run of a full-factorial SPSS ANCOVA using Type III sums of squares indicated that only two variables had significant linear relationships with IQ; RCF Delay Score, F (1,71) = 10.05, p = .002; FAS Total, F (1,71) = 8.84, p = ,004. As such, IQ is only considered a suitable covariate for these variables. Given this, all other variables were omitted from the analysis.

5.10.1.2 Homogeneity of regression

RCF Delay Score and FAS Total were the only variables examined against this assumption. Examination of the scatter plots revealed little difference between the regression slopes of the groups for both variables. The second run of the SPSS ANCOVA with the inclusion of the interaction between offence and IQ, confirmed that there was no significant difference in the slopes for RCF Delay Score, F (2,69) = 2.32, p = .106 or FAS Total, F (2, 69), □ .037, p □ .963. As such, IQ was considered an appropriate covariate for these two variables.

5.10.2 Results of analysis of covariance

A full factorial ANCOVA using Type III Sums of Squares was performed on RCF Delay Score and FAS Total score to assess the effect of IQ on participants' performance on these variables. The results indicated that after adjustment for IQ, there was still no difference between the mean RCF Delay scores, F (2,71) = 1.63, p □ .203 or mean FAS Total Scores, F (2,71) □ 1.55, p □ .220.

5.11 Factorial analysis of variance

Given that IQ was an inappropriate covariate for the majority of the dependent variables; IQ was converted into a categorical independent variable to use in a factorial ANOVA. The IQ categories used included: below average (scores of 89 and under), average (scores between 90-110) and above average (scores of 111 and over). When crossed with offence category, nine groups were produced. The sample size for each group is depicted in Table 8.

Table 8

Sample sizes for estimated full scale IQ by offence

	IQ range		
Offence Category	Below average	Average	Above Average
Sex offenders	5	8	12
Non-sex offenders	8	15	2
Controls	2	13	10

N = 75

5.11.1 Assumptions

Prior to the analysis all variables were examined against the assumptions of factorial ANOVA, such that the distributions of each variable in each sample were assessed for normality and homogeneity of variance.

5.11.1.1 Normality

The distributions of the variables in each group were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. The only skewness statistics exceeding two standard errors of skewness were the RAVLT Errors for sex offenders with above average IQ, RCF Copy for non-sex offenders with average IQ and FAS Total Errors for sex offenders with average IQ. However, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent.

5.11.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of three variables: RCF Copy Score ($p = .031$), FAS Total Score ($p = .015$) and FAS Errors ($p = .023$). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 3. With unequal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

5.11.2 Results of factorial ANOVA

A 3 x 3 factorial ANOVA was performed to determine the effects of IQ and offence history on the participants' performance on the RAVLT, RCF and FAS variables. No significant interactions were found between offence and IQ for any of the variables. Thus, indicating that the relationship between IQ and all test variables did not differ among the groups. As such, it appears that level of intelligence had little impact on the participant's performance.

5.12 Summary

Collectively, the results of the ANCOVAs and factorial ANOVAs indicate that age, level of education and level of intelligence had little effect on the participants' performance on the neuropsychological tests. As such, it appears that the observed group differences in the mean scores of the test variables are not attributable to the group differences in age, level of education or level of intelligence.

Section 3
Principal components analyses

5.13 Introduction

An exploratory principal components analysis was conducted to determine if there were any factors underlying those variables shown to be significantly different between the groups, or approaching significance at the level of .05. Given that the analysis was exploratory the less conservative significance level of .05 was used as an inclusion criteria to ensure that potentially significant variables were not omitted from the analysis. Fourteen variables were used in the analysis including: all four WAIS-III variables, RAVLT Trials 1, 5 and 6, Total Score, Total Errors and Delayed Recall, both RCF variables and two FAS variables; Total Score and Total Errors. Although the FAS variables A words and S words approach significance, FAS Total Score is a composite of these variables and as such they were omitted from the analysis.

5.13.1 Assumptions

Prior to analysis all 14 variables were examined for accuracy of data entry, missing values and fit between their distributions and the assumptions of principal components analysis. The variables were not examined separately for each of the three groups; rather the ungrouped data was assessed. No missing values were detected.

5.13.1.1 Normality

The distributions of the variables were examined for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. However, the distribution statistics were within two standard errors of skewness and kurtosis, with the exception of RAVLT Errors and FAS Errors. Examination of the graphical depictions indicated that no univariate outliers were present and that no serious deviation from normality was apparent.

5.13.1.2 Linearity

The difference in skewness for variables suggests possible curvilinearity for some pairs of variables. However, with 14 variables examination of all pairwise scatter plots is impractical. Therefore, only spot checks were conducted. While some plots indicated departure from linearity, there was no evidence of true curvilinearity.

5.13.1.3 Multivariate outliers

Multivariate outliers were assessed using Mahalanobis distance with a criterion of X^2 (14) □ 36.123, p = 0.001. The maximum value obtained was 26.310. As this is far below the critical value there is no suggestion of any multivariate outliers.

5.13.1.4 Factorability of R

Correlation matrices among the 14 variables reveal numerous correlations in excess of .30 and some considerably higher. Kaiser-Myer-Olkin measure of sampling adequacy is 0.742 and Bartlett's test of sphericity is significant, p = 0.000, indicating that there are significant correlations among the variables and that the data is suitable for principal components analysis.

5.14 Results of Principal Components Analysis

A principal components analysis with oblique rotation was performed on 14 variables for a sample of 75 men. Fourteen factors were extracted. However, using the criterion of retaining factors with eigenvalues of one or more, the first four factors were retained. These factors accounted for 36.92%, 13.30%, 8.86% and 7.54% of the total variance, respectively. That is, 66.62% of the total variance is attributable to four factors. The scree plot confirmed this potential four-factor model. Examination of the component correlation matrix indicated that these four factors were not strongly correlated, with all co-efficients being less than or equal to 0.30. Thus, suggesting that rotation is appropriate.

A second principal components analysis was run with varimax rotation. Although the total variance explained by the four factors remained at 66.62% after rotation, the percentage of variance accounted for by each factor changed. The four factors now account for 24.04%, 18.81%, 12.65% and 11.16% of the variance, respectively. The rotated component matrix

indicated cross-loading of variables across the factors. In particular, RAVLT Errors equally loaded on Factors 1 and 2, and RAVLT Trial 6 equally loaded on Factors 1, 3 and 4. Given that these cross-loadings hinder interpretation of the factors, they were omitted and a third analysis was run.

The third analysis utilised a more stringent cut of .45 for inclusion of variables in the interpretation of a factor, as higher loadings are reported to be indicative of a more pure measure of the factor (Tabachnick & Fidell, 2001). The results indicated that the removal of these two variables improved the solution, with the total variance explained by the four factors increasing from 66.62% to 72.01%. The four factors each account for 26.48%, 21.48%, 13.27% and 10.79% of the variance respectively.

Examination of the rotated component matrix indicated no cross loadings of variables across the factors. It can be seen from Table 9 that the variables representing the four factors are clearly related to the tests administered. Factor 1 relates to the RAVLT, Factor 2 consists of the WAIS-III subtests, Factor 3 represents the RCF test and Factor 4 contains the FAS variables. As such, these Factors are labelled by the test name they represent.

Table 9

Factor loadings of rotated componenf matrix

	Component			
	1	2	3	4
RAVLT Total Score	.934			
RAVLT Trial 5	.884			
RAVLT Delayed Recall	.862			
RAVLT Trial 1	.668			
Picture Arrangement		.796		
Block Design		.794		
Vocabulary		.786		
Arithmetic		.566		
RCF Copy			.886	
RCF Delay Score			.577	
FAS Errors				.874
FAS Total				.528

N = 75

Factor scores were created for each of these factors and the resultant four variables were used in subsequent analyses. The four factor variables were labelled Factor 1 (RAVLT), Factor 2 (WAIS-III), Factor 3 (RCF) and Factor 4 (FAS).

Section 4
Discriminant function analyses

5.15 Introduction

A discriminant function analysis was conducted to determine if group membership could reliably be predicted based on the scores that were shown to differ significantly or approached significance in the one-way analyses. Given that four factors were found to underlie these variables in the previous principal components analysis, the four variables created from factor scores were used in this analysis. The four factor variables included Factor 1 (RAVLT), Factor 2 (WAIS-III), Factor 3 (RCF) and Factor 4 (FAS).

5.15.1 Assumptions

Prior to analysis the four factor variables were examined for accuracy of data entry, missing values and fit between their distributions and the assumptions of discriminant analysis. The variables were examined separately for each of the three groups. No missing values were detected. The sample size of the smallest group (n = 25) exceeded the number of predictor variables.

5.15.1.1 Normality

The distributions of the variables were examined for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the variable distributions. However, the distribution statistics were within two standard errors of skewness and kurtosis. Examination of the graphical depictions indicated that no univariate outliers were present and that no serious deviation from normality was apparent.

5.15.1.2 Multivariate outliers

Multivariate outliers were assessed using Mahalanobis distance with a criterion of X^2 (4) = 18.467, p = 0.001 for each group. The maximum values obtained were 8.80, 10.41 and 10.07 for the sex offenders, non-sex offenders and the control group respectively. As these values are below that of the critical value there is no suggestion of any multivariate outliers.

5.15.1.3 Homogeneity of variance-covariance matrices

The homogeneity of variance-covariance was assed using Box's M. Given that this statistic was not significant, p = .432, there is no suggestion of heterogeneity.

5.15.1.4 Linearity

Scatter plots among all pairs of variables within each group were inspected for signs of non-linearity. While some plots indicated slight departure from linearity, there was no evidence of true curvilinearity.

5.15.2 Results of the discriminant function analysis

A direct discriminant function analysis was performed using four variable as predictors of membership in three groups; sex offenders, non-sex offenders and controls. Two discriminant functions were calculated and together they significantly discriminated between the groups, Wilks Lambda = .588, X^2 (8) = 37.426, p = .000. After removal of the first function, there was still a strong association between the groups and predictors, Wilks Lambda = .800, X^2 (3) = 15.700, p = .001. The two functions accounted for 59.1% and 40.9% of the between-group variability, respectively. This indicates that both dimensions are required to adequately differentiate between the three groups.

A jack-knifed classification procedure for the total sample (N = 75) indicated that 61.3% of cases were classified correctly. This is an improvement on chance allocation, in which 33% of cases would be correctly identified based on chance alone. Table 10 depicts the number of cases and percentages of each group correctly classified.

Table 10

Number and percentage of cases classified info the fhree groups for the original and *cross-*validation analyses

			Predicted Group Membership		
		Group	S.O	N.S.O	Controls
Original	Count	S.O[a]	14	7	4
		N.S.O[a]	3	17	5
		Controls[a]	5	5	15
	%	S.O[a]	56.0	28.0	16.0
		N.S.O[a]	12.0	68.0	20.0
		Controls[a]	20.0	20.0	60.0
Cross-validated	Count	S.O[a]	14	7	4
		N.S.O[a]	4	15	6
		Controls[a]	5	5	15
	%	S.O[a]	56.0	28.0	16.0
		N.S.O[a]	16.0	60.0	24.0
		Controls[a]	20.0	20.0	60.0

Note S.O = sex offenders, N.S.O = non-sex offenders

[a] $n = 25$

% = percentage

As can be seen from Table 10, the non-sex offenders were more likely to be classified correctly followed by the controls and then the sex offenders. Sex offenders were more often misclassified as non-sex offenders, whereas non-sex offenders were more often misallocated to the control group. The number of control cases misallocated to the other two groups was equal.

The stability of the classification procedure was checked by a cross-validation run. The overall percentage of cases correctly allocated dropped slightly to 58.7%. However, this is still far greater than the 33% of chance allocation. The number of cases and percentages of each group correctly classified are depicted in Table 10. From the table it can be seen that the results are the same as the original classification for the sex offenders and control group. The only difference in group percentages is the drop from 68% in the non-sex offender original classification rate to 60% in the cross-validation.

