

**A pilot study investigating the effectiveness of
cognitive rehabilitation therapy with patients
with schizophrenia with a forensic history.**

Julie Dodds

Doctorate in Clinical Psychology

University of Edinburgh

August 2009

Declaration

I, Julie Dodds, declare that this thesis was written by myself and that I conducted the work detailed herein. This work has not been submitted for, or accepted in any previous degree.

Julie Dodds

August 2009

Acknowledgements

This thesis would not have been possible without the support and guidance from a number of individuals, to whom I am truly grateful.

I am very grateful to all of the patients who took part in this study, without them this thesis would not have been possible. Also I would like to thank my colleagues within both the forensic and rehab teams for their support in helping with the recruitment of participants.

I would like to thank Dr Suzanne O'Rourke, my academic supervisor, for her encouragement, guidance and expertise. I would also like to express my gratitude to Mrs Joyce Edward, my clinical supervisor for her ideas, support and helpful guidance. I would also like to express my thanks to Dave Peck for his statistical guidance and support.

I would like to express my deepest thanks to my parents who have helped support me through this journey. They have provided me with the encouragement that has helped drive me throughout my studies.

I am indebted to my partner Darren who has given me endless support to help me fulfil my dreams and ambitions. To him I dedicate this thesis

CONTENTS

Title Page	1
Declaration of own work	2
Acknowledgements	3
Contents page	4
List of Tables	9
List of Figures	11
Abstract	12
Chapter 1: Introduction	
1.1 Schizophrenia	13
1.2 Cognition in Schizophrenia	15
1.3 Cognitive deficits associated with schizophrenia	17
<i>1.3.1 Working Memory</i>	19
<i>1.3.2 Executive Functioning</i>	20
<i>1.3.3 Attention and Information Processing</i>	22
<i>1.3.4 Learning and Memory</i>	22
<i>1.3.5 Perceptual Organisation and Visual Memory</i>	23
<i>1.3.6 Research into cognitive deficits</i>	24
1.4 Cognitive functioning comparisons between Violent and Non-violent patients with schizophrenia	24
1.5 Treatment of Cognitive Deficits in Schizophrenia	28
<i>1.5.1 Biological</i>	29

1.5.2 Psychological	31
1.5.3 Newer interventions	33
1.5.4 Functional Outcomes and Recovery	34
1.6 Cognitive rehabilitation interventions with schizophrenia	35
1.7 Methodology of cognitive rehabilitation/remediation therapy	37
1.8 Literature Review of computerised cognitive rehabilitation interventions with schizophrenia	45
1.9 Studies of non-computerised cognitive rehabilitation interventions	56
1.10 Current Study	59
1.10.1 Hypotheses	61
 Chapter 2: Methodology	
2.1 Design	62
2.2 Participants	62
2.3 Inclusion and Exclusion Criteria	64
2.3.1 Inclusion Criteria	64
2.3.2 Exclusion Criteria	64
2.4 Procedure	65
2.4.1 Recruitment	65
2.4.2 Assessment	66
2.5 Measures	70
2.5.1 Demographic Measures	70
2.6 Cognitive Assessments	71
2.6.1 Wechsler Test of Adult Reading (WTAR)	71

2.6.2	<i>Block Design (WASI/WAIS-III)</i>	72
2.6.3	<i>Modified Wisconsin Card Sorting Test (mWCST)</i>	74
2.6.4	<i>Trail Making Test Part A and B</i>	77
2.6.5	<i>Digit Span Forward and Backwards</i>	79
2.6.6	<i>Rey Complex Figure</i>	81
2.6.7	<i>Rey Auditory Verbal Learning Test</i>	83
2.7	Self Rated Assessments	85
2.7.1	<i>Rosenberg Self Esteem Questionnaire</i>	85
2.8	Intervention	86
2.8.1	<i>Cogpack Professional Software</i>	86
2.9	Ethical Issues	88
2.9.1	<i>Effect on participants</i>	88
2.9.2	<i>Informed Consent</i>	88
2.9.3	<i>Confidentiality</i>	89
2.9.4	<i>Ethical Approval</i>	89
2.10	Analysis	89
Chapter 3: Results		
3.1	Variables	92
3.2	Demographic Information	92
3.2.1	<i>Population</i>	92
3.2.2	<i>Medication</i>	94
3.3	Premorbid measure of Intelligence	95
3.4	Statistical Analysis	96

3.5 Hypothesis 1	98
3.5.1 <i>Digit Span</i>	98
3.5.2 <i>Block Design</i>	100
3.5.3 <i>Rey Complex Figure Test</i>	102
3.5.4 <i>Trail Making Test Part A and B</i>	106
3.5.5 <i>Rey Auditory Verbal Learning Test</i>	109
3.5.6 <i>Modified Wisconsin Card Sorting Test</i>	118
3.5.7 <i>Summary of Hypothesis 1 Results</i>	122
3.5.8 <i>Correlations</i>	123
3.6 Secondary Hypothesis: Hypothesis 2	126
3.6.1 <i>Rosenberg Self-Esteem Questionnaire</i>	126
3.7 Further Analysis – Qualitative Data	127
3.8 Hypothesis 3	128
Chapter 4: Discussion	
4.1 Interpretation of Results	135
4.1.1 <i>Hypothesis 1</i>	136
4.1.2 <i>Hypothesis 2</i>	152
4.1.3 <i>Hypothesis 3</i>	155
4.2 Clinical Implications	157
4.3 Methodological Strengths and Limitations	161
4.3.1 <i>Sample population and size</i>	161
4.3.2 <i>Design</i>	162
4.3.3 <i>Sampling Bias</i>	163

4.3.4. <i>Recruitment Issues</i>	164
4.3.5. <i>Length and number of sessions</i>	164
4.3.6. <i>Practice Effects on Cognitive Assessments</i>	165
4.3.7. <i>Examiner Effects</i>	166
4.3.8. <i>Intervention</i>	167
4.4 Recommendations	168
4.5 Conclusion	171
Chapter 5 References	175

Appendices

Appendix 1	Correspondence granting Ethical Approval from North of Scotland Research Committee
Appendix 2	Correspondence granting Ethical Approval from Research and Development
Appendix 3	Participant Information Sheet and letter of invitation
Appendix 4	Consent Form
Appendix 5	Rosenberg Self Esteem Questionnaire
Appendix 6	Tasks completed during intervention using ‘Cogpack’ software
Appendix 7	Table showing previous research in computer assisted cognitive rehabilitation therapy from 1990 to 2008
Appendix 8	Company leaflet outlining elements of the Cogpack software
Appendix 9	Correlations comparing relationships between improvements in scores relative to the different cognitive assessments

List of Tables

- Table 3.1 Table showing characteristics of participants
- Table 3.2 Table showing descriptive analysis on participant's performance on Digit Span Forward Test
- Table 3.3 Table showing descriptive analysis on participants' performance on Digit Span Backwards Test
- Table 3.4 Table showing descriptive analysis on participants' performance on the Block Design Test
- Table 3.5 Table showing participants' performances during the Rey CFT copy trial during each of the various assessment phases
- Table 3.6 Table showing participants' performances during a delayed recall trial of the Rey CFT
- Table 3.7 Table showing participants' performances on the Trail Making Test Part A
- Table 3.8 Table showing participants' performance on the Trail Making Test Part B
- Table 3.9 Table showing participants performance on the total mean number of words recalled during Trial 1 to 5 of the Rey AVLT
- Table 3.10 Table showing participants mean score for the greatest amount of words recalled during of the Rey AVLT
- Table 3.11 Table showing mean score obtained during recall of List B of the Rey AVLT
- Table 3.12 Table showing participants' performance on recall of list A after a short delay on the Rey AVLT

- Table 3.13 Table showing participants' performances during the long delayed recall trial of List A from Rey AVLT
- Table 3.14 Table showing mean number of words recognised of the Rey AVLT during the different assessment phases
- Table 3.15 Table showing descriptive data of the number of false positives identified during the recognition trial of the AVLT
- Table 3.16 Table showing the number of intrusion errors made by participants during the administration of the AVLT
- Table 3.17 Table showing participants' performance on the number of categories achieved during the mWCST
- Table 3.18 Table showing participants' performance regarding the number of perseverative errors made during the mWCST
- Table 3.19 Table showing participants' performance on the mean total number of errors obtained during the mWCST
- Table 3.20 Table showing mean scores for self esteem
- Table 3.21 Table showing descriptive statistics of mean scores on cognitive assessments during control, post-intervention and 3 month follow up assessments
- Table 3.22 Table showing inferential statistics comparing performances on cognitive assessments during control, post-intervention and 3 month follow up assessments

List of Figures

- Figure 2.1 Figure showing recruitment and drop out rates
- Figure 2.2 Figure showing recruitment procedure and assessment of participants
- Figure 2.3 Diagram showing a timeline of the Cognitive Rehabilitation Study
- Figure 3.1 Graph showing Psychopharmacology Treatment of Participants
- Figure 3.2 Graph showing participants estimated pre-morbid IQ
- Figure 3.3 Graph showing participants performance on Block Design task during various assessment phases
- Figure 3.4 Graph showing participants mean scores during Rey CFT delayed recall trial during the various assessment phases
- Figure 3.5 Graph showing participants mean time taken to complete Trails A across the various assessments

Word Count: 35,019

Abstract

Objectives: To evaluate the effectiveness of cognitive rehabilitation therapy with patients with schizophrenia within a forensic population. The intervention aimed to improve domains of cognitive functioning which have been found to be impaired as a result of schizophrenia. Forensic patients with schizophrenia have been found to have greater impairments in cognitive functioning relative to non-violent patients. Therefore interventions which target these deficits are important in rehabilitation interventions.

Design: A within subject repeated design was used. A control measure was also implemented which involved patients being used as their own control.

Method: 17 participants successfully completed the cognitive rehabilitation intervention. Initially 23 participants were recruited. Participants received approximately five hours of the computer-assisted cognitive remediation administered over seven weekly sessions. Outcome measures were cognitive assessments measuring executive functioning, attention, verbal learning and memory, perceptual organisation and visual memory. Outcome measures were administered pre-intervention, during treatment, post treatment and at three months follow up. A control assessment was also administered prior to the commencement of the intervention.

Results: Post treatment measures on attention, perceptual organisation, visual memory and aspects of executive functioning were found to be significantly improved in comparison to pre intervention and control assessments. At 3 month follow up these improvements in cognitive functioning were found to be sustained.

Conclusion: The pilot study indicated that cognitive rehabilitations are effective in improving cognitive functioning within forensic populations with schizophrenia. These results have the potential to improve functional outcomes and recovery, which could indirectly improve symptoms and risk of future violence. Further research is required in this area to provide additional evidence for this intervention to be available to forensic patients with schizophrenia.

INTRODUCTION

1.1 Schizophrenia

Schizophrenia is a debilitating and chronic mental health disorder (Kurtz et al, 2007). Kraepelin initially identified the disorder in 1883, naming the condition ‘dementia praecox’. Individuals with this disorder were described as having a ‘progressive and deteriorating illness with no return to pre-morbid levels of functioning’ (Bennett, 2003, pp.125). Bleuler later coined the term Schizophrenia and described positive symptoms such as delusions and hallucinations as cardinal features of the disorder (Bleuler 1950).

Schizophrenia affects approximately 1 per cent of the population (APA, 2000). The incidence of the disorder is stable across cultures, countries and over time (Bennett, 2003). The disorder predominantly presents in late adolescence or early adulthood but can occur at any time during the lifespan (Picchioni & Murray, 2007). The onset of the disorder tends to develop earlier in males than in females (Picchioni & Murray, 2007). The mean age of onset of a first psychotic episode in males occurs at 26.5 whereas for females it presents later, occurring round 30.6 years of age (Hafner et al., 1992, 2003). The WHO 10-country study reported similar results i.e. mean age for males 26.7 years and mean age for females was 30.1 years (Hambrecht et al., 1992). Males’ are also more likely to experience more negative symptoms and have less chance of full recovery (Jablensky, 2000). The prevalence rate of the disorder is higher in cities (Pedersen & Mortensen, 2001) and in migrants (McGrath, 2006). A global survey showed that schizophrenia accounted for approximately 1.1 per cent of the total disability figures (Picchioni & Murray, 2007).

Diagnosis of schizophrenia requires the presence of positive symptoms such as delusions, hallucinations, disorganised speech and grossly disorganised or catatonic behaviour. In 1974 the World Health Organisation (WHO) found that between 50 to 75 per cent of individuals with schizophrenia experienced hallucinations, delusions and negative symptoms (Sharma & Harvey, 2000). Negative symptoms are also a common feature of the disorder and can present in the form of avolition or flattened mood. The DSM-IV-TR states that individuals must have two or more of the above symptoms for a significant amount of time over a one-month period (APA, 2000).

Diagnosis of schizophrenia can be complicated as a result of the different symptomatology that presents in individuals. Individuals will have different experiences and the content of hallucinations and delusions vary greatly. The use of classification systems using the Diagnostic and Statistical Manual of Mental Disorders Version 4 (DSM-IV) and the International Classification of Diseases version 10 (ICD-10) have attempted to improve diagnosis of the disorder.

The aetiology of schizophrenia has brought about a considerable amount of debate. Various factors have been proposed to contribute to the development of the disorder. Biological factors which have focused on genetics or presented theories related to dysfunctional dopamine systems as a result of perinatal factors (Wykes & Reeder, 2005). Environmental and social factors have also been identified (Bennett, 2003). Psychological models focus on social and environmental aspects and the psychological processes that people experience (Bennett, 2003). In the 1980s schizophrenia was proposed as being a neurodevelopmental disorder. This model built upon the 'vulnerability-stress' theory and identified the "nature of the

vulnerability” and accounted for the “interplay between genes and the environment in the aetiology of schizophrenia” (Wykes and Reeder, 2005, pp.20). The neurocognitive aspects of schizophrenia had been identified by Kraepelin in 1913 as being an aspect of the disorder. This theory illustrated how neurocognitive deficits impact directly upon treatment (Green & Neuchterlein, 1999). All of these various theories have received supporting evidence, but the neurocognitive theory of schizophrenia has led to the increasing interest in cognitive rehabilitation techniques.

Treatment of schizophrenia has been considered to be the most expensive of all the mental disorders (Sharma & Antonova, 2003). The estimated societal cost of treating schizophrenia in England between 2004 and 2005 was over £6 billion. These figures were based upon the cost of direct treatment, unemployment and social benefits, premature mortality, criminal justice system and many others (Mangalore & Knapp, 2006).

1.2 Cognition in schizophrenia

Cognitive impairments have been identified as a core feature of the disorder in addition to positive and negative symptoms. “Cognition is what enables humans to function in everyday life: personal, social and occupational” (Sharma & Antonova, 2003, pp.25). Cognitions relate to how an individual processes data, learns new information and skills, their ability to problem solve, to understand language and to communicate. These are all mental processes that are commonly known as cognitive function (Sharma & Antonova, 2003).

Kraepelin identified intellectual deterioration as a key characteristic of ‘dementia praecox’, the forerunner of schizophrenia. Bleuler also cited cognitive difficulties, particularly attention, as a cardinal feature of the disorder (Wykes & Reeder, 2005). Although cognitive impairments were identified as a core symptom, little research was undertaken to address these difficulties. This area of schizophrenia has only been investigated since the late 1950s but the last 20 years has seen a dramatic increase in studies regarding these deficits.

“Deficits in cognition are the most consistent findings in the schizophrenia literature” (Sharma & Harvey, 2000, pp.286). Research has shown that majority of patients with schizophrenia experience cognitive difficulties when compared to healthy controls, although the level of impairment may vary for each individual (Sharma & Harvey, 2000). Even though cognitive deficits have been accepted as a common feature of the disorder, the diagnostic manual DSM-IV does not include this as one of the defining criteria of schizophrenia (Wykes & Reeder, 2005). The non inclusion of cognitive deficits has been proposed to be the result of difficulties associated with defining these impairments and their severity (Chong, 2008). Discussions have occurred and papers have been written presenting arguments for and against the inclusion of cognitive deficits as a symptom of the disorder within the next version of the DSM (Keefe, 2008; Chong, 2008). However, controversy still exists regarding the range and amount of cognitive deficits associated with schizophrenia and their consistency over time (Chong, 2008).

Impairment on neuropsychological assessments was found to occur in 85 per cent of patients with the disorder (Palmer et al, 1997). Cognitive dysfunction appears to be a characteristic of schizophrenia and individuals can experience further cognitive decline in old age (Harvey, 2001). Cognitive deficits can continue to be found in patients who have been in remission and therefore have been proposed to have little or no association with symptom severity. Sharma and Harvey (2000) evidenced the stability of cognitive impairments, in respect to their presence, by longitudinal studies of patients with schizophrenia. They found that deficits in cognitive functioning were still evident when the patient no longer suffered from any psychotic symptoms.

1.3 Cognitive deficits in schizophrenia

Individuals with schizophrenia can experience a deterioration in cognitive functioning before and after their first psychotic episode (Wykes & Reeder, 2005). These deficits may recover but it has been found that particular cognitive abilities will continue to be poorer than the expected level (Wykes & Reeder, 2005). These deficits can be found within executive functioning, attention, memory and early visual processing (Bilder et al, 2000; Gold, 2004; Wykes et al, 2005). A specific profile of cognitive impairment for individuals with schizophrenia has not been identified as the “deficits are highly heterogeneous” (Wykes and Reeder, 2000, pp.39). However cognitive impairments in schizophrenia have received the recognition they have required and are now identified as being the “critical treatment target” (Gold, 2004). This has been brought forward recently by the National Institute of Mental Health (NIMH). They have initiated two large studies within the

area of cognitive impairments i.e. Measurement and Treatment Research In Cognition in Schizophrenia (MATRICS) and Treatment Units for Research on Neurocognition in Schizophrenia (TURNNS) (Gold, 2004).

Impairments in cognitive functioning are not always experienced in all individuals with schizophrenia. Studies have shown that approximately 25 per cent of people with the disorder appear to be cognitively intact (Wykes and Reeder, 2000). These figures are greater than the figures stated by Palmer and colleagues (1997) in respect to cognitive impairments in schizophrenia. Kremen and colleagues (2001) proposed that individuals with a diagnosis of schizophrenia may have cognitive deficits even when their IQ is within the normal range. Therefore individuals may have been classified as cognitively intact based on their performance on general IQ tests rather than specific cognitive domains. Individuals with schizophrenia have been found to have a performance on neuropsychological assessments that lies between 1.5 and 2 standard deviations below the normal population (Bilder et al., 1995).

Deficits in cognitive functioning have been confirmed by the self reports of patients with the disorder. McGhie & Chapman (1961) found that patients with schizophrenia described having difficulties with their memory and attention as a result of the disorder.

The chronic nature of schizophrenia impacts greatly on how an individual functions on a daily basis. Independent living for many individuals with the disorder may present as a major challenge. Psychiatric services have focused primarily on treating

the psychotic symptoms rather than addressing other symptoms such as cognitive deficits. These deficits are more likely to be associated with functional outcomes rather than psychotic symptoms (Sharma & Harvey, 2000). Cognitive deficits in the areas of attention, executive functioning, working memory and verbal learning and memory were found to be the most consistent predictor of success or failure in relation to functional outcomes (Green, 1996; Green et al, 2000). The domains that are affected as a result of the disorder have been confirmed by a large meta-analysis performed by Heinrichs and Zakzanis in 1998. They investigated data from 204 studies of 7420 patients and 5865 controls. The results suggested that almost all cognitive domains were impaired to a degree with majority of cognitions indicating a medium to large effect size for deficits in comparison to controls (Gold, 2004).

1.3.1 Working Memory

Baddeley's model (1986) of working memory refers to a system used for temporarily storing and managing information needed to solve complex cognitive tasks, which includes both visual and auditory stimuli (Sharma & Antonova, 2003). It is required in tasks such as reasoning, learning and understanding information (Sharma & Antonova, 2003).

Impaired working memory has been found in patients with schizophrenia. Patients with the condition were found to be more impaired on tasks of working memory when compared to patients with other neurologic disorders (Pantelis et al, 1997). Studies investigating working memory deficits in schizophrenia have found impairments in verbal and visuo-spatial working memory. This suggests that the

working memory system of patients with schizophrenia is of a more limited capacity when compared to those without the disorder (Gold et al, 1997; Keefe et al, 1995; Stuss et al, 1982).

Working memory deficits are proposed to contribute to memory difficulties in general (Stone et al, 1998). If an individual is unable to reason and manipulate information in the short term it is unlikely that the data will be processed and retrieved by long term memory systems. This will affect the patient's ability to learn new skills and process complex information. It has also been found to have implications upon the functional outcome of patients (Sharma & Antonova, 2003).

Deficits in working memory and attention have been proposed to compromise other areas of cognitive functioning (Goldman-Rakic, 1991). They have also been suggested to be a factor related to positive symptoms as impairments in this area correlate significantly with formal thought disorder (Spitzer, 1993).

1.3.2 Executive Functioning

“Executive Function refers to the ability to use abstract concepts, to plan ones actions, to work out the strategies for problem solving and to execute them with the self monitoring of ones mental or physical processes”(Sharma & Antonova, 2003, pp.28). This cognitive function is required for even the simplest to the most complex of tasks.

Various neuropsychological tasks have been developed to measure executive functioning. Patients with schizophrenia have been found to perform poorly on these tasks relative to healthy subjects (Sharma & Antonova, 2003). However the level of impairment on these tasks can vary greatly in patients with the disorder (Goldberg et al, 1990).

Positive symptoms of schizophrenia such as hallucinations and delusions have not been found to correlate with the severity or degree of impairment of executive functioning (Morris et al, 1995). Voruganti and colleagues (1997) found that negative symptoms of the disorder correlate with deficits on executive functioning tasks such as flattening of affect, avolition and social withdrawal.

The Wisconsin Card Sorting Test (WCST) is a test of executive functioning. This test involves “conceptual learning, planning, monitoring, working memory and flexibility of thought” (Wykes & Reeder, 2005, pp.101). The theory of a frontal lobe deficit was proposed to be underlying to the cognitive impairments in schizophrenia. This theory was supported by performances of patients tested on the WCST (Wykes & Reeder, 2005). Patient’s performance on the WCST has been shown to correlate with poor insight into their illness (Voruganti et al, 1997; Young et al, 1993). Lack of insight has been associated with poor compliance with medication (Garavan et al, 1998), self injurious behaviour (Meltzer, 2001) and the risk of violence towards others (Arango et al, 1999; Sharma & Antonova, 2003). Sharma and Antonova (2003) indicated that impairments in executive functioning may lead to poorer outcomes for patients.

1.3.3 Attention and Information Processing

Attention refers to the processing involved in identifying stimuli encountered by the individual (Sharma & Antonova, 2003). “Attention may include maintaining an alert state, selectively filtering relevant information, shifting from one set to another and rapidly discriminating or scanning stimuli” (Wykes & Reeder, 2005, pp.33)

Attention deficits within individuals with schizophrenia have been found in research which has shown that these patients have slowed performances during timed tasks such as the trail making tests (Heaton et al, 1994; Watson et al, 1968). Attention and information processing deficits have been hypothesized to be a key feature of the disorder, as they may have a direct effect on working memory and execution functioning impairments (Sharma & Antonova, 2003). Cassidy and colleagues (1996) suggested that the first steps of any cognitive rehabilitation intervention were to target attention and concentration. This was supported by authors who proposed that deficits such as impaired vigilance or distractibility were factors which affected adaptive behaviour and individuals’ ability to learn new information and skills (Delahunty et al, 1993; Medalia et al, 1998).

1.3.4 Learning and Memory

Patients with schizophrenia have been found to have deficits in episodic or declarative memory. This system refers to an individual’s ability to learn and recall information from past events (Sharma & Antonova, 2003). Other memory functions have been found to be relatively intact.

Studies investigating memory functioning in schizophrenic patients have found that this area was more impaired than other areas of cognitive functioning, such as attention and executive function (Saykin et al, 1991; Saykin et al, 1994). These studies used patients who were medication free or medication-naïve and non-institutionalised. Therefore these researchers proposed that the deficits in memory were not the result of medication or institutionalisation, but a result of the disorder.

In respect to verbal learning and memory studies have shown that patients with schizophrenia perform poorer than controls on verbal learning tests (Koh et al, 1973; Paulson et al, 1995). It has been proposed that these individuals encode semantic information poorly (Kurtz et al, 2001). Verbal learning and memory have been proposed to be the crucial elements required for acquiring new skills (Silverstein et al, 1998; Spaulding et al, 1999). Belluci and colleagues (2002) indicated that interventions which target and improve these areas of cognitive functioning should have benefits for therapeutic outcomes.

1.3.5 Perceptual Organisation and Visual Memory

Perceptual organisation and visual memory have been less investigated than their verbal counterpart. Sullivan and colleagues (1992) proposed that organisational processing deficits play an important role in the memory difficulties of individuals with schizophrenia. Studies have shown that on the Rey Complex Figure test patients with schizophrenia perform poorly on both the copy and recall tasks in comparison to healthy controls and other psychotic illnesses (Seidman et al, 2003).

1.3.6 Research into cognitive deficits in schizophrenia

Cognitive deficits in schizophrenia were initially thought to be the result of medication and institutionalisation. Recent evidence has found that the presence of cognitive deficits may be a risk factor for the later development of the disorder (Gold, 2004). Niendam and colleagues (2003) found that individuals may experience difficulties with intellectual and academic functioning in early childhood prior to the occurrence of any schizophrenic symptoms. These deficits have also been found to occur in untreated first episode patients. Studies have indicated that the impairments found within schizophrenia are not the result of medication or institutionalisation but are a result of the disorder (Kuperberg & Heckers, 2000; Saykin et al, 1994).

1.4 Cognitive functioning comparisons between Violent and Non violent patients with schizophrenia

Schizophrenia has been associated with an increased risk of violence when patients are actively psychotic (Buckley et al, 2004; Link et al, 1998; Swanson et al, 1990). Research into the factors associated with violent behaviour amongst patients with schizophrenia has produced inconsistent results. A study by Roy and colleagues (1987) with inpatients with chronic schizophrenia found that violent patients outperformed nonviolent patients on a number of subscales of the Wechsler Adult Intelligence Scale, Revised (WAIS-R). This study was based upon a sample of 20 inpatients and participants were assigned to groups categorised as violent or non-violent. The sample size within this study was relatively small in order to make independent group comparisons. Therefore the conclusions from this study may need to be interpreted with caution.

Contrary to the above results other investigators found that violent patients with schizophrenia performed worse than nonviolent patients. Krakowski and colleagues (1989) investigated neuropsychological impairment amongst a sample of patients. They were classified into three groups indicating high level of violence, low level of violence and nonviolent. Patients within the high violent group were found to be significantly more impaired than the nonviolent group. This study had 61 participants providing greater statistical power within the design in comparison to Roy's study (1987) which had a smaller sample size. Similar results were found by Adams and colleagues (1990) who performed neuropsychological assessments on 37 inpatients.

Krakowski and colleagues (1997) found that a history of community violence was significantly associated with impairment on a measure of executive functioning i.e. WCST. This study recruited 102 patients. These results were replicated in a study in 2003 by Lafayette and colleagues who found that out patients who were violent performed worse than those considered non violent. Recruitment within this study was also high with 96 participants. Buckley and colleagues (2004) also found supporting evidence which indicated that violent patients were more likely to be more symptomatic, had poorer functioning and more insight deficits. One of the most recent study's in 2008 with a forensic population found that lower current IQ rates were associated with inpatient violence (Fullam & Dolan, 2008). Therefore the researchers concluded that low IQ has been associated with an increased risk of violence (Fullam & Dolan, 2008).

The literature has indicated that the risk of violence is higher in individuals with a personality disorder. Barkataki and colleagues (2005) performed a study comparing individuals with schizophrenia who had a history of violent behaviour and those who were nonviolent in addition to individuals with an antisocial personality disorder who had been violent. The results showed that there was a greater impairment observed in violent patients with schizophrenia compared to the non violent patients. The authors suggested that this level of impairment may only be present in those individuals with schizophrenia who did not have a co-morbid diagnosis of anti-social personality disorder. The presence of a personality disorder of the antisocial type may present as a protective factor against the neurocognitive deficits observed in patients with schizophrenia (Rasmussen et al, 1995). The authors concluded that the deficits in executive functioning found in violent patients with schizophrenia are more pronounced than in nonviolent patients with the disorder (Barkataki et al, 2005).

Although initial studies investigating violence and neurocognitive deficits in schizophrenia have been inconsistent more recent research has indicated that there is a link between the two. The studies of violence and cognitive functioning have a considerable degree of methodological variance. Operational definitions of violence may have varied greatly within studies and some have had to rely on the self reports of patients (Lapierre et al, 1995). On review of the literature the studies used different terminology to describe violent acts. Some studies specified violence within a particular time period i.e. over a one week period (Adams et al, 1990) or included the entire life span (Hoptman et al, 2002; Lapierre et al, 1995). Other

studies have defined violence as aggressive acts which have led to criminal proceedings (Barkataki et al, 2005; Lafayette et al, 2003) or based upon the severity of the violence (Lapierre et al., 1995). The definition of violence is a difficult concept and one which has caused some debate in the current study. There is also wide variation in the numerous neuropsychological assessments used throughout the studies which makes comparisons difficult. Sample sizes were generally small within the studies that investigated violence and intellectual ability (Naudts & Hodgins, 2005).

Studies showing a positive link (Krakowski et al, 1989; Krakowski et al, 1997; Lafayette et al, 2003) appeared to have better research designs and greater sample sizes than previous studies that did not find a positive relationship between violence and low IQ (Roy et al, 1987). A recent review performed by Taylor in 2008 explored the link between psychosis and violence. She concluded that both 'structural and functional measures' indicated more deficits in schizophrenia patients who have a history of violence in comparison to nonviolent patients with mental illness (Taylor, 2008).

Jones (1992) defined a number of features associated with violent behaviour including reduced inhibition and impaired memory, attention and concentration. Studies have also indicated a relationship between alcohol misuse and violent behaviour (Eronen, 1995; Tiihonen et al., 1993). In addition substance misuse amongst patients with schizophrenia increases the risk of violence (Swanson et al, 1990).

The risk of violence in patients with schizophrenia is greater when the content of their hallucinations and delusions are associated with being personally threatened (Krakowski et al, 1999). Brain injuries have also been found to be a factor identified as a risk of increased violence. “The presence of untreated or inappropriately treated brain damage increases likelihood of aggression in any given individual or diagnostic classification.” (Golden et al, 1996, pp.22).

Research conducted by Buckley and colleagues (2004) indicated that violent patients had significant deficits in respect to insight when compared to non violent patients. The researchers also found that lack of insight into illness amongst the violent patients was also strongly correlated with lack of forensic insight, which related to the legal consequences of their illness. The researchers recruited 115 patients who had a violent history and compared them to a nonviolent control group of 111 patients. Therefore this study appeared to have an adequate sample size. This research highlighted the sparse amount of literature investigating insight and violence amongst patients with schizophrenia.

1.5 Treatment of Cognitive deficits in Schizophrenia

The 1950s saw a revolution in the treatment of schizophrenia with an emphasis on the psychotic features of the disorder (Sharma & Antonova, 2003). By the 1960s clinicians found that effective treatment of the positive symptoms of schizophrenia did not result in the recovery of the disorder. There were no significant improvements in functional outcomes (Hegarty et al, 1994).

Recent investigations into the factors associated with functional outcomes have concluded that cognitive deficits are the ‘core and enduring’ feature of the disorder (Green 1996). Cognitive deficits have been identified as being more important in predicting functional outcome than positive symptoms and to some extent negative symptoms (Green, 1996). Impairments in cognitive functioning have been found to persist even after the psychotic episodes have been treated (Nuechterlein & Dawson, 1984; Spring et al, 1990).

Medication affects cognitive functioning, in addition to affecting patients’ mood and their level of motivation (Wykes & Reeder, 2005). However it is important to recognise that research has shown that cognitive deficits existed prior to the introduction of treatments such as medication (Wykes & Reeder, 2005). Therefore the cognitive deficits exhibited by patients are not solely the result of medication (Saykin et al, 1994). Spring & Ravdin (1992) proposed that “residual cognitive impairments stand as impediments to a full recovery from schizophrenia” (pp.18).

1.5.1 Biological

The theories surrounding the deficits of schizophrenia have brought about great interest regarding the effect of medication upon cognitive functioning. Various antipsychotics have been investigated to assess their effect upon areas of cognition. Clozapine is one of the atypical antipsychotics. This drug has been found to significantly improve measures of executive function on measures of Trail Making Test (Buchanan et al, 1994) and the WCST (Hagger et al, 1993). However several studies did not find significant results on the WCST (Buchanan et al, 1994; Daniel et

al, 1996; Goldberg et al, 1993; Hoff et al, 1996) or the Trails Part B (Daniel et al, 1996; Goldberg et al, 1993). Significant improvements were found on working memory (Galletly et al, 1997; Grace et al, 1996), however neither of these two studies used control groups. Hagger and colleagues (1993) found significant effects on tests of verbal learning and memory when comparing the treatment group to controls. Studies have also shown that when clozapine is administered for longer than 12 months the improvements in executive functioning dissipate over time (Buchanan et al, 1994; Goldberg et al, 1993; Hagger et al, 1993; Hoff et al, 1996).

In a review of effects of medication on cognition, risperidone was found to improve performance on tests measuring attention, executive function, working memory, verbal memory and motor processing (Meltzer & McGurk, 1999). Studies using Olanzapine found that there was a significant effect on measures of executive functioning and verbal memory and learning. The size of the effect in this study was greater than the effect found for clozapine or risperidone (Meltzer & McGurk, 1999).

These studies suggest that medications may be beneficial for some areas of cognitive functioning. Studies have shown that the benefits of newer antipsychotics may be relatively modest and will not produce significant effects in respect to premorbid levels (Harvey & Keefe, 2001; Meltzer & McGurk, 1999). However it is unlikely that medication decisions will be based upon the effect on cognitive functioning but rather on other symptoms such as delusions and hallucinations. Aspects related to cognitive functioning are seen as less important in the early stages of commencing antipsychotic medication.

“Complex interactions between different neurotransmitter actions of atypical antipsychotics in different brain regions in relation to cognition are poorly understood at present” (Sharma & Antonova, 2003, pp.36). Therefore more research is required in this area to decide on the possible functional benefits that may be achieved by the different antipsychotic medication. Medications which could have a detrimental effect on cognitive functioning should be avoided to ensure the best functional outcome of the patient. Such medications include those with anti-cholinergic properties which have been found to have a negative effect on cognitive domains particularly memory (Spohn & Strauss, 1989). Newer atypical medications have a less negative impact upon cognitive functioning in comparison to typical antipsychotics, however they do not “normalise” the cognitive impairments associated with schizophrenia (Keefe et al, 1999; Meltzer and McGurk, 1999).