Given that the classification confirmed the usefulness of the functions in differentiating between the groups, interpretation of the discriminant functions is warranted. The table of group centroids and territorial map indicated that the first discriminant function maximally separated the control group from both the sex offenders and non-sex offenders, with the controls having higher values on this function. The second discriminant function maximally differentiated the non-sex offenders and sex-offenders with the control group falling in between. The non-sex offenders tended to have lower values on this function.

The loading matrix of correlations between predictors and discriminant functions indicated that the best predictor for differentiating between sex offenders and non-sex offenders (Function 2) was the WAIS-III factor (.933). This suggests that scores on the four WAIS-III subtests are considered good predictors of group membership between sex offenders and non-sex offenders, with lower scores being indicative of non-sex offender group membership.

The best predictors for distinguishing between the controls and the other two groups (Function 1) were the RAVLT (.656), RCF (.764) and FAS (.438) factors. This indicates that scores on these tests are considered good predictors of distinguishing between membership of the control group and the other two groups, with higher scores being indicative of control group members. However, as FAS has a much lower correlation with this function than the other two factors, its contribution to the differentiation between the groups is much less. Further to this, it also has a moderate correlation with the second discriminant function. As such, its contribution to the discriminant analysis is questionable. Given this, the discriminant analysis was re-run without the inclusion of this factor.

A second direct discriminant function analysis was performed using only three variables as predictors of membership in three groups; sex offenders, non-sex offenders and controls. Two discriminant functions were calculated and together they significantly discriminated between the groups, Wilks Lambda = .635, X^2 (6) = 32.246, p = .000. After removal of the first function, there was still a strong association between the groups and predictors, Wilks Lambda = .834, X^2 (2) = 12.849, p = .002. The two functions accounted for 61.3% and 38.7% of the between-group variability, respectively. This indicates that both dimensions are required to adequately differentiate between the three groups.

A jack-knifed classification procedure for the total sample (N= 75) indicated that 62.7% of cases were classified correctly. This is an improvement on chance allocation, in which 33% of cases would be correctly identified based on chance alone. Given that the percentage has increased slightly compared with the last analysis (61.3%), this indicates that the removal of the FAS factor has increased predictability of group membership. Table 11 depicts the number of cases and percentages of each group correctly classified.

Table 11

Number and percentage of cases classified into the three groups for the original analysis

			Predicted Group Membership		
		Group	S.O	N.S.O	Controls
Original	Count	S.O[a]	15	7	3
		N.S.O[a]	4	15	6
		Controls[a]	3	5	17
	%	S.O[a]	60.0	28.0	12.0
		N.S.O[a]	16.0	60.0	24.0
		Controls[a]	12.0	20.0	68.0

Note S.O = sex offenders, N.S.O = non-sex offenders

[a] $n = 25$

% = percentage

As can be seen from Table 11, the controls were more likely to be classified correctly compared with the other two groups. Sex offenders were more often misclassified as non-sex offenders, whereas non-sex offenders were more often misallocated to the control group. The number of control cases misallocated was minimal. However, more cases were misclassified to the non-sex offender group.

The stability of the classification procedure was checked by a cross-validation run. The overall percentages and within group percentages were the same as for the original analysis. In comparison to the previous discriminant analysis, this cross validation is an improvement with the overall percentage of cases correctly classified increasing from 58.7% to 62.7%. In particular, predictability of group membership to the sex offender and control groups increased. This

suggests that by removing the FAS factor, it was easier to predict sex offender and control group membership.

Given that the classification confirmed the usefulness of the two functions in differentiating between the groups, interpretation of the discriminant functions is warranted. The table of group centroids indicated that the first discriminant function maximally separated the sex offenders from the control group, with the non-sex offenders falling in-between. However, both offender groups tended to have lower scores than the control group. The second discriminant function differentiated the non-sex offenders from the other two groups, with non-sex offenders having the lowest values on this function.

The loading matrix of correlations between predictors and discriminant functions suggested that the best predictors for distinguishing between the sex offenders and control group were the RCF (.816) and RAVLT (.592) factors. This indicates that the pattern of test scores on the RCF and RAVLT may be considered good predictors of distinguishing between membership of the sex offender group and the control group, with lower scores being indicative of sex offenders.

The best predictor for distinguishing between the non-sex offenders and the other two groups was the WAIS-III factor (.918). This suggests that the scores on the WAIS-III subtests may be considered good predictors of distinguishing non-sex offenders from both sex offender and control group members, with lower scores being indicative of non-sex offender group members.

5.16 Summary

In summary, the RAVLT, RCF, FAS and WAIS-III factors appear to be useful in discriminating between sex offenders, non-sex offenders and controls. However, the results suggest that the RAVLT, RCF and WAIS-III factors were the better predictors of sex offender group membership, with the percentage of correctly classified sex offender cases increasing with the removal of the FAS factor.

Although the RAVLT and RCF factors are important for distinguishing between sex offenders and controls, they were not sufficient to differentiate between the sex offenders and non-sex offenders. As such, it appears that the WAIS-III factor is important in further differentiating between the two offender types. Given that these factors are representative of the test variables,

it can be assumed that a combined pattern of lower RCF and RAVLT variable scores and higher WAIS-III variable scores are indicative of sex offender group membership.

Chapter 6

Cognitive performance of offenders and controls

6.1 Introduction

In Chapter 5 many differences were found between the control group and the two offending groups. However, only a few statistically significant differences were found between the sex offenders and non-sex offenders. As such, the two offending groups were collapsed to form one group labelled offenders. Given that both offending groups in the previous analyses performed poorly on all tests in comparison to the controls, it is hypothesised that in these analyses the pattern of tests results will indicate that the offenders' mean scores on all four test variables will be lower than the controls. Specifically, it is predicated that offenders, in comparison to the controls, will recall fewer words in the immediate and delay recall trials of the Rey Auditory Verbal Learning Test (RAVLT), produce a poorer reproduction of the Rey Complex Figure (RCF) after a time delay, recall fewer words in the FAS test (FAS) and complete fewer categories and produce more perseverative errors in the Wisconsin Card Sorting Test (WCST). This chapter presents the statistical analyses used to test these hypotheses and discusses the results in relation to functional abilities. This chapter has four sections.

Section 1 presents the demographic details of the newly formed offender group and the results of the one-way ANOVA's used to compare the combined offender group and controls on age, level of education, WAIS-III subtests and estimated full scale IQ. Section 2 presents the results of the one-way analyses of variance (ANOVA) computed to compare whether the performances of the two groups on the test variables differed significantly. Following a summary of these results is Section 3, which outlines a series of analyses utilised to assess the effects of age, level of education and estimated full scale IQ on the participants' performance. Each of the three variables was assessed for their suitability of use as covariates in analyses of covariance (ANCOVAs). However, in the instances where the use was inappropriate, the variables were categorised into discrete variables and used in factorial ANOVAs. After summation of these results, Section 4 is presented. This section reports the results of a discriminant function analysis and highlights the predictability of group membership into the two groups based on the underlying factors reported in the previous principal components analysis. Given the communality of all the cognitivelneuropsychologicalmeasures it is not appropriate to consider all analyses using the

different tests as independent. Therefore a conservative p value of .01 was utilised rather than the more stringent bon-feron correction, which assumes that all variables in different analyses are independent, which is an assumption that cannot be supported because of the high inter-correlation between the cognitive measures.

Section 1
Demographics of the offender group

6.2 Introduction

Although many differences were found between the control group and the two offending groups, only a few significant differences were found between the sex offenders and non-sex offenders. As such, the two offending groups were collapsed to form one group labelled offenders (n = 50), with a mean age of 39.32 years (SD = 12.73) and mean level of education of 9.65 years (SD = 2.16). No significant differences were found between the mean age of the offender group and the control group (M = 35.4, SD = 8.29), $F(1, 73) = 1.95$, $p = .167$. However, the mean level of education significantly differed, $F(1,73) = 7.13$, $p = .009$, with the control group receiving more education on average (M = 10.88, SD = 1.09).

Level of intelligence (estimated full scale IQ) was calculated from the results of the participants' performance on the four WAIS-III subtests: Vocabulary, Arithmetic, Block Design and Picture Arrangement. A series of one-way analyses of variance were conducted to determine if the groups differed, on average, in their performance on these tests and the resultant estimated full scale IQ. Prior to analysis the distributions of all variables were assessed against the assumptions of ANOVA. No serious violations of these assumptions were noted. A statistical significance criterion of .01 was used for all analyses.

The scores of the four tests were calculated in accordance with the WAIS-III scoring criteria. As such, a score of 10 is indicative of an average performance. Silverstein's (1982) conversion tables were used to estimate Full Scale IQ. The means and standard deviations for these tests and estimated IQ are presented in Table 12.

Table 12

Means and standard deviations for the WAIS-III variables and estimated full scale IQ

	Offenders[a]		Controls[b]	
WAIS-III Variable	M	SD	M	SD
Arithmetic**	9.20	3.14	11.44	2.84
Vocabulary	8.70	2.73	10.28	2.13
Block Design	10.72	2.60	11.68	2.51
Picture Arrangement	9.76	2.91	10.12	2.86
Est. Full Scale IQ	101.08	16.52	107.32	11.77

[a] $n = 50$ [b] $n = 25$

** $p<0.01$

Table 12 indicates that the controls had higher mean scores for all variables, with an average performance across all subtests. The mean scores for the offender group indicate a generally average performance, although a below average score was recorded for the Vocabulary subtest. Although the offenders had a lower mean estimated full scale IQ than the control group, this score is still considered indicative of average intelligence.

A series of one-way ANOVAs identified that only the mean Arithmetic scores differed significantly between the groups, $F(1,73) = 9.03$, $p = .004$. However, the difference in mean Vocabulary scores approached significance, $F(1,73) = 6.39$, $p = .014$. No significant differences were found between the mean scores of Block Design, $F(1,73) = 2.32$, $p = .132$, Picture Arrangement, $F(1,73) = .258$, $p = .613$ or estimated full scale IQ, $F(1,73) = 2.84$, $p = .096$.

Section 2
One-way analyses of variance

6.3 Introduction

A series of one-way analyses of variance (ANOVAs) were conducted to determine if the performances of the two groups on the four test variables differed significantly. Prior to analyses all variables were assessed against the assumptions of normality and homogeneity of variance. This section presents the assessment of assumption violations for all variables followed by the results of the one-way ANOVAs. The results of each test are discussed in four separate sub-sections followed by a summary discussion of the collective pattern of results.

6.3.1 Assumptions

Prior to analysis all variables were examined for accuracy of data entry, missing values and fit between their distributions and the assumptions of one-way analysis of variance. The variables were examined separately for each of the two groups. No missing values were detected.

6.3.1.1 Normality

The distributions of the variables were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. However, only the RAVLT Errors skewness statistic for the offender group exceeded two standard errors of skewness. Despite this, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent. As the assumption of normality applies to the sampling distribution of means and not raw scores, the central limit theorem assures that with sample sizes greater than 20, univariate ANOVA is robust to violations of normal variable distributions (Tabachnick & Fidell, 2001). With the sample size in each group being 25, the normality of sampling distributions of means is anticipated.

The distribution statistics for the WCST variables exceeded two standard errors of skewness and kurtosis. Inspection of histograms and box plots revealed serious departure from the normal distribution. Transformation of the variables was considered. However, the direction and severity

of skewness differed between the groups, rendering transformation inappropriate. Although the sample size is theorised to be large enough for the analysis to be robust against these violations, given the seriousness of the violations these variables were omitted from the univariate analysis. They were later analysed using non-parametric statistics.

6.3.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of three variables; RAVLT Total Score (p=.012), RCF Copy Score (p=.001) and FAS S words (p=.010). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 10. If sample sizes are within a ratio of 4 to 1 or less then this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

6.3.2 Results of one-way analyses of variance

A series of one-way analyses of variance were performed for each of the RAVLT, RCF and FAS variables. The results for each set of variables are discussed in turn.

6.3.2.1 Rev Auditory Verbal Learning Test

This test was scored as per the criteria in the previous chapter, section 5.3.1.1. The means and standard deviations for each RAVLT variable across each of the groups are presented in Table 13.