1.5.2 Psychological

Initially the focus of treatment for schizophrenia was dominated by the medical model using medication alone. The limitations of this treatment became evident as patients experienced difficulties in interpersonal domains and ability to cope with some of their residual symptoms. Initial psychological treatments focused on skills training and rehabilitation (Wykes et al., 1998). These interventions were based on social learning theories to help retrain patients in skills needed for independent living. Also at this time additional theories using operant learning aimed to modify patients’ behaviours with the use of rewards and punishment (Bradshaw, 1995; Haddock & Slade, 1996). Many of these treatments helped to produce short term benefits however the benefits were not sustained and they were not successful at

reducing the psychotic symptoms (Hussain, 2001). In the 1980s additional psychological theories and models were developed which included cognitive therapy. This therapy aimed to use techniques that helped to change patients beliefs which may have an underlying element to their psychotic symptoms. Cognitive Behavioural therapy has been further developed to include both cognitive and behavioural aspects. CBT has been found to have positive and lasting benefits for patients who experience treatment resistant symptoms (Kuipers et al., 1988; Kuipers et al., 1997). Within current guidelines psychological interventions have been included as an important aspect of treatment and management of schizophrenia (SIGN, 1998).

Treatments targeting the functional impairments of schizophrenia have focused on behavioural interventions (Sharma & Antonova, 2003). Examples of behavioural treatments include skills training, which aims to teach patients new skills using a variety of behavioural approaches. However these techniques have been limited in improving patient functioning (Sharma & Antonova, 2003).

Family education (Goldstein, 1984) and behavioural family therapy (Fallon et al, 1982) are other forms of psychological interventions that have focused on relapse prevention and symptomatology. Many of the interventions are greatly limited by the cognitive deficits that are experienced by many of our patients with schizophrenia. Cognitive impairments may lead clinicians to deem patients as unsuitable for psychological interventions because of their cognitive difficulties thereby limiting the effectiveness of rehabilitation.

1.5.3 Newer interventions

Researchers have proposed that the cognitive impairments experienced by patients with schizophrenia could be improved by techniques that have been used in the rehabilitation of patients with a brain injury. These techniques have been found to be effective with closed head injuries which focused on improving affected areas of cognitive functioning (Cicerone et al, 2000).

Researchers have found favourable evidence for the effectiveness of cognitive rehabilitation programs. These techniques use either drill and practice or drill and strategic learning to improve cognitive domains such as memory, attention and executive functioning. The interventions can be administered either via a computer package or using paper and pencil tasks. It has been recommended that these treatments are provided alongside other forms of treatment (McGurk et al, 2007). Improvements in cognitive functioning could therefore improve treatment outcomes of other types of psychological interventions by increasing patients understanding, recall of material and problem solving abilities (Wykes & Reeder, 2005). Results from a meta-analysis of integrated psychological therapy (Brenner et al, 1994) found that the greatest effects on functioning were attributed to interventions that integrated both cognitive rehabilitation techniques and social skills training in comparison to the interventions being offered alone (Roder et al, 2006). The effectiveness of rehabilitation techniques will be limited if patients are unable to remember the material or have difficulty following the information due to attention and concentration impairments. The treatment will also be limited if the patient is unable to generalise the therapy to their own situation and problem solve using executive

functioning abilities. Therefore cognitive deficits have direct and indirect effects upon functional ability.

Cognitive impairments have also been found to be related to patient insight. Those who have better cognitive abilities have been found to have more insight (Lysaker & Bell, 1995). Startup (1996) found a relationship between insight, cognitive functioning of patients and treatment adherence. Therefore cognitive deficits have an indirect effect upon symptoms in respect to these relationships. These are important considerations for the treatment of schizophrenia and cognitive rehabilitation techniques should be incorporated within present interventions to provide the best possibility of recovery.

1.5.4 Functional Outcomes and Recovery

Functional impairment is one of the main factors contributing to the cost of treatment for individuals with schizophrenia (Kenny & Meltzer, 1991). Treatments aimed at improving the functional outcome of patients are essential both from an individual perspective and an economic standpoint. Velligan et al (1997) proposed that cognitive deficits are an important area to be addressed in order to improve functional outcomes.

Treatments for schizophrenia have not been effective in terms of functional outcomes. Functional outcomes relate to a patient's ability to cope with the challenges of independent living. These tasks may be relatively basic such as paying rent or attending appointments with health care professionals. Complex tasks are

also necessary, such as remembering a number of items to purchase at the supermarket or problem solving abilities with finances or employment opportunities.

Individuals with schizophrenia represent a large proportion of the homeless population (Scott, 1993). In 2002 Lehman and colleagues researched employment outcomes amongst individuals with schizophrenia. They found that only 10 per cent of individuals had full time jobs and 20 per cent of patients had part time jobs. Therefore 70 per cent of their sample population were unable to sustain employment even on a part time basis. More significant indications of functional impairment were found during a study by Nanko and Moridaira (1993). They found that only 10 per cent of male patients with a diagnosis of schizophrenia were reported to have a child. These studies highlight the difficulties that are experienced by individuals attempting to function on a daily basis. This clearly identifies the need for treatments aimed at improving functional outcomes by providing interventions targeting cognitive deficits. Psychopharmacology interventions have limited effects on improving cognitive functioning (Marder, 2006; Rund et al, 1999) and even less on functional outcomes (Harvey et al, 2004).

1.6 Cognitive Rehabilitation/Remediation Therapies (CRT)

“Cognitive rehabilitation is defined as a systematic, functionally orientated service of therapeutic activities that is based on assessment and understanding of the patient’s brain-behavioural deficits” (Cicerone et al, 2000, pp.1596). Cognitive remediation therapies are different from other traditional rehabilitation and psychosocial

interventions as their key focus is upon alleviating the acquired neurocognitive impairments and disability.

Cognitive rehabilitation or remediation techniques have gained significant interest over the last 20 years. The resurgence of interest into cognitive deficits of schizophrenia led to the implementation of cognitive rehabilitation interventions similar to those used in acquired brain injury services. Initially the cognitive programs focused on tasks of long term concentration, known as the first generation of cognitive training (Sartory et al, 2005). Results from these studies have shown positive effects (Benedict et al, 1994; Olbrich & Mussgay, 1990) and others have found inconsistent results as indicated by the review by Suslow and colleagues (2001). More recent interventions have targeted the areas of impairment directly i.e. executive function, verbal memory and attention (Sartory et al, 2005).

The terms cognitive rehabilitation and cognitive remediation have been used interchangeably within the literature. These terms do not imply that individuals' level of cognitive functioning is restored to premorbid levels. Rather it is about improving these areas relative to the individual's current level of functioning.

Initial outcome studies within the area of cognitive rehabilitation were met with rather pessimistic opinions. A number of papers were written about the validity of the treatment and questioned whether this type of intervention should be used. One example of this was a paper by Bellack in 1992 titled "Cognitive rehabilitation for schizophrenia: Is it possible? Is it necessary?" Similar papers with rather cautionary

themes followed. These papers expressed considerable doubt regarding cognitive rehabilitation due to uncertainties regarding the possibility of being able to retrain areas of cognitive functioning. They also have reservations about the interventions and their generalisation of the skills improved during the treatment (Spring & Ravdin, 1992). A Cochrane review performed in 2000 did not provide positive evidence for the effectiveness of the intervention. However the review only included three studies which met their inclusion criteria.

Recent research has provided more comprehensive evidence for the effectiveness of cognitive rehabilitation interventions including a number of reviews and meta-analysis (McGurk et al, 2007). An interesting development has been the turnaround of the above authors who initially had major doubts about the treatment but have now written papers providing a more optimistic view about the effectiveness of these interventions. The American Psychiatric Association has recently recommended that cognitive remediation therapy is provided as a key component for the treatment of patients with schizophrenia (Heyebrand, 2007) given the increasing amount of evidence in support of the intervention.

1.7 Methodology issues of cognitive rehabilitation/remediation therapy

Use of technology

Cognitive rehabilitation therapies can be administered with the aid of computers and computer software which has many advantages. The computer provides tasks that alter in level of difficulty based upon the ability of the patient. They can also present various repetitions of tasks that may not have been possible using paper and pencil

tasks. Computers can provide explicit reinforcement and patients find the programs rewarding, therefore providing intrinsic rewards (Medalia et al, 1998). Patients may also find it less stressful and may be more willing to engage with the treatment (Field et al, 1997). Studies have shown that the use of computers to administer the cognitive remediation therapy was enthusiastically received by patients (Bradt et al, 1993; Brief, 1994; Burda et al, 1991). Computers provide structured yet flexible training tasks with clear, accurate and immediate feedback. Belluci and colleagues (2002) suggested that this method may be less threatening to the patients and therefore a more engaging option.

There are several computer software packages available for clinical populations. As can be seen in the table in *Appendix 7* the studies performed within this area have utilised a variety of these packages. The most common computer software used for cognitive rehabilitation therapies has been CogRehab, Cogpack, Captains Log and NEAR. These packages have been developed and tested within clinical populations of patients with schizophrenia.

Number of sessions

A recent meta-analysis by McGurk and colleagues (2007) showed that the number of hours of cognitive remediation treatment patients received did not relate to the amount of improvement in overall cognitive functioning, with the exception of verbal learning and memory. The intervention improved cognitive domains such as attention, concentration, executive functioning, verbal learning and memory. The authors suggested that between 5 to 15 hours of cognitive remediation therapy is

sufficient to improve attention, concentration, executive functioning and memory.

However the domains of verbal learning and memory were affected by the number of sessions of cognitive remediation and may require more sessions to produce a significant improvement (McGurk et al, 2007).

Suitability of treatment

Cognitive rehabilitation has been identified as a beneficial treatment in improving cognitive functioning and functional outcomes for schizophrenia (McGurk et al, 2007). There has been some debate about whether all patients with schizophrenia should obtain this form of therapy (Gold, 2004) even though the APA has recommended it as a key component (Heyebrand, 2007). This has been due to the heterogeneity of cognitive deficits experienced by patients with schizophrenia.

Studies have suggested that patients with schizophrenia who have the poorest scores on measures of working memory, executive function, verbal memory and vigilance are the least likely to benefit from these interventions (Liddle, 2000).

Weickert and colleagues (2000) indicated subgroups of cognitive deficits observed in individuals with schizophrenia. They proposed that patients with the disorder could be classified into specific groups based on their current cognitive deficits and the change in cognitive functioning since the onset of their condition. Three subgroups were identified. Firstly, the intellectual deteriorated group whose cognitive functioning declined after the onset of the disorder. The intellectually compromised group were composed of individuals who presented with consistently low intellectual functioning. Lastly was the intellectually preserved group. These individuals

intellectual functioning has remained relatively intact following the onset of the disorder. Fiszdon and colleagues (2006) provided supportive results for the subgroups identified by Weickert et al (2000). They found that individuals within the preserved intellect group performed the best on nearly all cognitive tasks. Where the deteriorated group and the compromised groups differed, results showed that the deteriorated intellect group performed better than the compromised group. The compromised intellectual group had the greatest difficulty in generalising their training to other areas of functioning compared to the other two groups. Therefore cognitive rehabilitation techniques may be effective for certain individuals and have limited effects on others based on how their cognitive functioning has been affected by their mental illness.

Presence of a therapist

The presence of a therapist during computerised cognitive rehabilitation interventions has identified some interesting findings. Krabbendam and Aleman (2003) found during their meta-analysis that when the therapist was an active participant during the intervention, effect size of cognitive improvements were almost twice as large (0.36 versus 0.69) but were not significant.

Self esteem issues

Self esteem is an important psychological trait in any individual and is an important aspect in individuals with schizophrenia. Studies investigating self esteem in patients with schizophrenia have found that items related to competence and personal

power are less likely to be scored by individuals with the disorder than controls (Garfield et al, 1987).

Wykes and colleagues (1999; 2003) performed several studies identifying the effect cognitive remediation training had upon self esteem. Their results showed that self esteem improved over the duration of the intervention but was not sustained after a 6 month follow-up. The authors proposed that the findings were not attributed to therapist contact but directly to the remediation training due to comparisons with a control group, who also received the same amount of therapist contact (Wykes et al, 1999; 2003). Improved cognitive function has been found to correlate with self-esteem (Wykes et al, 1999). Improvements in self esteem can help improve patients' perceived competence and amount of personal control. Interventions that are able to improve self esteem may also indirectly affect symptomatology by improving depression and mood (McGurk et al, 2005; Wykes et al, 2003).

Access to patients/ sample population

The majority of studies within the area of CRT have recruited patients who have a diagnosis of chronic schizophrenia. They also have been in regular contact with hospital services, many of whom have been in long term inpatient care. Sharma and Antonova (2003) proposed that there was a 'vicious cycle scenario' whereby those patients who were being referred to rehabilitation treatments were likely to have long psychiatric histories. Therefore these individuals were likely to be chronic sufferers and have severe cognitive impairments. Gold (2004) also indicated that many of the cognitive rehabilitation studies have been conducted with patients who are

chronically unwell. Therefore there are concerns regarding sampling bias i.e. whether there are limitations about using this type of intervention with this sample and are they the best candidates to benefit from these interventions.

The majority of the studies that have been included within this literature review have recruited patients who are well known to mental health services and therefore make access to the patients more convenient. The population sampled within cognitive rehabilitation studies highlights the lack of interventions that have targeted those individuals whose illness is less chronic or those experiencing their first psychotic episode. These are areas which require further investigations in view of the positive evidence that has been found for cognitive remediation therapies.

Patient motivation

Motivational factors have been suggested to play a vital role in the performance of individuals with schizophrenia. A study using monetary incentives for good performance on an executive function test, Wisconsin card sorting Test, found that poor motivation was not a contributing factor for poor performance. However, negative symptoms have been associated more significantly with poor performance (Bryson et al, 2001; Nieuwenstein et al, 2001).

Type of intervention

Cognitive remediation programs vary from one technique to the other, but they have common components such as practice and training strategies in addition to corrective feedback (Fiszdon et al, 2004). There has been no evidence to date regarding the best

form of cognitive rehabilitation treatment (Heydebrand, 2007). The model proposed by Spaulding in 2003 was suggested by Wykes and Reeder (2005) to be presented as the guide to how cognitive interventions should be conducted. The model highlighted the importance of practicing skills and reinforcement. The mechanisms involved in cognitive rehabilitation techniques that bring about changes in cognitive functioning are still poorly understood.

Majority of studies have either used a form of drill and practice or drill and strategy learning/coaching. Drill and practice methods require patients to practice skills within a particular area to obtain improvements. Drill and strategy coaching programs focus on teaching patients how to chunk pieces of information to enable recall and problem solving skills to improve memory and executive functioning (McGurk et al, 2007).

Areas of cognitive functioning to be targeted

Initial studies into the area of cognitive remediation were unclear about the areas of cognitive function that should be targeted. Recent studies have shown that attention, memory and executive function are the main areas of cognitive deficits experienced in schizophrenia (Bellack et al, 2005; Mueller et al, 2004). Executive functioning has been found to correlate highly with employment and independent living. In addition attention and vigilance has been found to be crucial for social and occupational functioning (Sharma & Antonova, 2003). Memory functions also correlate highly with functional outcomes (Sharma & Antonova, 2003) and therefore

these are the areas of cognitive functioning which should be targeted in cognitive remediation interventions.

Tests on vocabulary and information measure the most ‘crystallized aspects of intelligence’ which are suggested to be the most resistant to the effects of acquired cognitive impairment (Psychological Corporation, 1997). Therefore it is unlikely that there will be any improvements found in measures of general intellectual abilities (Penades et al, 2003).

Transferability of skills

Green and Nuechterlein (1999) proposed the ‘delta question’, whether changes in cognitive functioning could lead to changes in functional outcome. Penades and colleagues (2003) found a positive correlation for improvements in cognitive functioning and functional outcomes. They proposed that “cognitive rehabilitation will become an important tool in multimodal treatment of schizophrenia if this correlation is confirmed in further studies” (Penades et al, 2003, pp.226). Improved cognitive functioning could benefit other psychosocial interventions used in the treatment of schizophrenia. There have been doubts regarding whether improved cognitive functioning using rehabilitation techniques can be transferrable to other areas of functioning. Bellack and colleagues in 2001 were able to provide evidence that participants who had been given training in one area were able to use the skills learned to improve their performance on a different task. A study investigating cognitive training has shown that it can be beneficial in regards to independent outcome measures, in this case a work therapy program (Bell et al, 2001).

Efficacy/ Durability of treatment

Studies have shown that the improved cognitive functioning by cognitive remediation therapy is sustainable and durable (Bell et al, 2003; Fiszdon et al, 2004; Hogarty et al, 2004; McGurk et al, 2005, Vaughn et al, 2005). Research has also suggested that cognitive remediation therapy not only helps improve cognitive functioning but can improve symptoms of the disorder as measured by scales such as the Positive and Negative Symptoms Scale (PANSS) (Bark et al, 2003).

The efficacy of cognitive rehabilitation interventions continues to cause debate. However it “holds considerable promise and certainly represents hope for a population that is fairly marginalised” (Heydebrand, 2007, pp.191). The resurgence of interest in the field of cognitive rehabilitation has led to many studies investigating interventions for patients with schizophrenia. It is important that these programs are tailored to address the specific issues in question and to provide the most efficient treatment for these individuals.

1.8 Literature review of computer software in cognitive rehabilitation interventions with schizophrenia

A literature review of all the studies that have been carried out in the field of cognitive rehabilitation with schizophrenia was too huge a task to undertake. The review of the literature has focused on the computer interventions used in cognitive remediation therapy. The literature review covered OVID, PsycInfo, EMBASE and Cochrane Reviews databases. The years were limited to 1990 to 2008 and focused on studies carried out in the area of cognitive rehabilitation techniques conducted

with patients with schizophrenia. The following search items were used: cognitive rehabilitation, cognitive remediation, schizophrenia and computer. Studies meeting the following criteria were included: 1) Articles from a peer reviewed journal; 2) Studies evaluating the effectiveness of computer packages in cognitive rehabilitation interventions; 3) assessment of performance with at least one neuropsychological measure able to reflect generalisation of effects rather than assessments on trained tasks.

No research was found on cognitive rehabilitation treatments on patients with schizophrenia who have a forensic history or history of violence.

Five studies from the literature search met the above criteria and used Cogpack software which was administered as cognitive rehabilitation intervention. All studies randomly assigned patients to different treatment or control groups. All studies made comparisons between treatment groups and a control group.

McGurk and colleagues (2005) performed a study with 23 outpatients to evaluate the effectiveness of cognitive remediation therapy on competitive employment outcomes. Cognitive functioning was used as one of the researchers' outcome measures. They used a number of neuropsychological assessments including the WCST, Trails part A and B, Digit span, premorbid measures of intelligence and the CVLT, a measure of verbal learning. Results found improvements in cognitive measures, with a medium effect for verbal working memory and verbal learning. Follow up studies showed that those who had received cognitive rehabilitation

treatment in addition to supported employment had overall better functional outcomes. Effect size for functioning measures was 1.76. These individuals were significantly more likely to hold down a job, worked longer hours and got better pay. The follow up assessments occurred only at three months therefore additional follow up assessments would have been beneficial to investigate the effectiveness and durability of the intervention. This study illustrated the significance of offering cognitive rehabilitation interventions alongside work therapies upon functional outcomes. The researchers also recruited individuals who had experienced previous job failures and therefore indicated the effectiveness of their intervention for patients who may struggle with employment. A limitation of the study was its small sample size in which between groups comparisons were made.

Sartory and colleagues (2005) also used Cogpack as its cognitive rehabilitation treatment. The researchers randomly assigned participants to one of two groups, cognitive remediation or treatment as usual control group. The cognitive remediation group consisted of 21 participants completing 15 hours of treatment, using Cogpack, over a three week period. Neuropsychological assessments used included word fluency, Trail making test part B and memory tests. The results showed that cognitive remediation therapy led to significant improvements in areas of verbal memory, processing speed and executive functioning when compared to a control group. Effect sizes of treatment outcome were medium to large. Sartory and colleagues (2005) proposed that their sample consisted of younger individuals who had a mean of five years duration of the disorder. They concluded that the efficacy of cognitive rehabilitation may decrease with chronicity of the disorder i.e. those

who have been ill for longer may experience less benefits than those with a shorter duration of schizophrenia. Durability of the effects found within the study was not researched as the control group received the treatment after analyses of the two groups had been completed. This study limited practice effects by including parallel forms of the tests. This intervention was administered over a very short time scale i.e. three weeks. This study had a similar sample size as the study performed by McGurk and colleagues (2005) but provided less computer-assisted cognitive rehabilitation therapy. The authors concluded that computerised cognitive rehabilitation/remediation techniques were an important addition in the treatment of schizophrenia (Sartory et al, 2005).

Vaugh and colleagues (2005) used cognitive rehabilitation interventions alongside self management skills training for negative symptoms. Their sample consisted of 138 inpatients that were randomly assigned to one of three groups: i) computer assisted cognitive strategy training plus vocational rehabilitation; ii) training of self management skills for negative symptoms plus vocational rehabilitation; iii) vocational rehabilitation alone. The researchers used strategic learning approaches in their cognitive rehabilitation intervention which included the Cogpack software for 24 hours over 8 weeks. The participants were assessed using the letter cancellation test, a selective attention test. Cognitive tests were also administered in the area of planning abilities using the Tower of Hanoi and verbal learning and memory by the Rey Auditory verbal learning test. Results showed that there were significant effects found on measures of attention, verbal learning and memory. No significant effect was found for planning abilities. The authors also found a relationship between the

improvements on cognitive assessments and employment outcomes. At 12 month follow up there were significant effects found on verbal learning and memory and on employment. A shortcoming of this study was the high drop out rate, which was approximately 25 per cent. The study only used three cognitive assessments and the intervention makes it difficult to ascertain which element of the intervention was the most effective. However, this study demonstrated the effectiveness of the intervention alongside other rehabilitation approaches.

Wolwer and colleagues (2005) investigated remediation of impairments in facial affect recognition in schizophrenia. Although this study was predominantly looking at facial affect it was included as it used Cogpack as the cognitive rehabilitation intervention which was assessed using a number of cognitive assessments. There were 77 participants randomly assigned to one of three groups; training of affect recognition group, cognitive remediation therapy or treatment as usual. The cognitive remediation therapy group received nine hours of training which consisted of training with computer software Cogpack and desk work in the form of drill and strategic learning. Cognitive assessments measured attention, situational understanding and executive functioning. Results showed that there was a significant effect for memory for the cognitive remediation group when compared to the other groups. The study aimed to remediate facial affect and not cognitive deficits, which was used as an active control group. The shortcoming of this research for the current purposes, was that it focused upon the facial remediation aspect and conclusions are therefore hard to reach in respect to cognitive remediation therapy. A strength of this study was its use of a variety of cognitive assessments.

The methodology stated that the participants received nine hours of training which included computer and desk work but it was not made clear how much time was dedicated to the administration of the software Cogpack. Therefore the amount of time spent using the software may have had an effect on the results found within this study as this was a review of computer-assisted cognitive rehabilitation interventions. Although previous studies have found significant effect using paper and pencil tasks meta-analyses have found greater effect sizes for the effectiveness of computer assisted remediation in comparison to paper and pencil techniques (Suslow et al, 2001; Twamley et al, 2003).

The last study that was identified within the literature research that used Cogpack software as part of cognitive rehabilitation interventions was conducted by Lindenmayer and colleagues (2008). This study was a randomised control trial based on cognitive remediation with inpatients. The intervention consisted of 24 hours of computerized practice over 12 weeks alongside a weekly discussion group that lasted one hour. The intervention used a drill and strategic learning approach. Cognitive functioning was assessed in the areas of verbal working memory, psychomotor speed, information processing speed, verbal learning and memory and executive functioning. Results showed significant effects on measures of verbal learning, attention and psychomotor speed. There were no significant results found on measures of executive functioning or memory. Follow up analyses were conducted at 6 months and 12 months in respect to employment outcomes. The authors concluded that the group which received cognitive remediation therapy worked significantly more in terms of hours and weeks. This was the first study to evaluate

the effectiveness of cognitive remediation interventions on work outcomes within inpatients. The study assessed a wide range of cognitive domains in addition to psychiatric symptoms. The researchers provided an adequate amount of intervention via the computer. The results were similar to those found by McGurk and colleagues in 2005 who conducted a similar study with outpatients. However, a limitation of the study was that there was no follow up administered to evaluate the sustainability of these improvements within the targeted cognitive domains and work outcomes.

The above studies which utilised Cogpack computer software demonstrated significant effects in improving cognitive functioning across a wide range of cognitive domains. Four of the five studies consisted of drill and strategic learning methods in comparison to drill and practice strategies (Sartory et al, 2005). The methodology within these studies that used strategic learning methods did not describe these processes in detail. Therefore it is unlikely that replication of these studies could occur without this information. The sessions provided within the various studies will have presented different techniques and strategies based upon the researchers knowledge and expertise. The total time of computer assisted cognitive rehabilitation intervention ranged from 9 hours to 24 hours. Three of the five studies administered CRT in addition to providing employment and demonstrated the effectiveness and transferability of the skills in functional outcomes (Lindenmayer et al, 2008; McGurk et al, 2005; Vaugh et al, 2005). These studies had different methodologies including the software, length of sessions and outcome measures. Methodological issues are perhaps a result of the relatively broad definition attached

to cognitive remediation/ rehabilitation. However the studies demonstrate improvements in cognitive functioning and functional outcomes.

Other forms of computerised cognitive rehabilitation programmes have been used in studies with schizophrenia. Literature review of these various studies using computerised programmes was also performed. The current review will only reflect a summarised version of these studies. From the above literature research 19 studies, including the five studies that have already been discussed, were identified as fulfilling the above criteria (See Appendix 7). The review identified a number of meta-analyses that have occurred within the literature including the use of computerised cognitive rehabilitation methods.

Only one of the studies reported negative results for cognitive rehabilitation interventions (Field et al, 1997). This study used computer techniques to improve one area of cognitive functioning, and focused upon attention. The authors found no significant results attributed to the intervention. It is worth noting that the sample size was small consisting of only 10 participants in the control group and 10 in the treatment group. These small numbers make it difficult to draw firm conclusions due to issues of statistical power that would be required in order to receive a significant result. Parametric statistics were unable to be carried out due to the small sample size of this study and so nonparametric analysis was performed on the data. The researchers also identified that there was a large amount of within-group variability. Therefore the design of this study suggests that these results should be interpreted with caution.

The majority of the studies reviewed used randomised selection to groups and control groups, by which comparisons of the efficacy of the treatment could be made. Comparisons of the various studies were complicated by the different computer interventions used and the variety of neuropsychological assessments of outcome implemented.

Earlier studies within the literature review have focussed on cognitive rehabilitation techniques and their effect on cognitive functioning test results. Cognitive rehabilitation techniques reported improvements in working memory as measured by digits span backwards (Burda et al, 1994; Cassidy et al, 1996; Kurtz et al, 2007) verbal memory (Belluci et al, 2003; Burda et al, 1994; Lindenmayer et al, 2008; Sartory et al, 2005) attention (Belluci et al, 2003; Cassidy et al, 1996; Medalia et al, 1998) processing speed (Sartory et al, 2005) and problem solving (Medalia et al, 2001). One of the studies reported improvements in cognitive measures but did not present pre and post results within the journal article (Bark et al, 2003). The only study that showed improvements in executive functioning was Sartory and colleagues in 2005.

More recent research has investigated the effectiveness of cognitive rehabilitation interventions when administered alongside other treatments, i.e. work therapy upon functional outcomes. These studies were included as they reported pre and post measures of cognitive functioning during the intervention. Eight out of the nineteen studies researched the effectiveness of cognitive remediation therapies alongside work therapy or occupational type intervention. All of these studies reported positive

results. Improvements in working memory, represented by performance on digit span backwards, were reported in four of the studies (Bell et al, 2001; Bell et al, 2003; Fiszdon et al, 2004; Greig et al, 2007). The other studies reported improvements in verbal memory (Wolwer et al, 2005) executive functioning (Bell et al, 2001; Bell et al, 2003; Greig et al, 2007) and attention (Vauth et al, 2005). One of the studies did not provide pre and post measures in the results section of the article but reported significant improvements on neuropsychological tests (Fiszdon et al, 2006). The conclusion reached during this study appears to have been made with little evidence and therefore these results have been interpreted with caution.

Executive functioning improvements were more frequently reported during the studies that used cognitive remediation therapy as an adjunct to vocational training (Bell et al, 2001; Bell et al, 2003; Greig et al, 2007; Vauth et al, 2005). This suggests that interventions such as these are more likely to lead to increased improvements especially functional outcomes and the transferability of the skills. It is interesting to note that Bell and colleagues in three consecutive years experienced significant improvements in executive functioning. The methodology involved during the study appeared to be very comprehensive including cognitive exercises for up to five hours per week, weekly social processing group and feedback (Bell et al, 2001). The package involved within this research makes it difficult to accredit all of the improvements in cognitive functioning to the cognitive computer package and may have been helped by the extra interventions included in the cognitive rehabilitation program.

The studies above using cognitive rehabilitation techniques alongside vocational interventions showed overall improvements in functional outcomes. Many of the studies only reported the positive results found within their study and did not highlight those which were not significant. The results have high variability in the different areas of cognitive functioning that were improved. The comparison of these studies is difficult due to the heterogeneous nature of the methodology in each. (See Appendix 7)

Cognitive rehabilitation interventions have also been investigated in regards to the effect upon measures of symptom severity. The results were rather inconsistent with some demonstrating improvements in symptoms and others reporting no effect. Meta analysis by McGurk and colleagues (2007) found that there is a small effect size for the effect of cognitive rehabilitation interventions on symptom improvements.

Follow up studies of the durability and sustainability of the results found for cognitive remediation therapies were limited to a number of the studies (Bell et al, 2003; Fiszdon et al, 2004; Hogarty et al, 2004; Lindenmayer et al, 2008; Vaugh et al, 2005;). Most of these entailed cognitive rehabilitation plus vocational work therapy studies (Bell et al, 2003; Fiszdon et al, 2004; Lindenmayer et al, 2008; Vaugh et al, 2005). The results from these studies showed promising results for the effect on functional outcomes within vocational areas (Lindenmayer et al, 2008).

The durability and the gains of cognitive rehabilitation programs within these studies focused more frequently upon work outcomes than on cognitive functioning measures. The most consistent durable effect was found on verbal memory (Bell et al, 2004; Fiszdon et al, 2004; Vaugh et al, 2005). Hogarty and colleagues (2004) found a follow up medium effect on combined cognitive measures which were unable to be differentiated in terms of the various cognitive abilities. Research investigating the effectiveness of cognitive rehabilitation interventions has been based on functional outcomes in the longer term. It is reasonable that these studies are now focusing on functional outcomes rather than measuring sustained improved cognitive functioning.

1.9 Studies of Cognitive Rehabilitation/Remediation Therapy Non computer based

Studies which have not utilised computer assisted cognitive rehabilitation interventions have been important in providing supportive evidence for the effectiveness of the treatment. Penades and colleagues (2006) carried out a controlled and randomized study of cognitive remediation therapy for outpatients with chronic schizophrenia. Participants were randomly assigned to either the cognitive remediation therapy or cognitive behavioural therapy groups. Results showed that the cognitive remediation therapy produced an overall improvement in neurocognition. There was a medium to large effect size for verbal memory, nonverbal memory and executive function. Working memory and psychomotor speed showed lower effect sizes, classified by Cohen (1977) as small. Overall there was a medium effect found for the effectiveness of cognitive rehabilitation

interventions. Measures had been taken by the researchers to limit practice effects. A six month follow up of the study showed improvements in social functioning and sustained cognitive improvements demonstrating that this therapy is clinically meaningful (Penades et al, 2006).

A number of meta-analyses have been undertaken within the area of cognitive rehabilitation techniques over the last 10 years. One of the earliest reviews was a Cochrane review conducted in 2000 by Hayes and McGrath to investigate the efficacy of cognitive rehabilitation. Their analysis involved only three studies that met their inclusion criteria. Many of the studies within this area were excluded due to lack of information and methodology issues. They concluded that there was no evidence for or against the use of cognitive rehabilitation for schizophrenia. A favourable effect was found for the intervention on a measure of self esteem, using the Rosenberg Self Esteem questionnaire (Hayes & McGrath, 2000).

A meta-analysis performed by Krabbendam and Aleman in 2003 concluded that cognitive rehabilitation can improve cognitive performance which can be generalised to other tasks that were not practiced within the intervention. Previous meta-analyses performed during the early stages of cognitive remediation have produced inconsistent results or did not produce significant results (Hayes & McGrath, 2000).

A more recent meta-analysis has produced positive findings (McGurk et al, 2007) which may have been influential in recommendations made by the American Psychiatric Association and further interest within this area. The meta-analysis

showed that cognitive remediation therapy produced “robust improvements in cognitive functioning across a variety of program and patient conditions” (McGurk et al, 2007, pp.1798). There was some variability in the amount of cognitive improvements within the studies but an overall medium effect size was found within the meta-analysis. The effect size for visual learning and memory was not significant. Follow up studies also found a medium effect size for the durability of the cognitive improvements especially in the area of verbal learning and memory. They indicated that cognitive rehabilitation techniques produce moderate improvements in cognitive functioning. They also reported that when these interventions are offered alongside other forms of psychiatric rehabilitation they also improve functional outcomes. The results also suggest that “cognitive remediation may also improve the response of some patients to psychiatric rehabilitation” (McGurk et al, 2007, pp.1801).

The chronic nature of schizophrenia and the effect it has upon everyday functioning has been discussed. The low rate of individuals with a diagnosis of schizophrenia in employment highlights this as a major area of difficulty. Few studies have been performed within this area which focused on the effects of cognitive rehabilitation therapy on employment outcomes. Bell and colleagues (2004) carried out a study comparing individuals who had been assigned to work therapy versus cognitive enhancement plus work therapy. Their results showed that those in the latter group were able to work more hours and earned more in a week. A follow-up study showed that those in the cognitive rehabilitation program were able to further increase their working hours whereas, those in the work therapy group reduced their

overall working hours. This provides quite encouraging results for the transferrable benefits of such programs in functional outcome. More recent studies such as that by Lindenmayer and colleagues (2008) have produced similar findings which have provided supportive evidence for the effectiveness of cognitive remediation interventions when offered alongside other forms of rehabilitation and the functional outcomes that can be achieved.