Table *13*

Means and standard deviations for the RAVLT variables

	Offenders[a]		Controls[b]	
RAVLT Variable	M	SD	M	SD
Trial *1***	*5.94*	*1.53*	*7.16*	*1.52*
Trial *5***	*10.74*	*2.40*	*12.32*	*2.01*
Trial *7*	*9.20*	*3.02*	*10.44*	*2.60*
Total Score**	*43.90*	*10.00*	*51.72*	*6.68*
Total Errors	*5.72*	*4.96*	*8.60*	*6.26*
Trial *6***	*4.43*	*1.62*	*5.84*	*1.57*
Delayed Recall	*8.78*	*2.92*	*10.48*	*2.74*
Recognition List A	*13.74*	*1.79*	*14.24*	*0.83*
Recognition List B	*6.32*	*3.37*	*6.72*	*6.45*
Rate of Learning	*4.80*	*2.20*	*5.16*	*2.29*
Rate of Forgetting	*-0.42*	*1.53*	*0.04*	*1.69*
Retrieval List A	*4.96*	*2.51*	*3.76*	*2.52*
Retrieval List B	*1.98*	*3.13*	*0.88*	*2.77*
Proactive Interference	*-1.60*	*2.00*	*-1.32*	*2.14*
Retroactive Interference	-1.54	*1.94*	*-1.88*	*1.96*

[a] $n = 50$ [b] $n = 25$

** $p<0.01$

Table *13* shows that the control group recalled more words, on average, than the offenders on the immediate recall trials. However, despite the offenders recalling fewer words at Trials *1* and *5,* their rate of learning across the trials was similar to that of the controls, with both groups learning approximately five words on average. After a *30* minute delay period the controls recalled more words than the offenders, on average. However, the rate of forgetting scores indicates that both groups experienced little forgetting during the delay.

Table *13* also indicates that there was little difference in the mean recognition scores for both List A and List B. Both groups had positive mean retrieval scores, indicating greater facilitation of recall with recognition testing. However, the mean retrieval scores of both List A and B were

greater for the offenders compared to the controls, indicating that the offenders benefited more from retrieval cues in the recognition trial than did the controls.

The mean proactive and retroactive interference scores were similar for the two groups, indicating that both groups recalled fewer words after the presentation of an interference list. However, each group only lost between one and two words, suggesting that minimal interference was experienced. The controls produced more total errors on average, thus, indicating that they experienced more interference in the form of repetitions and extra-list inclusions than the other two groups.

One way analyses of variance confirmed that there was a significant difference between the mean number of words recalled over the immediate recall trials; Trial 1, $F(1,73) = 10.64$, $p = .002$; Trial 5, $F(1,73) = 8.01$, $p = ,006$; Trial 6, $F(1,73) = 14.52$, $p = .000$, and Total Score, ($F(1,73) = 12.46$, $p = .001$. However, the differences between the mean number of words recalled after a time delay and the mean number of errors produced failed to reach significance, $F(1,73) = 5.89$, $p = .018$; $F(1,73) = 4.70$, $p = .033$, respectively. Although the differences in the mean delayed recall scores approached significance.

Although the differences appear highly significant, the effect sizes of the overall ANOVA for each of these significant variables is small; Trial 1, $n^2=.13$; Trial 5, $n^2=.10$; Trial 6, $n^2=.17$ and Total Score, $n^2=.15$. As such, only between 10%-17% of the variability in these scores is attributable to offence history. This indicates that despite differences amongst the groups, the relationship between these RAVLT variables and offence history is small to moderate.

Mixed model analyses of variance with one between group factor and one within-subject factor were conducted to compare group differences in rate of learning (Trial 1 and Trial 5), rate of forgetting (Trial 7 and Delayed Recall Trial), proactive interference (Trial 1 and Trial 6), retroactive interference (Trial 5 and Trial 7) and retrieval (Delayed Recall and Recognition List A; Trial 6 and Recognition List B). No significant interactions were found among the groups for any of these variables, $F(1,73) = 0.43$, $p = .512$; $F(1, 73) = 1.41$, $p = .240$; $F(1,73) = 0.31$, $p = ,578$; $F(1,73) = 0.51$, $p = .478$; $F(1,73) = 3.79$, $p = ,055$; $F(1,73) = 2.22$, $p = .142$, respectively. This indicates that the groups did not differ in their rate of learning, rate of forgetting, retrieval abilities or interference effects. As such, the observation that offenders benefited more from retrieval cues in the recognition trial than the controls is not statistically supported.

In summary, the lack of significant differences found between the groups in rate of learning, forgetting and retrieval indicate that the offenders do not have impaired encoding, consolidation or retrieval abilities for verbal material in comparison to the controls. However, the difference between the mean scores of the delayed recall trial of the RAVLT approached significance. This suggests that retrieval may have been more difficult for the offenders during this trial. This differs to the finding of the previous chapter in which the differences between the three groups in their delayed recall scores were neither significant nor approached significance. As such, it may be offenders in general, rather than sex offenders specifically, that potentially have temporal lobe problems.

These findings do indicate that offenders differed from controls in their immediate recall of verbal information. This is consistent with the findings in the previous chapter, which also suggested that this might be indicative of a diminished working memory capacity. As such, this finding suggests that offenders in general may have frontal lobe impairment, although clearly the evidence for this position is not particularly compelling.

6.3.2.2 Rev Complex Figure

The test was scored as per the criteria in section 5.3.1.2. The means and standard deviations for the RCF variables across each of the groups are presented in Table 14.

Table 14

Means and standard deviations for the RCF variables

	Offenders[a]		Controls[b]	
RCF Variable	M	SD	M	SD
RCF Copy Score**	29.90	3.32	32.36	1.53
RCF Delay Score	16.74	6.47	20.28	5.97
Organisational Quality	1.62	0.88	1.88	1.05

[a] $n = 50$ [b] $n = 25$

* * $p<0.01$

Table 14 indicates that the control group had higher mean copy and recall scores than the offending group, indicating that they produced a better copy of the diagram and recalled a larger

portion of the figure after a time delay. One-way analyses of variance indicated that these mean copy scores were significantly different between the groups ($F(1,73) = 12.36$, $p = .001$, $n^2 = .15$). Although, the differences in the mean delayed recall scores were not significant ($F(1,73) = 5.24$, $p = .025$) they did approach significance.

Despite this highly significant difference, the effect size, $n = .15$ indicates that the relationship between RCF copy score and offence history is small, with only 15% of the variance in copy score being explained by offence history.

Table 14 indicates that the groups did not differ in their organisational quality scores, indicating that both groups had poor organisational quality and made two or more configural errors during the copy trial. However, closer inspection of the types of configural errors made indicate very different patterns of errors for the controls compared with the two offender groups. The types of configural errors were described in the previous chapter.

Qualitative analysis of the offenders' copy trial indicate that 72% of the group had configural mistakes relating to the rectangle, 50% drew the midlines as segments and 98% drew details before the midlines. This suggests that the offenders had difficulty not only perceiving the larger configural units but also had difficulty planning and organising unstructured material. Contrarily, the controls configural mistakes largely related to poor planning and organisation rather than the misperception of the rectangle and midlines, with 36% of the group making configural mistakes relating to the rectangle, 36% drawing the midlines as segments and 56% drawing details before the midlines.

The sex offenders' pattern of performance indicates that while they produced a poor copy of the figure in comparison to the controls, over time they were able to consolidate the information and reproduce a copy not statistically different to that of the control group. However, the difference in the mean delayed recall scores did approach significance, indicating that the offenders had more difficulty retrieving this information than the controls. This differs to the finding of the previous chapter in which the differences between the three groups in their delayed recall scores of the RCF were neither significant nor approached significance. This again indicates that it may be offenders in general, rather than sex offenders specifically, that potentially have temporal lobe problems.

The finding of significant differences between the groups' mean copy scores and pattern of qualitative errors is consistent with the findings in the previous chapter. Thus, the poor copy scores may be more reflective of a diminished working memory capacity in the offenders rather than an impaired visual-constructional ability. This indicates that offenders, in general, may have a frontal lobe deficit.

6.3.2.3 FAS test

Scores were calculated as per the criteria in Section 5.3.1.3. The means and standard deviations for each FAS variable across each of the groups are presented in Table 15.

Table 15

Means and standard deviations for the FAS variables

	Offenders[a]		Controls[b]	
FAS Variable	M	SD	M	SD
F words	11.68	4.26	12.00	3.69
A words	9.02	3.58	11.20	3.89
S words*	12.00	4.84	15.40	3.62
FAS Total Score	32.50	11.49	38.52	9.38
FAS Total Errors*	1.82	1.62	3.08	2.12

[a] $n = 50$ [b] $n = 25$

** $p<0.01$

Table 15 indicates that, on average, the control group produced more A and S words than the offenders but produced a similar number of F words. Although one-way analyses of variance indicated that there were no significant differences between the mean number of A, $F(1,73) = 5.82$, $p = .018$ and F words produced, $F(1,73) = 0.102$, $p = .750$, there was a significant difference in the average number of S words produced, $F(1,73) = 9.61$, $p = .003$. However, the effect size was small ($n^2 = .12$) indicating that only 12% of the variance in the number of S words produced was attributable to offence history.

Table 15 also shows that, on average, the control group produced more words overall than the offenders and made more errors. However, the large standard deviations for Total Score indicate that there is a lot of variability amongst the scores in the groups, particularly in the offender

group. Although one-way analyses of variance indicated that these mean differences in total words recalled were not significant, $F(1,73) = 5.14$ $p = .026$, the differences in mean number of errors produced was significant, $F(1,73) = 8.14$, $p = .006$. However, the effect size was small ($n^2 = .10$) indicating that only 10% of the variance in the number of errors produced was attributable to offence history.

The observed pattern of results indicates that the offenders produced fewer words than the control group. Specifically, the offenders produced significantly fewer S words. This finding indicates that the offenders may have had more difficulty in word production than the controls. This differs to the ANOVA finding of the previous chapter in which the differences between the three groups in their mean FAS variables scores were neither significant nor approached significance. However, this result is consistent with the previous findings of the planned contrasts, which identified that the offenders and controls significantly differed in S word production and approached significance for A word production and Total Words. Given that depressed fluency scores are indicative of frontal lobe deficits. This finding potentially indicates that offenders, in general, may have frontal lobe impairment.

6.3.2.4 Wisconsin Card Sorting Test

Due to the violations of normality assumptions, one-way analyses were unable to be performed on these variables. As such, the equivalent non-parametric test for k independent samples, Kruskal-Wallis, was produced for each of these variables. The means and standard deviations for each WCST variable across each of the groups are presented in Table 16.

Table 16

Means and standard deviations for the WCST variables

	Offenders[a]		Controls[b]	
WCST Variable	M	SD	M	SD
No, categories completed	3.62	2.27	4.80	1.96
No, of trials	114.62	20.11	107.89	21.83
Conceptual level responses	56.34	20.03	63.36	18.66
Perseverative errors	23.32	16.02	16.40	10.14
Non-perseverative errors	20.74	14.33	16.16	13.91

[a] $n = 50$ [b] $n = 25$

Table 16 indicates that, on average, the control group completed more categories in fewer trials, produced more conceptual level responses and made fewer errors than the offender group. This indicates that the offenders, in general, had more difficulty than the controls in forming concepts, planning an appropriate problem-solving strategy and changing their inappropriate responses based on feedback. Additionally, the discrepancy between the mean number of perseverative errors and non-perseverative errors is much larger for the offenders than the controls. This suggests that the offenders' perseverative errors are reflective of inflexibility in thinking, rather than guessing.

Despite these observed mean score differences, the Kruskal-Wallis test indicated that the groups did not differ significantly in the mean number of perseverative errors, X^2 (1) = 3.41, p = .065 or conceptual level responses, X^2 (1) = 2.85, p ¤ .091. The Kruskal-Wallis test further indicated that no significant group differences were observed between the mean scores of number of categories, X^2 (1) = 4.41, p = .036, number of trials, X^2 (1) = 2.80, p = .094 and non-perseverative errors, X^2 (1) = 3.26, p = .071.