Comparing the various studies within the literature review is a difficult task due to the high variability in methodology. These vast differences in methodology may be explained by the broad definition associated with cognitive rehabilitation/ remediation therapies. The patient population and the tasks undertaken within sessions described in methods could not be replicated using this information. However, the more recent studies and meta-analyses have provided supportive evidence in favour of cognitive rehabilitation interventions which improve cognitive functioning and functional outcomes.

1.10 Current Study

On reviewing the literature of cognitive rehabilitation techniques used within schizophrenia populations it was apparent that none of these interventions had been used with patients involved in forensic services or those who have a history of violence. These individuals may have been used within previous studies but direct reference to this population was not made in the literature. The definition of violence within the current study will use the definition outlined by the HCR-20. This states that “violence is actual, attempted or threatened harm to a person or persons.

Violence is behaviour which obviously is likely to cause harm to another person or persons” (HCR-20 version 2, Webster et al, 1997 pp.24).

As discussed earlier, patients with a diagnosis of schizophrenia who have a history of violence or are involved with forensic services are likely to have more severe cognitive deficits than patients with schizophrenia who are nonviolent. Patients involved in forensic services or who are violent may also have a history of substance misuse and sustained head injuries which may not have been diagnosed. These factors are also likely to lead to poorer cognitive functioning.

Patients in forensic settings usually undergo an intense program of rehabilitation offered by several disciplines including psychiatry, nursing, occupational therapy, physiotherapy, education, psychology, art therapy and many others. Offence focused work is an essential intervention that takes place within inpatient settings. The ability for a patient to process the information within these sessions is an important part of their rehabilitation. Therefore it is likely that any form of cognitive rehabilitation will benefit these individuals who have greater deficits and therefore have a greater need for these interventions. These interventions may have implications on functional outcomes for forensic patients such as recovery and risk of violence.

Cognitive rehabilitation has yet to be performed with this population and therefore the proposed research is a pilot study aiming to initially evaluate the effectiveness of these interventions upon measures of cognitive functioning. The current study will

be similar to that performed by Sartory and colleagues (2005) which used drill and practice computer software aimed at improving cognitive functioning. This treatment will not be given alongside another measure of treatment other than treatment as usual.

1.10.1 Hypotheses

- 1) Cognitive rehabilitation using a computer package will significantly increase patients' performances on measures of cognitive functioning including attention, visual memory, verbal learning and memory, working memory and executive functioning in comparison to a control condition.
- 2) Cognitive rehabilitation using a computer package will significantly improve participants self esteem as measured by the Rosenberg Self Esteem Questionnaire in comparison to a control condition.
- 3) The effects of cognitive rehabilitation will be durable and sustained after a period of three months follow up. Participants' performances will remain significantly higher than the control assessment and have no significant differences to the post intervention assessments.

METHOD

Overview

This study investigated the effectiveness of cognitive rehabilitation with patients who had a diagnosis of schizophrenia in addition to a history of violence or who had been involved with the forensic mental health services.

2.1 Design

The design of the study was a within subject design, repeated measures. Patients were tested before the intervention in addition to having a control assessment which occurred after a waiting period prior to the treatment being commenced. This was to demonstrate that changes were the result of the intervention and not as a result of time. Therefore the participants served as their own controls. Participants also completed a mini assessment after 3 sessions of the intervention and after the intervention had been completed. In addition participants were also assessed after a 3 month follow up period to investigate the durability of the interventions effectiveness.

2.2 Participants

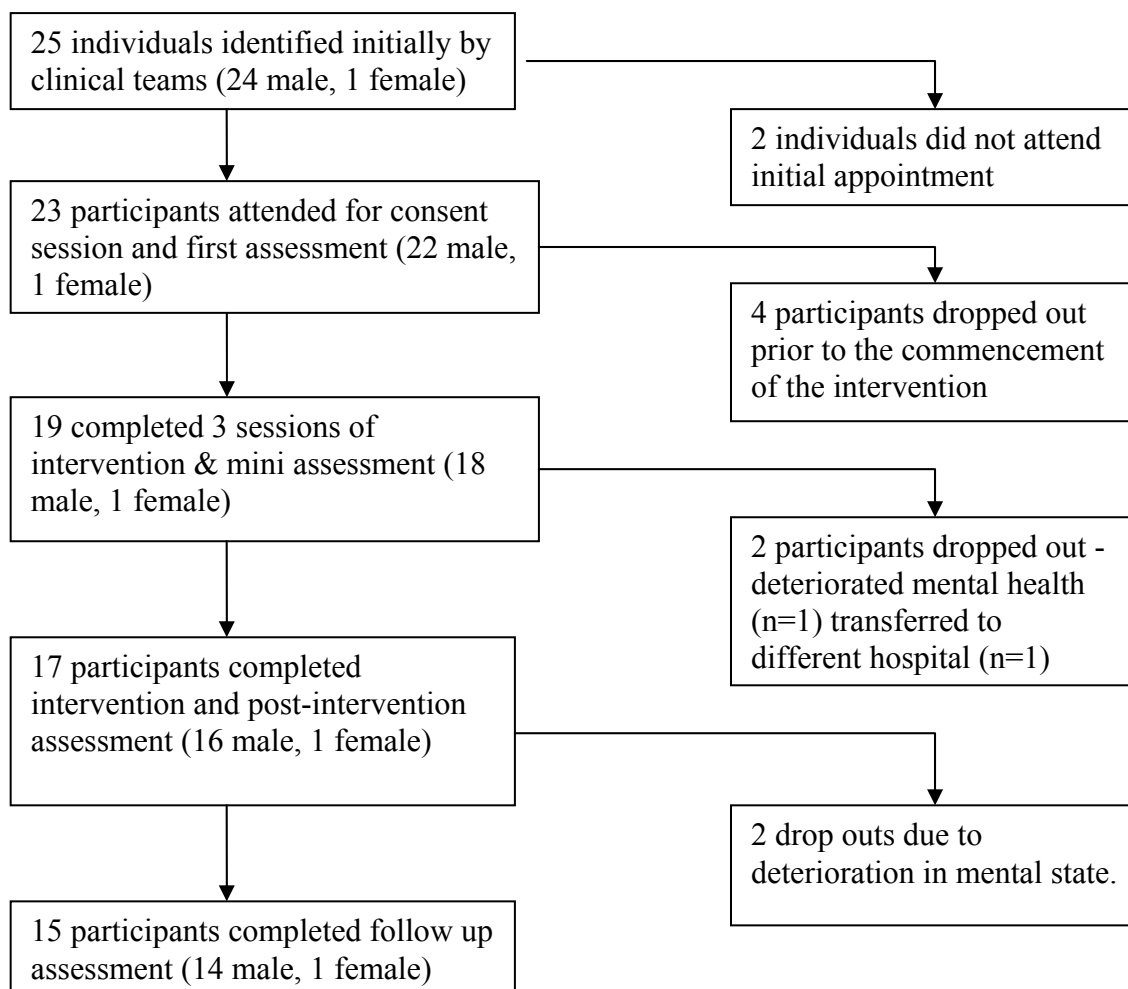
The sample comprised patients who had a forensic history or a history of violence who also had a diagnosis of schizophrenia. Participants included both inpatients and outpatients involved with either the forensic services or adult mental health services.

Participants were aged between 22 and 64 years of age with a mean age of 41.5.

Initially 23 participants were recruited for the intervention. Four of these individuals

completed the initial assessment and did not attend for their second assessment approximately eight weeks later. These drop outs occurred prior to the intervention being administered. At the intervention stage 19 participants completed the two assessment sessions, three sessions of the intervention and a mini assessment.

Figure 2.1 – Figure showing recruitment and drop out rates



Further dropouts included one participant who was transferred from hospital, making access difficult in relation to delivering the intervention. Another participant had to be withdrawn from the study due to a deterioration in his mental state. A total of 17

participants completed the intervention and the post assessment. In summary data was obtained from 19 participants, 18 males and 1 female. At the 3 month follow up 15 participants were assessed as 2 of the original 17 that completed the intervention were unable to be assessed due to a deterioration in their mental state.

2.3 Inclusion and Exclusion criteria

2.3.1 Inclusion Criteria

All participants were required to:

- ❖ Have a diagnosis of schizophrenia or schizoaffective disorder
- ❖ Be either inpatients or outpatients
- ❖ Have a history of violent behaviour
- ❖ Have had contact with forensic services or adult services

2.3.2 Exclusion Criteria

Those individuals who were acutely unwell or were not cognitively able to complete the cognitive rehabilitation program due to their illness or cognitive ability were not included within the present study. Individuals with an IQ less than 70 were not included in the study. The program required participants to be able to read the commands of the various tasks administered on the computer, therefore illiterate individuals were excluded from the study.

The forensic service is predominately for male patients but there was the opportunity to provide the intervention to a female forensic patient and she was included in the study as she met all of the other inclusion criteria.

2.4 Procedure

2.4.1 Recruitment

Recruitment of patients for this study was envisaged to be a difficult process.

Information was provided to the Consultant Psychiatrists who were involved with this population to explain the intervention so that the potential participants could be identified. The researcher organised presentations about cognitive rehabilitation interventions. Within these sessions the audience were informed about the high rates of cognitive difficulties experienced by patients with schizophrenia and to emphasise the need for treatments within this area. These presentations were offered to teams which had patients who met the inclusion criteria. The audience comprised of consultants psychiatrists as well as nurses, occupational therapists, psychologists and ward managers. This provided opportunities for team members to discuss and ask the researcher questions about the study and to provide further information. Participant information sheets and letters were then given to the teams to give to those patients who were suitable for the study (Appendix 3).

The Consultant Psychiatrists provided the information sheets to their patients during their appointments. The Consultant Psychiatrists then discussed with the patients if they wanted to participate in the research. Those individuals who were agreeable to the idea of participating and wanted more information were made known to the researcher. The researcher arranged an appointment with the patients and they had the opportunity to discuss the research and decide if they wanted to participate. The researcher and the participants went through the information sheet together to ensure that they were aware of the requirements imposed by the study. Patients were told

that they would have a number of assessments carried out over an extended period of time to review their progress and measure any changes in their performance after they had received the intervention. They were informed about the amount of time that the research would incur and the need to attend weekly sessions during the intervention phase. Patients were told that the intervention would be undertaken using a computer. A number of the participants had some anxieties about using computers as they had no prior experience but were reassured by the fact that the sessions were on a one to one basis and that the researcher would be present in the room at all times.

Twenty five patients were agreeable to the study and they were given another appointment a week later to obtain informed consent and begin the first cognitive assessment. Informed consent was discussed with the patient and they were reassured that their participation in the study did not affect their treatment in any way. They were also informed that their participation was voluntary and that they could withdraw from the study at any time.

2.4.2 Assessment

At the assessment session informed consent was again discussed with the patient and all those who were willing to participate signed the consent form. (See appendix 4) Two individuals dropped out at this stage and did not complete the initial assessment or consent forms. The patients undertook a battery of cognitive assessments which lasted up to 60 minutes. An additional assessment was administered at this stage which was the Wechsler Test of Adult Reading (WTAR). This assessment was

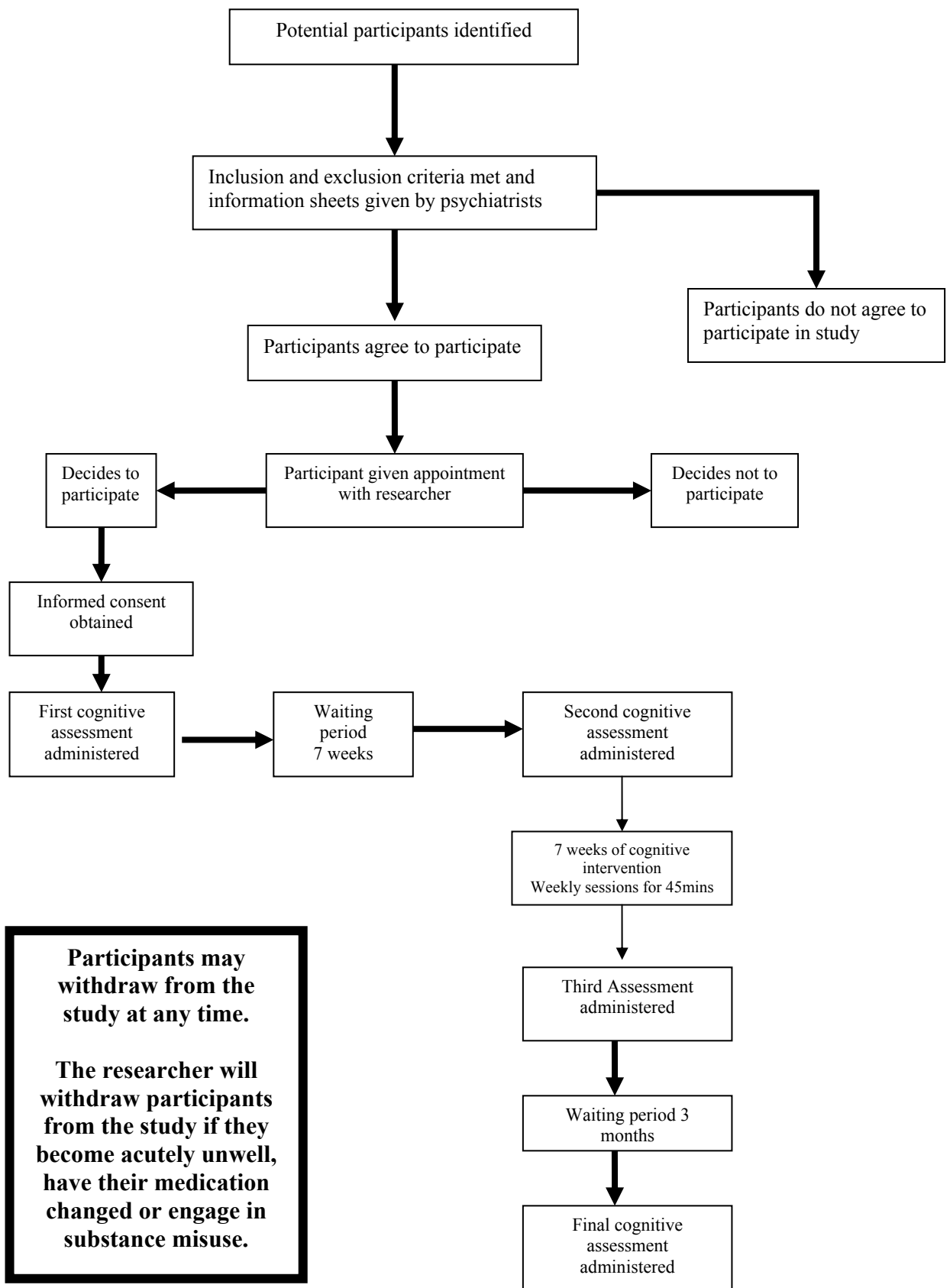
included as a measure of premorbid intelligence of the participants. (Assessments will be discussed later in the method section). Participants were informed that their next appointment would be in approximately seven weeks time and reminded about the reasons why this needed to occur, which had already been discussed during the initial appointment.

A waiting period of seven weeks elapsed before participants were given an appointment for their second assessment. The second assessment session involved repeating cognitive assessments that had been administered during the first assessment stage. Alternative versions of the assessments were used, where possible, to reduce the presence of practice effects within the current study and will be discussed later in this section.

At this stage four participants failed to attend their second appointments. Another appointment was sent and it was decided that if they failed to attend again that they no longer wanted to participate in the research and they would be withdrawn. The information that had been obtained at this stage was not considered useful as no comparisons could be made and therefore was not included in the analyses.

Once participants had been assessed for a second time they were able to have the intervention administered. Participants were given another appointment for the following week to commence the intervention. They were informed that the session would last up to 45 minutes and would require them to use a computer.

Figure 2.2 - PROCEDURE OF RECRUITMENT AND ASSESSMENT OF PARTICIPANTS



The intervention sessions lasted approximately 45 minutes each for 7 weeks.

Therefore each participant received over five hours of the intervention. Each session comprised various tasks on the Cogpack computer software. The Cogpack program provided testing and training on areas of visuomotor, comprehension, reaction, vigilance, memory, language, intellectual and professional skills. Each section had various tasks in each of these areas. The tasks that were completed by each of the participants have been documented in appendix 6. The software altered in its level of difficulty based on the participants' performance. Therefore the patients did not obtain a sense of failure as the program adjusted according to the level of the individual. The program also provides feedback to the participants about their performance on each of the tasks completed. All participants completed the same tasks.

Participants carried out the various tasks and were provided with instructions and feedback by the computer. The researcher had minimal contact with the participant during the intervention sessions and was present to ensure that there were no problems encountered with either the software or the computer. At the end of session three a mini cognitive assessment was administered. This was to ensure that data was not lost due to participant dropout rates. The mini assessment consisted of the Rosenberg self esteem questionnaire, the Trails A and B, Digit span and the Wisconsin card sorting test.

At the end of the seven sessions of the cognitive rehabilitation intervention a final cognitive assessment was administered during a separate session. The assessment

administered comprised the same test battery as administered at the pre intervention and control assessment stages, using alternative versions were possible. Participants were given the opportunity to be provided with feedback about their performance over the course of the intervention. They were also reminded that the researcher would send out an appointment in three months time to evaluate the durability of the intervention over time.

At the three month follow up stage participants were sent out an appointment with the researcher to administer the final cognitive assessment. Participants attended the session which lasted approximately 50 to 60 minutes.

2.5 Measures

2.5.1 Demographic Measures

Demographic measures were obtained from participants psychiatric notes.

Permission from participants to access their psychiatric notes was sought during the initial assessment session when informed consent was obtained. One of the items in the informed consent document required patients to initial in regards to access to medical and psychiatric notes.

Demographic information included was:

- ❖ Gender
- ❖ Age
- ❖ Date of birth
- ❖ Psychiatric diagnosis including age of onset and chronicity of problems

- ❖ Forensic history – type of offence and/or history of violence
- ❖ History of substance misuse – i.e. alcohol or illicit substances
- ❖ Current medication and duration on current dose
- ❖ History of traumatic brain injury
- ❖ Inpatient or outpatient status

2.6 Cognitive Assessments

2.6.1. Wechsler Test of Adult Reading (WTAR)

The WTAR was administered to obtain participants estimated premorbid level of intelligence. This assessment was administered only during the initial cognitive assessment session. The WTAR is an estimate of an individual's premorbid level of intellectual functioning prior to the onset of injury or illness (Psychological Corporation, 2001). In this case it measures individuals premorbid cognitive functioning prior to their psychotic illness. This assessment can be used on adults aged 16 to 89 years of age. The WTAR was developed and co-normed with the WAIS assessments both in America and in the UK.

The WTAR is based upon a “reading-recognition paradigm” which requires participants to pronounce words that have an ‘irregular grapheme to phoneme translation’ (Psychological Corporation, 2001). The WTAR was standardised in the UK with 331 participants both male and female of various ages and years of education.

Psychometric Properties

The WTAR has displayed excellent internal consistency with coefficients from 0.87 to 0.95 for the UK sample, which indicates that the measurement error is relatively small (Psychological Corporation, 2001).

Standardisation of the WTAR in the UK sample showed that education level was a significant factor related to WTAR performance and intellectual functioning. The WTAR has been designed to enable measurement of premorbid ability. The WTAR is not resistant to the effects of psychiatric disorders or normal aging but is more stable than other measures of intelligence and memory. The validity of the WTAR in respect to psychiatric disorders shows that within a group of individuals with schizophrenia their performance was consistent with a control group (Psychological Corporation, 2001).

Administration

The WTAR is administered to participants using the WTAR word card. Examinees are asked to pronounce all of the words in turn and correct responses are awarded one point. The examiner sums up the points to obtain a raw score which is converted to a standard score relative to the participant's age.

2.6.2. Block Design Subtest of Wechsler Abbreviated Scale of Intelligence (WASI/WAIS-III)

The Block Design is a construction test which is seen as the best measure of visuospatial organisation within the Wechsler Intelligence scales. Participants with

any kind of brain injury tend to have lower scores on this test in comparison to matched controls (Lezak, 1995). Within the current study participants were presented with different versions of the block design used across the various Wechsler assessments to reduce practice effects.

The Block Design test has been suggested to measure general ability to a moderate extent. It enables those who have limited education attainment to obtain a high score on this test (Lezak et al, 2004). Performance on this test tends to be lower if the individual has sustained any brain injury (Lezak et al, 2004).

Administration and Scoring

Participants are presented with white and red blocks. Each block has two white and two red sides and two half red half white sides. The participant must use the blocks to construct the design presented by the examiner. Each design increases in difficulty and the participant is timed during his performance. Initially the participants are given four block designs which they have one minute to complete correctly. After completing these trials the examinees are given nine block designs, which have a time limit of two minutes. Participants can also obtain bonus points if they complete the design quickly (Lezak et al, 2004).

Psychometric Properties

Reliability coefficients for the block design are 0.90 to 0.94 (Psychological Corporation, 1999). Correlation of WASI and WAIS-III block design subtest is 0.74 (Strauss et al, 2006). These correlations will be taken into consideration within the

current study when analysing participants' performances on these tests. Reliability coefficients of the WAIS-III block design for clinical samples are between 0.88 to 0.90 (Zhu et al, 2001). Test retest reliabilities of the WAIS-III block design when retested over intervals of two to twelve weeks ranged from 0.80 to 0.88 (Zhu et al, 2001).

The design of the WASI should help to reduce practice effects when it is used alongside the WAIS-III. There are some concerns regarding procedural learning effects which were found to reveal minimal but significant discrepancies, approximately one point difference among sample populations (Zhu et al, 1999). Normative data on the WAIS showed that practice effects can occur following short retest periods. The data showed that adults obtained scores between 0.6 to 2.8 points higher following retest of the same version of the Block design. These were based on retest intervals ranging from 2 to 12 weeks (Strauss et al, 2006). The adults used within this sample were deemed as normal without any psychiatric diagnosis or traumatic brain injury (Strauss et al, 2006). Axelrod (2002) gave both the WAIS-III and the WASI block design test to a mixed clinical sample of 72 participants. He found that there was no evidence of practice effects even though the two tests were administered on the same day.

2.6.3. Modified Wisconsin Card Sorting Test (WCST) – Measure of executive functioning

The WCST was developed to measure 'abstract behaviour' and 'shift of set' (Lezak, 1995). Participants are presented with a pack of cards on which there are between

one and four symbols namely a triangle, star, cross or circle which are in red, green yellow or blue. No two cards are identical. The participant is asked to sort the cards under the four stimulus cards – one red triangle, two green stars, three yellow crosses and four blue circles. The participant must decide upon a rule on which to sort the cards from the pack under the stimulus cards. The examinee begins by placing cards and the examiner states whether each placement is correct. After the participant has correctly placed the required number of cards in a row the examiner will state that the rule has changed.

A modified version of the WCST was developed by Nelson in 1976 (Lezak et al, 2004). The modified version of the WCST “eliminates all cards from the pack that share more than one attribute with a stimulus card” (Lezak et al, 2004, pp.591). “Only 24 of the original 64 card deck satisfy the requirement of being correct for only one attribute at a time. The modified version removes ambiguity in the examiners responses thereby simplifying the task for the patient and clarifying the nature of errors for the examiner” (Lezak et al, 2004, pp.591). The modified WCST was considered to be a better assessment to be administered within the current study. This version has advantages over the original WCST in that it reduces fatigue due to its shorter administration time, therefore measurement of patients’ attention during the task may be improved as the change occurs after 6 responses and not 10 (Lezak et al, 2004). It has also been indicated to reduce patient distress which can occur when the categories shift without warning (Lezak et al, 2004).

The WCST helps to measure perseveration tendencies (Pendleton & Heaten, 1982). The test performances can be scored in a number of ways. Categories achieved and perseverative errors. The number of categories achieved refers to the number of correct sets of six achieved which ranges from zero to six. Perseverative errors relates to when the examinee continues to sort the cards according to his last response to a previous successful principle. These errors are important as they indicate participants' difficulties in forming concepts, 'conceptual flexibility' and benefiting from correction by the examiner (Lezak, 1995).

The test earned a reputation as a measure of frontal dysfunction by Milner (1963). He documented defective performances on the test by patients who had frontal damage. Patients with frontal damage have been found to perform more perseverative errors when compared with controls (Grafman et al, 1990; Janowsky et al 1989). Further evidence supporting the use of the WCST in testing executive functioning has been through neuroimaging studies which have indicated the role of the frontal lobes during this test (Berman et al, 1995; Esposito et al, 1999). A meta-analysis conducted by Alvarez and Emory in 2006 indicated that the WCST had the "strongest and most consistent relationship to the frontal lobes" (pp.31) in comparison to other tests of executive functioning.

Psychometric Properties

Lineweaver (1999) reported modest test-retest correlation coefficients after 1 year for Nelsons version of the Modified version of WCST (48 cards). They reported coefficients of 0.46 for nonperseverative errors, 0.56 for categories completed and

0.64 perseverative errors. There was also no practice effects observed. Scoring of the WCST has shown high inter-rater reliability (Axelrod et al 1992). Scoring reliability for perseverative responses was 0.93, 0.92 for perseverative errors and 0.88 for nonperseverative errors.

Rossi et al (2000) found that using the WCST approximately 60% of clinical populations, schizophrenia, bipolar and controls were discriminated overall. Recent investigations into the ecological validity of the WCST have demonstrated that it can predict the ability to carry out activities of daily living and the type of occupational position one is likely to hold (Kibby et al, 1998; Little et al, 1996). Furthermore, accuracy on a shopping task (Rempfer et al, 2003) can be predicted from the number of perseverative responses. Trials to First Category and total correct responses can predict task orientation at a vocational work placement in a sample of schizophrenics (Lysaker et al, 1995).

2.6.4. Trail Making Test Part A and B – Measure of Psychomotor Speed

The trail making test was originally part of the Army Individual Test Battery (1944) (Lezak et al, 2004). The TMT has been considered to be a test of complex visual scanning alongside having a motor component (Shum et al, 1990). The TMT has been shown to be susceptible to the effects of brain injury due to the tests requirements of attention and motor speed (Armitage, 1946; Reitan, 1958). The TMT is within the public domain and can be reproduced without permission.

Administration and scoring

Administration of the TMT is given in two parts, Part A and Part B. Part A requires participants to connect up the numbered circles in numerical order starting from one until all the numbers have been connected. Part B is the more complex of the tasks. Part B requires participants to connect the circled numbers and letters in order of numerical and alphabetical sequence starting with 1 – A and so on. Therefore they must alternate between the two. Participants are urged to complete both of the tasks as fast as they can without lifting the pencil from the page (Lezak et al, 2004).

The tasks require the examiner to point out any errors which the participant has made so that the task can be completed without any errors and that scoring is based on time alone (Lezak et al, 2004). This method of scoring was designed by Reitan and is the most common measure of scoring used today. Opposition to this method of scoring has been voiced due to the issue of reliability as the examiners reaction time and method of pointing out the errors to the individuals is an important factor to consider when recording the final speed measured for the individual (Lezak, 1995).

Limitations of the TMT - Practice effects

Lezak (1982) examined the practice effects on the TMT. She found that a cumulative practice effect of 5.63 seconds on part A was significant after the third administration of the task. The average time on the TMT-part B was not found to reduce significantly. Further research showed that successive administration of Part B over a three month period showed significant practice effects over four successive trials (Lezak, 1995).

There have been alternative forms of the TMT which have been able to discriminate organicity in groups of brain damaged and normal control participants (Hoffman, 1997). However these alternative forms have not been validated and therefore the original Trails A and B was used throughout the study. Therefore the results obtained within the current study need to take into consideration the effect of practice over the repeated administration of the tasks.

Another consideration of using the TMT is the low reliability coefficient in relation to the performance of patients with schizophrenia on Part A of the task ($R=.36$) (Lezak, 1995). Therefore participants' performance may vary over the numerous trials. This will be taken into consideration when analysing the results from the current study.

2.6.5. Digit Span – Measure of Working Memory

The digit span is a subtest from the Wechsler Adult Intelligence Scale. It is commonly used for measuring individuals' span of immediate verbal recall. The Digit Span test is comprised of two different tests, Digits Forward and Digits Backward.

During these tests participants are presented with seven pairs of random number sequences increasing in length from two digits to nine digits. The tasks require auditory attention in addition to short-term retention capacity (Shum et al, 1990). However the two versions of the digit span measure two different abilities.

Psychometric Properties

Test-retest validity of the digit span ranges from 0.66 to 0.89, which is dependent on the participants age and interval length (Lezak et al, 2004). The digits backward task appears to be more sensitive to any brain injury than the digits forward test. The correlation between digits forward and backwards is also low at approximately 0.6 (Lezak et al, 2004).

Digit span forwards test has been proposed to measure the 'efficiency of attention' (Lezak et al, 2004). Others have referred to it as the "passive span of apprehension" (Hayslip & Kennelly, 1980). The participants are asked to recall the sequence of numbers that are read aloud by the examiner in the same order given.

The digit span backwards has been identified as a measure of working memory (Lezak et al, 2004). "It tests how many bits of information a person can attend to at once and repeat in reverse order" (Lezak et al, 2004 pp.358). This task involves mental double-tracking as both memory and reversing operations must occur simultaneously. During the administration of digits backward, the examinee is given a sequence of numbers in increasing digits and asked to recall them in the reverse order. Digit span backwards is sensitive to the effects of brain damage. Factor analysis of individuals' performances on digits backward tasks has indicated the involvement of visual and verbal processes (Larrabee & Kane, 1986).

2.6.6 Rey Complex Figure Test (CFT)

The complex figure was developed by A. Rey (1941) who aimed to examine visual memory and perceptual organisation amongst brain injured individuals (Lezak et al, 2004). In 1944 the figure was standardised by Osterrieth who produced norms after a study involving almost 300 participants including both adults and children (Lezak et al, 2004).

The test was further developed by L.B Taylor in 1979 who produced an alternative complex figure for use in retesting (Lezak et al, 2004). Further alternative figures have been introduced including the Medical College of Georgia (MCG) which provides four additional figures when retesting is required. Comparability of the various figures has found that participants rarely show more than a one or two point difference in immediate and delayed recall trials across the various tests (Berry et al, 1991). The test retest reliability using alternative forms was in the 0.6 to 0.76 range (Berry et al 1991). Investigators have suggested that the Rey figure is a little more difficult to remember than the Taylor figure (Casey et al 1991) or the MCG figures (Lee et al 1989).

All of the figures use the 36 point scoring system so that comparison of individuals' performance over time can be made. The scoring system refers to the different areas and details of the figure. Each element of the figure can be given up to a score of two based on correct reproduction of that part (Lezak et al, 2004).

Participants are first asked to copy the image that they are presented with.

Administration of the test can include an immediate recall of the image after the copy trial. After a delay of 30-45 minutes they are asked to recall and draw as much of the image as possible. Individuals are not forewarned that they will be asked to recall the image during the copy administration trial of this task. Research has shown that higher scores occur during the delayed recall if the short term recall task is given earlier in comparison to if only the delayed trial is given (Loring et al, 1990). During the current study participants were only asked to recall the figure after a long delay and were not administered the immediate recall trial.

The current study used alternative versions of the Rey to reduce the effect of practice effects. Therefore four different versions of the Rey CFT were used (Original Rey CFT, Modified Taylor CFT, two figures of Medical College of Georgia (MCG figures) (Pierson et al, 1997). Based on the literature on the Rey, there is an expectation that participants' performance on the original Rey figure will be lower than the alternative versions (Hamby et al, 1993; Tombaugh & Hubley, 1991). Taking this into consideration participants are therefore expected to have approximately a two point difference during the administration of the tests (Hubley et al, 2002). However, the use of an alternative during the control assessments will be able to identify if this has occurred. There were no significant differences in test scores between the Taylor and the MCG figures (Meador et al, 1993).

The Rey copy trial of the assessment is a measure of visual spatial constructional ability whereas the latter trial is a test of visual memory i.e. the delayed recall. The

copy element enables the examiner to identify if the participant approached the task in a 'conceptual, fragmented or confused manner' (Lezak et al, 2004). Positive correlations have been found between the Rey CFT and the Block design $r= 0.628$ (Wood et al, 1982).

2.6.7 Rey Auditory Verbal Learning Test (AVLT) – Measure of verbal memory

The Rey Auditory Verbal Learning Test (AVLT) measures immediate memory span, learning curves and the techniques that individuals may use or not utilise when having this test administered. The test is also sensitive to measuring participants' tendencies to confabulate and their vulnerability to interference. The AVLT assess both short and long memory retention (Lezak, 2004).

Administration

The test consists of presenting a list of 15 words orally to the individual and asking them to recall as many words as possible. Participants' responses are recorded in the order that they are given including any errors. The same list (List A) is presented five times. Then a different list (List B) is given to the individual, known as the interference list and again the participant is asked to recall as many of the items as possible. After this trial the examinee is asked to recall as many words from the first list (List A) as they are able. After a period of 25-35 minutes the participant is asked to recall as many words from the first list (List A) as they can. If the participant recalls less than 13 words they are presented with a number of words either verbally or visually and asked to identify the words that were within the first list that was read out five times (Lezak et al, 2004).

The score for each trial is the number of words that has been correctly recalled. Words that the participants have stated that were not on the list are marked as errors. These errors can be categorised as either being confabulations or as phonemic or semantic associations derived from the original words. Participants can also make intrusion errors. Intrusion errors are made when individuals state items from list A when asked to recall List B, or when items from list B are recalled as being items from List A. “Patients who make these kinds of errors tend to have difficulty in maintaining the distinction between information coming from the outside and their own associations or in distinguishing between data obtained at different times.” (Lezak, 1995, pp.440) If the individuals are unable to make either of these distinctions they will have great difficulty in self monitoring functions.

Practice effects

Practice effects on the AVLT have been investigated. Lezak (1982) reported a significant although small practice effect on retesting of group of normal subjects at 6 and 12 month retest. Test retest performance was also investigated by Crawford and colleagues (1989) when participants were presented with the same list versus those presented with an alternative list. They found that practice effects were only found amongst those individuals who were given the same list. Practice effects on this test are largely due to the retention of the test information and this can be overcome by using alternative forms (Lezak et al, 2004)

Ryan and Geisser (1986) found that the alternative form (Form C) developed by Lezak showed high comparability with the original list (Form A). Jones-Gottman et

al (1993) developed further alternative forms which have been considered to be comparable to the original form A (Lezak, 1995). Due to the high rate of practice effects found during repeated assessments of the same list the current study administered alternative forms of the Rey AVLT to limit such effects.

2.7 Self rated Questionnaire

2.7.1 Rosenberg Self Esteem Questionnaire (Rosenberg, 1965)

The Rosenberg Self-Esteem Scale is a self-report measure of global self-esteem (Appendix 5). The questionnaire is made up of 10 statements related to overall feelings of self-worth or self-acceptance. Individuals are asked to rate each of the statements using a four-point scale, ranging from strongly agree to strongly disagree. The scale is commonly used as it is short and quick to administer. The SES can also be administered as an interview (Rosenberg, 1965).

The scale was originally developed to assess self-esteem among adolescents based on their global feelings of self-worth or self-acceptance. These factors have been indicated as being the standard against which other measures of self-esteem are compared. The Rosenberg Self-Esteem Scale has demonstrated good reliability and validity across a large number of different sample groups i.e. male and female adolescents, adults and elderly populations. The SES has been validated for use with substance abusers and other clinical groups, and is regularly used in treatment outcome studies. Scores range from 10 to 40, with higher scores indicating higher self-esteem. The RSE is within the public domain and use of the questionnaire does not require consent from the author (Rosenberg, 1965). The Rosenberg Self Esteem

questionnaire was chosen for the current study due to its quick and easy administration.

2.8 Intervention

2.8.1 Cogpack Professional Software

Cogpack is a computer software programme that has been developed by a German company for rehabilitation within clinical populations. The software has been used since 1986 in neurological, psychiatric and rehabilitation centres around Austria, Switzerland and Germany. Reports confirm high acceptability, improved skills, and the development of realistic self-assessment. The programme delivers various tasks and games that are aimed at improving areas of cognitive functioning. This software has been clinically tested with individuals who have a diagnosis of schizophrenia.

Cogpack has included aspects of learning theory and motivation when developing the tasks and components of the program. The choice of material was based on the concepts reported by Weinert in 1974. This has shown that material related to everyday life and work is the most stabilising, communicable and motivating for many patients and for many problems. The software has been developed and utilised within psychiatric populations. The computer software appear to offer a more appealing way of performing cognitive enhancing techniques that previously have been based on paper and pencil tasks.

Computer software programmes have increasingly been utilised to present various interventions. Cogpack computer software was selected as the intervention within

the current study based on its validity with the proposed population of the current study i.e. clinical population with a diagnosis of schizophrenia, and also due to cost measures.

Each participant was given an individual ID code to ensure that information remains confidential and results for each participant were stored in a locked filing cabinet. The length and number of sessions were decided upon based on literature review of previous studies that have been undertaken using computer based cognitive rehabilitation interventions with patients with schizophrenia. A meta-analysis by McGurk et al (2007) showed that the number of hours of cognitive remediation treatment patients received did not relate to the amount of improvement in overall cognitive functioning. However, improvements in verbal learning and memory were affected by the amount of sessions of cognitive remediation. The authors suggested that between 5 to 15 hours of cognitive remediation therapy is sufficient to improve cognitive functioning. Therefore the amount of intervention was just over five hours. This figure was decided upon due to time constraints and the length of time needed to administer the intervention to all of the participants. The length of session was chosen to suit the clinical population within the current study. These individuals were likely to have difficulty concentrating over an extended session due to their cognitive abilities, diagnosis and effects of medication.

2.9 Ethical Issues

2.9.1 Effect on participants

The likelihood of patients becoming distressed during the intervention was limited. Patients whose mental state was considered to have deteriorated were withdrawn from the study. If patients were deemed acutely unwell or did not want to continue they were automatically withdrawn from the study. If patients appeared anxious regarding the content of the study these issues were discussed with them and the participant was able to decide if they wanted to continue with the study.

2.9.2 Informed Consent

Participants for the current study were recruited by the consultant psychiatrists within the relevant departments. These professionals would have determined potential participants' ability to provide consent prior to referring them to the researcher. Only those individuals who were able to provide informed consent were included within the research. Informed consent was obtained from all participants prior to the commencement of the study. During the initial appointment potential participants were given information regarding the requirements of the study and what was entailed. Patients were asked to sign a consent form to show that they understood the nature of the study. Participants were informed that they could withdraw from the study at any time without prejudice and that the researcher required access to their psychiatric files to obtain additional information. Participants had the opportunity to ask the researcher questions and to clarify any concerns they had about the research. A copy of the informed consent form has been attached (appendix 4)

2.9.3 Confidentiality

When participants completed the informed consent session they were assigned a number that would be used for all of their information. All information pertaining to participants was kept in a locked filing cabinet within NHS premises. The computer programme contained no identifiable information on participants with the exception of their ID number, known only to the researcher. The computer was also kept in a locked filing cabinet when it was not being used to present the intervention.

2.9.4 Ethical Approval

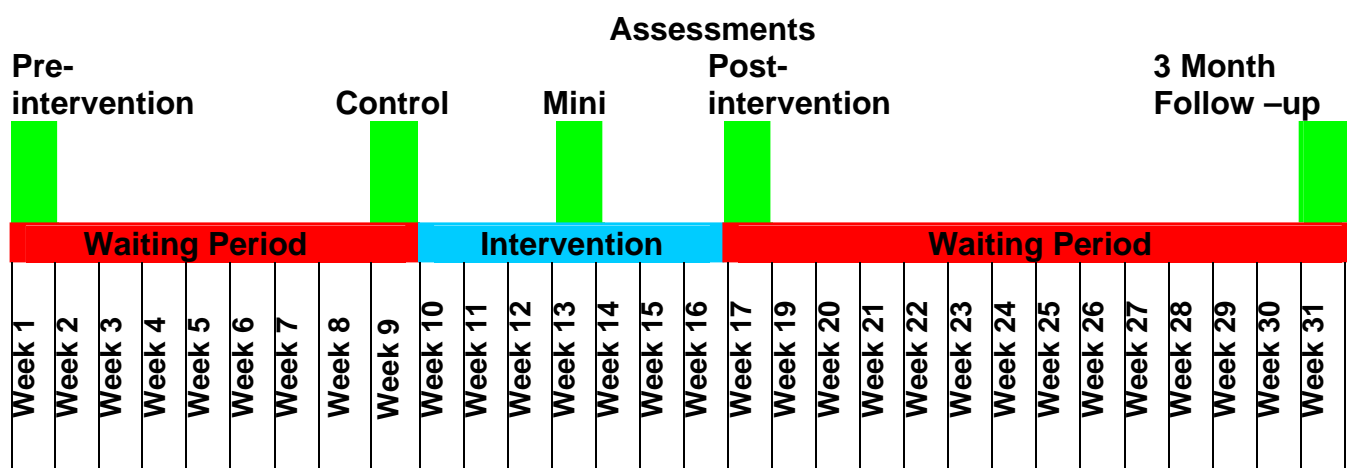
Ethical approval for the current study was sought through the North of Scotland Ethics Committee. Ethical approval was granted by the committee in August 2008 (See Appendix 1). A copy of the approval was sent to NHS Grampian Research and Development Department and approval from R& D was granted in September 2008 (See Appendix 2). The study was commenced following all necessary approvals and recruitment of participants begun.

2.10 Analysis

The results have been analysed using Statistical Package for Social Sciences (SPSS) version 14 software using raw scores of participants' performance on the various neuropsychological assessments. Exploratory analysis of the data was performed to assess the distribution of the data regarding normal distribution. These analyses indicated that the data did not appear to meet the assumptions required for parametric statistics to be used. Therefore nonparametric analyses were conducted using Friedman's ANOVA to assess for significant changes across the various assessment

stages. Further analyses using Wilcoxon signed rank tests to investigate the significance between each assessment phase relative to one another. Figure 2.3 shows a timeline of the administration intervals of the control condition and the intervention in addition to the administration of each of the assessment stages.

Figure 2.3 – Diagram showing a timeline of the Cognitive Rehabilitation Study



Results have been analyzed for significant effects in relation to the hypotheses:

1. Cognitive rehabilitation using a computer package will significantly increase patients' performances on measures of cognitive functioning including attention, visual memory, working memory verbal learning and memory and executive functioning in comparison to a control condition. Comparisons have been made between participants' performances on the pre assessment, the control assessment the mini assessment and the post intervention assessment. The effect of time will be assessed by analysing differences in participants' scores between the pre-intervention assessment and the control assessment.
2. Cognitive rehabilitation using a computer package will significantly improve participants self esteem as measured by the Rosenberg Self Esteem

Questionnaire. The results will be analysed relative to the various assessment stages including a control condition.

3. The effects of cognitive rehabilitation will be durable and sustained after a period of three months follow up. Participants' performances on cognitive assessments will remain significantly higher than the control assessments and have no significant differences to post intervention assessments.

Participants were given the opportunity to be informed regarding the results of the research and provided with feedback regarding their individual performance. Many of the participants were keen to find out their own individual performance and separate appointments were arranged to provide this feedback.

A follow-up cognitive assessment was administered three months after the intervention to evaluate the sustainability of the cognitive rehabilitation treatment. Therefore the researcher was assessing whether any improvements in cognitive abilities were present after three months of the intervention. Analysis of the sustainability of the intervention post three months was explored using nonparametric statistic Wilcoxon Signed ranks test. This indicated significant results between the control and the follow-up assessments in addition to comparisons made between the post-intervention and follow-up assessments.

RESULTS

3.1 Variables

The current research investigated the effectiveness of a cognitive remediation intervention on improving participants' performance on cognitive assessments. These assessments measured cognitive abilities including, attention, verbal learning and memory, executive functioning, visuo-spatial perception and visual memory. Each participant was assessed at different time intervals prior, during, post intervention and at a three month follow-up. A control assessment was undertaken to rule out effects related to improvements in time. The raw score values of the assessments were used to make comparisons to identify participants' improvements in performance.

3.2 Demographic Information

3.2.1 Population

The clinical population within the current study was not a clear sample and included individuals who had a diagnosis of schizophrenia (89.5 per cent) and schizoaffective disorder (10.5 per cent). In addition to this many of the individuals had co-morbid diagnoses, 31.6 per cent of participants. These co-morbid disorders included OCD, anxiety disorder, depressive disorder, bipolar disorder and alcohol dependence. Therefore the sample population, although not a clear sample, may be representative of the complex patients that are seen within forensic settings. Demographic information and the characteristics of the population have been displayed in Table 3.1.

Table 3.1 – Table showing characteristics of participants

Demographic and characteristics of patients		Number of participants	Percentage of Participants
Diagnosis of Schizophrenia		17	89.5%
Diagnosis of Schizoaffective Disorder		2	10.5%
Co morbid Diagnosis		6	31.6%
Inpatient Status		8	42%
Outpatient Status		11	58%
History of violence		19	100%
History of Substance Misuse	Drugs only	2	10.5%
	Alcohol only	7	36.8%
	Drugs & Alcohol	9	47.4%
	None	1	5.3%
History of Head Injury		2	10.5%

Participants were aged between 22 and 64 years of age with a mean age of 41.5.

The study included both inpatients and outpatients, 58 per cent of participants were outpatients and 42 per cent inpatients. The inpatients that were included in the study had been mentally stable and maintained on medication for several months.

All of the participants (100 per cent) had a forensic history or history of violence in which the majority were related to some form of assault upon another individual.

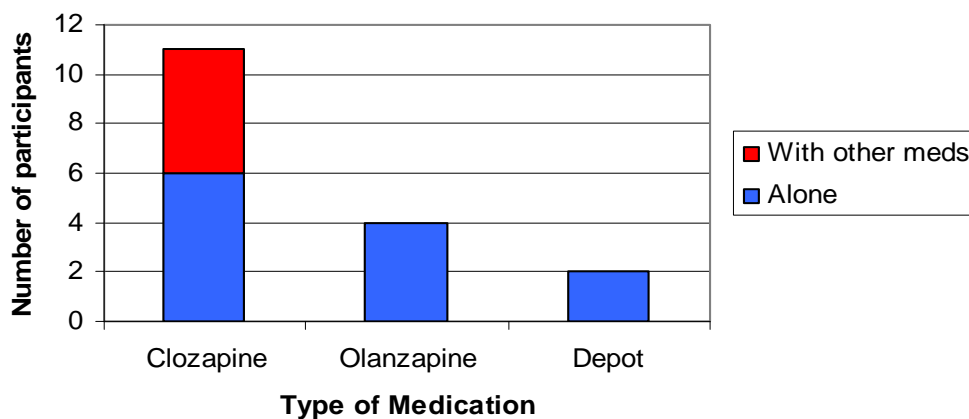
These ranged from severe assaults to minor assaults.

The incidence of substance misuse among the current population was 94.7 per cent. Many individuals substance misuse was based on alcohol abuse alone, drug misuse alone or both alcohol and drug misuse. A number of individuals had a history of brain injury documented within their psychiatric notes (10.5 per cent).

3.2.2 Medication

Pharmacology treatments of participants' were obtained from their psychiatric records for which consent was obtained from each of the individuals at the beginning of the study. The treatments have been displayed in Figure 3.1. All participants (100 per cent) received antipsychotic medication, which was administered either orally or intravenously. The majority of participants were treated with clozapine medication (64.7 per cent). Almost half (54.5 per cent) of these individuals were also treated with antidepressants, anti-anxiety medication or another antipsychotic in combination with clozapine.

Figure 3.1 – Graph showing Psychopharmacology Treatment of Participants



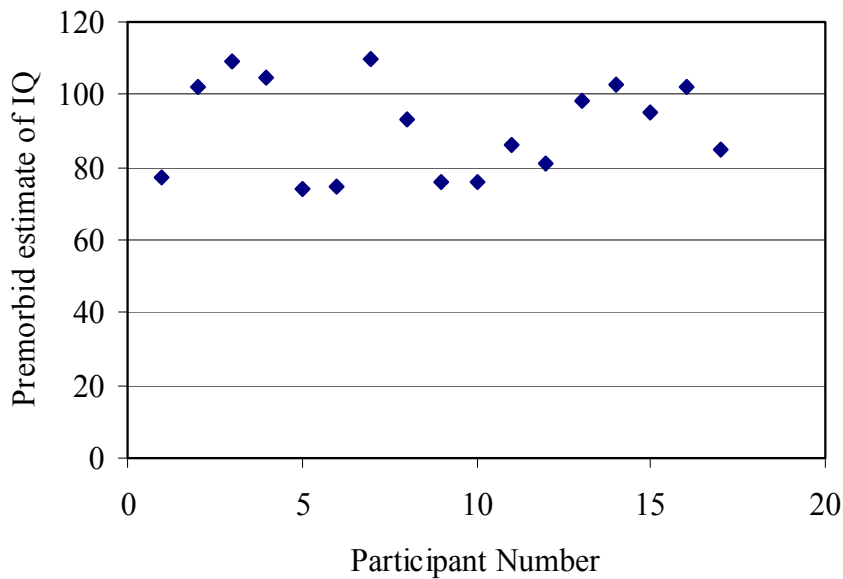
Almost one quarter of participants were treated with olanzapine (23.5 per cent) and none of these individuals received any additional medication. The remaining participants were treated with depot medication, Risperidal Consta, which was administered intravenously (11.8 per cent).

Participants within the current study had been stabilised on their respective medication for over three months before being included within the research. No changes to any of the involved participants' medication had been made over the duration of the study with the exception of those individuals who were withdrawn from the study due to a deterioration in their mental state.

3.3 Estimated Premorbid Measure of Intelligence

Individuals' premorbid level of intelligence was assessed using the Wechsler Test of Adult Reading (WTAR). Participants' level of premorbid intelligence was within the range 74 to 110, low average to high average respectively. The mean level of premorbid intelligence within the population was 91 (SD=12.96), which lies within the average range. The distribution of participants estimated premorbid IQ is shown in Figure 3.2.

Figure 3.2 – Graph showing participants estimated premorbid IQ



3.4 Statistical Analyses

Statistical Analyses of the data were carried out using the computer software Statistical Package for Social Sciences (SPSS) version 14. Exploratory analysis of the data was performed to assess the distribution of the data. These analyses indicated that the data did not appear to meet the assumptions required for parametric statistics to be used. Therefore nonparametric analyses were conducted using Friedman’s ANOVA to assess for significant changes across the various assessment stages. Further analyses were conducted using Wilcoxon signed rank tests to investigate the significance between each assessment phase. Bonferroni corrections were applied to reduce Type 1 errors. Analyses between the different assessments’ using Bonferroni corrections required the significance level to be divided by the number of conditions. Therefore those tests which had 4 conditions required significance levels <0.0125 and those with 3 conditions required significance levels

<0.016. Significance levels were selected using one tailed significance as the direction that the expected effects were due to occur were stated.

Descriptive statistics were also calculated to obtain means, standard deviations and confidence intervals. Each of the dependent variables were analysed individually as it was predicted that the amount of change within each area of cognitive functioning could have different degrees of improvement.

Significant effects have been indicated by a significant value lower than or equal to 0.05. Effect sizes have been calculated on those results that found a significant effect during the Friedman ANOVA. Effect sizes (r) have been categorised as representing large effects if the value is equal to 0.5, medium at 0.3 and a small effect if equal to 0.1 (Cohen, 1988).

The analyses of the data were conducted using a repeated measures design and only the data that was obtained from the 17 participants who completed the intervention was able to be assessed. Therefore the data that was collected from the two participants who only completed up to session three of the intervention was not used in the analysis as it contained missing values.

3.5 Hypothesis 1: Participants cognitive functioning as measured by cognitive assessments will improve as a result of the intervention.

3.5.1. Digit span

Results for the digit span test were analysed in two parts – digit span forward and digit span backwards. These tests measured two different cognitive skills and were assessed individually.

i) Digit Span Forward

Participants' scores on digit span forward were based on the longest digit that they were able to recall. Descriptive data indicated that the highest mean score was obtained during the post intervention assessment (Mean = 6.12) and the lowest mean was found in the pre intervention assessment (Mean = 5.53). Table 3.2 shows the descriptive data in full.

Table 3.2 – Table showing descriptive analysis on participants performance on Digit Span Forward Test.

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	5.53	1.28	4	9
Control	6.06	1.44	4	9
Mini Assessment	5.65	1.37	4	9
Post intervention	6.12	1.54	4	9

Inferential statistical analysis using Friedman's ANOVA indicated that there were significant effects found between the different assessments [$\chi^2(3)=8.784$, $p<0.05$]. Post hoc statistics were conducted using Wilcoxon Signed ranks with Bonferroni corrections reported at a significance level less than 0.0125. The results indicated that there were no significant effects found between the pre-intervention and the control assessments [$z=-2.183$, $p=0.024$, $r=-0.374$]. However there were no significant effects found between the pre-intervention and post-intervention assessments [$z=-2.090$, $p=0.020$, $r=-0.358$] or the control and post-intervention assessments [$z=-0.173$, $p=0.500$, $r=-0.030$]. Therefore the results do not support the initial hypothesis that the intervention would significantly improve participants' performances on this test.

ii) Digit Span Backwards

Participants' performances on the digit span backwards test were based on the longest sequence of digits that were recalled in reverse order (Table 3.3). Both the pre-intervention and control assessments had lower mean scores for digit span backwards. The post intervention produced the highest mean score for digits span backwards. Inferential statistical analyses conducted using Friedman's ANOVA showed that there were no significant different found between the assessments [$\chi^2(3)=6.605$, $p=0.083$]. Therefore the intervention did not significantly improve participants' scores on a test of digit span backwards. These results did not support hypothesis 1 which stated that the intervention would significantly improve individuals' cognitive functioning as measured by this test.

Table 3.3 –Table showing descriptive analysis on participants’ performance on Digit Span Backwards Test

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	4.18	1.43	3	7
Control	3.94	1.03	2	7
Mini Assessment	4.41	1.28	3	8
Post intervention	4.47	1.23	3	8

3.5.2. Block Design

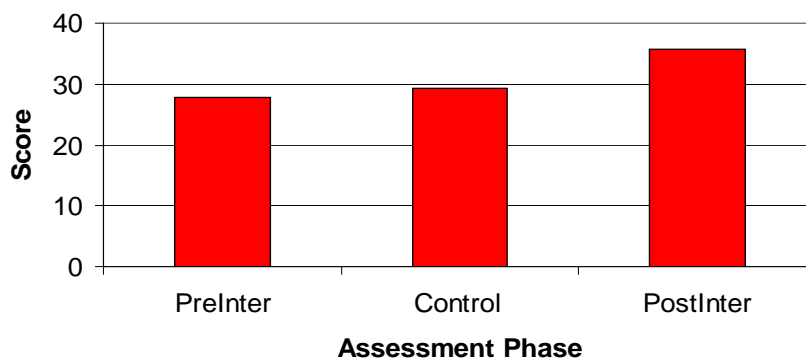
Participants’ performance on a task of block design was based on the raw score obtained during the test. During the pre intervention phase participants’ mean score was 27.82 and the control assessment mean score was 29.41. The mean score obtained during the post intervention phase was 35.76, over 6 points greater than either the control or the pre-intervention assessments. The mean scores are presented in Table 3.4 and illustrated in Figure 3.3.

Table 3.4 - Table showing descriptive analysis on participants performance on the Block Design Test

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	27.82	15.56	4	55
Control	29.41	13.69	12	54
Post intervention	35.76	16.03	7	58

Inferential statistical analyses were performed using Friedman's ANOVA. The results indicated that there were significant differences found between the three assessment phases [$\chi^2(2)=6.909$, $p<0.05$].

Figure 3.3 - Graph showing participants performance on Block Design task during various assessment phases



Comparisons of the assessment phases were calculated using Wilcoxon Signed Ranks Test with a Bonferroni correction for main effects reported at a one tailed significance less than 0.016. The statistics found a significant effect between the pre assessment and post assessment [$z=-2.700$, $p<0.005$, $r=-0.463$]. Therefore the scores obtained during these assessments were significantly different. Significant effects were also found between the control assessment and the post assessment [$z=-2.362$, $p<0.01$, $r=-0.405$]. Again this indicated that there were significant differences in scores during the two assessment phases. There were no significant effects between the pre intervention assessment and the control assessment [$z=-0.604$, $p=0.280$, $r=-0.104$]. This indicated that there were no significant differences in participants' performances on this task during the pre-intervention or control assessment.

Interpretation of these significant effects required analyses of the descriptive data. This data indicated that scores obtained during the post intervention phase were higher than both the pre intervention and control assessments. Both the descriptive and inferential analyses showed that the significant effect indicated that scores were higher after the administration of the intervention. The non significant comparison of the pre intervention and control assessments indicated that participants' performances were not improved as an effect of time but were the effect of the intervention. The results supported hypothesis 1 which predicted that the intervention would significantly improve individuals cognitive functioning.

3.5.3. Rey Complex Figure (RCF)

The Rey complex figure task was composed of two parts producing two scores for each participant during each of the assessment phases. These scores were based on participants' performance during a copy trial and the delayed recall trial.

i) Copy task of Rey Complex Figure

The descriptive data showed that participants' scores during the pre-intervention assessment produced a mean of 25.91. Participants' scores during the control assessment produced a mean of 28.77. The post-intervention assessments mean score was 31.68. The descriptive data showed that the highest mean score during the copy trial was obtained during the post intervention phase, which also had the lowest standard deviation. Details of the descriptive data are compiled in a table 3.5.

Table 3.5 – Table showing participants' performances during the Rey CFT copy trial during each of the various assessment phases.

Assessment Phase	Mean	Standard Deviation	Min.	Max.
Pre-intervention	25.91	10.48	8	36
Control	28.77	6.94	13.5	36
Post-intervention	31.68	5.67	15	36

Inferential statistical analyses of the results were performed using Friedman's ANOVA. The results showed that there were significant differences found between the various assessment phases [$\chi^2(2)=13.069$, $p<0.001$].

Further analyses of the data using Wilcoxon Signed Ranks Test with a Bonferroni correction for main effects reported at a one tailed significance level less than 0.016. The results indicated that there were no significant differences found between the pre-intervention and control assessments [$z=-1.635$, $p=0.053$, $r=-0.280$]. Significant effects were found when the post intervention assessment was compared with both the pre-intervention [$z=-2.9$, $p<0.001$, $r=-0.497$] and control intervention assessments [$z=-2.938$, $p<0.001$, $r=-0.504$]. Therefore these results indicated that scores obtained during the post intervention phase were significantly different from both the pre-intervention and control assessments. Analyses of the inferential and descriptive data showed that participants' scores were significantly higher after the intervention had been administered. The non significant effects found between the pre-intervention and control assessments indicated that participants' scores did not

significantly increase as an effect of time. The data showed that participants' performances on the copy trial of the Rey CFT were significantly improved as a result of the intervention. These results supported hypothesis 1 which predicted that the intervention would significantly improve the cognitive functioning of individuals.

ii) Recall Task of the Rey Complex Figure

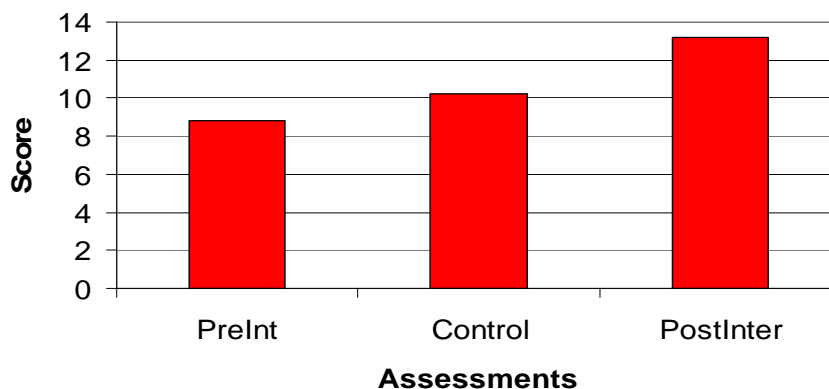
Participants are asked to recall the Rey Complex Figure that they had been presented approximately 30 minutes earlier (Table 3.6). Descriptive statistics showed that the highest mean score occurred during the post-intervention assessment phase. During the pre-intervention phase the mean score obtained was 8.82 and the control assessment phase produced a mean score of 10.18. These figures are displayed in Figure 3.4.

Table 3.6 – Table showing scores during a delayed recall trial of the Rey CFT

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	8.82	5.62	0.5	20.5
Control	10.18	5.58	2	18
Post intervention	13.21	6.88	2	27

Inferential statistical analyses were performed using Friedman's ANOVA. Analyses indicated that there were significant differences found between the scores during the various assessment phases [$\chi^2(2)=14.800, p<0.001$]. Therefore participants' performances during the various assessments were significantly different.

Figure 3.4 - Graph showing participants mean scores during Rey CFT delayed recall trial during the various assessment phases



Further analyses of the data were conducted using Wilcoxon Signed Ranks Test. A Bonferroni correction was applied and so all effects were reported at a 0.0167 level of significance. Further analyses of the data indicated that there were no significant differences found between the pre-intervention and control assessments [$z=-0.937$, $p=0.181$, $r=-0.161$]. Significant effects were found when the post-intervention assessment results were compared with both the pre-intervention [$z=-2.748$, $p<0.005$, $r=-0.471$] and control intervention assessments [$z=-2.500$, $p<0.005$, $r=-0.429$]. This indicated that scores obtained during the post intervention phase were significantly different from both the pre-intervention and control assessments. Analyses of this data and the descriptive data showed that participants' scores were significantly higher after the intervention had been administered. The non significant effects found between the pre-intervention and control assessments indicated that participants' scores did not significantly increase as an effect of time. Therefore the data indicated that the participants' performance during the delayed recall trial of the Rey CFT had significantly increased as a result of the intervention. These results

supported hypothesis 1 which predicted that the intervention would significantly improve individuals cognitive functioning as measured by this test.

3.5.4. Trail Making Test

The trail making test was composed of two parts, Trails Part A and Trails Part B. Scoring of these assessments are based upon the length of time, in seconds, the participants' took to complete the tasks,.

i) Trails Part A

Descriptive statistics obtained during TMT Part A indicated a mean time of 44.47 seconds during the pre-intervention phase. The means time taken for the control assessment phase was 48.28 seconds and for the mini assessment 38.00. The shortest time taken to complete the task occurred during the post-intervention phase, mean=35.00. Full descriptive statistics are displayed in table 3.7.

Table 3.7 – Table showing participants performances on the Trail Making Test

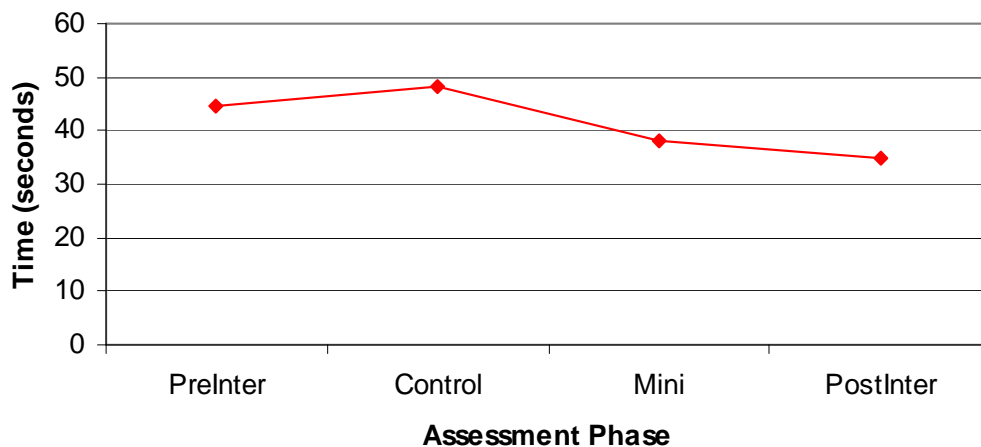
Part A

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	44.47	17.54	25	88
Control	48.29	18.74	26	91
Mini Assessment	38.00	16.50	22	79
Post intervention	35.00	15.59	20	85

Inferential statistical analysis was performed using Friedman’s ANOVA.

Analysis found a significant effect for the time taken to complete the task across the different assessment phases [$\chi^2(3)=17.192$, $p<0.001$].

Figure 3.5 – Graph showing participants mean time taken to complete Trails A across the various assessments



Further analyses of the data were conducted using Wilcoxon Signed Ranks Test. A Bonferroni correction was applied and so all effects were reported at a 0.0125 level of significance. The results showed that there were significant effects found between the post intervention assessment when compared with both the pre intervention [$z=-2.977$, $p<0.001$, $r=-0.511$] and control assessments [$z=-3.459$, $p<0.001$, $r=-0.593$].

This indicated that the time taken by participants to complete Trails Part A were significantly different during the post-intervention phase in comparison to both the pre-intervention and control assessments. There were no significant effects found between the pre-intervention and control assessments [$z=-1.068$, $p=0.149$, $r=-0.183$].

This indicated that time taken to complete the task did not improve as a result of

time. There was also no significant difference found between the mini assessment and the post intervention assessment [$z=-0.779$, $p=0.227$, $r=-0.134$].

The descriptive and inferential statistics indicated that participants' performances on Trails Part A were significantly faster at the post-intervention assessment in comparison to both the pre-intervention and control assessments, as can be seen from Figure 3.5. The results suggested that participants' scores significantly improved after the intervention had been administered. The results have supported hypothesis 1 which predicted that the intervention would produce a significant improvement in individuals cognitive functioning as measured by these tests.

ii) Trails Part B

Part B of the Trail Making Test is considered to be more complex than Part A. Table 3.8 illustrates the descriptive data obtained during this test. The mean time taken to complete Trails Part B during the pre-intervention phase was 157.18 seconds.

During the control assessment phase participants took a mean time of 134.35 seconds and during the mini assessment phase a mean of 135 second. The shortest mean time participants took to complete Part B occurred during the post-intervention phase (Mean = 106.59).

Inferential Statistics using Friedman's ANOVA showed a significant effect regarding the time participants took to complete Trails Part B [$\chi^2(3)=10.735$, $p<0.05$].

Table 3.8 – Table showing participants’ performance on the Trail Making Test

Part B

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	157.18	82.12	69	339
Control	134.35	64.61	63	300
Mini Assessment	135.00	76.83	50	300
Post intervention	106.59	46.51	59	251

Further analyses using Wilcoxon signed ranked tests with a Bonferroni correction compared participants performances during each of the assessments phases. These results indicated that although a significant difference had been found between the assessments, the scores during the assessments were not significantly different from one another. These results suggested that there were no significant differences in the time taken by participants’ to complete the task during each of the assessments. Therefore the results did not support the hypothesis, which predicted that participants cognitive functioning would improve after the intervention had been administered.

3.5.5. Auditory Verbal Learning Test

Analysis of the AVLT was undertaken by comparison of each of the individual recall trials of this test. Each of the participants’ trials were compared relative to each of the assessment phases.

The results of the AVLT were complicated by the number of trials that are administered during the test. In total there were ten trials which represented the five repeated presentations of List A, presentation of List B, a short delayed recall of List A, a long delayed recall of list A, a recognition trial and the number of perseveration errors identified during the recognition trial. The researcher attempted to simplify these results into seven trials by adding up the total number of words recalled across the five presentations of list A and recording the highest number of words recalled during the first five trials of the repeated presentations of List A.

Therefore results were based upon

- i) Total number of words recalled during trials 1-5 List A
- ii) Highest number of words recalled during trials 1-5 List A
- iii) Immediate Recall of List B
- iv) Short delayed recall of List A
- v) Long delayed recall of List A
- vi) Recognition of words
- vii) Number of false positives identified during the recognition trial

i) Total number of words from List A recalled during trials 1-5

Descriptive statistics (Table 3.9) of the total number of words recalled during trials 1 to 5 indicated that the mean number of words recalled during the pre-intervention phase was 32.35. The fewest mean number of words recalled occurred during the post-intervention phase. During the control assessment participants recalled a mean number of 35.88 words across the first 5 trials.

Table 3.9 - Table showing participants performance on the total mean number of words recalled during Trial 1 to 5.

Assessment Phase	Mean	Standard Deviation	Min.	Max.
Pre-intervention	32.353	9.151	19	46
Control	35.882	8.628	23	52
Post-intervention	31.175	8.489	16	46

Inferential statistical analysis using Friedman’s ANOVA found that the total number of words recalled during trials 1 to 5 was not significantly different across the various assessment phases [$\chi^2(2)=2.358$, $p=0.321$]. Therefore, there were no significant differences in participants’ performances prior to or after the intervention had been administered.

ii) Highest number of words recalled during trials 1 to 5

Descriptive statistics indicated that the highest mean number of words recalled during the pre-intervention phase was 9.00 and during the control assessment 9.12. The highest mean number of words recalled during the post-intervention assessment was 8.77. Table 3.10 illustrates the full descriptive data of participants’ performances during this task.