These results are consistent with those reported in the previous chapter of no significant differences between the three groups in their mean WCST scores. Although the offenders' performance appears poorer than that of the control group, the finding of no statistical differences between the two groups renders it difficult to conclude that this performance is indicative of frontal lobe impairment in the offenders.

6.4 Summary

In summary, it appears that the control group performed better than the offenders on all four neuropsychological tests. In general, the pattern of results indicate that the offenders recalled fewer words in the immediate and delay recall trials of the RAVLT, produced poorer copies of the Rey Complex Figure, recalled less of the figure after a time delay, produced less words in the FAS test and completed fewer categories and produced more perseverative errors in the WCST.

This overall observed pattern of results appears reflective of a frontal-temporal deficit. However, this observation is only partially supported by the results of the statistical analyses. The groups did not differ significantly in the delayed recall trials of either the RAVLT or RCF and as such there is no statistical evidence of temporal lobe impairment in the offenders. However, given that these differences approached significance, this type of impairment in offenders cannot be dismissed.

The offenders and controls also significantly differed in their mean scores of the immediate recall trials of the RAVLT and RCF copy trial. Thus, suggesting a possible diminished working memory capacity and hence potentially supporting a frontal lobe deficit. Further support for this type of impairment is found in the findings of significant differences in word production between the groups. However, the finding of no significant differences between the mean WCST scores contradicts the evidence of frontal lobe impairment. Nevertheless the results, in general, indicate a potential frontal lobe deficit in offenders. The following section examines whether these findings remain if age, level of education and level of intelligence are statistically controlled.

Section 3

Effects of age, level of education and level of intelligence

6.5 Introduction

In the demographics section of this chapter, it was identified that the groups only differed significantly in their mean level of education. However, to ensure that the observed group differences in the mean scores of the test variables are not due to the effects of age, level of education or level of intelligence, each of the three variables was assessed for the suitability of use as a covariate in ANCOVA. In some instances the use was inappropriate. In these situations the variables were categorised into discrete variables and used in a factorial ANOVA. In these cases the interaction is the only effect of interest. The results of these analyses are discussed in the following sections. To reduce the possibility of Type I errors due to the large number of analyses, a statistical criterion of .01 will be used. Given the severity with which the WCST variables violate the normality assumption they were omitted from all the following analyses.

Age

6.6 Analysis of covariance

Prior to an ANCOVA using age as the covariate, a correlation analysis using Pearson's r was run to determine the relationship between age and offence history. The results indicated the presence of a very weak, non-significant correlation between these two variables ($r = -0.161$, $p = .167$). As such, the covariate (age) is unrelated to the independent variable (offence history). Given this, ANCOVA is considered an appropriate method to assess the effects of age on the participants' performance on the neuropsychological tests.

6.6.1 Assumptions

Prior to analysis age was further assessed against the criteria for covariates. A .01 criterion of statistical significance was employed for all tests.

6.6.1.1 Linearity

Scatter plots of the dependent variables versus the covariate were produced and examined for linearity. No serious departures of linearity were noted. However, the first run of a full-factorial SPSS ANCOVA using Type III sums of squares indicated that only one variable had significant linear relationships with age; RCF Copy Score, $F(1,72) = 9.60$, $p = .003$. As such, age is only considered a suitable covariate for this variable. Given this, all other variables were omitted from the analysis.

6.6.1.2 Homogeneity of regression

RCF Copy Score was the only variable examined against this assumption. Examination of the scatter plot revealed little difference between the regression slopes of the groups for RCF Copy Score. The second run of the SPSS ANCOVA with the inclusion of the interaction between offence and age, confirmed that there was no significant difference in the slopes for RCF Copy Score, $F(1,71) = 0.142$, $p = .707$. As such, age was considered an appropriate covariate for these two variables.

6.6.2 Results of analysis of covariance

A full factorial analysis of covariance using Type III Sums of Squares was performed on RCF Copy Score to assess the effect of age on the participants' performance on this variable. The results indicated that after adjustment for age, there was still a difference between the mean RCF Copy scores, $F(1,72) = 10.04$, $p = .002$.

6.7 Factorial analysis of variance

Given that age was an inappropriate covariate for the majority of the dependent variables; age was converted into a categorical independent variable to use in a factorial ANOVA. Age was categorised into three categories; 20-29 years, 30-39 years and 40+ years. When crossed with offence category, six groups were produced. The sample size for each group is depicted in Table 17.

Table 17

Sample sizes for age by offence

	Age Group		
Offence Category	20-29 years	30-39 years	40+ years
Offenders	14	15	21
Controls	6	11	8

N = 75

6.7.1 Assumptions

Prior to the analysis all variables were examined against the assumptions of factorial ANOVA, such that the distributions of each variable in each sample were assessed for normality and homogeneity of variance.

6.7.1.1 Normality

The distributions of the variables in each group were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. The only skewness statistics exceeding two standard errors of skewness were the RAVLT Total Errors variable in the offender group aged 30-39 years and the FAS Total Errors variable in the offender group aged 40+ years. However, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent.

6.7.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of two variables; RCF Copy Score ($p = .002$), and RAVLT Total Errors ($p = ,006$). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 3. With unequal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

6.7.2 Results of factorial ANOVA

A 2 x 3 factorial ANOVA was performed to determine the effects of age and offence history on the participants' performance on the RAVLT, RCF and FAS variables. No significant interactions were found between offence and age for any of the variables. Thus, indicating that the relationship between age and all test variables did not differ among the groups. As such, it appears that age had little impact on the participant's performance.

Level of education

6.8 Analysis of covariance

Prior to an ANCOVA using level of education as the covariate, a correlation analysis using Pearson's r was run to determine the relationship between level of education and offence history. The results indicated the presence of a weak, but significant correlation between these two variables ($r = 0.289$, $p = .009$). As such, the use of level of education as a covariate is inappropriate. Given this, level of education was converted into a categorical independent variable to use in a factorial ANOVA.

6.9 Factorial analysis of variance

Level of education was converted into two categories; 10 years and under; 11 years and over. When crossed with offence category four groups were produced. The sample size for each group is depicted in Table 18.

Table 18

Sample sizes for level of education by *offence*

	Education Level	
Offence Category	9 years and under	11+ years
Offenders	35	15
Controls	10	15

$N = 75$

6.9.1 Assumptions

Prior to the analysis all variables were examined against the assumptions of factorial ANOVA, such that the distributions of each variable in each sample were assessed for normality and homogeneity of variance.

6.9.1.1 Normality

The distributions of the variables in each group were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. The only skewness statistics exceeding two standard errors of skewness was the RAVLT Total Errors for the offender group. However, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent.

6.9.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated a significant difference in the variance of only one variable; RCF Copy Score ($p = .003$). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for this variable did not exceed 3. With unequal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

6.9.2 Results of factorial ANOVA

A 2 x 2 factorial ANOVA was performed to determine the effects of level of education and offence history on the participants' performance on the RAVLT, RCF and FAS variables. No significant interactions were found between offence and level of education for any of the variables. Thus, indicating that the relationship between level of education and all test variables did not differ among the groups. As such, it appears that level of education had little impact on the participant's performance.

6.10 Analysis of covariance

Prior to an ANCOVA using estimated full scale IQ (IQ) as the covariate, a correlation analysis using Pearson's r was run to determine the relationship between IQ and offence history. The results indicated the presence of a weak, non-significant correlation between these two variables ($r = .193$, $p = .096$). As such, the covariate (IQ) is unrelated to the independent variable (offence history). Given this, ANCOVA is considered an appropriate method to assess the effects of level of intelligence on the participants' performance on the neuropsychological tests.

6.10.1 Assumptions

Prior to analysis IQ was further assessed against the criteria for covariates. A .01 criterion of statistical significance was employed for all tests.

6.10.1.1 Linearity

Scatter plots of the dependent variables versus the covariate were produced and examined for linearity. No serious departures of linearity were noted. However, the first run of a full-factorial SPSS ANCOVA using Type III sums of squares indicated that only two variables had significant linear relationships with IQ; RCF Delay Score, $F(1,72) = 10.81$, $p = .002$; FAS Total, $F(1,72) = 3.05$, $p = .002$. As such, IQ is only considered a suitable covariate for these variables. Given this, all other variables were omitted from the analysis.

6.10.1.2 Homogeneity of regression

RCF Delay Score and FAS Total were the only variables examined against this assumption. Examination of the scatter plots revealed little difference between the regression slopes of the groups for both variables. The second run of the SPSS ANCOVA with the inclusion of the interaction between offence and IQ, confirmed that there was no significant difference in the slopes for RCF Delay Score, $F(1,71) = 2.23$, $p = .139$ or FAS Total, $F(1, 71) = 0.03$, $p = .874$. As such, IQ was considered an appropriate covariate for these two variables.

6.10.2 Results of analysis of covariance

A full factorial analysis of covariance using Type III Sums of Squares was performed on RCF Delay Score and FAS Total score to assess the effect of IQ on participants' performance on these variables. The results indicated that after adjustment for IQ, there was still no difference between the mean RCF Delay scores, $F(1,72) = 3.09$, $p = .083$ or mean FAS Total Scores, $F(1,72) = 3.05$, $p = .085$.

6.11 Factorial analysis of variance

Given that IQ was an inappropriate covariate for the majority of the dependent variables; IQ was converted into a categorical independent variable to use in a factorial ANOVA. The IQ categories used included: below average (scores of 89 and under), average (scores between 90-110) and above average (scores of 111 and over). When crossed with offence category, six groups were produced. The sample size for each group is depicted in Table 19.

Table 19

Sample sizes for esfimated full scale IQ by offence

	IQ range		
Offence Category	Below average	Average	Above Average
Offenders	13	23	14
Controls	2	13	10

$N = 75$

6.11.1 Assumptions

Prior to the analysis all variables were examined against the assumptions of factorial ANOVA, such that the distributions of each variable in each sample were assessed for normality and homogeneity of variance.

6.11.1.1 Normality

The distributions of the variables in each group were evaluated for skewness and kurtosis through distribution statistics, histograms and box plots. However, distribution statistics were unable to be calculated for the control group with below average intelligence, as the sample size

was too small. Slight skewness and kurtosis was evident in some of the RAVLT, RCF and FAS variable distributions. The only skewness statistics exceeding two standard errors of skewness were the FAS Total Errors for offenders with average and above average IQ. However, examination of the graphical depictions confirmed that no outliers were present and that no serious departures from normality were apparent.

6.11.1.2 Homogeneity of variance

Levene's test for equality of variance was obtained for each of the RAVLT, RCF and FAS variables. Using a significance level of .05, the Levene Statistic indicated significant differences in the variance of three variables; RCF Copy Score (p = .014), FAS Total Score (p = .005) and RAVLT Total Errors (p = ,042). Although this is indicative of an assumption violation, the ratios of largest cell variance to smallest cell variance (F_{max}) for each variable did not exceed 3. With unequal sample sizes this is considered acceptable and not in violation of the assumption (Tabachnick & Fidell, 2001).

6.11.2 Results of factorial ANOVA

A 2 x 3 factorial ANOVA was performed to determine the effects of IQ and offence history on the participants' performance on the RAVLT, RCF and FAS variables. No significant interactions were found between offence and IQ for any of the variables. Thus, indicating that the relationship between IQ and all test variables did not differ among the groups. As such, it appears that IQ had little impact on the participant's performance.

6.12 Summary

Collectively, the results of the ANCOVAs and factorial ANOVAs indicate that age, level of education and level of intelligence had little effect on the participants' performance on the neuropsychological tests. As such, it appears that the observed group differences in the mean scores of the test variables are not attributable to the group differences in age, level of education or level of intelligence.

Section 4
Discriminant function analyses

6.13 Introduction

A discriminant function analysis was conducted to determine if group membership could reliably be predicted based on the scores that were shown to differ significantly or approached significance in the one-way analyses. These variables included the RAVLT, RCF and FAS variables. The principal components analyses outlined in Chapter 5 indicated that four factors were found to underlie these variables. As such, factor scores were created for each of the two groups and the resultant four variables were used in this analysis. The four factor variables included Factor 1 (RAVLT); Factor 2 (WAIS-III), Factor 3 (RCF) and Factor 4 (FAS).