Table 3.10 – Table showing participants mean score for the greatest amount of words recalled during each of the assessment phases.

Assessment Phase	Mean	Standard Deviation	Min.	Max.
Pre-intervention	9.00	2.69	5	13
Control	9.12	2.32	5	14
Post-intervention	8.77	2.51	4	13

Inferential statistical analysis was carried out using Friedman’s ANOVA. Tests found that the highest number of words recalled during trials 1 to 5 was not significantly different across the various assessment phases [$\chi^2(2)=0.857$, $p=0.678$]. Therefore, there were no significant differences in participants’ performances before or after the intervention had been administered.

iii) Recall of List B

Table 3.11 illustrates the descriptive data obtained for participants mean number of words recalled from List B. The highest mean was achieved during the control assessment, followed by the post-intervention assessment phase. The lowest mean was obtained during the pre-intervention phase.

Friedman’s ANOVA indicated that there was a significant difference across the assessments [$\chi^2(2)=6.980$, $p<0.05$]. Comparisons using Wilcoxon Signed ranks tests with Bonferroni corrections at a level of 0.016 significance indicated that there was a significant effect found between the pre-intervention and control assessment ($z=-2.601$, $p<0.005$, $r=-0.446$). There were no significant differences found between the

control and post-intervention assessment phases [$z=-1.116$, $p=0.155$, $r=-0.191$] or between the pre-intervention or post intervention assessments [$z=-2.351$, $p=0.028$, $r=-0.403$]. Therefore results showed that the number of words recalled from List B does not support hypothesis one which predicted that an improvement in cognitive function would be found as a result of the intervention being administered.

Table 3.11 – Table showing mean score obtained during recall of List B during the various assessments.

Assessment Phase	Mean	Standard Deviation	Min.	Max.
Pre-intervention	3.41	1.70	0	7
Control	4.65	1.45	3	8
Post-intervention	4.12	1.22	3	7

iv) Short delayed recall of List A.

Descriptive statistics (Table 3.12) indicated that the mean number of words recalled from List A after a short delay was 6.00 during the pre-intervention assessment. The control assessment produced a mean of 6.12. The mean number of words recalled during the post-intervention assessment was 5.41.

Analysis using Friedman’s ANOVA indicated that there was no significant difference in number of words recalled from List A after a short delay during the various assessments [$\chi^2(2)=1.233$, $p=0.565$]. Therefore the intervention did not

significantly improve the amount of words recalled after a short delay and did not support hypothesis one.

Table 3.12 - Table showing participants' performance on recall of list A after a short delay

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	6.00	2.83	1	11
Control	6.12	2.09	3	10
Post intervention	5.42	3.00	1	10

v) Long delayed recall of List A

Participants were asked to recall as many words as possible from List A after a delay of 25 to 35 minutes. Descriptive data indicated that the mean number of words recalled after a long delay was greatest during the control stage followed closely by the pre-intervention phase as can be seen from the data in Table 3.13. The post-intervention assessment produced the lowest mean number of words.

Inferential statistical analysis was carried out using Friedman's ANOVA. Tests showed that the number of words recalled after a long delay was not significantly different when comparisons were made with all of the various assessment phases [$\chi^2(2)=1.037, p=0.618$]. Therefore there were no significant differences in participants' scores prior to or after the intervention had been administered. These results do not support hypothesis one.

Table 3.13 - Table showing participants' performances during the long delayed recall trial of List A from Rey AVLT

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	4.94	2.75	1	10
Control	4.94	2.11	2	10
Post intervention	4.35	2.89	1	9

vi) Recognition Trial

A recognition trial of the Rey AVLT was included to measure participants performance at identifying the original words from List A amongst a list of words composed of words from List B and those which have semantic links to list A. The descriptive statistics from Table 3.14 indicated that the mean number of words recognised from the original word list was greatest during the control assessment, approximately 11 words. During the post-intervention phase the mean number of words recognised was approximately 10, closely followed by performances within the pre-intervention phase.

Inferential statistical analyses were conducted using Friedman's ANOVA. Tests found that the number of words identified during the recognition trial were not significantly different across the various assessment phases [$\chi^2(2)=3.500$, $p=0.173$]. Therefore there were no difference in scores prior to or after the intervention was administered.

Table 3.14 – Table showing mean number of words recognised of Rey AVLT during the different assessment phases.

Assessment Phase	Mean	Standard Deviation	Min.	Max.
Pre-intervention	9.94	3.19	5	14
Control	11.24	2.33	6	14
Post-intervention	10.18	2.65	5	14

vii) False positives Identified during Recognition Trial

The descriptive data obtained during this trial is illustrated in table 3.15. The results showed that the highest number of false positive words were identified during the post-intervention phase. The least amount of false positives that were identified occurred during the pre-intervention phase.

Table 3.15 - Table showing descriptive data of the number of false positives identified during the recognition trial of the AVLT

Assessment Phase	Mean	Standard Deviation	Min.	Max.
Pre-intervention	3.12	3.50	0	11
Control	3.41	4.52	0	17
Post-intervention	4.77	5.06	0	20

Inferential statistical analyses were conducted using Friedman’s ANOVA. Tests found that the number of false positives identified were not significantly different

across the various assessment phases [$\chi^2=2.433$, $p=0.317$]. Therefore there were no differences in scores prior to or after the intervention had been administered.

Intrusion Errors

The number of intrusion errors made by the participants during all trials of the AVLT were calculated and have been illustrated in Table 3.16.

Table 3.16 Number of intrusions made during trials of the AVLT

	Total no. of intrusions made during assessment	No of Participants who made intrusions	% difference in pre to control	% difference in pre to post	% different in control to post
Pre-Intervention Assessment	2	2	+300%	+250%	-12.5%
Control Assessment	8	5			
Post-Intervention Assessment	7	5			

The greatest amount of intrusion errors occurred during the control assessment stage closely followed by the post-intervention assessment. The percentage change in intrusion errors made by participants' increased during the control and post-intervention assessments relative to the pre-intervention assessment. On closer examination of the data the same individuals continued to make intrusion errors. Those that incurred intrusions during the pre-intervention stage continued to make intrusion errors in both of the other two assessments. Three individuals did not make any intrusion errors during the pre-intervention assessments, however they did make intrusion errors during both the control and post-intervention assessments.

In summary there were no significant results found during any of the trials of the AVLT to indicate that the intervention had a positive effect on participants' performance on this assessment. There were no significant effects found when trials were compared over the various assessment phases. Therefore, there were no significant differences found in participants' scores before or after the intervention had been administered. The results do not support hypothesis 1 which predicted that the intervention would improve cognitive functioning as assessed by cognitive assessments such as the AVLT.

3.5.6. Wisconsin Card Sorting Test (WCST)

The Wisconsin Card Sorting Test produced three scores during the administration of the assessment. These scores indicated (i) the number of categories that each individual achieved; (ii) the number of perseverative responses and (iii) the number of errors.

i) WCST – Number of Categories Achieved

Descriptive statistics performed on the data relative to the number of categories participants identified found a mean of 3.00 during the pre-intervention assessment followed by a mean of 2.41 during the control assessment. Mean categories achieved during the mini assessment was 2.82 and during the post-intervention phase 3.65. The highest mean of categories achieved was during the post-intervention phase with the least obtained during the control assessment phase as can be seen from Table 3.17.

Table 3.17 - Table showing participants' performance on the number of categories achieved during the WCST

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	3.00	1.70	1	6
Control	2.41	1.50	0	5
Mini Assessment	2.82	1.74	1	6
Post intervention	3.65	1.27	1	6

Inferential statistical analyses were performed on the data using Friedman's ANOVA. Tests found a significant effect between the various assessments [$\chi^2(3)=11.021, p<0.01$]. Therefore there were significant differences in participants' performances during the different assessments. Post Hoc analyses using Wilcoxon Signed Ranks test with a Bonferroni correction applied so that effects were reported at a 0.0125 level of significance. Results indicated that there was only one significant difference in scores which was found between the control assessment and the post intervention assessment ($z=-2.716, p<0.005, r=-0.466$). No other significant effects were found. There were no significant differences in scores between the pre-intervention and control assessments [$z=-2.145, p=0.021, r=-0.368$], between the pre-intervention and post-intervention assessments [$z=-1.813, p=0.044, r=-0.311$] or between the mini and post-intervention assessments [$z=-2.041, p=0.025, r=-0.350$].

These results indicated that participants' scores did not significantly improve as a result of the intervention. Although the highest mean for categories achieved

occurred after the intervention had been administered this was not found significantly different from the other assessments and will be discussed in the next section.

ii) WCST – Number of Perseverative Responses

Descriptive statistics representing the number of perseverative responses that were made by participants during the various assessments found that the Mini assessment had the highest mean score of perseverative errors. The lowest mean number of perseverative responses occurred during the post-intervention assessment as can be seen from table 3.18.

Table 3.18 - Table showing participants’ performance regarding the number of perseverative errors made during the WCST

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	14.35	13.77	0	42
Control	14.35	14.04	0	42
Mini Assessment	16.47	16.08	0	42
Post intervention	10.24	13.79	0	42

Inferential statistical analysis was performed using Friedman’s ANOVA. The results showed that the number of perseverative responses made before and after the intervention were not significantly different [$\chi^2(3)=5.683$, $p=0.127$]. Therefore the intervention did not significantly improve the number of perseverative responses made by participants. These results do not support hypothesis 1 which predicted that

there would be a significant improvement in cognitive functioning based on participants' scores of cognitive assessments as a result of the intervention.

iii) WCST - Number of Total Errors

The descriptive data based upon the total number of errors participants made during the various assessments indicated that the highest mean number of errors was made during the control assessment. The lowest mean number of errors made was during the post-intervention assessment. Table 3.19 illustrates the descriptive data obtained by participants during this test.

Table 3.19 - Table showing participants' performance on the mean total number of errors obtained during the various assessments.

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	20.71	12.87	0	42
Control	21.29	14.75	0	42
Mini Assessment	18.82	16.78	0	42
Post intervention	12.06	13.88	0	42

Inferential statistical analyses were conducted using Friedman's ANOVA. The results indicated that there were significant differences in scores between the assessment phases [$\chi^2(3)=17.829$, $p<0.001$].

Further analyses of the data were conducted using Wilcoxon Signed Ranks test. A Bonferroni correction was applied and effects were reported at a 0.0125 level of

significance. These results showed a significant effect between the post-intervention when compared with the pre-intervention assessment ($z=-2.699$, $p<0.005$, $r=-0.463$) and the control assessment ($z=-3.301$, $p<0.001$, $r=-0.566$) in addition to the mini assessment phase ($z=-2.547$, $p<0.005$, $r=-0.437$). There were no significant differences found between the control assessment and the pre-intervention assessment [$z=-0.261$, $p=0.404$, $r=-0.045$]. These results in association with the descriptive data indicated that the number of errors made by participants during the post-intervention assessment were significantly lower in comparison to the assessments completed prior to the intervention being administered or during the mini assessment. Therefore these results supported hypothesis 1 which predicted that the intervention would improve participants cognitive functioning as assessed by cognitive tests.

3.5.7 Summary of Results in relation to Hypothesis 1.

Descriptive and inferential statistics indicated that the intervention produced a significant improvement in participants' performances within several cognitive assessments. These include the block design, the Rey complex figure test, Trail Making Test Part A and aspects of the Wisconsin card sorting test (Number of Errors). There were no significant differences in participants' scores on auditory verbal learning tasks as measured by the Rey AVLT. No significant effects were found on either digit span forward or backward. Within the WCST the number of categories achieved and the number of perseverative errors were not significantly improved. Also the results found for Trail Making Test Part B will be discussed

further in the next section, which had a significant effect found but may be the result of practice effects.

3.5.8 Correlations investigating the relationship between improvements in performances relative to the cognitive assessments

Correlations were conducted to investigate any relationship between the improvements in participants' scores relative to the cognitive assessments administered. Scores were calculated by subtracting performances during the control assessment from the scores obtained after the intervention was administered. These scores were then analysed in relation to the various cognitive assessments to investigate if there was any relationship with improved performances relative to the cognitive domains. As the data did not fulfil the assumptions for parametric statistics, non-parametric statistics were conducted using Kendall's Tau b. The level of significance was based on a 2 tailed test at the 0.05 level. To ensure that Type 1 errors were not a factor Bonferroni corrections were implemented stating a level of significance of 0.0029 based on the number of factors included within the correlation analysis.

A significant positive correlation was found between performances on the Trail Making Test Part A and Part B [$\tau=0.412$, $p<0.05$]. Therefore there was a moderate positive relationship between improvements in participants' scores during the Trail Making Test Part A and Part B.

Other positive correlations were observed between the Rey Auditory Verbal Learning Test total score and the highest amount of words recalled during trials 1 to 5. Kendall's Tau B indicated that there was a positive relationship between both of these tests [$\tau=0.744$, $p<0.001$]. The correlation was close to 1 indicating a strong positive relationship. Therefore as the highest number of words recalled increased so did the total amount of words recalled.

Also the scores obtained during the short delayed recall of list A and the long delayed recall of list A during the AVLT indicated that there was a relationship regarding participants' performance during these two tasks [$\tau=0.529$, $p<0.01$]. The correlation was a moderate positive relationship between performances during these two tasks. Therefore as participants' performance during the short delayed recall improved so did their performance during the long delayed recall of List A.

On the Modified version of the Wisconsin Card Sorting Test a significant correlation was found for participants performances during the categories achieved and the total number of errors accrued [$\tau=0.543$, $p<0.01$]. There was a moderate positive relationship between performances during these two tasks. Therefore as the number of categories identified increased the total number of errors improved (i.e. reduced).

Correlations conducted on the results without any corrections indicated that there were a number of positive relationships amongst the different trials of the AVLT. Positive correlations were found for the AVLT highest number of words recalled during trials 1 to 5 with performances during the delayed recall of the AVLT,

recognition, number of false positives (scored in reverse) and recall after a short delay. These relationships were considered to be weak relationships as many of the correlation coefficients were less than 0.4. Additional positive correlations were found for participants' performances for the total score of the AVLT when compared with short delayed recall, long delayed recall and recognition trial.

Other positive correlations were found when performances during the highest amount of words recalled were compared with participants' recall of the Rey complex figure. In addition recall of the Rey complex figure had a positive relationship with participants' performances during the long delayed recall trial of the AVLT. However the correlation coefficients indicated that these relationships were weak. All correlations have been included in appendix 9.

Bonferroni corrections were applied to reduce the possibility of Type 1 errors being made. Therefore the level of significance that set at a 0.0029 level. Due to this level of significance no further significant correlations were found within the data. The amount of improvement in performance of participants before the intervention until after the treatment did not indicate other significant relationships relative to the cognitive assessments that were conducted. Therefore the amount of improvement did not have a strong relationship with the amount of improvements within other cognitive domains.

3.6 Secondary Hypothesis

Hypothesis 2: Self esteem will increase as a result of the intervention.

3.6.1 Self Esteem

Self esteem was assessed using the Rosenberg Self Esteem Questionnaire. This is a self report of self esteem based on 10 statements. Participants' raw scores from the questionnaire were used to investigate the effects which cognitive rehabilitation interventions have upon self esteem. Table 3.20 illustrates the mean scores for self esteem during each of the assessment phases. Descriptive statistics performed on the data found the lowest mean score during the pre-intervention phase and the highest mean score during the post-intervention phases.

Table 3.20 – Table showing mean scores for self esteem

Assessment phase	Mean	Standard Deviation	Min.	Max.
Pre intervention	18.41	3.79	11	27
Control	19.88	4.72	12	28
Mini Assessment	19.65	4.81	11	28
Post intervention	20.06	5.47	7	28

Inferential statistics were undertaken using Friedman's ANOVA. Analyses indicated that there were no significant effects found for self esteem [$\chi^2(3)=3.327$, $p=0.352$].

Therefore there were no significant differences in scores found for self-esteem across the various assessments.

Secondary hypothesis within the current study predicted that there would be a significant increase in participants' self esteem as measured by an increase in the raw score obtained during the questionnaire. This hypothesis was not supported by the statistical analyses above.

Self esteem was measured at the three month follow up assessment phase.

Descriptive data indicated that the mean scores on the Rosenberg self esteem questionnaire were greater by 0.73 at the 3 month follow up when compared to the post-intervention assessment. There were no significant differences found for scores when comparing the post-intervention assessment and the three month follow-up assessment.

3.7 Further Analysis – Qualitative Data

The current study had not intended to collect any qualitative data during the planning or data collection stages of the research. The researcher has included comments which had been recorded during the administration of the intervention that appeared important in relation to the treatment and its acceptability to patients.

During the data gathering stage of the research a number of the participants actively sought out the researcher to enquire about their sessions. This indicated that they had high levels of motivation to participate in the programme. A number of participants stated that they found the sessions enjoyable and the sessions appeared less stressful for the participants in comparison to a one to one interview. The participants appeared to talk more freely and rapport appeared to be established quite quickly. It

was envisaged that a number of participants would drop out during the intervention. However, only two dropouts were reported during the administration of the intervention, which were the result of a participant being transferred to another hospital and the other becoming mentally unstable therefore being withdrawn from the study. Therefore all those individuals who remained mentally stable and did not experience transfer from hospital participated in the intervention through to completion. This was also found during the follow up stage of the study as all of the participants that were able to be assessed successfully attended their appointment. Only two participants who had completed the intervention were not included in the follow up stage as their mental state had deteriorated.

Since the intervention has been completed a number of individuals have actively sought out the researcher to enquire about the possibility of continuing to use the computer programme. The majority of participants were also keen to learn the outcome of their own individual test results and attended sessions to be provided with feedback.

3.8 Hypothesis 3: The effects of the intervention will be sustained at follow up.

A three month follow up was administered to investigate the sustainability and effectiveness of the intervention. The number of participants who completed the follow up assessment was 15, 1 female and 14 males. Two of the participants' who had successfully completed the intervention experienced a deterioration in their

mental state and they were not included in this assessment phase. Therefore analysis of their data at follow up has been lost at this stage.

The sustainable effects of the intervention were analysed using Wilcoxon Signed Ranks Test. All results were assessed by comparing scores obtained during the control assessment with participants' performances during the follow up assessment. The control condition was selected as this had taken into account the effect of practice effects and occurred immediately prior to the commencement of the intervention. The results indicated that the intervention was sustainable after a three month period if the scores on tests remained significantly improved at the three month follow-up. Additional Wilcoxon Signed Ranks Test were conducted between the post treatment assessment and the three month follow-up to establish if the results were significantly different from one another. The sustainability of the intervention was assessed relative to each of the cognitive assessments. Descriptive data comparing means during the control assessment, the post intervention phase and three month follow up can be seen in table 3.21.

Table 3.21 – Table showing descriptive statistics of mean scores on cognitive assessments during control, post-intervention and three month follow up assessment.

Cognitive Assessments	Control Assessment		Post-intervention Assessment		3 Month Follow-up	
	Mean	SD	Mean	SD	Mean	SD
WCST Total Errors	21.29	14.75	12.53	14.75	15.13	15.09
TMT Part A	48.29	18.74	35.00	16.14	30.67	6.93
TMT Part B	134.35	64.61	109.8	48.64	94.27	40.97
Rey CFT Copy	28.77	6.94	32.57	3.91	34.73	1.33
Rey CFT Recall	10.18	5.58	13.43	7.02	17.10	6.03
Block Design	29.41	13.69	36.93	15.79	35.33	12.33

Inferential statistical analyses were conducted using Wilcoxon Signed Ranks Test.

These results are displayed in table 3.22. Results obtained from the three month follow-up were compared with participants' performances during the control and post intervention assessments. The sustainability of the intervention on tests of the Rey AVLT, Digit Span, WCST categories and WCST perseverative errors were not analysed as they were not found to be significantly improved at the post-intervention stage.

Table 3.22 - Table showing inferential statistics comparing performances on cognitive assessments during post-intervention and three month follow up assessment.

Cognitive Assessment Comparisons	Diff. in mean scores	Z	Significance
WCST Errors Control V 3 mth FU	6.16	-2.630	0.007*
WCST Errors Post V 3 mth FU	2.6	-1.260	0.229
Trails A Control V 3 mth FU	17.62	-3.266	0.000**
Trails A Post V 3 mth FU	4.33	-1.224	0.233
Trails B Control V 3 mth FU	40.08	-2.556	0.008*
Trails B Post V 3 mth FU	15.53	-2.412	0.013*
Rey CFT Copy Control V 3mth FU	3.96	-2.752	0.004**
Rey CFT Copy Post V 3mth FU	2.16	-1.959	0.053
Rey CFT Recall Control V 3mth FU	6.92	-2.844	0.001**
Rey CFT Recall Post V 3mth FU	3.67	-3.354	0.000**
Block Design Control V 3mth FU	5.92	-2.248	0.011*
Block Design Post V 3mth FU	1.6	-0.819	0.435

*p<0.05 **p<0.005

Modified Wisconsin Card Sorting Test

Statistical analyses of participants' performances on the modified Wisconsin Card Sorting Test (WCST) indicated that participants performances during the three month follow-up remained significantly improved in comparison to the control assessment [z=-3.301, p<0.01, r=-0.48]. There were no significant differences between the post-intervention scores and the three month follow up assessments for

the total number of errors. Participants' performances on the total number of errors were slightly poorer during the three month follow-up in comparison to the post-intervention assessment. However the differences in performances for mean scores remained significantly improved at three month follow up in comparison to a control assessments indicating that performances were sustained.

Trail Making Test

The descriptive data on both the trails part A and B showed that participants completed the tasks faster at the three month follow up when compared with the post-intervention assessment. During Trails Part A participants performed a mean of approximately 4.4 seconds faster and during Trails B participants were a mean of over 15 seconds quicker. On the Trail Making Test part A there were no significant differences in scores when post-intervention assessments were compared with the three month follow up assessments. During the Trail Making Test Part B participants performance was significantly different during the post-intervention and follow-up assessment [$z=-2.412$, $p<0.05$, $r=-0.440$]. Participants performances remained significantly improved at three month follow-up in comparison to a control assessment for both the Trails Part A [$z=-3.266$, $p<0.001$, $r=-0.596$] and the Trails Part B [$z=-2.556$, $p<0.01$, $r=-0.467$]. Therefore participants' performances were sustained three months after the completion of cognitive rehabilitation therapy.

Block Design

Participants performances on the block design remained significantly improved at three month follow up in comparison to a control assessment [$z=-2.248$, $p<0.05$, $r=-$

0.410]. There were no significant differences found on the block design performances between the post-intervention and three month follow up assessments [$z= 0.819$, $p=0.435$, $r=-0.150$]. Therefore participants' performances were sustained three months after the administration of the intervention.

Rey CFT

The descriptive data for the Rey CFT during the copy and recall trials indicated that scores had increased at the three month follow up relative to scores achieved at the post-intervention assessment. Participants performances remained significantly higher in comparison to a control assessment at 3 month follow up for both the copy trial of the Rey CFT [$z=-2.752$, $p<0.01$, $r=-0.502$] and the recall trial of the test [$z=-2.844$, $p<0.005$, $r=-0.519$]. Inferential statistics performed using Wilcoxon Signed Ranks test indicated that there were significant differences for the recall trial of the Rey CFT between the post-intervention and the three month follow up assessments [$z=-3.354$, $p<0.001$, $r=-0.612$]. Participants performances during the copy trial of the test indicated that there were no significant differences between the post-intervention and follow up assessments [$z=-1.959$, $p=0.053$].

Conclusions for Hypothesis 3

The results investigating the sustainability of participants performances indicated that the improvements in cognitive functioning that were found as a result of the intervention were sustainable after a three month follow-up. Sustainable results were found on the block design, Trail Making Test Part A and the copy trial of the Rey CFT. Results obtained for the recall trial of the Rey CFT and Trail Making Test

Part B were found to have improved significantly at the three month follow up in comparison to participants' performance during the post intervention assessment. These results supported hypothesis three which stated that the improvements found on tests of cognitive functioning would be sustained at a three month follow-up.

DISCUSSION

4.1 Interpretation of Findings

The current pilot study investigated the effectiveness of cognitive rehabilitation therapy within a forensic mental health population. Treatments using cognitive remediation therapies have not previously been administered within this population. Previous research has found that the treatment can improve cognitive functioning in addition to improving functional outcomes for patients with schizophrenia. Initial studies within this area need to identify improvements in cognitive functioning as the first steps before additional functional outcomes are investigated, as in the research using cognitive rehabilitation interventions with patients with schizophrenia without forensic histories.

Initially each hypothesis will be discussed in turn with respect to each of the cognitive assessments that were administered. The first hypothesis aimed to identify whether there were any improvements in participants' performances as a result of the intervention. The second hypothesis assessed the effect of the treatment upon self-esteem. Lastly the final hypothesis examined the sustainability of the participants' improvements in performance after a three month follow-up.

4.1.1 Hypothesis 1 – The intervention will improve cognitive functioning as measured by cognitive assessments.

Attention

Research has shown that patients with schizophrenia have impaired reaction times and span of apprehension (McGhie & Chapman, 1962). The cognitive domain of attention was measured within the current study using Digit Span Forwards and the Trail Making Test Part A.

The findings within the present study indicated that participants' performance on the TMT-Part A significantly improved after the intervention had been administered.

The results were in keeping with previous studies that used computer assisted cognitive rehabilitation, which also found significant effects on attention as measured by Trail Making Test Part A (Burda et al, 1994; Wolwer et al, 2005; Lindenmayer et al, 2008). Other studies have found significant effects on attention using other cognitive assessments, for example the Continuous Performance Test (Medalia et al, 1998) and Letter Cancellation Test (Vaugh et al, 2005). Previous effect sizes for Trail making Test part A have been medium to large. The current study effect size based on Partial eta squared was considered as a large effect in respect to statistical definitions provided by statisticians (Stevens, 2002). Therefore the results of the present study showed that this domain can be improved and may be beneficial in regards to functional outcome for these individuals. Practice effects have been considered due to the repeated presentations of the same version of the Trails Part A. However, the improvements in participants' performances appear to be greater than what would be expected as a result of practice effects. Performances are greater than

the proposed cumulative practice effects that were found by Lezak in 1982 when administering the Trail making test within a very short time frame to adults with no cognitive difficulties.

The Digit Span Forward test has been considered a test of attention, span of apprehension and span of immediate verbal recall (Lezak, 2004). In regards to the Digit Span Forwards test the current study did not find a significant improvement on this task as a result of the cognitive rehabilitation intervention. Several studies have found significant improvements on this test following administration of cognitive remediation treatments (Burda et al, 1994; Lindenmayer et al, 2008). However the present results are in keeping with previous findings of computer assisted cognitive remediation therapies (Greig et al, 2007; McGurk et al 2005).

Results regarding the effect of cognitive rehabilitation therapy upon attention have been mixed. Attention as measured by Trails A appears to have produced more favourable results than studies that administered the digits span forward test. Although both of these assessments measure attention they measure different types as one relies on visual attention and the other on verbal attention. The meta-analysis conducted by McGurk and colleagues in 2007 identified that verbal skills required more sessions of the intervention to achieve significant results. The results of the current study were in this direction, however more research is needed within this area to identify whether the number of sessions are a factor in the improvement of verbal memory.

Executive Functioning

Executive functioning was measured by Trails B and the Modified Wisconsin Card Sorting Test (mWCST). A review of cognitive rehabilitation treatments found that improvements on the WCST have been found when the intervention has taken a 'strategic and instructional' form (Kurtz et al, 2001). These interventions use strategic and instructional techniques where patients are given explicit instructions and detailed explanations of the principles of rule sorting. However limitations of these studies are that the researchers have used the same assessments to evaluate patients which they have used to train them (Bellack et al, 1990; Bellack 1996; Gold et al, 1992; Metz et al, 1994).

On the modified WCST there were no significant differences regarding the number of categories that were identified when assessment phases were compared and also no significant effects were found for perseverative errors. However, a significant effect was found on the number of total errors participants' made during the task. Individuals made significantly fewer total errors at the post-intervention stage in comparison to the pre-intervention and control assessments.

Previous studies using computer based cognitive rehabilitation interventions have found significant effects on measures of executive function i.e. WCST (Bell et al, 2001; Fiszdon et al, 2006; Greig et al, 2007). In contrast to these studies other computerised interventions did not report significant effects using the WCST (Lindemayer et al, 2008; McGurk et al, 2005). All of the studies that reported a significant effect for executive function as measured by the Wisconsin Card Sorting

Test (original version) used the computer software CogReHab and all administered approximately 130 hours of the intervention. The current study only administered five hours of cognitive rehabilitation training and therefore it was hypothesised that effects upon all aspects of executive functioning will require more intense interventions.

Lineweaver and colleagues (1999) reported moderate test-retest reliability of the modified version of the WCST. The authors also found no significant practice effects, particularly for categories completed and perseverative errors. This is in keeping with the results from the current study. Past research indicated that patients with schizophrenia performed poorly on the Wisconsin card sorting test even when they were provided with explicit practice and instructions (Goldberg et al, 1987). The reduction in the total number of errors made post-intervention in comparison to pre-intervention assessments does not appear to be the result of practice effects. However these findings may need to be considered in respect to making firm conclusions based on these results.

The modified card sorting test was selected as a more appropriate test within the present study due to its clinical relevance within populations with severe impairment. The modified version has been considered to be better as it was proposed to be a better test within this clinical sample in comparison to the original version (Mitrushina et al, 2005). The modified version reduces patient distress (Lezak et al, 2004) which was an important consideration within the present study due to the

patient population. The number of perseverative errors did not significantly improve and illustrates this as a continuing difficulty for individuals within this population.

Executive functioning was also measured by The Trail Making Test Part B. Both part A and B of the Trail making test require skills in visual perceptual, spatial and visuo-motor scanning, visuo-motor speed and coordination. The tests also require motor problem solving, sustained attention and mental tracking (Mitrushina et al, 2005). Part B is a more complex test than Part A which requires sequence alteration. Part A of the Trail Making test has been discussed as a measure of attention. Part B has been considered a measure of executive functioning (Mitrushina et al, 2005). The current study found significant results for improvements in participants' performance over the various assessments. The results showed that participants' performances did not significantly improve in relation to the various assessments, however participants were completing the tasks quicker each time with the exception of comparisons between the control and mini assessment stages. Research has shown that repeated administration can result in practice effects (Lezak et al, 2004). The results found for Trails Part B may have been due to practice effects and procedural learning. Also these results may highlight the low reliability coefficient related to performance of patients with schizophrenia (Lezak, 1995).

There has been significant effects found on the Trail Making Test Part B in a number of studies that used computer based cognitive remediation interventions (Burda et al, 1994; Fiszdon et al, 2006; Kurtz et al, 2007; McGurk et al, 2005). Non significant results were also reported (Belluci et al 2002; Field et al, 1997; Lindenmayer et al,

2008; Sartory et al, 2005; Wolwer et al, 2005). Within the studies that found a significant effect there were various amounts of time dedicated to the cognitive remediation therapy, which ranged from 12 hours to 100 hours. There was also a range of computer software used including Cogpack (McGurk et al, 2005), CogReHab (Fiszdon et al, 2006; Kurtz et al, 2007) and Captains Log (Burda et al, 1994). Two of the four studies that found significant results included work therapy alongside the cognitive rehabilitation interventions (Fiszdon et al, 2006; McGurk et al, 2005), whereas only one of the non-significant results were found within a study combining work with cognitive remediation therapy (Lindenmayer et al, 2008). Also three out of the four studies which found significant findings used drill and practice methods (Burda et al, 1994; Fiszdon et al, 2006; Kurtz et al, 2007). Therefore it is difficult to ascertain what were the important elements or 'active ingredients' that led to the significant results.

In line with the current study the other study that had quite similar methodology was performed by Sartory and colleagues (2005). This study as discussed earlier used the same computer software for the cognitive rehabilitation intervention without an adjunctive treatment. The significant effect found within the current study was not found in a similar study, which may indicate that the result was due to practice effects. McGurk and colleagues (2005) found a significant effect using Cogpack, however their study design incorporated supported employment in addition to the cognitive intervention. Therefore direct comparisons could not be made in respect to the current study findings.

Forensic patients or those with a history of violence have been found to have more pronounced deficits in executive functioning (Barkataki et al, 2005). Previous studies have proposed that those who have the greatest cognitive impairments are the least likely to improve from these interventions (Liddle, 2000). However individuals within this population may benefit from these treatments. The results from the current study showed improvements within some areas of executive functioning. Executive functioning has been associated with risk of violence, treatment compliance and functional outcomes therefore these results are clinically positive and should encourage further investigations to support the need for this treatment to be offered within this population.

Visual Memory and Perceptual Organisation

The results of the Rey Complex Figure test showed that the intervention indicated improvements on participants performances on both copy and recall elements of this assessment. Therefore this suggests that the intervention improved visuo-spatial skills in addition to visual memory. The results from these tests were not due to practice effects as measures had been taken to use alternative versions of the original test. Discussion of the comparability of these alternative figures have been discussed in section 2.6.6.

There have been limited studies that have included visual memory assessments. Kurtz and colleagues in 2007 administered the Rey complex figure as a measure of visual episodic memory and found significant effects on the measure. Bell and colleagues (2001) included the figural memory test taken from the Wechsler Memory

Scale but found no significant effect for visual memory. Studies investigating the effectiveness of computer assisted cognitive rehabilitation interventions upon visual learning and memory have been limited. These interventions could lead to better outcomes in comparison to pencil and paper tasks due to the predominant visual element of computer software.

Visuo-spatial Organisation

Visuo-spatial organisation was assessed using the block design subscale of the Wechsler Adult Intelligence Scale. The results of the current study showed that patients' performances during the post intervention stage were significantly better than either of the assessments completed prior to the commencement of the intervention. This indicated that improved performance occurred after the intervention had been administered. The intervention was predominantly based upon visual modalities which may have been beneficial when completing this assessment.

Zhu and colleagues (2001) indicated that practice effects could increase participants' performances by up to 2.8 points when administering the same version of the test.

Within the current study alternative versions of the test were administered to reduce the presence of confounding factors and participants performances were greater than 2.8 points at the post intervention assessment relative to both the control and pre-intervention phases. Rawlings and Crewe (1992) found that repeated presentations of the block design with a group of moderately to severely head injured patients did not raise scores beyond that expected for the first post-trauma year. They proposed that practice effects for these patients are negligible. The current study used

alternative versions of the block design and therefore the results indicated that the improvements were a result of the intervention rather than due to practice effects. The reliability correlation of the WAIS and WASI block design tests were 0.74. The administration of the pre-intervention and the control assessment indicated that there was no significant difference between participants' performances. Although the correlation of the two was not ideal it did not appear to have any significant effect upon the participants' scores during both of these versions.

Only one other study, within the selected studies that had used computerised cognitive intervention, had included the block design as a measure of reasoning and problem solving (Kurtz et al, 2007). The authors found a significant effect on this measure which was in keeping with the current study. A study by Ueland and Rund (2005) investigating cognitive remediation in early intervention of psychosis found that visual information processing improved. The results were also durable at one year follow up. Therefore these studies suggest that visual memory and processing are another difficulty for individuals with a diagnosis of schizophrenia and interventions can be used to improve performances. The computer assisted cognitive remediation therapies predominantly targets visual modalities and therefore this method may be the most appropriate medium at improving these domains.

Verbal Learning and Memory

The results of the current study indicated that performance on the Rey Auditory Verbal Learning test did not improve as a result of the intervention. This is in contrast to a number of studies that have found significant results for verbal learning

and memory (Belluci et al, 2002; Benedict et al, 1994; Burda et al, 1994; Fiszdon et al, 2004; Kurtz et al, 2007; Lindenmayer et al, 2007; McGurk et al, 2005; Sartory et al, 2005; Vaugh et al, 2005). However the results from the current study are in keeping with three previous studies (Bark et al, 2003; Bell et al, 2001; Greig et al, 2007). Therefore there are quite stark differences in terms of the effects cognitive remediation interventions have upon measures of verbal memory. On further exploration of the studies many of the positive results have used software such as Captains Log, CogReHab or Cogpack. Bark and colleagues (2003) did not find positive effects when administering the intervention for less than five hours. Exploration of the studies that found significant results indicated that six of the nine showing significant results on verbal learning and/or memory administered cognitive rehabilitation interventions alongside a form of work therapy. The remaining three had used drill and practice methods. These results could suggest that verbal abilities may be further enhanced and practiced within an employment situation and therefore led to both clinical and statistical significance.

The percentage change in the number of intrusion errors made by participants during the administration of the AVLT did not decrease as a result of the intervention. The least amount of intrusions were made during the pre-intervention stage, however the number of intrusions during the control and post-intervention stage were similar and made by the same people. Therefore the intervention had no positive effect upon reducing individuals with schizophrenia ability to distinguish pieces of information from different sources. Again these results may have been due to the limited amount of verbal learning training required to make a significant difference in

participants' performances. Further research may help to highlight if intrusion errors may be reduced.

The different computer software offer similar elements targeting cognitive domains. However the current study utilised the Cogpack software and is therefore only in a position to comment on the elements contained within this programme. Further investigations into the effectiveness of computer assisted cognitive rehabilitation software may be important in understanding the critical tasks and components that may lead to greater effect sizes both statistically and clinically. These results could have implications on identifying and providing the best form of intervention which could also improve functional outcomes.

McGurk and colleagues (2007) meta-analysis on cognitive remediation therapy in schizophrenia found that improvements in verbal learning and memory were related to the amount of hours and type of training e.g. drill and practice methods.

They suggested that these areas of cognitive functioning were more sensitive to "methods and extent of cognitive remediation" (pp.1799). Effect sizes for verbal learning and memory were greater when there had been more hours of cognitive remediation (McGurk et al, 2007). This is in keeping with the present study regarding the results found on auditory verbal learning tests. There were no significant results found during these tests and this suggests that the limited amount of cognitive remediation therapy training on these domains may have contributed to the limited improvements found on these tests.

Working Memory

Working memory was assessed using the test of digit span backwards. Results from the current study indicated that the intervention did not have a significant effect upon performances of working memory. Significant results on digit span as a measure of working memory have been reported on many computerised cognitive intervention studies (Bell et al, 2001; Bell et al, 2003; Fiszdon et al, 2004; Fiszdon et al, 2006; Greig et al, 2007; Kurtz et al, 2007). The current results are in keeping with three previous studies that used computer assisted cognitive remediation therapy (Lindenmayer et al, 2008; McGurk et al, 2005; Wolwer et al, 2005).

This measure of working memory focuses only on verbal working memory. As discussed in relation to verbal learning and memory, this assessment may have been affected by the amount of sessions of the intervention due to its verbal element. Verbal domains are sensitive to the extent of cognitive remediation interventions (McGurk et al, 2007) and therefore more sessions may have led to improvements in participants' performances within this domain.

Improvements in cognitive functioning relative to the different cognitive domains

The correlations performed to investigate the amount of improvement in cognitive domains relative to the cognitive assessments administered. The results showed that there were moderate and strong relationships for the amount of improvements on cognitive assessments. Moderate positive relationships were found for both parts of the Trail Making Test, AVLT recall of List A after a short and long delay and finally during the WCST the number of categories and the total number of errors made. A

strong positive relationship was found on the AVLT for the total number of words recalled and the highest amount of words recalled. All other correlations did not meet the required level of significance after a Bonferroni correction had been applied. Therefore this indicated that the level of improvements were different from one another relative to the cognitive domains that were being assessed. This may suggest that cognitive rehabilitation techniques differ in the effect they may have on the different cognitive domains.

Comparison of current study to other cognitive rehabilitation studies that used Cogpack Software

The literature review of computer assisted cognitive rehabilitation identified five studies which administered Cogpack software. The results from the current study have been examined in respect to previous research which has used the same package.

In respect to TMT Part B three of the five studies that used Cogpack as the computer assisted software for cognitive rehabilitation did not find significant improvements on this test (Lindemayer et al, 2008; Sartory et al, 2005; Wolwer et al, 2005;). Only the study performed by McGurk and colleagues (2005) found significant results on the TMT-Part B. In relation to methodology those that did not find significant results were composed of both drill and practice strategies (Sartory et al, 2005) as well as drill and strategic coaching (Lindemayer et al, 2008; Wolwer et al, 2005). There was also the administration of the intervention adjunct to employment (Lindemayer et al, 2008; Wolwer et al, 2005) and a study which did not include any work elements

(Sartory et al, 2005). Therefore it is difficult to be conclusive about which elements of the study performed by McGurk and colleagues (2005) led to a significant result as it shared some of the common methodological procedures with those conducted by studies that did not find significant findings (Lindemayer et al, 2008; Wolwer et al, 2005). The current study did not find significant results for improvements for the TMT-Part B but participants' performance continued to improve during each administration of the test. The results of the current study appear to be in line with previous research which did not find significant results on the TMT part B. Previous research using the TMT-Part A and Cogpack assisted software indicated inconsistent results. Two of the three identified studies that included TMT-Part A as an outcome measure found significant effects as a result of the intervention (Lindemayer et al, 2008; McGurk et al, 2005). Only one study did not find significant effects (Wolwer et al, 2005) however, the main aim of this study was not researching the effectiveness of cognitive rehabilitation intervention but rather facial recognition. The methodology within this study indicated that not all cognitive rehabilitation sessions were focused on computer assisted cognitive rehabilitation therapy but included desk work. The study was included within the current literature review because it had used cognitive assessments as outcome measures and administered cognitive rehabilitation as a control group. Therefore the methodology has not been specific to allow firm conclusions to be made about the results of this study. The results of the current study for TMT-Part A were significant and are in keeping with the majority of studies above. These results indicated that similar findings were produced when the cognitive rehabilitation was administered alone, as

in the current study, or included alongside employment therapies (Lindenmayer et al, 2008; McGurk et al, 2005).

The results on measures of verbal learning and memory have been inconsistent. The current study did not find any significant improvements on either verbal learning or memory as measured by the Rey Auditory Verbal Learning Test. Four of the five studies included measures of verbal learning and memory either the California VLT (McGurk et al, 2005) or Rey AVLT (Lindenmayer et al, 2008; Vaugh et al, 2005; Wolwer et al, 2005). Significant results were found by two of the studies in both verbal learning and memory (McGurk et al, 2005; Vaugh et al, 2005). However two studies found significant results on either verbal learning (Lindenmayer et al, 2008) or verbal memory (Wolwer et al, 2005). All studies offered cognitive remediation alongside work therapy and had an adequate amount of sessions. The results from the present study were not found to be significant in either verbal learning or memory. A possible explanation for a lack of improvement in participants' performances on these tests may have been the result of fewer sessions of the intervention in respect to the above studies which found significant effects. All of the studies that found significant results offered cognitive rehabilitation therapy alongside employment. Therefore this may have an important implication within this cognitive domain which was not offered within the current study.

Other cognitive assessments that were used within the current study which can be compared to previous research included the Digit Span Test. Only two studies included this as an outcome measure (Lindenmayer et al, 2008; Wolwer et al, 2005).

Both studies did not find significant improvements on this test as a result of the intervention. The results of the current study are in the direction that was expected for this test. These results are interesting in respect to previous research as verbal learning and memory were found to be significant when measured by the auditory verbal learning tests (Lindenmayer et al, 2007; McGurk et al, 2005; Sartory et al, 2005; Vaugh et al, 2005;). Therefore there is the expectation that other verbal tests such as the digit span test would also be improved. However further investigations into this area are required to explain these results.

The Wisconsin Card Sorting Test was administered as an outcome measure within two of the five studies that used Cogpack software as the cognitive rehabilitation intervention (Lindenmayer et al, 2008; McGurk et al, 2005). Both of these studies did not find significant improvements in executive functioning as measured by the WCST. The results of the current study are in keeping with the findings from previous research using Cogpack. There have been significant results found on this measure within previous computer-assisted interventions. These studies utilised CogReHab software and measured executive functioning using the WCST (original version). Therefore the effectiveness of this software in respect to improving executive functioning may need to be investigated further.

The current study also included measures of visuo-spatial organisation and visual memory using the block design from the WAIS-III and the Rey Complex Figure Test. These measures were included as they measure areas of cognitive domains that are impaired in individuals with schizophrenia (Fiszdon et al, 2006; Wykes &

Reeder, 2005). Results from the current study indicated that these areas of cognitive functioning were significantly improved as a result of the intervention. Previous studies using Cogpack software within cognitive rehabilitation research have not investigated these domains of cognition. These areas may not be seen as having prominence in respect to verbal learning and memory, attention and executive functioning but visual domains may be relevant in respect to working memory according to Baddeleys model (Keefe et al, 2005). Further evidence will be needed to support the effectiveness of cognitive rehabilitation techniques upon visual domains.

4.1.2 Hypothesis 2 – Self esteem measures will improve as a result of the intervention

Self esteem was measured using the Rosenberg Self Esteem Questionnaire. The results showed that participants' self esteem was not significantly improved as a result of the cognitive rehabilitation intervention. However, the mean score within the population was rated highest during the post-intervention assessment phase. This indicated that participants' rated their self-esteem higher after the intervention had been administered in comparison to the pre-intervention and control assessment stages. Although these results may not be statistically significant they may have clinical relevance, especially in respect to the current population. Interventions such as cognitive rehabilitation which could have an indirect effect on self esteem are beneficial within any clinical population. The impact of improving self esteem within forensic mental health settings is important as it is an under-researched area. Also low self esteem has been associated with positive symptoms particularly

persecutory delusions (Bentall et al, 1994). Therefore benefits to self esteem may help to reduce positive symptoms and have implications upon risk of violence.

The results regarding self-esteem should be assessed alongside the qualitative data that has been included within the results section. It was evident that participants enjoyed the study and were willing to travel to weekly sessions for approximately 45 minutes at a time.

The current study found that the researcher has been approached by a number of the participants who want to continue to use the computer software. These individuals are aware that the study has been completed and that their performance is no longer being assessed as part of a pilot study, however they were still keen to continue to access the programme. The duration of the study took approximately seven months to complete in total therefore it is unlikely that motivational factors, especially in relation to this population, could be a major factor to consider in regards to the results found.

Within the computer-assisted cognitive remediation intervention studies Belluci and colleagues (2002) found no significant effect for self esteem but only found significant improvements in verbal memory as a result of the treatment. Medalia and colleagues (1998) performed computerised cognitive rehabilitation which found a significant effect on attentional training. Although the authors did not utilise a standardised measure of self esteem within their study they did propose that the participants self esteem seemed to improve. This was based on qualitative data

which recorded patients' boasting about their involvement in the study to both other patients and staff.

Non-computerised cognitive rehabilitation studies have found conflicting results. A number of studies indicated that cognitive training had a positive effect upon self esteem (Hayes & McGrath, 2000; Wykes et al, 1999, 2003). Wykes and colleagues (1999) proposed that improvements in self esteem were due to the positive feedback that was provided by the therapist in addition to the feedback from their own inspection of their performance. Hogarty and Flesher (1999) found non-significant but "encouraging" improvements in self esteem and the current results are in the direction of this research

Little evidence has been produced investigating the effects of computer assisted cognitive rehabilitation interventions upon self-esteem, therefore more evidence is needed before firm conclusions are reached. However the qualitative data which was reported to the researcher indicated that participants gained a sense of achievement after sessions on the computer. The positive feedback which participants received from the computer based on their performance during tasks was hypothesised to help improve self esteem. Further research is needed in this area to investigate the effects this intervention may have upon self esteem if it is administered for a greater amount of time.

4.1.3 Hypothesis 3 – The effects of the intervention will be durable after a three month follow up.

The results from the current study indicated that those cognitive areas that were significantly improved after the intervention had been administered were sustained at a three month follow up. The results showed that participants performances remained significantly improved at a three month follow-up relative to the control assessment, which was administered immediately prior to the intervention. There were no significant differences in participants' performances on measures of attention, executive functioning and visuo-spatial organisation during the post-intervention and follow-up assessments. The results also found a further significant improvement on visual learning and memory as measured by the Rey complex figure test between post-intervention assessment and the three month follow up assessment. These results provide promising evidence to support the use of cognitive remediation interventions in terms of the benefits and sustainability of effects in a forensic population with schizophrenia.

In respect to the results that were found on the copy trial of the Rey CFT, McGurk and colleagues (2007) suggested that “the amount of cognitive remediation may not be related to immediate gains in cognitive functioning but could contribute to the retention of improvements following the termination of treatment” (pp.1799).

Therefore this may be a possible explanation for the results obtained within this test.

The results were not due to practice effects as alternative forms of the CFT were used.

Of those studies which investigated the durability of their intervention, Vaugh and colleagues (2005) found small to medium effect sizes on verbal memory at follow up. These results are in keeping with studies by Bell and colleagues (2003) and Fiszdon et al (2004) who also found significant effect sizes for verbal memory at follow up, 0.48 and 0.66 respectively. The current study did not find a significant effect for improvement on verbal learning and memory therefore we cannot compare the results based on hypothesis 3. Further studies which provide the necessary amount of rehabilitation in the area of verbal learning are required before testing the durability of the treatment.

Other cognitive functioning areas that have been found significant at follow up have included speed of processing with a large effect size of 0.86 in addition to average effect size for cognitive measures indicating a medium effect of 0.67 (Hogarty et al, 2005). The above studies are the only computer assisted follow up studies that have been conducted within the selected literature review (Appendix 7). Many of the studies administering follow ups were performed at 12 months post intervention which provides encouraging results regarding the benefits the treatment can have longer term. However, comparison of the results in light of previous research have meant that firm conclusions cannot be made based on the little evidence to date and further research is needed within this area.

Wykes and colleagues (2000) proposed that the durability of the intervention was associated with the initial deficits experienced by individuals with schizophrenia. They suggested that those with the least deficits had more durable effects in regards

to the intervention in comparison to individuals with greater cognitive deficits. They suggested that the latter individuals could learn and benefit from the treatment but the gains would not be durable. Little research has been conducted in this area and further studies are needed to support or disprove the effectiveness of the treatment in relation to the severity of patients' cognitive deficits.

Meta analysis performed by McGurk and colleagues (2005) found medium effect sizes regarding improvements on cognitive functioning. Follow up studies have indicated a medium effect size on sustainability of effects of cognitive rehabilitation on cognitive functioning (McGurk et al, 2005).

Krabbendam and Aleman in 2003 performed a quantitative analysis of controlled studies of cognitive remediation therapy. They concluded that many studies within this area have failed to produce follow up data. This has limited any firm conclusions that can be made about the durability of this intervention.

The follow up of the current study was limited to a 3 month follow up and further analysis should be undertaken to investigate the durability of the intervention at 12 months and more.

4.2 Clinical Implications

The results of the current study were encouraging regarding the effects cognitive rehabilitation interventions have upon cognitive functioning for patients with schizophrenia who have a forensic history. The intervention that was provided used the least amount of sessions needed to produce a positive effect and have found good

effect sizes on the significance of the treatment. Specific areas of cognitive functioning that had significant effects were attention, visual memory, visuo-spatial ability and some aspects of executive functioning. Areas of cognitive functioning that were not significantly improved were working memory, verbal learning and memory which has been indicated to be the result of the small number of sessions of the intervention. A recent meta-analysis performed by McGurk and colleagues in 2007 indicated that this cognitive skill requires more sessions of the intervention in order to find significant improvements. There was no distinction made between inpatients and outpatient performance as this suggests that this is a viable treatment regardless of patient status.

Krabbendam and Aleman (2003) indicated that this form of intervention has the potential to improve cognitive performances on tasks that were not used within the training intervention. This is in keeping with the data that has been discussed above. All of the above studies administered interventions that did not train individuals on a particular cognitive assessment. The interventions aimed to improve domains of intellectual functioning measured by cognitive assessments. Therefore skills performed within the intervention were transferrable to other tasks showing improved performance in these areas. Bell and colleagues (2001) have produced substantial evidence for the benefits of computer aided cognitive rehabilitation and showed significant improvements in various areas of cognitive functioning on tasks that had not been trained upon as part of the intervention. The current study utilised methodology in keeping with these findings as cognitive assessments were not included as practice tasks within the intervention process.

The benefits of psychiatric rehabilitation are limited by cognitive impairments associated with schizophrenia (McGurk et al, 2004; Mueser et al, 1991; Wykes et al, 1990). Neuropsychological assessments have indicated that patients with a history of violence have poorer performances on tests of executive functioning (Pantelis et al, 1997); memory and attention (Jones, 1992) and formation and planning (Morris et al, 1995). Therefore interventions that improve these domains of cognitive functioning may help decrease the risk of violence.

Violence amongst patients with schizophrenia has also been associated with employment status, poor insight and non-adherence to treatment (Soyka, 2000; Swartz et al, 1998). Cognitive domains such as executive functioning have been found to correlate with both lack of insight and non compliance with medication (Lysaker and Bell, 1995). Therefore any improvements that could be made in cognitive functioning may have an indirect effect upon symptoms.

A systematic review based upon the treatments that were administered to patients with schizophrenia to improve compliance with treatment found that psycho-education was ineffective (Zygmunt et al, 2002). The researchers found that strategies involving problem solving and motivational techniques were more effective. These interventions required patients to use cognitive skills such as problem solving, reasoning, memory and verbal skills. Interventions that target cognitive deficits may help improve the effectiveness of these techniques and other forms of rehabilitation. This could greatly benefit forensic rehabilitation

interventions in decreasing risk and recidivism by ensuring insight into the illness and treatment adherence.

Cognitive rehabilitation interventions have been found to have a significant effect on psychosocial functioning (McGurk et al, 2007). Patients with schizophrenia who have participated in cognitive remediation interventions showed greater improvements in obtaining and working in competitive jobs (McGurk et al, 2005; Vauth et al, 2005). Violence in patients with schizophrenia has also been associated with employment status (Soyka, 2000). Therefore interventions that can help facilitate patients obtaining and maintaining a job may also indirectly reduce the risk of future violence.

A recent meta-analysis (McGurk et al 2007) proposed that cognitive rehabilitation interventions may have an effect upon symptoms of psychosis because it could help individuals self esteem. This could be beneficial in helping patients attain personal goals and may improve symptoms of depression. This has been supported by studies that have found that cognitive rehabilitation interventions improved patients' mood (Belluci et al, 2002; McGurk et al, 2005; Wykes et al, 1999). In addition patients also reported better quality and satisfaction within their interpersonal relationships (Hogarty et al 2004) and were more capable in solving interpersonal problems (Spaulding et al, 1999).

Wykes and Reeder (2005) stated that the main rationale for cognitive intervention techniques aimed at improving cognitive functioning in schizophrenia is to improve

functioning and recovery. This research has been a first step towards demonstrating that cognitive rehabilitation interventions may make a significant difference in the functioning of patients within a forensic population. The next step in future research will be to focus on improving cognitive functioning alongside other rehabilitation treatments in terms of functional outcomes. Future research may also identify whether these treatments are cost effective for both patients, mental health services and NHS trusts.

4.3 Methodological Strengths and Limitations

4.3.1 Sample Population and Size.

The length of participants' involvement within the present study had a huge impact regarding predicted drop out rates. The study design made it difficult to continue recruitment after the study had commenced and relied upon those participants who began the study to complete it. However, the researcher continued to inform the relevant departments about the current study to recruit additional participants. The nature of the forensic services means that new patients and those suitable for interventions such as this are limited. Many new admissions were acutely unwell and therefore did not meet the current inclusion criteria. The length of time required for rehabilitation within forensic services meant that access to new patients was limited. In addition the mental health of existing patients may deteriorate.

Within the current study 17 participants out of 25 completed the intervention. Two individuals were withdrawn from the study at the mini assessment stage. One of the participants experienced a deterioration in their mental state and another individual

was transferred to a different hospital. Therefore, when it became evident that the sample comprised of 17 participants the time required to complete both the control and intervention phases prevented further recruitment within the study's time scale. The current study estimated that in order to reach power it required between 20 to 25 participants. The number of individuals that completed the intervention was 17, therefore the current study may be a little under power based on power calculations carried out during the planning of this research. However, a number of significant results were obtained within the current pilot but a larger sample may provide more robust evidence on the effectiveness of the intervention.

The current study has investigated cognitive remediation therapy with a new clinical population. Previous research that has been conducted on cognitive rehabilitation interventions and major mental illness has focused in the area of schizophrenia. The population within the present study may have more pronounced cognitive difficulties, which have been indicated within forensic populations (Fullam & Dolan, 2008; Krakowski et al, 1997). The findings within the current study provide encouraging results based on the significant effects that were found in a number of cognitive areas i.e. attention, visual memory, visuo-spatial abilities and aspects of executive functioning.

4.3.2 Design

The design of the current study implemented a control condition where individuals served as their own controls to demonstrate that the improvements in cognitive functioning were not due to the effects of time but a result of the intervention. This

design was selected due to the high level of recruitment that was needed for an independent groups design (approximately 40 patients in each group). These sample size figures were not deemed attainable within the current setting and therefore the study would not have reached adequate power to either obtain significant results or to see any improvements in cognitive functioning.

4.3.3 Sampling Bias

A strength of the current study was that the population consisted of both inpatients and outpatients. Therefore the gains observed appear to be beneficial for both types of patient care. Many previous studies using computerised cognitive rehabilitation have targeted only one type of patient status within this area which has usually been inpatients who have chronic illnesses (Bark et al, 2003; Bell et al, 2001; Bell et al, 2003; Burda et al, 1994; Medalia et al, 1998; Medalia et al, 2001; Sartory et al, 2005; Vaughn et al, 2005). The current study did not bias results by using only those individuals who had chronic difficulties. Only participants whose mental state was stable and who had been stabilised on their current medication were included within the study. The sample within the current study was forensic patients with schizophrenia, however the chronic nature of their disorder appeared quite similar to populations within previous research conducted in this area. Many of the studies included patients with both a diagnosis of schizophrenia and schizoaffective disorder. The mean age within the current study was 41.5, which was around the median age for studies using computer assisted cognitive rehabilitation interventions.

4.3.4 Recruitment Issues

Recruitment was effective as a result of the support that was obtained from the clinical teams working with the targeted population. It was envisaged that recruitment may have been poorer if presentations and awareness of this intervention had not been performed. This enabled the researcher to be confident that the consultant psychiatrists and other members of the team would provide information about the treatment and study to potential participants. Therefore the researcher was ensuring that ethical procedures regarding recruitment as set out by the ethical committee were adhered to.

4.3.5 Length and Number of sessions

The length and number of sessions offered within the present study were limited to ensure that participants would successfully complete the intervention and necessary outcome assessments. It was envisaged that a greater number of sessions would lead to higher drop out rates. The number of sessions in respect to the amount of time spent using the computer assisted intervention was within the time scales stated to produce a positive effect, but towards the lower end. McGurk and colleagues (2007) performed a meta-analysis on cognitive remediation therapy with schizophrenia and indicated that “a relatively limited amount of cognitive remediation (e.g. 5 to 15 hours) is sufficient to produce improved cognitive functioning” (pp.1799). The current study found that participants showed an improvement in cognitive functioning after receiving five hours of the intervention as measured by a number of outcome measures. However not all of the cognitive assessments found significant effects. Therefore the number of sessions administering the intervention may have

implications upon improvements in cognitive functioning. This has been found to be an important factor in respect to measures of verbal learning and memory (McGurk et al, 2007).

The amount of time that was invested by the researcher was great. Each of the participants were seen on a one to one basis for approximately 10 hours each. This contributed to almost 200 hours of participant contact and data gathering. The study was very labour intensive which resulted in the intervention only being administered on a weekly basis. Many of the previous studies administered the intervention during several occasions on a weekly basis (Bark et al, 2003; Bell et al, 2003; Belluci et al, 2002; Fiszdon et al, 2004; Lindenmayer et al, 2008; Sartory et al, 2005; Vaugh et al, 2005). This may have helped to maximise the benefits and produced greater improvements across all domains of cognitive functioning.

4.3.6 Practice Effects on Cognitive Assessments

Practice effects on cognitive assessments may have been a confounding factor for those assessments which did not have comparable or alternative versions of the original test, i.e. the Trail Making Tests Part A and B and the Modified Wisconsin Card Sorting Test. The results of these assessments have been closely analysed and practice effects appear to have been limited (see section 2.6). The only test that may have shown evidence of practice effects was the Trail Making Test Part B.

In respect to the possibility of practice effect on the TMT Part B these results may have been due to procedural learning. The inclusion criteria indicated that all

participants must be literate which was assessed during the recruitment stage of the research. However, it was evident that during Part B of the TMT test many participants had difficulty remembering numerical and alphabetical sequences in order. Many participants within the current study had poor academic histories and therefore the practice effects may have been the result of procedural learning, whereby the individuals learnt the order of the connections rather than where the items were placed on the page.

4.3.7 Examiner Effects

Within the current study all cognitive assessments and sessions of the intervention were carried out by the researcher. This has helped to reduce the likelihood of examiner effects caused by differential protocol and abilities that occurs during administration of assessments. This was highlighted as a limitation of the Trail making test which requires examiners to be vigilant of examinees errors and their ability to correct them efficiently. The speed of correction was an important aspect of the test, however the examiners method was consistent throughout the study reducing the presence of examiner effects.

The researcher was not aware of any negative effects as a result of having only one examiner within the current study, however this variable requires some consideration. Examiner effects may have been more evident if a number of different examiners had been involved in the study and could have presented as a possible variable in respect to participants performance during the research.

4.3.8 Intervention

The use of technology within the current study provided a non-threatening situation for the participants which many of the individuals stated they enjoyed. The Cogpack software enabled tasks to be replicated and adjusted to suit the participant's ability, which would not have been possible with pencil and paper tasks. The computer software provided reinforcement in the form of intrinsic rewards and these findings are in keeping with previous studies that used computer assisted cognitive rehabilitation (Field et al, 1997; Medalia et al, 1998). Therefore this form of intervention may have contributed to participants' engagement and continued attendance at sessions which was in keeping with previous study by Burda and colleagues (1994). They found that almost all of their participants were able to complete the required number of sessions and that attendance was very high.

Studies have shown that the use of computers to administer the cognitive remediation therapy was enthusiastically received by the patients (Bradt et al, 1993; Brief, 1994; Burda et al, 1991). It has been proposed that computers provide structured yet flexible training tasks with clear, accurate and immediate feedback. Belluci and colleagues (2002) suggested that this method may be less threatening to the patients. This may have been an important factor concerning engagement within the current study due to the forensic population. It is interesting to note that Bloom in 1992 found that patients who were quite disturbed were able to interact effectively with computers but were not able to have sessions with mental health professionals. This would be in keeping with the less threatening element and non-judgemental appraisal computers offer. Therefore computer assisted cognitive rehabilitation interventions

might be the way forward within this area especially in respect to populations where engagement may be difficult.

Research has indicated that basic levels of cognitive functioning such as attention and concentration responds best to continuous practice (Bell et al, 2001). However higher order tasks such as problem solving (Medalia et al, 2001) and executive functioning (Bellack et al, 1990) may be better improved with strategic methods of training (Bellack et al, 2005). Wykes and Reeder (2005) proposed that cognitive remediation treatments needed to place great importance on practicing skills and reinforcement. The cognitive rehabilitation software package 'Cogpack' that was used within the current study was predominantly based upon these principles. The effectiveness and acceptability of computer software should help to provide both of these attributes to achieve the best possible outcomes. Therefore computer software programmes may be the best medium to provide treatments such as cognitive rehabilitation interventions due to their high acceptability by patients and the barriers that can overcome in respect to their paper and pencil counterparts. Also a number of meta-analyses have found that they produce higher effect sizes in comparison to paper and pencil strategies (Suslow et al, 2001; Twamley et al, 2003).

4.4 Recommendations

This is the first known study using cognitive remediation therapy with a forensic population who have a diagnosis of schizophrenia. It is important that this study is replicated to provide supporting evidence of the benefits this intervention has within this population.

The current study administered the intervention in the shortest amount of sessions to produce a positive effect based on studies indicating the amount of cognitive rehabilitation therapy required (McGurk et al, 2007). Future studies should provide more sessions that occur more frequently to ensure that the maximum benefits of the intervention are achieved.

The amount of time required to administer the interventions and assessments made the study very labour intensive therefore the cost effectiveness of offering the intervention may require alternative arrangements such as offering it within a group context or employing additional staff.

The range of participants' abilities within the current study was highly heterogeneous. It may be beneficial to place individuals within groups of similar abilities to compare the effectiveness of the intervention across these groups in respect to the different classifications of schizophrenia and cognitive impairment (Fiszdon et al, 2006; Weickert et al, 2000;).

Future studies should administer cognitive assessments where alternative normed versions are available to enable repeated measurements to be conducted. In respect to the types of cognitive assessments administered one particular test may have been poorly selected in relation to the targeted population. Following the participants difficulties observed during the Trail Making Test Part B it was evident that although all of the individuals were literate, as required for the inclusion criteria, many had

difficulties recalling numerical and alphabetical sequences. The TMT Part B relies upon the English alphabet and is problematic when participants have language or reading disorders in addition to limited education (Lezak et al, 2004). The Color Trails Test (CTT) was created to allow application of the test to be used in cross-cultural contexts and it can also be used in population where language disorders or poor academic histories are present (Mitrushina et al, 2005). It relies on numbered coloured circles which are universal symbols rather than relying on English letters (Mitrushina et al, 2005). Therefore, future research should administer the CTT rather than the trail making test to ensure similar findings are not produced i.e. procedural learning which can produce practice effects.

Sharma and Antonova (2003) indicated that participants within rehabilitation studies are those who are the most impaired and least likely to improve as a result of the interventions. Many of the participants within the current study had long standing chronic psychiatric problems and had been involved with mental health services for many years. Therefore, if we are to accept the claims made by Sharma et al (2003) we would expect to see greater improvements in individuals who are experiencing their first psychotic episode. These types of interventions may be more beneficial within early intervention settings as cognitive functioning may not be as impaired in comparison to those with chronic illness. In addition these results may have important implications in respect to reducing risk of violence which has been related to executive functioning and insight related issues (Lysaker & Bell, 1995).

The results of the current study showed significant results on block design, TMT Part A, Rey CFT and aspects of the modified WCST. These assessments are based on visual processing, attention, learning and memory. The intervention was based significantly upon visual tasks and although tasks involving verbal and auditory elements were administered the amount of time dedicated to these tasks may have been influential on participants' performance on assessments measuring these skills. As discussed earlier, verbal domains are sensitive to the "method and extent of cognitive remediation" (McGurk et al, 2007, pp.1799). This indicated that the limited amount of time spent on auditory verbal tasks may have contributed to the lack of significant improvements upon auditory verbal assessments of cognitive functioning. Therefore future research should ensure that a greater amount of time is dedicated to the completion of verbal tasks administered by the intervention and to measure the benefits that could be achieved.

4.5 Conclusions

Schizophrenia and its associated cognitive deficits have been recognised as core symptoms which have great implications upon functional recovery, relative to the positive and negative symptoms of the disorder. Wykes and Reeder (2005) indicated that not all individuals with schizophrenia performed below the average range of intellectual intelligence, however they may have difficulties with particular domains of cognitive functioning. This is in keeping with the present study as not every individual's global IQ was impaired but cognitive deficits in memory, attention or executive functioning presented as a difficulty for some individuals.

The cognitive deficits experienced in patients with schizophrenia have a considerable impact upon functional outcomes. Schizophrenia is one of the most costly mental disorders to treat due to the debilitating effect it has upon the individual. Traditional treatments which have targeted positive and negative symptoms have had some good effects but have been limited in respect to functional outcomes. However research has shown that the functional outcomes of many patients with schizophrenia are associated more with the individuals' cognitive ability and the skills they require to maintain daily tasks. The field of cognitive remediation therapy based on the neurocognitive theory of schizophrenia has led to a surge of research within the last 20 years and produced various outcomes. Within the last 15 years, computer assisted cognitive rehabilitation software has been developed and administered within these studies.

Forensic patients with a diagnosis of schizophrenia have been found to have more pronounced cognitive deficits in comparison to patients with schizophrenia without a violent history (Buckley et al, 2004; Fullam & Dolan, 2008; Krakowski et al, 1997). The current study investigated this treatment as a pilot within this population. The results of the present study have shown that a limited amount of cognitive rehabilitation therapy can produce significant effects in areas of attention, visual memory, visuo-spatial perception and organisation and aspects of executive functioning. In respect to forensic populations this intervention may be particularly suitable to their needs.

These results provide encouragement for the benefits this intervention may have upon other forms of psychosocial treatments. Cognitive deficits also have an effect upon patients' ability to attend to information and learn, therefore making traditional rehabilitation interventions less effective (Mueser et al, 1991; Wykes, 1994).