6.13.1 Assumptions

Prior to analysis the four factor variables were examined for accuracy of data entry, missing values and fit between their distributions and the assumptions of discriminant analysis. The variables were examined separately for each of the two groups. No missing values were detected. The sample size of the smallest group (n = 25) exceeded the number of predictor variables.

6.13.1.1 Normality

The distributions of the variables were examined for skewness and kurtosis through distribution statistics, histograms and box plots. Slight skewness and kurtosis was evident in some of the variable distributions. However, the distribution statistics were within two standard errors of skewness and kurtosis. Examination of the graphical depictions indicated that no univariate outliers were present and that no serious deviation from normality was apparent.

6.13.1.2 Multivariate outliers

Multivariate outliers were assessed using Mahalanobis distance with a criterion of X^2 **(4) =** 18.467, p = 0.001 for each group. The maximum values obtained were 12.12 and 10.07 for the

offender and control groups respectively. As both these values are below the critical value there is no suggestion of any multivariate outliers.

6.13.1.3 Homogeneity of variance-covariance matrices

The homogeneity of variance-covariance was assed using Box's M. Given that this statistic was not significant, p = .326, there is no suggestion of heterogeneity.

6.13.1.4 Linearity

Scatter plots among all pairs of variables within each group were inspected for signs of non-linearity. While some plots indicated slight departure from linearity, there was no evidence of true curvilinearity.

6.13.2 Results of discriminant function analysis

A direct discriminant function analysis was performed using the four factor variables as predictors of membership in two groups; offenders and controls. One significant discriminant function was calculated, Wilks Lambda = .738, X^2 (4) = 21.60, p = .000.

A jack-knifed classification procedure for the total sample (N= 75) indicated that 77.3% of cases were correctly classified. This is an improvement on chance allocation, in which 50% of cases would be correctly identified based on chance alone. Table 20 depicts the number of cases and percentages of each group correctly classified.

Table 20

Number and percentage of cases classified into the two groups for the original and *cross*-validation analyses

			Predicted Group Membership	
		Group	Offenders	Controls
Original	Count	Offenders[a]	37	13
		Controls[b]	4	21
	%	Offenders[a]	74.0	26.0
		Controls[b]	16.0	84.0
Cross-validated	Count	Offenders[a]	33	17
		Controls[b]	6	19
	%	Offenders[a]	66.0	34.0
		Controls[b]	24.0	76.0

[a] $n = 50$ [b] $n = 25$

% ▫ percentage

The stability of the classification procedure was checked by a cross-validation run. The overall percentage of cases correctly allocated dropped to 69.3%. However, this is still greater than the 50% of chance allocation. This is also an improvement on the cross-validation classification rate of 62.7% for the three groups. The number of cases and percentages of each group correctly classified are depicted in Table 20.

Given that the classification confirmed the usefulness of the function in differentiating between the groups, interpretation of the discriminant function is warranted. The loading matrix of correlations between predictors and the discriminant function indicated that the best predictors for differentiating between the controls and offenders were the RCF (.715) and RAVLT (.653) factors. Although the FAS and WAIS-III factors correlated with the discriminant function, .498 and .220 respectively, they were far weaker than the correlations of the other contributing factors. The functions at group centroids further indicated that the controls had higher values on this function than the offenders. This suggests that scores on the RCF and RAVLT variables are possibly better predictors of group membership to the offender and control groups, with higher scores being indicative of control group members.

Given that the FAS and WAIS-III factors did not correlate highly with the discriminant function, a second direct discriminant function analysis was performed to ascertain the usefulness of only the RCF and RAVLT factors in discriminating between the two groups. One significant discriminant function was calculated, Wilks Lambda = ,798, X^2 (2) = 16.28, p = .000.

A jack-knifed classification procedure for the total sample (N = 75) and a cross-validation run were produced. The results for both procedures were identical, indicating that 73.3% of cases were correctly classified. This is an improvement on chance allocation, in which 50% of cases would be correctly identified based on chance alone. This overall percentage has decreased slightly compared with the original run of the previous analysis (77.3%). However, this is an improvement on the previous classification rate of the cross validated cases (69.3%).

Furthermore the percentages of offender and control cases correctly classified have increased to 70% and 80% respectively. Both these classification rates are an improvement on the cross-validated run of the previous analysis. This indicates that the removal of the FAS and WAIS-III factors has increased predictability of group membership into both the offender and control groups.

As the classification procedure confirmed the usefulness of the function in differentiating between the groups, interpretation of the discriminant function is warranted. The loading matrix of correlations between predictors and the discriminant function indicated high correlations between the RCF (.783) and RAVLT (.716) factors with the function. The functions at group centroids further indicated that the controls had higher values on this function than the offenders. This suggests that scores on the RCF and RAVLT variables may be good predictors of group membership to the offender and control groups, with higher scores being indicative of control group members.

6.14 Summary

In summary, the RAVLT, RCF, FAS and WAIS-III factors appear to be useful in discriminating between offenders and controls. However, the results suggest that the RAVLT and RCF factors were the better predictors of group membership, with the classification rate improving with the removal of the FAS and WAIS-III factor variables. Given that these factors are representative of

the test variables, it can be assumed that the RAVLT and RCF variables are more important in identifying offenders from a control group.

When these results are combined with the results of the discriminant function of the three groups in Chapter 5 an interesting pattern emerges. Although the WAIS-III was not an important predictor between offenders and controls, it was important in the differentiation of the three groups. As such, this analysis confirms the earlier finding that the WAIS-III factor appears important in further dividing the offenders into the subgroups, sex offenders and non-sex offenders. The pattern of results indicates that poor scores on the RAVLT and RCF factor variables combined with high WAIS-III factor values are representative of the sex offender group. Contrarily, a pattern of poor scores on the RAVLT, RCF and WAIS-III factors appear indicative of non-sex offenders. Furthermore, controls appear to be defined by average scores on all three factor variables.

Chapter 7

Discussion and conclusions

7.1 Introduction

The aim of this study was to investigate the brain function of males convicted and incarcerated for sexual offences against children using neuropsychological assessment. Specifically, it was hypothesised that sex offenders would show functional impairment in the frontal and temporal brain regions. Chapter 2 discussed the definition of sex offenders and the various theoretical attempts to explain such behaviour. Chapter 3 outlined evidence linking sexual behaviour to the frontal and temporal lobes and highlighted the relevance for research in to the brain function of sex offenders. Chapter 3 also provided an overview of the past research utilising both functional and structural techniques to assess the brains of sex offenders and discussed various methodological limitations. Chapter 4 outlined the research design, including the hypotheses to be tested, definition of participant groups and the neuropsychological tests to be used. Chapters 5 and 6 provided the results of the statistical analyses computed to assess the data and offered interpretations of the results in terms of the participants' cognitive functions.

This chapter summarises and concludes the study, discussing the findings in relation to current methodological limitations, potential theoretical and clinical implications and recommendations for future research. It is divided into six sections. Section 1 summarises and discusses the results in terms of the research hypotheses and offers general conclusions as to the nature of functional brain impairment in sex offenders. Section 2 discusses the methodological limitations of this study, identifying areas in which future research should focus. Section 3 discusses the broader significance of the hypothesis emerging from the present results in terms of the current social-cognitive perspective on sexual offending. Section 4 provides a brief overview of potential clinical implications in terms of the assessment and treatment of sex offenders. Section 5 summaries the recommendations for future research outlined throughout the chapter. Section 6 re-iterates the conclusions of this study.

7.2 General conclusions

This section offers a summary of the results outlined in Chapters 5 and 6, followed by interpretations of the results in terms of functional impairment in the frontal and temporal lobes. A general conclusion is then reported.

7.2.1 Summary of results

Chapter 5 highlighted that the sex offenders performed significantly worse than the controls on all neuropsychological tests. However, statistically significant differences were only found between the groups on the immediate recall trials of the Rey Auditory Verbal Learning Test (RAVLT) and Rey Complex Figure (RCF), rather than in the delay recall trials of the RAVLT or RCF, the Wisconsin Card Sorting Test (WCST) or FAS test variables. It was further indicated that few significant differences were found between the sex offenders and non-sex offenders. Thus, it was hypothesised that the wider criminal population may have functional brain impairment, rather than just the sex offender population.

This hypothesis was explored in Chapter 6 by collapsing the two offender groups into one offender group and comparing their performance on the neuropsychological tests to that of the controls. A similar pattern emerged as in Chapter 5, with the offenders performing worse on all neuropsychological tests, yet only differing significantly in their scores on the immediate recall trials of the RAVLT and RCF tests.

These observed differences did not change when age, level of education and level of intelligence were statistically controlled for in either the ANCOVAs or factorial ANOVAs. This indicates that although there were significant differences between the groups in age, level of education and level of intelligence, these differences did not impact on the participants' performance. As such, the differences in the groups' performance on the neuropsychological tests may not be attributable to group differences in these three demographic variables. Given this, it is plausible to assume that the group differences in the scores on the immediate recall trials of the RAVLT and RCF may, in part, be due to differences in the groups' brain function.

7.2.2 Interpretation of results

In Chapter **4** it was hypothesised that if sex offenders have a temporal lobe impairment they will perform significantly worse in comparison to the controls on all RAVLT indices and the delayed recall trial of the RCF. The results of this study, however, identified that the groups only differed significantly on the immediate recall trials of the RAVLT and RCF, rather than the delayed recall trials. Therefore, based on the hypothesis, these results do not support the existence of a temporal lobe deficit in sex offenders.

Despite the lack of significant differences between the groups in their delayed recall trial scores, the discriminant function analysis indicated that the RAVLT and RCF factors were the best predictors for distinguishing between the sex offenders and control group. As these factors are reflective of both immediate and delayed recall trials on both tests, it may be assumed that the controls had a significantly different pattern of scores on the RAVLT and RCF tests compared with the sex offender group.

This is contradictory to the findings of the ANOVAs. However, this discrepancy may be attributed to the fact that the discriminant analysis utilised factor scores computed from the factors ascertained in the principle components analysis, rather than the actual variable scores used in the ANOVAs. Alternatively, this discrepancy may be a product of methodological limitations, such that, the limitations of this study may have precluded the detection of small but significant group differences in the ANOVAs or indicated the existence of group differences that in fact do not exist.

Although there is insufficient evidence to implicate the existence of a temporal lobe deficit in sex offenders, these results indicate that this hypothesis should not be dismissed. However, the lack of significant differences between the offenders and non-sex offenders in the RAVLT and RCF variable scores and the inability of the RAVLT and RCF factors to sufficiently differentiate between these two groups in the discriminant analysis, indicates that if this deficit exists, it may be in the wider criminal population, rather than exclusive to sex offenders.

It was also hypothesised in Chapter 4 that if sex offenders have a frontal lobe deficit then they would perform significantly worse than the controls on the WCST and FAS test. Although the sex offenders did produce more perseverative errors, completed fewer categories and recalled less F,

A and S words, their performances did not differ statistically from the controls. Therefore, based on the hypothesis, these results do not support frontal lobe impairment in sex offenders.

Chapter 4 also highlighted that the differences between the sex offenders and controls in their immediate recall trial scores of the RAVLT and RCF results suggested that sex offenders might have had difficulty on tasks requiring working memory. Given that working memory is reported to be dependent on intact functioning of the prefrontal cortex (Hartman et al., 2001), it is possible that the sex offenders have impaired frontal lobe functioning. However, these results contradict that of the WCST and FAS test.

One possible reason for this discrepancy is that the WCST and FAS may rely on different regions of the frontal lobe than working memory. It has been reported that while the WCST is sensitive to damage in the dorsolateral prefrontal cortex (DPFC) (Stuss & Levine, 2000), certain aspects of working memory may rely on the functioning of the ventral prefrontal cortex (VPFC) (Mottaghy, Gangitano, Sparing, Krause & Pascual-Leone, 2002; Sala, Rama & Courtney, 2003). Furthermore, patients with VPFC lesions have shown no impairment on the standard measures of the WCST (Stuss & Levine). Therefore, it is possible that only part of the frontal lobes is impaired in the sex offenders. Further to this, a lack of significant differences between the sex offenders and non-sex offenders on the WCST and FAS test indicate that this impairment may exist in the general offender population.

7.2.3 Conclusion

In conclusion, there is insufficient evidence from this study to support the existence of temporal lobe impairment in sex offenders and inconsistent evidence to conclude that sex offenders have frontal lobe impairment. As such, the hypothesis of this study that sex offenders have functional impairment in their frontal and temporal brain regions is not supported.

The results, however, suggest that the general criminal population may have frontal lobe impairment to some extent and that the possibility of temporal lobe impairment in this population should not be dismissed. As this research used a different sex offender population to that of past research, it is difficult to compare these current results to that of the past. This limitation is discussed further in section 2.

7.3 Methodological limitations

Chapter 3 identified a number of important methodological limitations associated with past research including types of sex offender populations used, lack of normal control groups and the limitations associated with the choice of functional brain measures. Although the current study utilised strategies to account for these limitations, they still appear to have impacted on the research. Firstly, these limitations may have masked potential differences between the groups. Secondly, they may have indicated that group differences exist when in fact they don't. Thirdly, these limitations may account for the observed group differences in cognitive performance. This section discusses previous methodological limitations with respect to the current study, identifying the strategies used to account for these limitations and discussing the areas that still require improvement. Methodological limitations specifically arising from this study are also discussed, as are suggestions for combating these in future research.

7.3.1 Sex offender population

Chapter 3 identified that the lack of a consistent definition of sex offenders in previous research has produced some difficulties in studying the biological basis of pedophilia as it is difficult to ascertain from previous research, with any precision, the group of sex offenders to which a brain dysfunction has been attributed. In an effort to avert this limitation and provide a precise definition of the sex offender population used, this study utilised the current conventional research definition of child molester. This construct defines child molesters as any individual who has committed a sexual offence against a child, (Marshall, 1997; O'Donohue et al., 2000), whereby the governing laws and legal age of consent define the terms "sexual offence" and "child". Further to this, a child molester is considered as such irrespective of whether the behaviour is persistent (Marshall). However, the offender must be at least 16 years old and five years older than the victim (Barbaree & Seto, 1997). As such, all sex offenders in this study had been convicted of sexual offences against children.

While utilising this precise and current definition of sex offenders alleviates a common limitation of sex offender research in this study, it does so at the expense of being able to compare current results to that of past research. For example, many past studies have utilised non-convicted samples of men who have been phallometrically assessed to determine their sexual preference (Langevin et al., 1988; Langevin, Lang et al., 1989). As such, it appears that men with specific sexual preferences have been assessed rather than sex offenders. Given this, the current study

has assessed a different population to that of previous research, thus, rendering it difficult to compare the results. Future research should, therefore, ensure that this conventional research definition of child molester be used as the selection criteria for the sex offender group so as the results of future studies can be compared and contrasted.

The heterogeneity of the sex offender population was also raised in Chapter 3 as a concern in sex offender research. However, given that previous research did not report differences between various subtypes of sex offenders (Langevin et al., 1988), the current study did not divide the sex offender group according to victim type or level of violence. Subsequently incest and extra-familial sex offenders were included in this study. Consequently, this may have prevented potential group differences from being uncovered. For example, the results of the WCST identified large standard deviations for the variables, indicating that there was a large variability amongst the scores of individuals within the groups. As such, it is possible that individuals within the sex offender group performed differently. Therefore, it is possible that subgroups of offenders may differ in their performance on neuropsychological tests.

Future research should, therefore, not only utilise the conventional research definition of sex offender, but also devise specific definitions of subgroups of sex offenders according to victim type and level of violence. These groups could then be used in subsequent studies to ascertain potential differences between these subgroups and to identify, with some precision, the group to which potential functional brain impairment is attributed.

7.3.2 Control groups

A major limitation of the previous research identified in Chapter 3 was the lack of appropriate control groups, resulting in difficulty ascertaining whether sex offenders differed from other non-sex offenders and the general population. As such, this study utilised two control groups to control for offence type, effects of imprisonment, age, level of education and level of intelligence. A group of incarcerated men convicted of offences of a non-sexual basis were recruited through the Victorian prison system. A second group comprising individuals with no offence history were recruited through the community. Limitations associated with demographic variables, heterogeneity of the non-sex offender control group, incarceration and treatment effects are discussed in the following four subsections.

3 Limitations associated with demographic variables

The aim of including these control groups was to match the groups on age, level education and level of intelligence. However, statistical analyses revealed that there were significant differences between the groups on these variables. In general, all groups left school prior to completing Year 11 and had average estimated full-scale IQ (IQ) scores. However, the non-sex offenders were significantly less educated than the controls and had a significantly lower mean IQ score relative to the other groups. The sex offenders were also significantly older than both the controls and non-sex offenders.

This pattern is similar to that reported in previous research where incest offenders were identified as significantly older than their non-sex offender counterparts and averaging 10 years of education (Langevin et al., 1988). If was further reported that these demographics were typical of the incest offender population in the authors' clinic (Langevin et al.).

This raises interesting questions regarding potentially inherent demographic variables of the two offender groups, such that, are sex offenders a generally older population than non-sex offenders? And do offenders, in general, have lower levels of education? As such, the differences identified in this study between the demographic variables of the groups may not be a product of an inappropriate matching procedure, but rather may be a consequence of the inherent demographic variables of the sex offender and non-sex offender populations.

This has implications for future research, such that, matching a non-offending control group to both sex offenders and non-sex offenders may prove difficult. For example, with the sex offenders being generally older than the non-sex offenders, it will be difficult to recruit a control group matched on age to both these groups. Therefore, future research should take this into consideration and ensure that appropriate statistical measures are employed to account for potential group differences in demographic variables.

Further limiting the methodology of this study is the use of the Silverstein's (1982, 1985) four-subtest short form of the WAIS-R. It is reported that there is tendency for this measure to overestimate full-scale IQ by about one to three points (Kaufman et al., 1991). Although the estimated full-scale IQ scores of the participants would still remain in the average range, even if adjusted for this overestimation, it is possible that the reported estimated IQ scores in this study are not a true reflection of the level of intelligence of the groups. Furthermore, this study used the

subtests of the WAIS-III rather than that of the WAIS-R. Given that the WAIS-III subtests were not used in Silverstein's short-form, it cannot be assumed that the short form used in this study has the same psychometric properties as the original form using WAIS-R subtests. This further indicates that the estimated full-scale IQ scores of the groups in this study may not be an accurate reflection of their level of intelligence. As such, the observation of no effects of intelligence on the performance of the neuropsychological tests in this study may be questionable. Given this, the observed differences between the groups may be a result of differences in level of intelligence, rather than brain impairment. Therefore, future research should use the most recent measure of the Wechsler scales of intelligence.

7.3.2.2 Limitations associated with the heterogeneity of the non-sex offender control group

Recruitment difficulties and the subsequent small sample sizes led to the formation of a heterogeneous control group comprising men with histories of both violent and non-violent non-sex offences. This may limit the generalisability of the findings of this study as it has been speculated that frontal lobe dysfunction may be associated with violent offending (Mills & Raine, 1994). Therefore, the inclusion of violent non-sex offenders in the non-sex offender control group may have masked potential differences between the sex offenders and non-violent non-sex offenders.

Future research should therefore aim to control for violent offending by including two separate offender control groups. This would help ascertain whether the neuropsychological performance observed in this study's control group is specific to all non-sex offenders or whether the performance differs for violent and non-violent non-sex offenders.

7.3.2.3 Limitations associated with using an incarcerated population

The effect of incarceration is another potential factor that may limit the generalisability of the findings of this study. This study utilised incarcerated samples of both sex offenders and non-sex offenders, thus potentially matching the groups on the effects of incarceration. However, without information on time spent in prison or an understanding of the effects of imprisonment, it is difficult to know whether this was actually controlled for in this study. Further to this, it is unclear as to how incarceration effects cognitive impairment. As such, it is difficult to ascertain whether

differences in cognitive performance were due to brain impairment or potential incarceration effects.

This has two implications for future research. Firstly, specific research exploring the impact of incarceration on cognitive ability should be conducted. Secondly, further studies on sex offenders should include both incarcerated and non-incarcerated offenders to ascertain the existence of any differences amongst the groups. However, it is acknowledged that this would be a difficult task given that current non-incarcerated offenders may have once been incarcerated and could therefore still suffer the effects of incarceration. Additionally, offenders who have not been incarcerated may not be as freely accessible and may also be unwilling to participate.

7.3.2.4 Limitations associated with using a population with unknown treatment effects

The effects of treatment may also be another limiting factor of this study. During this research it was noted that a number of incarcerated offenders had participated or were currently participating in psycho-educational programs, cognitive-behavioural treatment programs or individual therapy with a psychologist. Although it is unclear as to how these treatment modalities effect cognitive impairment, given that many of the offenders in this study had received some form of treatment it is difficult to ascertain whether differences in cognitive performance were due to brain impairment or potential treatment effects.

Future studies should, therefore, firstly explore the effects of current treatment programs on cognitive ability and secondly incorporate both treated and untreated offender groups to ascertain whether differences in cognitive performance are due to brain impairment or potential treatment effects.

7.3.3 **Sample size**

The issue of sample size has not been a major criticism of previous research (Langevin, Wortzman et al., 1989), with only a few studies reporting the use of very small samples (Graber et al., 1982). However, it is raised as a limitation of this study.

Ideally the sample size should be determined prior to the conduction of research by statistical analyses to ensure that neither too few nor too many participants are recruited. With an

adequate sample size the statistical power of the research increases, such that, there is a strong probability that existing effects will have a chance of producing statistical significance in the results (Tabachnick & Fidell, 2001). However, the sample size of this study was restricted by recruitment difficulties. As such, this statistical analysis was not conducted for this research.

Recruitment difficulties have not been reported in previous research (Langevin et al., 1988; Langevin, Wortzman et al., 1989), however, they did impact on the recruitment of participants in this study, with resistance experienced by all groups. Specifically, the sex offenders raised concerns about participating in "sex offender" research, and the associated stigma of being labelled a sex offender. Furthermore, the lack of incentives for participation appeared to play a role in the unwillingness of both the sex offenders and non-sex offenders to take part. Additionally, the untrusting nature of the offenders also appeared to contribute to their resistance with questions raised about the utility of the results and access to the data. Although the study was not highlighted as "sex offender" research, and issues around anonymity and confidentiality were fully explained both verbally and in written form, resistance was still experienced.

Difficulty was also experienced in the recruitment of the non-offending control group, such that, it was difficult to find males in the matching age bracket that had less than a high school education and that wanted to participate. During the recruitment process, these men raised concerns about being the comparison group for offenders and doing an assessment in which their results may not differentiate them from a "sex offender". Although the purposes of this research were clearly outlined and that tests results were not indicative of offending behaviour, resistance was still experienced. It appears that these difficulties are indicative of the public's perception of sex offenders and the fear associated with being labelled as such.

It is unclear how future research can address these recruitment difficulties and improve co-operation from these individuals, as the resistance seems to be a product of the individuals' personality characteristics and perception of sex offenders. For example, the untrusting nature of the offenders and the public's perception of what it means to participate in sex offender research are characteristic to these individuals and their beliefs. As such, it appears unlikely that a change in methodological procedure will change these characteristics. Although incentives could be utilised, this breaches ethical standards. Rather, more public education surrounding the importance of sex offender research is required, as is an understanding that refusal to participate may be an inherent problem associated with this type of research.

As a consequence of these difficulties, the sample size of each group was small. This is problematic for the current research, in so far as; the samples may not be representative of the populations from which they come. As such, interpretation and generalisability of these findings to the wider population must be made with caution. Secondly, small sample sizes are associated with reduced statistical power, thus, reducing the potential for detecting small but significant differences (Tabachnick & Fidell, 2001).