Already it has been found that cognitive remediation therapy enables skills to be transferrable (Bellack et al, 2001), which may benefit the effectiveness of other forms of rehabilitation therapies within forensic populations.

This area requires further investigation to provide additional support on the effectiveness of this intervention within a forensic population. Other future research should examine the effects of the intervention on functional outcomes. Already the literature within schizophrenia and cognitive remediation therapy has shown promising results. Many studies have shown the benefits of this intervention on functional outcomes such as employment (Bell et al, 2001; McGurk et al, 2005; Penades et al, 2003).

Studies have also shown that the improvements achieved by cognitive rehabilitation therapies are sustainable and durable (Fiszdon et al, 2004). Cognitive remediation therapies may therefore be the way forward for individuals with schizophrenia who have a forensic history. These interventions may further assist rehabilitation by improving cognitive functioning and functional outcomes which may indirectly reduce risk and recidivism as a result of improving self esteem and insight.

Violence associated with mental illness continues to be a major issue. Government legislation and policies have been created based on single incidents carried out by a violent patient with mental illness. These interventions have already brought hope regarding the functional outcomes of patients with schizophrenia without a history of violence. Therefore these treatments may also be beneficial for forensic populations with schizophrenia in respect to recovery and risk.

REFERENCES

Adams, J.J., Meloy, J.R. & Moritz, M.S. (1990). Neuropsychological deficits and violent behavior in incarcerated schizophrenics. *Journal of Nervous and Mental Disease*, 178, 253-256.

American Psychiatric Association (APA). (2000). *Diagnostic and Statistical Manual of Mental Disorders*. Washington DC: APA.

Arango, C., Calcedo, B.A., Gonzalez, S. (1999). Violence in inpatients with schizophrenia: a prospective study. *Schizophrenia Bulletin*, 25, 493-503.

Armitage, S.G. (1946). An analysis of certain psychological tests used for the evaluation of brain injury. *Psychological Monographs*, 60, 1-47.

Axelrod, B.N. (2002). Validity of the Wechsler Abbreviated Scale of Intelligence and other very short forms of estimating intellectual functioning. *Assessment*, 9, 17-23.

Axelrod, B.N., Goldman, R.S. & Woodard, J.L. (1992). Inter-rater reliability in scoring the Wisconsin Card Sorting Test. *The Clinical Neuropsychologist*, 6, 143-155.

Baddeley, A. (1986). *Working Memory*. Oxford: Oxford Science Publications.

Bark, N., Revheim, N., Huq, F., Khalderov, V., Ganz, Z.W. & Medalia, A. (2003). The impact of cognitive remediation on psychiatric symptoms of schizophrenia. *Schizophrenia Research*, 63, 229-235.

Barkataki, I., Kumari, V., Das, M., Hill, M., Morris, R., O'Connell, P., Taylor, P. & Sharma, T. (2005). A neuropsychological investigation into violence and mental illness. *Schizophrenia Research*, 74, 1-13.

Bell, M., Bryson, G. & Wexler, B.E. (2003). Cognitive remediation of working memory deficits: durability of training effects in severely impaired and less severely impaired schizophrenia. *Acta Psychiatrica Scandinavica*, 108, 101-109.

Bell, M., Bryson, G., Greig, T., Corcoran, C. & Wexler, B.E. (2001). Neurocognitive Enhancement Therapy With Work Therapy: effects on neuropsychological test performance. *Archives of General Psychiatry*, 58, 763-768.

Bell, M.D., Bryson, G., Fiszdon, J.M., Greig, T. & Wexler, B.E. (2004). Neurocognitive enhancement therapy and work therapy in schizophrenia: work outcomes at 6 months and 12 month follow up. *Biological Psychiatry*, 55, 335-

Bellack, A.S. (1992). Cognitive rehabilitation for schizophrenia - is it possible - is it necessary. *Schizophrenia Bulletin*, 18, 43-50.

Bellack, A.S., Dickinson, D., Morris, S.E. & Tenhula, W.N. (2005). The Development of a Computer-Assisted Cognitive Remediation Program for Patients with Schizophrenia. *The Israel Journal of Psychiatry and Related Sciences*, 41(1), 5-14.

Bellack, A.S., Mueser, K.T., Morrison, R.L., Tierney, A. & Podell, K. (1990). Remediation of cognitive deficits in schizophrenia. *American Journal of Psychiatry*, 147, 1650-1655.

Bellack, A.S., Weinhardt, L.S., Gold, J.M. & Gearon, J.S. (2001). Generalization of training effects in schizophrenia. *Schizophrenia Research*, 48, 255-262.

Bellucci, D.M., Glaberman, K. & Haslam, N. (2002). Computer-assisted cognitive rehabilitation reduces negative symptoms in the severely mentally ill. *Schizophrenia Research*, 59, 225-232.

Benedict, R.H.B., Harris, A.E., Markow, T., McCormick, J.A., Nuechterlein, K.H. & Asarnow, R.F. (1994). Effects of attention training on information-processing in schizophrenia. *Schizophrenia Bulletin*, 20, 537-546.

Bennett, P. (2003). *Abnormal and Clinical Psychology. An Introductory Textbook*. Great Britain: Open University Press.

Bentall, R.P., Kinderman, P. & Kaney, S. (1994). The self, attributional processes and abnormal beliefs: towards a model of persecutory delusions. *Behavioural Research and Therapy*, 32, 331-341.

Berman, K.F., Ostrem, J.L. & Randolph, C. (1995). Physiological activation of a cortical network during performance of the Wisconsin Card Sorting Test: A positron emission tomography study. *Neuropsychologia*, 33, 1027-1046.

Berry, D.T.R., Allen, R.S. & Schmitt, F.A. (1991). Rey-Osterrieth Complex Figure: Psychometric characteristics in a geriatric sample. *Clinical Neuropsychologist*, 5(2), 143-153.

Bilder, R.M., Goldman, R.S., Robinson, D., Reiter, G., Bell, L., Bates, J.A., et al (2000). Neuropsychology of first-episode schizophrenia: Initial characterization and clinical correlates. *American Journal of Psychiatry*, 157, 549-559.

Bleuler, E. (1950). *Dementia Praecox or the Group of Schizophrenia*. New York: International Universities Press.

Bradshaw, T. (1995). Psychological Interventions with psychotic symptoms: a review. *Mental Health Nursing*, 15(4).

Bradt, S., Crilly, J. & Timvik, U. (1993). Computer training for the young adult patient with chronic mental illness. *Journal of Rehabilitation*, 59, 51-54.

- Braff, D.L. (1993). Information processing and attention dysfunctions in schizophrenia.. *Schizophrenia Bulletin*, 19, 233-259.
- Brenner, H., Roder, V., Hodel, B., Kienzle, N., Reed, D. & Liberman, R. (1994). *Integrated Psychological Therapy for Schizophrenic Patients*. Seattle: Hogrefe & Huber.
- Brieff, R. (1994). Personal computers in psychiatric rehabilitation: a new approach to skills training. *Hospital & Community Psychiatry*, 45, 257-260.
- Bryson, G., Whelahan, H.A. & Bell, M. (2001). Memory and executive function impairments in deficit syndrome schizophrenia. *Psychiatry Research*, 71, 29-37.
- Buchanan, R.W., Holstein, C. & Breier, A. (1994). The comparative efficacy and long-term effect of clozapine treatment on neuropsychological test performance. *Biological Psychiatry*, 36, 717-725.
- Buckely, R.F., Hrouda, D.R., Friedman, L., Noffsinger, S.G., Resnick, P.J. & Camlin-Shingler, K. (2004). Insight and its Relationship to Violent Behavior in Patients with Schizophrenia. *American Journal of Psychiatry*, 161, 1712-1714.
- Burda, P.C., Starkey, T.W. & Dominguez, F. (1991). Computer administered treatment of psychiatric inpatients. *Computers in Human Behavior*, 7, 1-5.

Burda, P.C., Starkey, T.W., Dominguez, F. & Vera, V. (1994). Computer-assisted cognitive rehabilitation of chronic psychiatric inpatients. *Computers in Human Behavior, 10*, 359-368.

Casey, M.B., Winner, E., Hurwitz, I. & DeSilva, D. (1991). Does processing style affect recall of the Rey-Osterrieth or Taylor Complex Figures? *Journal of Clinical and Experimental Neuropsychology, 13*, 600-606.

Cassidy, J.J., Easton, M., Capelli, C., Singer, A. & Bilodeau, A. (1996). Cognitive remediation of persons with severe and persistent mental illness. *Psychiatric Quarterly, 67*, 313-321.

Chong, S.A. (2008). Inclusion of cognitive impairment in the DSM diagnosis of schizophrenia: if not now, when? *World Psychiatry, 7*(1), 37-38.

Cicerone, K.D., Dahlberg, C., Kalmar, K., Langenbahn, D.M., Malec, J.F., Bergquist, T.F., et al. (2000). Evidence-based cognitive rehabilitation: recommendations for clinical practice. *Archives of Physical Medicine and Rehabilitation, 81*, 1596-1615.

Clarke-Carter, D. (2004). *Quantitative Psychological Research. A Student's Handbook*. New York: Psychology Press.

Cohen, J. (1969). *Statistical Power Analysis for the Behavioral Sciences*. New York: Academic Press.

Cohen, J. (1977). *Statistical Power Analyses for the Behavioral Sciences*. Hillsdale NJ: Lawrence Erlbaum Associates.

Crawford, J.R., Stewart, L.E. & Moore, J.W. (1989). Demonstration of savings on the AVLT and development of a parallel form. *Journal of Clinical and Experimental Neuropsychology*, *11*, 975-981.

Daniel, D.G., Goldberg, T.E., Weinberger, D.R., Kleinman, J.E., Pickar, D., Lubick, L.J. et al. (1996). Different side effect profiles of risperidone and clozapine in 20 outpatients with schizophrenia or schizoaffective disorder: a pilot study. *American Journal of Psychiatry*, *153*, 417-419.

Delahunty, A., Morice, R. & Frost, B. (1993). Specific cognitive flexibility rehabilitation in schizophrenia. *Psychological Medicine*, *23*, 221-227.

Delaney, R.C., Prevey, M.L., Cramer, J. & Mattson, R.H. (1992). Test-retest comparability and control subject data for the Rey Auditory-Verbal Learning Test and Rey-Osterrieth/Taylor complex figures.. *Archives of Clinical Neuropsychology*, *7*(6), 523-528.

Eronen, M. (1995). Mental disorders and homicidal behavior in female subjects. *American Journal of Psychiatry*, 152, 1216-1218.

Esposito, G., Kirkby, B.S. & Van Horn, J.D. (1999). Context dependent, neural system-specific neurophysiological concomitants of ageing: Mapping PET correlates during cognitive activation. *Brain*, 122, 963-979.

Falloon, I.R.H., Boyd, J.L., McGill, C.W., Rayani, J., Moss, H.B. & Gilberman, A.M. (1982). Family management in the prevention of exacerbations of schizophrenia: A controlled study. *New England Journal of Medicine*, 306, 1437-1440.

Field, C.D., Galletly, C., Anderson, D. & Walker, P. (1997). Computer-Aided Cognitive Rehabilitation: Possible Application to the Attentional Deficit of Schizophrenia, A Report of Negative Results. *Perceptual and Motor Skills*, 85, 995-1002.

Fiszdon, J.M., Bryson, G.J., Wexler, B.E. & Bell, M.D. (2004). Durability of cognitive remediation training in schizophrenia: performance on two memory tasks at 6-month and 12-month follow up. *Psychiatry Research*, 125, 1-7.

Fiszdon, J.M., Choi, J., Bryson, G.J. & Bell, M.D. (2006). Impact of intellectual status on response to cognitive task training in patients with schizophrenia. *Schizophrenia Research*, 87, 261-269.

Fullam, R.S. & Dolan, M.C. (2008). Executive function and in-patient violence in forensic patients with schizophrenia. *The British Journal of Psychiatry*, 193, 247-253.

Galletly, C.A., Clark, C.R., McFarlane, A.C. & Weber (1997). Relationships between changes in symptom ratings, neuropsychological test performance and quality of life in schizophrenic patients treated with clozapine. *Psychiatric Research*, 72, 161-166.

Garavan, J., Browne, S., Gervin, M. (1998). Compliance with neuroleptic medication in outpatients with schizophrenia: relationship to subjective response to neuroleptics; attitudes to medication and insight. *Comprehensive Psychiatry*, 39, 215-219.

Garfield, D.A.S., Rogoff, M.L. & Steinberg, S. (1987). Affect recognition and self-esteem in schizophrenia. *Psychopathology*, 20, 225-233.

Gold, J.M. (2004). Cognitive deficits as treatment targets in schizophrenia. *Schizophrenia Research*, 72, 21-28.

Gold, J.M., Carpenter, C., Randolph, C., Goldberg, T.E., & Weinberger, D.R. (1997). Auditory working memory and Wisconsin Card Sorting Test performance in schizophrenia. *Archives of General Psychiatry*, 54(2), 159-165.

Gold, J.M., Randolph, C., Carpenter, C.J., Goldberg, T.E. & Weinberger, D.R. (1992). Forms of memory failure in schizophrenia. *Journal of Abnormal Psychology*, *101*, 487-494.

Goldberg, T.E., Greenberg, R.D., Griffin, S.J., Gold, J.M., Kleinman, J.E., Pickar, D., Schulz, S.C. & Weinberger, D.R. (1993). The effect of clozapine on cognition and psychiatric symptoms in patients with schizophrenia. *British Journal of Psychiatry*, *162*, 43-48.

Goldberg, T.E., Saint-Cry, J.A. & Weinberger, D.R. (1990). Assessment of procedural learning and problem solving in schizophrenia patients by Tower of Hanoi type tasks. *Journal of Neuropsychiatry and Clinical Neuroscience*, *2*, 165-173.

Goldberg, T.E., Weinberger, D.R., Berman, K.F., Pliskin, N.H. & Podd, M.H. (1987). Further evidence of dementia of the prefrontal type in schizophrenia? A controlled study of teaching the Wisconsin Card Sorting Test.. *Archives of General Psychiatry*, *44*, 1008-1014.

Golden, C.J., Jackson, M.L., Peterson-Rohne, A. & Gontkovsky, S.T. (1996). Neuropsychological Correlates of Violence and Aggression: A Review of the Clinical Literature. *Aggression and Violent Behavior*, *1*(1), 3-25.

Goldman-Rakic, P.S. (1991). Prefrontal cortical dysfunction in schizophrenia: The relevance of working memory. In B.J. Carroll & J.E. Barrett (Eds) *Psychopathology and the Brain* (pp.1-23). New York: Raven Press.

Goldstein, M.J. (1984). Family intervention programs. In A.S. Bellack. *Schizophrenia: Treatment, Management, and Rehabilitation* (pp.281-305). Orlando FL: Grune & Stratton.

Grace, J., Bellus, S.B., Raulin, M.L., Herz, M.I., Priest, B.L., Brenner, V., Donnelly, K., Smith P. & Gunn, S. (1996). Long-term impact of clozapine and psychosocial treatment on psychiatric symptoms and cognitive functioning. *Psychiatric Services*, 47, 41-45.

Grafman, J., Jonas, B. & Salazar, A. (1990). Wisconsin Card Sorting Test performance based on location and size of neuroanatomical lesion in Vietnam veterans with penetrating head injury. *Perceptual and Motor Skills*, 71, 1120-1122.

Green, M.F. (1996). What are the functional consequences of neurocognitive deficits in schizophrenia? *American Journal of Psychiatry*, 153, 321-330.

Green, M.F. & Nuechterlein, K.H. (1999). Should schizophrenia be treated as a neurocognitive disorder? *Schizophrenia Bulletin*, 25(2), 309-311.

Green, M.F., Kern, R.S., Braff, D.L. & Mintz, J. (2000). Neurocognitive deficits and functional outcome in schizophrenia: Are we measuring the "right stuff"?

Schizophrenia Bulletin, 26, 119-136.

Greig, T.C., Zito, W., Wexler, B.E., Fiszdon, J. & Bell, M.D. (2007). Improved cognitive function in schizophrenia after one year of cognitive training and vocational services. *Schizophrenia Research*, 96, 156-161.

Haddock, G. & Slade, P. (1996). *Cognitive-Behavioural Interventions with Psychotic Disorders*. Routledge, UK.

Hafner, H. (2003). Gender differences in schizophrenia. *Psychoneuroendocrinology*, 28(2), 17-54.

Hafner, H., Riecher-Rossler, A., Hambrecht, M., Maurer, K., Meissner, S., Schmidtke, A., et al. (1992). IRAOS: an instrument for the assessment of onset and early course of schizophrenia. *Schizophrenia Research*, 6, 209-223.

Hagger, C., Buckley, P., Kenny, J.T., Friedman, L., Ubogy, D. & Meltzer, H.Y. (1993). Improvement in cognitive functions and psychiatric symptoms in treatment refractory schizophrenia patients receiving clozapine. *Biological Psychiatry*, 34, 702-712.

Hambrecht, M., Maurer, K., Sartorius, N. & Hafner, H. (1992). Transnational stability of gender differences in schizophrenia? An analysis based on the WHO study on determinants of outcome of severe mental disorders. *European Archives of Psychiatry and Clinical Neuroscience*, 242, 6-12.

Hamby, S.L., Wilkins, J.W. & Barry, N.S. (1993). Organizational quality on the Rey-Osterrieth and Taylor Complex Figure tests: A new scoring system. *Psychological Assessment*, 5, 27-33.

Harvey, P.D. (2001). Cognitive impairment in elderly patients with schizophrenia: age related changes. *International Journal of Geriatric Psychiatry*, 16(S1), S78-S85.

Harvey, P.D. & Keefe, R.S. (2001). Studies of cognitive change in patients with schizophrenia following novel antipsychotic treatment. *American Journal of Psychiatry*, 158, 176-184.

Harvey, P.D., Green, M.F., Keefe, R.S. & Velligan, D.I. (2004). Cognitive functioning in schizophrenia: a consensus statement on its role in the definition and evaluation of effective treatments for the illness. *Journal of Clinical Psychiatry*, 65, 361-372.

Hayes, R.L. & McGrath, J.J. (2000). Cognitive rehabilitation for people with schizophrenia and related conditions. *Cochrane Database of Systematic Reviews*, (3),

Heaton, R., Paulsen, J.S., Mcadams, L.A. Kuck, J., Zisook, S., Braff, D., et al. (1994). Neuropsychological deficits in schizophrenics - relationship to age, chronicity and dementia. *Archives of General Psychiatry*, 51, 469-476.

Hegarty, J.D., Baldessarini, R.J., Tohen, M., Wateraux, C. & Oepen, G. (1994). One hundred years of schizophrenia: a meta-analysis of the outcome literature. *American Journal of Psychiatry*, 151, 1409-1416.

Heinrichs, R.W. & Zakzanis, K.K. (1998). Neurocognitive deficit in schizophrenia: a quantitative review of the evidence. *Neuropsychology*, 12, 426-445.

Heydebrand, G. (2007). Issues in Rehabilitation of Cognitive Deficits in Schizophrenia: A Critical Review. *Current Psychiatry Reviews*, 3, 186-195.

Hoff, A., Faustman, W., Wieneke, M., Espinoza, S., Costa, M., Wolkowitz, O. & Csernansky, J. (1996). The effect of clozapine on symptom reduction neurocognitive function and clinical management in treatment refractory state hospital schizophrenic inpatients. *Neuropsychopharmacology*, 15, 361-369.

Hoffman, H. & Kupper, Z. (1997). Relationships between social competence, psychopathology and work performance and their predictive value for vocational rehabilitation of schizophrenic outpatients. *Schizophrenia Research*, 23(1), 69-70.

Hogarty, G.E. & Flesher, S. (1999). Developmental theory of a cognitive enhancement therapy of schizophrenia. *Schizophrenia Bulletin*, 25, 677-692.

Hogarty, G.E., Flesher, S., Ulrich, R., Carter, M., Greenwald, D., Pogue-Geile, M. et al. (2004). Cognitive Enhancement Therapy for Schizophrenia. Effects of a 2-Year Randomised Trial on Cognition and Behavior. *Archives of General Psychiatry*, 61, 866-876.

Hoptman, M.J., Volavka, J., Johnson, G., Weiss, E., Bilder, R.M. & Lim, K.O. (2002). Frontal white matter microstructure, aggression, and impulsivity in men with schizophrenia: a preliminary study. *Biological Psychiatry*, 2, 9-14.

Hublely, A.M. & Tremblay, D. (2002). Comparability of total score performance on the Rey-Osterrieth Complex Figure and a modified Taylor Complex Figure. *Journal of Clinical and Experimental Neuropsychology*, 24(3), 370-382.

Jablensky, A. (2000). Epidemiology of schizophrenia: the global burden of disease and disability. *European Archives of Psychiatry and Clinical Neuroscience*, 250, 274-285.

Janowsky, J.S., Shimamura, A.P., Kritchevsky, M. & Squire, L.R. (1989). Cognitive impairment following frontal lobe damage and its relevance to human amnesia. *Behavioral Neuroscience*, 103, 548-560.

Jones, H. (1992). Neuropsychology of violence. *Forensic Reports*, 5, 221-233.

Keefe, R.S.E (2008). Should cognitive impairment be included in the diagnostic criteria for schizophrenia? *World Psychiatry*, 7, 22-28.

Keefe, R.S.E., Lees Roitman, S.E., Harvey, P.D., Blum, C., DuPre, R.L., Davidson, M. & Davis, K.L. (1995). A pen-and-paper human analogue of a monkey prefrontal cortex activation task: spatial working memory in patients with schizophrenia.. *Schizophrenia Research*, 17, 25-33.

Keefe, R.S.E., Silva, S.G., Perkins, P.O. & Lieberman, J.A. (1999). The effects of atypical antipsychotic drugs on neurocognitive impairment in schizophrenia. A review and meta-analysis. *Schizophrenia Bulletin*, 25(2), 210-222.

Kenny, J.T. & Meltzer, H.Y. (1991). Attention and higher cortical functions in schizophrenia. *Journal of Neuropsychiatry and Clinical Neuroscience*, 3, 269-275.

Kibby, M.Y., Schmitter-Edgecombe, M. & Long, C.J. (1998). Ecological validity of neuropsychological tests: Focus on the California Verbal Learning Test and the Wisconsin Card Sorting Test. *Archives of Clinical Neuropsychology*, 13, 523-534.

Koh, S.D., Kayton, L. & Berry, R. (1973). Mnemonic organisation in young non-psychotic schizophrenics. *Journal of Abnormal Psychology*, 81, 299-310.

Krabbendam, L. & Aleman, A. (2003). Cognitive rehabilitation in schizophrenia: a quantitative analysis of controlled studies. *Psychopharmacology*, 169, 376-382.

Krakowski, M., Czobor, P. & Chou, C.Y. (1999). Course of Violence in Patients With Schizophrenia: Relationship to Clinical Symptoms. *Schizophrenia Bulletin*, 25(3), 505-517.

Krakowski, M., Czobor, P., Carpenter, M.D., Libiger, J., Kunz, M., Papezova, H., Parker, B.B., Schmader, L. & Abad, T. (1997). Community violence and inpatient assaults: neurobiological deficits. *Journal of Neuropsychiatry and Clinical Neuroscience*, 9, 549-555.

Krakowski, M.I., Convit, A., Jaeger, J., Lin, S. & Volavka, J. (1989). Neurological impairment in violent schizophrenic inpatients. *American Journal of Psychiatry*, 146, 849-853.

Kremen, W.S., Seidman, L.J., Faraone, S.V. & Tsuang, M.T. (2001). 'Intelligence quotient and neuropsychological profiles in patients with schizophrenia and in normal volunteers'. *Biological Psychiatry*, 50(6), 453-462.

Kuipers, E., Garety, P., Fowler, D., Dunn, G., Debbington, P.E., Freeman, D. et al. (1997). The London-East Anglia randomised controlled trial of cognitive behaviour therapy for psychosis. I: Effects of the treatment phase. *British Journal of Psychiatry*, 171, 319-327.

Kuipers, E., Fowler, D., Garety, G., Chisholm, D., Feeman, D., Dunn, G. et al. (1998). The London-East Anglia randomised controlled trial of cognitive behaviour therapy for psychosis. III: Follow up and economic evaluation at 18 months. *British Journal of Psychiatry*, *173*, 61-68.

Kuperberg, G. & Heckers, S. (2000). Schizophrenia and cognitive function. *Current opinion in Neurobiology*, *10*, 205-210.

Kurtz, M.M., Moberg, P.J., Gur, R.C. & Gur, R.E. (2001). Approaches to Cognitive Remediation of Neuropsychological Deficits in Schizophrenia: A Review and Meta-Analysis. *Neuropsychology Review*, *11*(4), 197-210.

Kurtz, M.W., Seltzer, J.C., Shagan, D.S., Thime, W.R. & Wexler, B.E. (2007). Computer-assisted cognitive remediation in schizophrenia: What is the active ingredient? *Schizophrenia Research*, *89*, 251-260.

Lafayette, J.M., Frankle, W.G., Pollock, A., Dyer, K. & Goff, D.C. (2003). Clinical Characteristics, Cognitive Functioning, and Criminal Histories of Outpatients With Schizophrenia. *Psychiatric Services*, *54*(12), 1635-1640.

Lapierre, D., Braun, C.M., Hodgins, S., Toupin, J., Leveillee, S. & Constantineau, C. (1995). Neuropsychological correlates of violence in schizophrenia. *Schizophrenia Bulletin*, *21*, 253-262.

Larrabee, G.J. & Kane, R.L. (1986). Reversed digit repetition involves visual and verbal processes. *International Journal of Neuroscience*, 30, 11-15.

Lee, G.P., Loring, D.W. & Thompson, J.L. (1989). Construct validity of material-specific memory measures following unilateral temporal lobe ablations. *Psychological Assessment*, 1, 192-197.

Lehman, A.F., Goldberg, R., Dixon, L.B., McNary, S., Postrado, L., Hackman, A., & McDonnell, K. (2002). Improving employment outcomes for persons with severe mental illnesses. *Archives of General Psychiatry*, 59, 165-172.

Lezak, M.D. (1982). The test-retest stability and reliability of some tests commonly used in neuropsychological assessment. In: *Paper presented at the Fifth European Conference of the International Neuropsychological Society* (1982).

Lezak, M.D. (1995). *Neuropsychological Assessment*. (3rd ed). New York: Oxford University Press.

Lezak, M.D., Howieson, D.B. & Loring, D.W. (2004). *Neuropsychological Assessment*. (4th ed). New York: Oxford University Press.

Liddle, P.F. (2000). Cognitive impairment in schizophrenia: its impact of social functioning. *Acta Psychiatrica Scandinavica*, 101(400), 11-16.

Lindenmayer, J.P., McGurk, S.R., Mueser, K.T., Khan, A., Wance, D., Hoffman, L. et al. (2008). A Randomised Controlled Trial of Cognitive Remediation Among Inpatients With Persistent Mental Illness. *Psychiatric Services*, 59(3), 241-247.

Lineweaver, T.T., Bondi, M.W., Thomas, R.G. & Salmon, D.P. (1999). A normative study of Nelson's (1976) modified version of the Wisconsin Card Sorting Test in healthy older adults. *Clinical Neuropsychologist*, 13(3), 328-347.

Link, B.G., Stueve, A. & Phelan, J. (1998). Psychotic symptoms and violent behaviors: probing the components of "threat/control-over-ride" symptoms. *Social Psychiatry and Psychiatric Epidemiology*, 33(suppl 1), S55-S60.

Little, M.M., Williams, J.M. & Long, C.J. (1986). Clinical memory tests and everyday memory. *Archives of Clinical Neuropsychology*, 1, 323-333.

Loring, D.W., Martin, R.C., Meador, K.J. & Lee, G.P. (1990). Psychometric construction of the Rey-Osterrieth Complex Figure: Methodological consideration and interrater reliability. *Archives of Clinical Neuropsychology*, 5, 1-14.

Lysaker, P. & Bell, M. (1995). Work rehabilitation and improvements in insight in schizophrenia. *Journal of Nervous and Mental Disease*, 183, 103-106.

Mangalore, R. & Knapp, M. (2006, October 8). *Cost of Schizophrenia in England*. Canterbury: Personal Social Services Resource Unit.

Marder, S.R. (2006). Initiatives to promote the discovery of drugs to improve cognitive function in severe mental illness. *Journal of Clinical Psychiatry*, 67(Suppl 9), 31-35.

McGhie, A. & Chapman, J. (1961). Disorders of attention and perception in early schizophrenia. *British Journal of Medical Psychology*, 34, 103-113.

McGrath, J.J. (2006). Variations in the incidence of schizophrenia: data versus dogma. *Schizophrenia Bulletin*, 32, 195-197.

McGurk, S.R., Mueser, K.T. & Pascaris, A. (2005). Cognitive Training and Supported Employment for Persons With Severe Mental Illness: One Year Results From a Randomised Controlled Trial. *Schizophrenia Bulletin*, 31(4), 898-909.

McGurk, S.R., Twamley, E.W., Sitzer, D.I., McHugo, G.J. & Mueser, K.T. (2007). A Meta-Analysis of Cognitive Remediation in Schizophrenia. *The American Journal of Psychiatry*, 164(12), 1791-1802.

Meador, K.J., Moore, E.E., Nicols, M.E., Abney, O.L., Taylor, H.S., Zamrini, E.Y. & Loring, D.W. (1993). The role of cholinergic systems in visuospatial processing and memory. *Journal of Clinical and Experimental Neuropsychology*, 15, 832-842.

Medalia, A., Aluma, M., Tryon, W. & Merriam, A.E. (1998). Effectiveness of attention training in schizophrenia. *Schizophrenia Bulletin*, 24, 147-152.

Medalia, A., Revheim, N. & Casey, M. (2001). The remediation of problem-solving skills in schizophrenia. *Schizophrenia Bulletin*, 27, 259-267.

Meltzer, H.Y. (2001). Treatment of suicidality in schizophrenia. *Annals of New York Academy of Sciences*, 932, 44-58.

Meltzer, H.Y. & McGurk, S.R. (1999). The Effects of Clozapine, Risperidone and Olanzapine on Cognitive Function in Schizophrenia. *Schizophrenia Bulletin*, 25, 233-254.

Metz, J.T., Johnson, M.D., Pliskin, N.H. & Luchins, D.J. (1994). Maintenance of training effects on the Wisconsin Card Sorting Test performance by patients with schizophrenia or affective disorders. *American Journal of Psychiatry*, 151, 120-122.

Milner, B. (1963). Effects of different brain lesions on card sorting. *Archives of Neurology*, 9, 90-100.

Mitrushina, M., Boone, K.B., Razani, J. & D'Elia, L.F. (2005). *Handbook of Normative Data for Neuropsychological Assessment*. New York: Oxford University Press, Inc.

Mohamed, S., Paulsen, J.S., O'Leary, D., Arndt, S. & Andreasen, N. (1999). Generalized Cognitive Deficits in Schizophrenia: A Study of First-Episode Patients. *Archives of General Psychiatry*, 56, 749-754.

Morris, R.G., Rushe, T., Woodruffe, P.W., Murray, R.M. (1995). Problem solving in schizophrenia: a specific deficit in planning ability. *Schizophrenia Research*, 14, 235-246.

Mueller, B., Sartory, G. & Bender, S. (2004). Neuropsychological deficits and concomitant clinical symptoms in schizophrenia. *European Journal of Psychology*, 9, 96-106.

Mueser, K.T., Bellack, A.S., Douglas, M.S. & Wade, J.H. (1991). Prediction of social skill acquisition in schizophrenic and major affective-disorder patients from memory and symptomatology. *Psychiatry Research*, 37, 281-296.

Mueser, K.T., Sturt, E., Douglas, M.S. & Wade, J.H. (1991). Prediction of social skill acquisition in schizophrenia and major affective disorder patients from memory and symptomatology. *Psychiatry Research*, 37, 281-296.

Nanko, S. & Moridaira, J. (1993). Reproductive rates in schizophrenic outpatients. *Acta Psychiatrica Scandinavica*, 87, 400-404.

Naudts, K. & Hodgins, S. (2006). Neurobiological Correlates of Violent Behavior Among Persons With Schizophrenia. *Schizophrenia Bulletin*, 32(3), 562-572.

Niendam, T.A., Bearden, C.E., Rosso, I.M., Sanchez, L.E., Hadley, T., Nuechterlein, K.H. & Cannon, T.D. (2003). A prospective study of childhood neurocognitive functioning in schizophrenic patients and their siblings. *American Journal of Psychiatry*, *160*, 2060-2062.

Nieuwenstein, M.R., Aleman, A. & de Haan, E.H.F. (2001). Relationship between symptom dimensions and neurocognitive functioning in schizophrenia: a meta-analysis of WCST and CPT. *Journal of Psychiatric Research*, *35*, 119-125.

Nuechterlein, K.H. & Dawson, M.E. (1984). Information processing and attentional functioning in the developmental course of schizophrenic disorders. *Schizophrenia Bulletin*, *10*, 160-203.

Olbrich, R. & Mussgay, L. (1991). Reduction of schizophrenic deficits by cognitive training: an evaluation study. *European Archives of Psychiatry and Clinical Neuroscience*, *239*, 366-369.

Palmer, B.W., Heaton, R.K., Paulsen, J.S., Kuck, J., Braff, D., Harris, M.J., Zisook, S. & Jeste, D.V. (1997). 'Is it possible to be schizophrenic yet neuropsychologically normal?' *Neuropsychology*, *11*, 437-446.

Pantelis, C., Barnes, T.R., Nelson, H.E., Tanner, S., Weatherley, L., Owen, A.M. & Robbins, T.M. (1997). Frontal-striatal cognitive deficits in patients with chronic schizophrenia. *Brain*, *120*, 1823-1843.

Paulsen, J.S., Heaton, R.K., Sadek, J.R., Perry, W., Delis, D.C., Braff, D., Kuck, J., Zisook, S., & Jeste, D.V. (1995). The nature of learning and memory impairments in schizophrenia. *Journal of the International Neuropsychology Society*, *1*, 88-99.

Pedersen, C.B. & Mortensen, P.B. (2001). Evidence of a dose-response relationship between urbanicity during upbringing and schizophrenia risk. *Archives of General Psychiatry*, *58*, 1039-1046.

Peirson, A.R. & Jansen, P. (1997). Comparability of the Rey-Osterrieth and Taylor forms of the Complex Figure Test. *Clinical Neuropsychologist*, *11*(3), 244-248.