A post-hoc power analysis using GPower was conducted to determine whether the sample sizes in this study were sufficient to detect small significant differences between the sex offenders and non-sex offenders. Cohen's d was first calculated using the Effect Size Generator (Devilly, 2004). The resultant effect sizes were small, ranging from 0.02 to 0.35. These effect sizes were then used in GPower to determine the post-hoc power level. The results indicated that the power levels ranged from 0.05 to 0.23 for the RAVLT, RCF and FAS test variables. This indicates that the statistical analyses used in this study had low power, and in some cases no power, in detecting small size differences between the sex offenders and non-sex offenders in these test variables. However, although there was low power, there was low power to detect very small differences in cognitive processes between the different groups. Even a much larger sample producing statistically significant differences between the groups would not increase the size of these differences. In general, the results indicate very small differences between the groups that are not likely to be of theoretical or clinical importance even if statistical significance could be observed with much larger sample sizes. Here there is an obvious difference between statistical and psychological significance. Therefore in summary, although it is not possible to claim that there are no actual differences between the groups it is possible to indicate that even if these differences exist (based on the present data), these differences are so small so as to not be useful theoretically or clinically.

7.3.4 Neuropsychological tests

Chapter 3 identified that a gap in sex offender research lay in the choice of neuropsychological tests. Although the Luria Nebraska Neuropsychological Battery (LNNB) and Halstead Reitan Neuropsychological Battery (HRNB) are reported as being valid and reliable measures of global brain function by some researchers (Russell, 1998; Purisch, 2001), the controversy surrounding these measures rendered their utility in this study questionable. Specifically, these lengthy

assessments are not considered standard practice in Australia for both ethical and economical reasons (McDonald, 1995). Therefore, the literature was reviewed to find a suitable test for global functioning and to determine the most appropriate neuropsychological tests to assess the frontal and temporal lobe functions. Consequently, Silverstein's (1982, 1985) four-subtest short form of the WAIS-R was chosen to assess global brain functioning; RAVLT and RCF were chosen to assess temporal lobe functions and WCST and FAS test were chosen to assess frontal lobe functions.

These tests were chosen based on their known association with the frontal and temporal lobe functions, however, they are not without their limitations. In this study inconsistent findings relating to impairment in the frontal lobes was noted. This raises questions as to the utility of the chosen frontal tests in assessing frontal lobe functions.

Verbal fluency tasks are one of the most popular frontal tests (Stuss & Levine, 2002) and there is evidence to support that patients with frontal lobe damage perform poorly on these tasks (Stuss et al., 1998; Tucha, Smely & Lange, 1999). However, research also indicates that patients with parietal damage are impaired in their performance on these tasks (Stuss et al., 1998). Furthermore, Martin et al. (2000) reported that verbal fluency performance improved after anterior temporal lobectomy, indicating that this task was also sensitive to temporal lobe involvement. In Pihlajamaki et al's (2000) functional magnetic resonance imaging study, the role of the temporal lobes was also implicated in verbal fluency. Specifically, it was reported that the medial temporal lobes were activated during a category fluency task.

Similar limitations also exist with the WCST. Although this is the most widely used neuropsychological measure of frontal lobe function (Stuss & Levine, 2002), research has shown that not all patients with frontal lobe damage perform poorly on this task (Anderson et al., 1991; Corcoran & Upton, 1993). Furthermore, one review of WCST studies (Mountain & Snow, 1993) concluded that there is insufficient evidence to indicate that the WCST is a measure of frontal lobe function. This review further questioned the utility of the WCST in both a clinical and research setting arguing that there is only weak evidence supporting the idea that frontal lobe patients perform poorly, relative to non-frontal patients (Mountain & Snow). More current research, however, has identified that the WCST is sensitive to frontal lobe impairment (Demakis, 2003; Stuss et al., 2000;). Although, Stuss et al., identified that only patients with dorsolateral

prefrontal cortex (DLPFC) lesions were impaired on this task, rather than patients with ventral prefrontal cortex (VPFC) lesions.

These limitations of the frontal tests have important implications for the interpretation of the findings of this study. Firstly, the inconsistency between the results of the WCST, FAS test and the immediate recall trials of the RAVLT and RCF may, in part, be attributed to problems associated with the regional specificity of the frontal tasks. That is, it is unclear whether the WCST and FAS test actually assessed frontal lobe functioning in this study. Therefore, specific conclusions regarding the functioning of the sex offenders' frontal lobes in this study should be made with caution. Given this, future research should ensure the inclusion of numerous tests of both frontal and temporal lobe functions. Furthermore, the inclusion of both neuropsychological measures and neuroimaging techniques may help to ensure that the functions of the frontal and temporal lobes are actually being assessed.

Alternatively, the inconsistency in the results may have arisen due to the WCST and FAS test assessing a different aspect of the frontal lobe than the immediate recall trials of the RAVLT and RCF. As reported in Chapter 5, the immediate recall trials appear to be reflective of working memory, which is related to the functioning of the prefrontal cortex (Hartman et al., 2001). However, there is emerging evidence that although the prefrontal cortex is related to working memory, certain aspects of working memory may rely on the functioning of the ventral prefrontal cortex (VPFC) rather than the dorsolateral prefrontal cortex (DLPFC) (Mottaghy et al., 2002; Sala, et al., 2003). Although much research is required to confirm the functional organisation of working memory in the prefrontal cortex, it is possible that some aspects of working memory may be impaired, despite an intact DLPFC (Mottaghy et al.). Given this, it may be speculated that the working memory components required for performance on the RAVLT and RCF, may reflect functioning in the VPFC rather than the DLPFC. As the WCST is sensitive to damage in the DLPFC and not the VPFC (Stuss et al., 2000) and patients with VPFC lesions have shown no impairment on the standard measures of the WCST (Stuss et al.), it is possible that two different areas of the prefrontal cortex were assessed in this study.

It is acknowledged that this possibility is pure speculation, however, it is important when considering the findings, such that, the findings of the current study may not be inconsistent, but rather indicate that offenders may be impaired in only part of the prefrontal cortex, specifically the VPFC. However, this interpretation must be regarded with caution as no specific test of working

memory was utilised in this study and the functional organisation of working memory in relation to the VPFC is unclear (Mottaghy et al., 2002). Nevertheless, given that this part of the frontal cortex is reported to have extensive connections with the limbic system and is reportedly involved in inhibition, emotion and reward processing (Stuss & Levine, 2002), it is plausible to hypothesise that this area may be impaired in sex offenders and the general criminal population. Therefore, future research aimed at assessing the brain functions of sex offenders should employ tests that specifically assess the VPFC.

7.3.5 Summary

A number of methodological limitations impacting on this study have been discussed and speculations have been made to account for the possible discrepancies in some of the results. Thus, indicating that potential group differences in cognitive performance were possibly masked and that this field of research is worth pursuing. However, it remains that few statistically significant findings were found between the groups' cognitive performance in this study and that many of the methodological limitations discussed may account for the few significant differences that were noted. As such, it may be the case that sex offenders do not show frontal or temporal lobe impairment.

7.4 Theoretical implications

The findings of this study indicate that very few differences exist between the cognitive performance of sex offenders and controls, and that even if these differences exist, they may be so small so as not to be useful theoretically or clinically. As such, theoretical implications from the findings of the present study are limited. However, an emerging hypothesis from this study is that offenders, in general, may have impairment in the ventral prefrontal cortex (VPFC). It is acknowledged that this is not a conclusion of the current research and is speculative at best given the methodological limitations and the unclear association between working memory and the VPFC. However, the contribution that this hypothesis could have to the theoretical context of sex offender research is important. As such, speculations as to how this hypothesis may link to the current social-cognitive perspective of sexual offending are discussed in the following sections.

Section 1 provides an overview of Keenan and Ward's (2000) proposed theory of mind deficits in sex offenders. Section 2 discusses the neural basis of theory of mind. Section 3 discusses the link between a proposed hypothesis emerging from the current findings and this theoretical perspective of sexual offending, identifying that theory of mind deficits may be understood in terms of impairment in the VPFC. However, these implications are regarded as tentative at best, given that the findings of this study do not support the hypothesis of functional impairment in the frontal and temporal brain regions of sex offenders.

7.4.1 Theory of mind deficits in sex offenders

Theory of mind constitutes the ability to understand both our own and other's behaviour in terms of desires, thoughts, beliefs and emotions (Wellman, Cross & Watson, 2001). It is organised into many specific implicit theories, which individuals rely on when making sense of their social worlds. These theories guide the processing of incoming information such that it is interpreted according to the assumptions in the underlying theories. As such, information contradicting these basic theories is either rejected or distorted so that it becomes congruent (Ward & Keenan, 1999). Therefore, these theories enable individuals to explain and predict future behaviour.

It has been proposed that the deficits in intimacy, empathy and cognition observed in sex offenders may indicate a lack of awareness of other peoples' desires, beliefs, perspectives and needs (Ward et al., 1999). As such, Keenan and Ward (2000) have suggested that sex offenders may suffer from a deficit in their theory of mind. It is further suggested that different developmental issues may lead to different kinds of theory of mind problems resulting in a number of observed deficiencies in sex offenders. Thus, the difficulties experienced are likely to vary among sex offenders depending on the causal mechanism involved. While Keenan & Ward have reported that much research is needed before the links between theory of mind deficits and subsequent sexual offending behaviour are known, they have speculated that four pathways may be applicable to sex offenders. These four pathways are briefly summarised below.

7.4.1.1 Global and specific deficits

Both global and specific deficits in theory of mind have been proposed in the sex offender population (Keenan & Ward, 2000). A global deficit refers to a general distortion in the way individuals process information about their own and other's mental states. On the other hand,

individuals with specific theory deficits may only lack a theory relating to specific mental states in specific relationships. For example, child sex offenders with specific theory deficits may lack an understanding of the mental states of young children. However, are capable of understanding the mental states of adults (Keenan & Ward).

These deficits lead to offending, such that, a lack of understanding of other's mental states may lead to the development of false assumptions in individuals' underlying implicit theories (Keenan & Ward, 2000). As these theories guide the processing of incoming information, theories based on false assumptions serve to distort the way in which offenders interpret victim's behaviour and justify offending by distorting beliefs so they are consistent with these theories (Keenan & Ward). Five common implicit theories are reported to underlie sex offenders' thinking including, children as sexual beings; entitlement - individuals have the right to assert their needs above those judged as less important; dangerous world - the world and the people in it are dangerous; uncontrollability - the world is uncontrollable; nature of harm - sexual activity is beneficial and unlikely to harm (Ward & Keenan, 1999).

7.4.1.2 Developmental delay in acquisition

Research on children's acquisition of theory of mind indicates that delay in this development may lead to an inability to deal appropriately in social interactions (Keenan & Ward, 2000). This in turn, leaves individuals vulnerable to the development of other problems in areas such as social competence and peer relationships. It is further reported that this delay in acquisition may be related to early developmental factors including the security of attachment and early conversational experience within the family (Keenan & Ward).

The experience of developmental adversity in childhood is often noted in the sex offender research, with the most common experiences being insecure attachment bonds (Ward et al., 1996), problematic relationships with their parents (McCormack et al., 2002) and physical and sexual abuse (Fagan & Wexler, 1988). As such, it is speculated that sex offenders may have developmental delay in their acquisition of theory of mind. Therefore, leaving them vulnerable to the development of social competence problems and consequently increasing the likelihood of sexual offending behaviour (Keenan & Ward, 2000).

7.4.1.3 Affective deficit

Theory of mind is reportedly required for empathy. That is, the ability to feel another individual's mental state (Blair et al., 1996). It is argued that deficits in theory of mind may fail to trigger the processes required for empathy, thus resulting in an impaired empathic response. Although this theory was not substantiated in a study of psychopaths (Blair et al.), Keenan & Ward (2000) argued that this research was confounded by a number of methodological limitations. Thus, stating that Blair et al's conclusion that psychopaths did not have theory of mind deficits was premature. As such, Keenan & Ward speculate that this pathway may still be relevant to psychopaths. Although how this pathway specifically links theory of mind deficits to sex offending behaviour remains unclear.

7.4.1.4 Failure of self-regulation

This pathway identifies that rather than sex offenders having theory of mind deficits, they may have impaired self-regulation processes that prevent intact theory of mind being applied in specific situations. It is speculated that strong negative affective states, situations of extreme stress and the effects of alcohol may trigger the disengagement of self-regulatory ability. Given that sex offenders report negative affective states and often commit offences while intoxicated or under stress, it is possible that their self-regulatory ability is temporarily disinhibited. It is reported that this reduces their capacity to use their knowledge of other people's mental states and increases the loss of behavioural control. Consequently, potential victim's mental states are not considered and the situation may be interpreted based on the offender's own emotional state. As such, interpretations of the victim's behaviour and situation may be distorted. Thus, there is an increased likelihood of sexual offending behaviour (Keenan & Ward, 2000).

7.4.2 The neural basis of theory of mind

The neural basis of theory of mind is an emerging area of research and therefore limited information is available as to the specific neural mechanisms involved (Stone, Baron-Cohen & Knight, 1998). However, it is hypothesised that given that theory of mind is such a complex cognitive ability it is more likely related to an underlying neural network or circuit, rather than associated with a specific brain region (Stone et al.). One region that repeatedly emerges as relevant to theory of mind and is thought to form part of this neural circuit is the ventral medial/orbital frontal cortex (Stone et al.).

Functional imaging studies using individuals without neurological impairment have identified activation in the orbito-frontal cortex (Baron-Cohen et al., 1994) and left medial frontal cortex (Goel, Grafman, Sadato & Hallett, 1995) during theory of mind tasks. Observations of patients with lesions in the orbito-frontal cortex report a number of deficits relevant to theory of mind including a limited insight into the social and emotional consequences of actions, poor interpersonal judgment, impulsiveness and lack of concern (Cummings, 1985). However, only two studies have used lesion patients in their research. Firstly, Stone et al's (1998) comparison of patients with bilateral damage in the orbito-frontal cortex (OFC) to patients with unilateral damage in the dorsolateral frontal cortex (DFC), found that OFC patients and not the DFC patients showed impairment in a series of theory of mind tasks. Secondly, Stuss, Gallup and Alexander (2001) further implicated the ventral medial frontal cortex as playing a role in theory of mind, specifically in the detection of deception, in their study of patients with focal lesions in the frontal and non-frontal brain regions.

Although more research is required before identifying the neural basis of theory of mind, Stone et al. (1998) proposes that a neural circuit involving many regions of the cortex and the limbic system is involved. Specifically, it is hypothesised that while the orbito-frontal and left medial frontal cortex appear to be crucial elements of this circuit, the dorsolateral prefrontal cortex is not (Stone et al.).

7.4.3 Contributions of the current findings

The findings of this study do not support the existence of functional brain impairment in the frontal and temporal brain regions of sex offenders. However, an emerging hypothesis from this study is that offenders, in general, may have impairment in the ventral prefrontal cortex. It is acknowledged that this is not a conclusion of the current research and is speculative at best given the methodological limitations and the unclear association between working memory and the VPFC. However, the contribution that this hypothesis could have to the theoretical context of sex offender research is important. As such, speculations as to how this hypothesis may link to the current theoretical perspective on sex offenders are briefly discussed in this section.

The hypothesis emerging from this study is that the general criminal population, including sex offenders may have impairment in their ventral prefrontal cortex (VPFC). Further to this, the

previous section identified that this neural region appears to be crucial to the neural circuit underlying theory of mind (Stone et al., 1998) and that patients with damage to this region are impaired on theory of mind tasks (Stone et al.; Stuss et al., 2001). As such, it is plausible to assume, that if sex offenders have deficits in their VPFC, then they may also have theory of mind deficits. This supports the current social-cognitive perspective of sexual offending, which hypothesises that this population has deficits in their theory of mind (Keenan & Ward, 2000).

Further to this, reviewing the functions associated with the VPFC may elucidate the pathways through which theory of mind deficits link to sexual offending behaviour. For example, the VPFC is reportedly involved in inhibition, emotion and reward processing and, as such, is considered to play a role in behavioural self-regulation (Stuss & Levine, 2002). The term "self-regulation disorder" has been used to describe the syndrome exhibited by patients with VPFC lesions and is defined as the inability to regulate behaviour according to internal goals and constraints (Stuss & Levine). As such, it is possible that sex offenders with impairment in VPFC, may also have difficulty in self-regulation. This in turn may lead to sexual offending behaviour, via the failure to self-regulate pathway outlined by Keenan & Ward (2000). As stated previously in section 7.4.1.4, impaired self-regulation may reduce the offenders' capacity to use their knowledge of other people's mental states and increases the loss of behavioural control. Consequently, potential victim's mental states are not considered and the situation may be interpreted based on the offender's own emotional state. As such, interpretations of the victim's behaviour and situation may be distorted. Thus, there is an increased likelihood of sexual offending behaviour (Keenan & Ward).

The VPFC is also involved in emotional processing and has connections to the limbic system. As such, the affective deficit pathway (Keenan & Ward, 2000) may also play a role in linking theory of mind deficits to sex offending behaviour. This indicates that perhaps a combination of the pathways outlined by Keenan and Ward, are required to understand theory of mind deficits in sex offenders.

7.4.4 Summary

In summary, the hypothesis emerging from this study that the general criminal population, including sex offenders may have impairment in their ventral prefrontal cortex (VPFC), potentially supports the current social-cognitive perspective of sexual offending and offers a way in which

theory of mind deficits in sex offenders may be understood in terms of impairment in the VPFC. As such, this hypothesis serves to link the biological and social-cognitive perspectives of sexual offending. Furthermore, it supports two of the proposed pathways linking theory of mind deficits to sexual offending behaviour, suggesting that perhaps a combination of these pathways play a role. Given this, future research should pursue both perspectives in order to uncover a global etiological theory of sexual offending.

7.5 Clinical implications

The findings of this study do not support the existence of frontal or temporal brain impairment in sex offenders. As such, the implications for the assessment and treatment of sex offenders based on this study are limited. In short, one of the main clinical implications associated with potential neural impairment in this population would be the need for rigorous neuropsychological assessment prior to the implementation of a treatment plan. This could then ensure that offenders' receive treatment tailored to their cognitive capabilities and are not participating in a group program that is beyond their capacity. Further to this, if the sex offender population are identified as having neural impairment, then current treatment programs would need to be re-evaluated to ensure that they take into account the offenders' reduced cognitive capacity.

7.6 Summary of recommendations for future research

This research has potentially identified that the biological perspective of sexual offending offers a way in which to understand the theory of mind deficits outlined in the social-cognitive perspective, such that, theory of mind deficits in sex offenders may be understood in terms of impairment in the VPFC. As such, future research should focus on both these perspectives in order to understand sexual offending behaviour.

While this is the area that future studies should target, this study has identified that research in this area is fraught with many methodological limitations that often prevent definitive conclusions about the nature and extent of potential brain impairment in sex offenders. A number of suggestions for improving the methodological quality for future research in the sex offender field have been outlined throughout this chapter. In summary, they include (1) the use of the conventional definition of child molester (2) defining and utilising sub-groups of offenders; (3) statistically matching groups on age and other demographics that may occur naturally between

sex offender and other control populations; (4) the use of separate violent and non-violent non-sex offender comparison groups; (5) the use of the most recent measure of the Wechsler scales of intelligence; (6) accounting for incarceration effects by either specifically researching the effects of incarceration on individuals or including both incarcerated and non-incarcerated samples; (7) accounting for treatment effects by either researching the effects of treatment programs on cognitive ability or by including treated and untreated samples; (8) using power analysis to determine adequate sample size; (9) including more tests of frontal and temporal lobe functions; (10) including tests that specifically assess functions of the ventral prefrontal cortex; (11) including neuroimaging techniques.

The numerous recommendations for future research indicate that there is a great deal of work to be done prior to a conclusion regarding potential brain impairment in the sex offender population. It further highlights the complexity of sex offender research and the many confounding influences that need to be addressed prior to a conclusion being reached. While some of these influences can be directly assessed in studies focusing on brain impairment (i.e. improving sample size, use of additional tests), the effects of other factors, such as incarceration and treatment, on cognitive ability may need to be addressed separately prior to the conduction of further brain impairment studies. Although this may seem like an arduous task, with the potential relevance that this research has to the biological and social-cognitive perspectives of sexual offending, further research addressing such influences is encouraged. With a systematic approach to research, whereby these confounding influences are eliminated, it is possible that a conclusion regarding the nature and extent of brain impairment in sex offenders will be reached and progression will be made towards a global etiological theory of sexual offending.

7.7 Conclusion

In conclusion, there is insufficient evidence from this study to support the hypothesis that child sex offenders have functional impairment in the frontal and temporal regions of the brain. However, given the relevance of potential brain impairment to both the biological and social-cognitive perspectives of sexual offending, future research in this field is warranted.

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APPENDIX 1: INFORMATION SHEET
A NEUROPSYCHOLOGICAL ASSESSMENT

My name is Megan Joseph and I am seeking your participation as a subject in my Ph.D. project at the Brain Sciences Institute. The study examines your performance on a range of psychological tests.

You will be asked to complete a series of tasks such as explaining meaning of words, ordering pictures, sorting cards, constructing models using blocks, recalling words and completing maths problems. This will take approximately 1.5 hours. There are no associated risks with this study and as it will be conducted at a time convenient to you, there will be minimal inconvenience and discomfort.

Your participation in this study is voluntary and you are free to withdraw at any time should you desire, without any adverse consequences. All information you supply will remain confidential. You will be given a code number and the link between your name and code number will be broken immediately after all the data is collected.

It is possible that the research data collected for the study may be published or provided to other researchers. However, at no point will identification be made.

A written report providing you with full feedback about your performance will be available at your request.

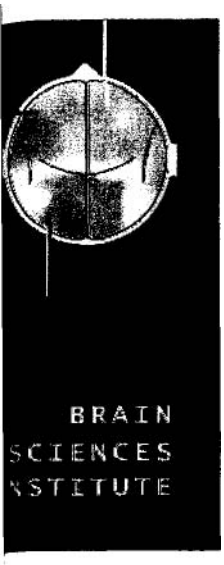
This information is summarised in a consent form and you will be asked to sign and keep this form before the study begins.

This research is beneficial as the findings will not only help to better our understanding of offending behaviour, but it will guide us in the development of new treatment programs.

Should you have any questions regarding the study please do not hesitate to ask. Any further queries can be directed either to myself or my supervisor Dr. Con Stough at the Brain Sciences Institute on 9214 8167.

If you have any other questions that cannot be answered by my supervisor or myself or have any complaints about the study, you can write to either:
The Chair, Human Experimentation Committee, Swinburne University of Technology
P.O. Box 218 Hawthorn Vic 3122 Or

Secretary to the Research Ethics Committee,
C/o Criminal Justice Statistics and Research Unit Department of Justice, Level 3, 55 St. Andrews Place, East Melbourne, 3002



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APPENDIX 2: INFORMED CONSENT FORM

A NEUROPSYCHOLOGICAL ASSESSMENT

I _____ agree to participate in a research project entitled " A Neuropsychological Assessment", conducted by Megan Joseph.

My agreement is based on:

1. My involvement entails the completion of several neuropsychological tests.
2. The risks, inconvenience and discomfort have been explained to me.
3. I have read the attached Information Sheet and understand the general purposes, methods and the demands of the study where appropriate.
4. I understand that the project may not be of direct benefit to me.
5. I can withdraw from the study at any time, without prejudicing my current or future circumstances.
6. I am satisfied with the explanation given in relation to the project so far as it effects me and my consent is given freely.
7. If I wish I can obtain a written report providing me with feedback.

Signature of Researcher: _____ Date: _____

Signature of Participant: _____ Date: _____

Signature of Witness: _____ Date: _____

Please feel free at any time to contact the researcher with regard to any queries or concerns you may have with regard to your participation in this project or else the Department of Justice Research Ethics Committee via its Secretary (I. Dussuyer) on telephone 9651 6970 or fax 9651 6977