Penades, R., Boget, Catalan, R., Bernardo, M., Gasto, C. & Salamero, M. (2003). Cognitive mechanisms, psychosocial functioning, and neurocognitive rehabilitation in schizophrenia. *Schizophrenia Research*, *63*, 219-227.

Penades, R., Catalan, R., Salamero, M., Boget, T., Puig, O., Guarch, J. & Gasto, C. (2006). Cognitive Remediation Therapy for outpatients with chronic schizophrenia: A controlled and randomized study. *Schizophrenia Research*, *87*, 323-331.

Pendleton, M.G. & Heaton, R.K. (1982). A comparison of the Wisconsin Card Sorting Test and the Category Test. *Journal of Clinical Psychology*, *38*, 392-396.

Picchioni, M.M. & Murray, R.M. (2007). Schizophrenia. *British Medical Journal*, *335*, 91-95.

Psychological Corporation (The) (2001). *Wechsler Test of Adult Reading*. San Antonio, TX: Harcourt Assessment.

Psychological Corporation (The) (1997). *WAIS-III technical manual*. San Antonio, TX: The Psychological Corporation.

Rasmussen, K., Levander, S. & Sletvold, H. (1995). Aggressive and non-aggressive schizophrenics: symptom profile and neuropsychological differences. *Psychology, Crime & Law*, 2, 119-129.

Rawlings, D.B. & Crewe, N.M. (1992). Test-retest practice effects and test score changes of the WAIS-R in recovering traumatically brain-injured survivors. *The Clinical Neuropsychologist*, 6, 415-430.

Reitan, R. (1958). Validity of the trail making test as an indicator of organic brain damage. *Perceptual and Motor Skills*, 8, 271-276.

Rempfer, M., Hamera, E., Brown, C. & Cromwell, R. (2003). The relations between cognition and the independent living skill of shopping in people with schizophrenia. *Psychiatry Research*, 117, 103-112.

Roder, V., Mueller, D.R., Mueser, K.T. & Brenner, H.D. (2006). Integrated psychological therapy (IPT) for schizophrenia: is it effective? *Schizophrenia Bulletin*, 32(Suppl 1), S81-S93.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton: Princeton University Press.

Rossi, A., Arduini, L., Daneluzzo, E., Bustini, M., Prosperini, P. & Stratta, P. (2000). Cognitive function in euthymic bipolar patients, stabilized schizophrenic patients, and healthy controls. *Journal of Psychiatric Research*, 34, 333-339.

Roy, S., Herrera, J., Parent, M. & Costa, J. (1987). Violent and nonviolent schizophrenic patients clinical and developmental characteristics. *Psychological Reports*, 61, 855-861.

Rund, B.R.& Borg, N.E. (1999). Cognitive deficits and cognitive training in schizophrenic patients: a review. *Acta Psychiatrica Scandinavica*, 100, 85-95.

Ryan, J.J., Geisser, M.E., Randall, D.M. & Georgemiller, R.J. (1986). Alternate form reliability and equivalency of the Rey Auditory Verbal Learning Test. *Journal of Clinical and Experimental Neuropsychology*, 8, 611-616.

Sartory, G., Zorn, C., Groetzinger, G. & Windgassen, K. (2005). Computerized cognitive remediation improves verbal learning and processing speed in schizophrenia. *Schizophrenia Research*, 75, 219-223.

Saykin, A.J., Gur, R.C., Gur, R.E., Mozley, P.D., Mozley, L.H., Resnick, S.M., Kester, D.B., & Stafiniak, P. (1991). Neuropsychological function in schizophrenia: selective impairment in memory and learning. *Archives of General Psychiatry*, *48*, 618-624.

Saykin, A.J., Shtasel, D.L., Gur, R.E., Kester, D.B., Mozley, L.H., Resnick, S.M., Kester, D.B. & Stafiniak, P. (1994). Neuropsychological deficits in neuroleptic naive patients with first-episode schizophrenia. *Archives of General Psychiatry*, *51*, 124-131.

Scott, J. (1993). Homelessness and mental illness. *British Journal of Psychiatry*, *162*, 314-324.

Scottish Intercollegiate Guidelines Network (1998) (SIGN) Guidelines 30
Psychosocial interventions for the management of Schizophrenia. Edinburgh, UK:
SIGN,.

Seidman, L.J., Lanca, M., Kremen, W.S., Faraone, S.V. & Tsuang, M.T. (2003). Organizational and Visual Memory Deficits in Schizophrenia and Bipolar Psychoses Using the Rey-Osterrieth Complex Figure: Effects of Duration of Illness. *Journal of Clinical and Experimental Neuropsychology*, *25*(7), 949-964.

Sharma, T. & Antonova, L. (2003). Cognitive function in schizophrenia. Deficits, functional consequences and future treatment. *Psychiatric Clinics of North America*, 26, 25-40.

Sharma, T. & Harvey, P.D. (2000). Cognition in Schizophrenia. Impairments, Importance and Treatment Strategies. In T. Sharma & P. Harvey (Eds.) *Cognition and Schizophrenia: Impairments, Importance and Treatment Strategies* (pp.286-302). Oxford: Oxford University Press.

Shum, D.H.K., McFarland, K.A. & Bain, J.D. (1990). Construct validity of eight tests of attention: Comparison of normal and closed head injured samples. *The Clinical Neuropsychologist*, 4, 151-162.

Silverstein, S.M., Schenkel, C.V. & Nuernberger, S.W. (1998). Cognitive deficits and psychiatric rehabilitation outcomes in schizophrenia. *Psychiatric Quarterly*, 69, 169-191.

Soyka, M. (2000). Substance misuse, psychiatric disorder and violent and disturbed behaviour. *British Journal of Psychiatry*, 176, 345-350.

Spaulding, W.D., Fleming, S.K., Reed, D., Sullivan, M., Storzabach, D. & Lam, M. (1999). Effects of cognitive treatment in psychiatric rehabilitation. *Schizophrenia Bulletin*, 25, 657-676.

Spitzer, M. (1993). The psychopathology, neuropsychology and neurobiology of associative and working memory in schizophrenia. *European Archives of Psychiatry and Clinical Neuroscience*, 243, 57-70.

Spohn, H.E. & Strauss, M.E. (1989). Relation of neuroleptic and anticholinergic medication to cognitive functions in schizophrenia. *Journal of Abnormal Psychology*, 98, 367-380.

Spring, B., Lemon, M. & Fergeson, P. (1990). Vulnerabilities to schizophrenia: Information processing markers. In E.R. Straube & K. Hahlweg (Eds.) *Schizophrenia: Concepts, Vulnerability, and Intervention* (pp.97-114). Heidelberg: Springer-Verlag.

Spring, B.J. & Ravdin, L. (1992). Cognitive Remediation in Schizophrenia: Should We Attempt It?. *Schizophrenia Bulletin*, 18(1), 15-20.

Startup, M. (1996). Insight and cognitive deficits in schizophrenia: evidence for a curvilinear relationship. *Psychological Medicine*, 26, 1277-1281.

Stevens, J.P. (2002). *Applied multivariate statistics for the social sciences*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Stone, M., Gabrieli, J.D.E., Stebbins, G.T. & Sullivan, E.V. (1998). Working and strategic memory deficits in schizophrenia. *Neuropsychology*, *12*, 278-288.

Strauss, E., Sherman, E.M.S. & Spreen, O. (2006). *A Compendium of Neuropsychological Tests. Administration, Norms and Commentary*. New York: Oxford University Press.

Stuss, D.T., Kaplan, E.F., Benson, D.F., Weir, W.S., Chiulli, S. & Sarazin, F.F. (1982). Evidence for the involvement of orbitofrontal cortex in memory functions: an interference effect. *Journal of comparative and physiological psychology*, *96*, 913-925.

Sullivan, E.V., Mathalon, D.H., Ha, C.N., Zipursky, R.B. & Pfefferman, A. (1992). The contribution of constructional accuracy and organizational strategy to nonverbal recall in schizophrenia and chronic alcoholism.. *Biological Psychiatry*, *32*, 312-333.

Suslow, T., Schonauer, K. & Arolt, V. (2001). Attention training in the cognitive rehabilitation of schizophrenic patients: a review of efficacy studies. *Acta Psychiatrica Scandinavica*, *103*, 15-23.

Swanson, J.W., Holzer, C.E., Ganju, V.K. & Jono, R.T. (1990). Violence and Psychiatric Disorder in the Community: Evidence From the Epidemiologic Catchment Area Surveys . *Hospital and Community Psychiatry*, *41*, 761-770.

Swartz, M.S., Swanson, J.W., Hiday, V.A., Borum, R., Wagner, H.R. & Burns, B.J. (1998). Violence and Severe Mental Illness: The Effects of Substance Abuse and Nonadherence to Medication. *American Journal of Psychiatry*, 155, 226-231.

Taylor, P.J. (2008). Psychosis and Violence: Stories, Fears, and Reality. *The Canadian Journal of Psychiatry*, 53(10), 647-659.

Tiihonen, J., Eronen, M., & Hakola, P. (1993). Criminality associated with mental disorders and intellectual deficiency. *Archives of General Psychiatry*, 50, 917-918.

Tombaugh, T.N. & Hubley, A.M. (1991). Four studies comparing the Rey-Osterrieth and Taylor Complex Figures. *Journal of Clinical and Experimental Neuropsychology*, 13, 587-599.

Twamley, E.W., Jeste, D.V. & Bellack, A.S. (2003). A review of cognitive training in schizophrenia. *Schizophrenia Bulletin*, 29, 359-382.

Ueland, T. & Rund, B.R. (2005). Cognitive remediation for adolescents with early onset psychosis: a 1-year follow-up study. *Acta Psychiatrica Scandinavica*, 111, 193-201.

Vaugh, R., Corrigan, P.W., Clauss, M., Dietl, M., Dreher-Rudolph, M., Stieglitz, R.D. et al. (2005). Cognitive Strategies Versus Self-Management Skills as Adjunct to Vocational Rehabilitation. *Schizophrenia Bulletin*, 31(1), 55-66.

Velligan, D.I., Mahurin, R.K., Diamond, P.L., Hazleton, B.C., Eckert, S.L. & Muller, A.L. (1997). The functional significance of symptomatology and cognitive function in schizophrenia. *Schizophrenia Research*, 25, 21-31.

Voruganti, L.N., Heslegrave, R.J. & Awad, A.G. (1997). Neurocognitive correlates of positive and negative syndromes in schizophrenia. *Canadian Journal of Psychiatry*, 42, 1066-1071.

Watson, C.G., Thomas, R., R.W., Andersen, D. & Felling, J. (1968). Differentiation of organics from schizophrenics at two chronicity levels by use of Reitan-Halstead organic test battery. *Journal of Consulting and Clinical Psychology*, 32, 679-684.

Webster, C.D., Douglas, K.S., Eaves, D. & Hart, S.D. (1997). *HCR-20: assessing risk for violence (version 2)*. Vancouver (BC): Simon Fraser University.

Weickert, T.W., Goldberg, T.E., Gold, J.M., Bigelow, L.B., Egan, M.F. & Weinberger, D.R. (2000). Cognitive impairments in patients with schizophrenia displaying preserved and compromised intellect. *Archives of General Psychiatry*, 57, 907-913.

Wolwer, W., Frommann, N., Halfmann, S., Piaszek, A., Streit, M. & Gaebel, W. (2005). Remediation of impairments in facial affect recognition in schizophrenia:

Efficacy and specificity of a new training program. *Schizophrenia Research*, 80, 295-303.

Wood, F., Ebert, V. & Kinsbourne, M. (1982). *The episodic-semantic memory distinction in memory and amnesia: Clinical and experimental observations*. Hillsdale, NJ: Lawrence Erlbaum.

Wykes, T. (1994). Predicting symptomatic and behavioural outcomes of community care. *British Journal of Psychiatry*, 165, 486-492.

Wykes, T. (2000). Cognitive rehabilitation and remediation in schizophrenia. In T. Sharma & P. Harvey (Eds.) *Cognition and Schizophrenia: Impairments, Importance and Treatment Strategies* (pp.332-351). Oxford: Oxford University Press.

Wykes, T. & Reeder, C. (2005). *Cognitive Remediation Therapy for Schizophrenia. Theory and Practice*. East Sussex: Routledge.

Wykes, T., Reeder, C., Corner, J., Williams, C. & Everitt, B. (1999). The effects of neurocognitive remediation on executive processing in patients with schizophrenia. *Schizophrenia Bulletin*, 25, 291-307.

Wykes, T., Reeder, C., Corner, J., Williams, C. & Everitt, B. (1999). The effects of neurocognitive remediation on executive processing in patients with schizophrenia. *Schizophrenia Bulletin*, 25, 291-308.

Wykes, T., Reeder, C., Williams, C., Corner, J., Rice, C. & Everitt, B. (2003). Are the effects of cognitive remediation therapy (CRT) durable? Results from an exploratory trial in schizophrenia. *Schizophrenia Research*, 61, 163-174.

Wykes, T., Sturt, E. & Katz, R. (1990). The prediction of rehabilitative success after three years - the use of social, symptom and cognitive variables. *British Journal of Psychiatry*, 157, 865-870.

Wykes, T., Tarrier, N. & Shon, L. (1998). *Outcome and Innovation in Psychological Treatment of Schizophrenia*. Wiley: UK.

Young, D.A., Davila, R. & Scher, H. (1993). Unawareness of illness and neuropsychological performance in schizophrenia. *Schizophrenia Research*, 10, 117-124.

Zhu, J., Tulskey, D.S., Price, L. & Chen, H.Y. (2001). WAIS-III reliability data for clinical groups.. *Journal of the International Neuropsychological Society*, 7, 862-866.

Zygmunt, A., Olfson, M., Boyer, C.A & Mechanic, D. (2002). Interventions to improve medication adherence in schizophrenia. *The American Journal of Psychiatry*, 159, 1653-1664.

APPENDICES

Appendix 1

Correspondence granting Ethical Approval from North of Scotland Research
Committee

Appendix 2

Correspondence granting Ethical Approval from Research and Development

Appendix 3

Participant Information Sheet and letter of invitation

Appendix 4
Consent Form

Appendix 5

Rosenberg Self Esteem Questionnaire

Appendix 6

Tasks completed during intervention using 'Cogpack' software

Appendix 7

Table showing previous research in computer assisted cognitive rehabilitation
therapy from 1990 to 2008

Appendix 8

Company leaflet outlining elements of the Cogpack software

Appendix 9

Correlations comparing relationships between improvements in scores relative to the
different cognitive assessments

North of Scotland Research Ethics Committees

Summerfield House
2 Eday Road
Aberdeen
AB15 6RE

Telephone: 01224 558480
Facsimile: 01224 558609
Email: nosres@nhs.net



25 August 2008

Miss Julie Dodds
Trainee Clinical Psychologist
NHS Grampian
Blair Unit, Royal Cornhill Hospital
Aberdeen
AB25 9AG

Dear Miss Dodds

Full title of study: Cognitive rehabilitation with a forensic population with schizophrenia
REC reference number: 08/S0802/137

Thank you for your letter of 20 August 2008, responding to the Committee's request for further information on the above research and submitting revised documentation.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Ethical review of research sites

The favourable opinion applies to the research sites listed on the attached form.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission at NHS sites ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission is available in the Integrated Research Application System or at <http://www.rdforum.nhs.uk>.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

<i>Document</i>	<i>Version</i>	<i>Date</i>
Application		
Investigator CV		
Protocol		
Covering Letter		
Letter from Sponsor		
Peer Review		
Compensation Arrangements		
Letter of invitation to participant	1	24 July 2008
Letter of invitation to participant		
GP/Consultant Information Sheets	1	24 July 2008
Participant Information Sheet	2	24 July 2008
Participant Consent Form	2	23 July 2008
Response to Request for Further Information		
Letter for confirmation of student status		
Security Report		
Care Standards		
Risk assessment of Patients for Research	1	20 August 2008
CV - Dr Suzanne O'Rourke		

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Now that you have completed the application process please visit the National Research Ethics Website > After Review

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

We would also like to inform you that we consult regularly with stakeholders to improve our service. If you would like to join our Reference Group please email referencegroup@nres.npsa.nhs.uk.

08/S0802/137

Please quote this number on all correspondence

With the Committee's best wishes for the success of this project

Yours sincerely

AS *RSvenables*
Dr Sheila A Simpson
Chair

Enclosures: After ethical review – guidance for researchers
Site approval form

North of Scotland Research Ethics Committee (2)

LIST OF SITES WITH A FAVOURABLE ETHICAL OPINION

For all studies requiring site-specific assessment, this form is issued by the main REC to the Chief Investigator and sponsor with the favourable opinion letter and following subsequent notifications from site assessors. For issue 2 onwards, all sites with a favourable opinion are listed, adding the new sites approved.

REC reference number:	08/S0802/137	Issue number:	0	Date of issue:	25 August 2008
Chief Investigator:	Miss Julie Dodds				
Full title of study:	Cognitive rehabilitation with a forensic population with schizophrenia				
<p>This study was given a favourable ethical opinion by North of Scotland Research Ethics Committee (2) on 18 August 2008. The favourable opinion is extended to each of the sites listed below. The research may commence at each NHS site when management approval from the relevant NHS care organisation has been confirmed.</p>					
<i>Principal Investigator</i>	<i>Post</i>	<i>Research site</i>	<i>Site assessor</i>	<i>Date of favourable opinion for this site</i>	<i>Notes ⁽¹⁾</i>
Miss Julie Dodds	Trainee Clinical Psychologist	NHS Grampian, Royal Cornhill Hospital, Aberdeen	North of Scotland Research Ethics Committee (2)	25/08/2008	
<p>Approved by the Chair on behalf of the REC:</p> <p><i>R Venables</i> (Signature of Chair/Co-ordinator) (delete as applicable)</p> <p><i>Rachel S Venables</i> (Name)</p>					

(1) The notes column may be used by the main REC to record the early closure or withdrawal of a site (where notified by the Chief Investigator or sponsor), the suspension or termination of the favourable opinion for an individual site, or any other relevant development. The date should be recorded.

Research and Development Foresterhill House Annexe
Foresterhill
Aberdeen
AB25 2ZB



Date 08/09/2008
Ethics :08/S0802/137
R&D Ref:2008MH007

Miss Julie Dodds
Blair Unit, Block D,
Royal Cornhill Hospital
Aberdeen
AB25 2ZH

Enquiries to Omotunde Funsho
Extension 53846
Direct Line 01224 553846
Email omotundefunsho@nhs.net

Dear Miss Dodds,

Project title: Cognitive rehabilitation with a forensic population with schizophrenia

Thank you very much for sending all relevant documentation. I am pleased to confirm that the project is now registered with the NHS Grampian Research & Development Office. The project has R & D Management Approval to proceed locally.

Please note that if there are any other researchers taking part in the project that are not named on the original Ethics application, please advise the Ethics Committee in writing and copy the letter to us so that we may amend our records and assess any additional costs.

Wishing you every success with your research.

Yours sincerely

A handwritten signature in purple ink, appearing to be 'O. Funsho'.

Omotunde Funsho
Data Co-ordinator

Department of Forensic Psychiatry
Blair Unit
Royal Cornhill Hospital
Aberdeen
AB25 2ZH
Tel: 01224 557931



Date

Dear Participant

You are being invited to participate in research investigating techniques that could help to improve skills that have been found to be affected by schizophrenia. It is important that we try to find new treatments for this population. I have enclosed an information sheet which will explain more about the study and its possible benefits.

If you would be willing to participate please do not hesitate to contact me on 01224 557931 or inform your psychiatrist at your appointment who will be able to contact me. For those of you, who are not interested in taking part, please ignore this letter.

Whatever your decision I would like to thank you for taking the time to read and consider this.

Best wishes

Julie Dodds
Trainee Clinical Psychologist

Information Sheet

Cognitive Rehabilitation with a forensic population with schizophrenia.

You have been invited to participate in a study being carried out as part of a Doctorate in Clinical Psychology in association with the University of Edinburgh and NHS.

The purpose of the study is to provide treatments to help patients with schizophrenia that have had difficulty with remembering information and have trouble concentrating. These treatments could help to improve skills that you feel have been affected by your mental illness.

It is important for you to understand why the research is being done and what it will involve if you agree to take part. Please take time to read the following information carefully and discuss it with others if you wish. If there is anything that is not clear, or if you would like more information do not hesitate to contact us.

Why have I been chosen?

This research is being conducted with individuals with schizophrenia who have a forensic history or a history of violent behaviour.

Do I have to take part?

No, it is up to you to decide whether to take part. If you do decide to take part you will be asked to sign a consent form, although you are still free to withdraw at any time and without giving a reason. Your decision not to take part or to withdraw at any time will not affect the service you receive from the NHS.

What will happen to me if I take part?

If you decide to take part you will be asked to:-

- Complete a number of assessments over the duration of the research.
- Participate in a number of trials using a computer package to practice skills over 7 weeks.

What are the possible benefits of taking part?

It is hoped the results of this study will improve your memory and cognitive functioning and inform future treatments.

Will my taking part in this study be kept confidential?

All information, which is collected, about you during the course of the research will be kept strictly confidential.

What will happen to the results of the research study?

The research is being conducted as part of a Doctorate in Clinical Psychology and will be written up in the form of a thesis, a copy of which will be stored at the University of Edinburgh's Library. The study may also be presented for publication at a later date.

Feedback on your individual results will be given if requested. With your permission your GP will be informed that you have participated in this research, but they will not receive your results. Results of the study will be presented by group effects so that no individuals will be identified.

Who is organising and funding the research?

The research is being conducted as part of a Doctorate in Clinical Psychology, in association with the University of Edinburgh. The researcher is not being paid for conducting this research.

Who has reviewed the study?

The North of Scotland research ethics committee has reviewed this study.

Contact for Further Information

If you would like any further information or have any questions please do not hesitate to contact me:

Julie Dodds on 01224 557931 or my supervisor Joyce Edward on 01224 557931

Thank you for taking the time to read this.

Centre Number:

Study Number:

Patient Identification Number for this trial:

CONSENT FORM

Title of Project: Cognitive Rehabilitation with a forensic population with Schizophrenia.

Please
initial
box

Name of Researcher: Julie Dodds

1. I confirm that I have read and understand the information sheet dated 23/7/2008 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

3. I understand that my medical notes may be looked at by the researcher where it is relevant to my taking part in this research. I give permission for the researcher to have access to my records.

4. I agree to my GP being informed about my participation in this study.

5. I agree to take part in the above study.

Name of Patient

Date

Signature

Name of Person

Date

Signature taking consent

When completed, 1 for patient; 1 for researcher site file; 1 (original) to be kept in medical notes

Rosenberg Self-Esteem Scale (Rosenberg, 1965)

The scale is a ten item Likert scale with items answered on a four point scale - from strongly agree to strongly disagree. The original sample for which the scale was developed consisted of 5,024 High School Juniors and Seniors from 10 randomly selected schools in New York State.

Instructions: Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle **SA**. If you agree with the statement, circle **A**. If you disagree, circle **D**. If you strongly disagree, circle **SD**.

1.	On the whole, I am satisfied with myself.	SA	A	D	SD
2.*	At times, I think I am no good at all.	SA	A	D	SD
3.	I feel that I have a number of good qualities.	SA	A	D	SD
4.	I am able to do things as well as most other people.	SA	A	D	SD
5.*	I feel I do not have much to be proud of.	SA	A	D	SD
6.*	I certainly feel useless at times.	SA	A	D	SD
7.	I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8.*	I wish I could have more respect for myself.	SA	A	D	SD
9.*	All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10.	I take a positive attitude toward myself.	SA	A	D	SD

Scoring: SA=3, A=2, D=1, SD=0. Items with an asterisk are reverse scored, that is, SA=0, A=1, D=2, SD=3. Sum the scores for the 10 items. The higher the score, the higher the self esteem.

The scale may be used without explicit permission. The author's family, however, would like to be kept informed of its use:

The Morris Rosenberg Foundation
c/o Department of Sociology
University of Maryland
2112 Art/Soc Building
College Park, MD 20742-1315

References

References with further characteristics of the scale:

Crandal, R. (1973). The measurement of self-esteem and related constructs, Pp. 80-82 in J.P. Robinson & P.R. Shaver (Eds), **Measures of social psychological attitudes. Revised edition**. Ann Arbor: ISR.

Rosenberg, M. (1965). **Society and the adolescent self-image**. Princeton, NJ: Princeton University Press.

Wylie, R. C. (1974). **The self-concept. Revised edition**. Lincoln, Nebraska: University of Nebraska Press.

Cogpack Exercises

Ball	Visumotor test game
Calender	
Comparisons	comparing two simultaneously appear character strings for similarity
Color& Labels	similar to stroop tests
Concepts	work out the concept linking various terms
Connect	join up points using mouse clicks according to rules given in the Task file
Eyewitness	trainees must recall short street scenes with random combinations or image, text, sound and movement elements. Tests quick perception and passive reproduction of several simultaneous stimuli.
Falling Stars	Catch falling stars produced at random intervals and positions
Follow-up	continue a series of characters according to deducible rules
Labyrinths	Escape from randomly generated labyrinths with only one solution and one exit using mouse and cursor keys.
Line Segments	lines of various lengths and positions to be divided into 2 or more parts
Logic	Complete a block of regularly ordered characters. Rule recognition. Mathematics – basic arithmetic
Memory	tests memory function using selectable material and selectable recall options. Also requires active reproduction of 10 words shown or spoken.

Money	mathematic calculations using currency
New or Not	displays a series of texts, patterns or images and subjects must push a key if an item has been displayed before.
On the Road	on a schematic road, signs and traffic are seen passing from the perspective of a car driver. The scene halts abruptly and questions are asked about the present stat of speed-limits, and how many other vehicles have passed.
Piecework	Assembly line simulation where defective pieces must be removed.
Reaction	requires subjects to click in reaction to a particular character in a random series.
Route	planning tasks to optimise a trip which has to touch several points. Sequences
Visuomotor	follow random paths quickly using a mouse
Who or What	

Review of studies administering computer assisted cognitive rehabilitation therapy from 1990 to 2008.

	AUTHORS	POPULATION DEMOGRAPHIC INFORMATION	INTERVENTION	METHOD	OUTCOME	FOLLOW UP
1	Benedict et al, 1994	N=38 Outpatients schizophrenia and schizoaffective disorder	Computerised Attention Training (Bracy, 1982) – ‘A home based Cognitive Rehabilitation Program.’ 12.5 hours over 3-5 weeks Drill & Practice	CRT (n=16) V Control (n=17) <u>Cognitive Measures:</u> Continuous Performance Test Span of Apprehension Test Word list Recall Task	Attention/ vigilance =0.41 Verbal learning and memory =0.13	No Follow up
2	Burda et al, 1994	N=69 Schizophrenia Inpatients Mean age = 46.6 (2 females)	12 hrs training over 8 weeks. Captains Log Drill & Practice	<u>Cognitive Assessments:</u> WMS Trail Making Test Part A and B, Shipley Institute of Intelligence Scale 2 groups Treatment (n=40) Vs Control (n=29)	Significant effects - Trails A and B, WMS subscales mental control, memory passages, digit span and associative learning.	No Follow up
3	Cassidy 1996	N=13 (9males, 4 females) Schizophrenia(n=8) and schizoaffective	3 hrs per week over 10 wks. Computer software	<u>Cognitive Assessments</u> Digits Span Timed cancellation	Significant effects on digit span forward and backwards.	No Follow up

		disorder (n=5) Inpatients Mean age 42	developed for brain injured populations focusing on attention, concentration and cognitive flexibility	3 groups: i) Computer ii) Paper and pencil iii) control group		
4	Field 1997	N=10 (1 female) Schizophrenia Mean age=28.6 Range 20-46	Training Vs Control 6hrs over 3 wks	<u>Cognitive Assessments:</u> TMT – Part A and B Stroop Test Letter cancellation Purdue Pegboard	No significant outcomes.	No Follow up
5	Medalia et al, 1998	Inpatients N=54 Schizophrenia Mean age 32.5	6hrs training / 1 hr per week Attentional training ORM- computer program for remediating attention (Ben-Yishay et al, 1987) Drill & Practice	<u>Assessment:</u> Continuous performance test (CPT) Experimental (n=27) Vs Control Group (n=27)	Significant effect P<0.02	
6	Medalia et al, 2001	N=54. Inpatients Schizophrenia (n=41)	6 hrs Memory group– Memory Package (Sunburst Software) -Drill & Practice	Assessments: Independent Living Scale, Problem Solving subscale WAIS-R Comprehension test 3 groups	Sig effects on WAIS-R-CT scores for both problem solving group and memory group	No Follow up

		Schizoaffective Disorder (n=13) Mean age 36.3 Males 32 Females 22	Problem solving software - Where in the USA is Carmen San Diego (Broderbund Software Version 2.0) - Drill & Strategy	i) Problem solving group ii) Memory group iii) Control Group	Sig effect on ILS-PS for problem solving group	
7	Bell 2001	N=65 Schizophrenia Schizoaffective Disorder Inpatients Mean age 43.6 Male 78%	NET 5hrs per week for 26 weeks. CogReHab Software Drill & Practice	2 groups i)NET+WT (n=31) ii)WT alone (n=34) <u>Cognitive Assessments:</u> Digit span, LNS and Digit symbol Substitution task (WAIS-III) Visual Reproduction, and Logical Memory (WMS-R) <i>Memory</i> - Hopkins Verbal Learning Test (HVLT) Figural Memory <i>Attention-</i> Continuous Performance Test <i>Executive Function</i> – WCST, Gorham’s Proverb Test Bell Lysaker Emotion Recognition Task Hinting Task Trail Making – Test B	Sig effects on executive function, working memory and affect recognition	No Follow up

8	Belluci 2002	<p>N=34</p> <p>Outpatients</p> <p>Schizophrenia (n=16) Schizoaffective Disorder (n=18)</p> <p>Female 16 Male 42</p>	<p>16 sessions over 8 wks (8 hrs)</p> <p>Captains Log Software</p> <p>Drill & Practice</p>	<p><u>Cognitive Assessments:</u> Trail making test WMS- Digit Span, Verbal Paired Associates, Logical Memory Mini Mental State Exam</p> <p>Rosenberg Self Esteem Q'aire Pre and post assessments 8 wks apart</p> <p>2 groups i) CACR – computer assisted cognitive rehabilitation (n=17) ii) Control Group (n=17)</p>	<p>Sig effects Verbal memory</p>	<p>No Follow up</p>
9	Bark et al 2003	<p>N=54</p> <p>Inpatients</p> <p>Schizophrenia (n=41) Schizoaffective Disorder (n=13)</p> <p>Mean age 36.78</p>	<p>Single Blind treatment</p> <p>Memory group– Memory Package (Sunburst Software) - Drill & Practice</p> <p>Problem solving software - Where in the USA is Carmen San Diego (Broderbund Software Version 2.0) -Drill & Strategy</p>	<p><u>Cognitive Assessments:</u> WMS – Logical memory WAIS – Comprehension Test California VLT Independent Living Scale – Problem Solving Subscale (ILS-PS)</p> <p>3 groups i) Problem solving group ii) Memory group iii) Control Group</p>	<p>No significant effects reported</p>	<p>No Follow up</p>

			50 mins per wk for 5 wks (4hrs10mins)			
10	Bell, Bryson & Wexler, 2003	N=102 Schizophrenia (n=71) Schizoaffective Disorder (n=31) Inpatient Mean age 42.85 Males= 79 Females= 23	NET 5 sessions for 26 weeks. (Total 36 hrs) CogReHab Software Drill & Practice	<u>Cognitive Assessments:</u> Digit Span Backwards (WAIS-III) 2 groups i)NET+WT (n=47) ii)WT alone (n=55)	Significant Verbal Working memory 0.4	Follow up Verbal Memory 0.48
11	Fiszdon et al, 2004	N=94 Outpatients Schizophrenia (n=64) and schizoaffective disorder (n=30) Mean age 42.55 Females= 21 Males= 73	Trained digit span and word list recall tasks CogReHab software 5x45mins per week, 48 sessions. Total 36 hrs Drill & Practice	<u>Cognitive Assessments:</u> Digit Span Word Lists 2 groups i)CRT + WT (n= 45) ii) WT alone (n=49)	Sig effects Verbal Memory Effect size 0.53	Verbal Memory 0.66
12	Hogarty et al, 2004	N=121 Schizophrenia	75 hrs of software training 104 wks	Cognitive Enhancement Therapy (CET) (n=67) vs Enriched Supportive Therapy	Effect sizes: Processing	2 year Follow up:

		schizoaffective disorder Outpatients Mean age 37.3	CogReHab Software plus social cognition exercises Drill & Strategy Coaching	(EST) (n=54) <u>Cognitive Assessments:</u> <i>Verbal Working Memory</i> - Digit Span <i>Psychomotor Speed</i> - Digit Symbol <i>Verbal learning and memory</i> - WMS, CVLT <i>Executive Functioning/Cognitive Flexibility</i> -Trails B, WCST	speed=0.92 Neurocognition=0.63.	Cognitive Measures =0.67
13	McGurk, Mueser & Pascaris, 2005	N=44 Schizophrenia (n=32) Schizoaffective disorder (n=2) Mood Disorder (n=10) Outpatients Mean age 37.55 Males 24 Females 20	Cognitive Training (CT) + Supported Employment (SE) 2 sites Cogpack Total 24 hours Drill & Strategy Coaching	CT+SE Vs SE alone Assessments: baseline, 3 mths <u>Cognitive Assessments:</u> <i>Attention</i> - Digit span <i>Psychomotor Speed</i> - TMT-PartA <i>Information Processing Speed</i> - Digit Symbol Substitution test <i>Verbal learning and memory</i> - CVLT <i>Executive Functioning</i> - WCST, TMT-Part B	Sig effects TMT-part B, CVLT verbal learning Speed of Processing =0.27 Verbal working Memory= 0.42 Verbal Learning and Memory=0.45 Reasoning and problem solving=0.18	No Follow up
14	Sartory et al, 2005	N=42 Inpatients Chronic	Treatment Computerised Training program (n=21) Vs Control Waiting list	<u>Cognitive Assessments:</u> IQ estimate Word fluency Trail Making Test B	No significant effects for Verbal IQ or Trails B.	No follow up

		schizophrenia Mean age 36.4 Male 67%	group (n=21) 15 daily 45 mins over 3 weeks – total 11.25 hrs. Cogpack Drill & Practice	Digit Symbol Prose recall (Logical Memory)	Significant effects digit symbol ($\eta^2=0.1$), word fluency ($\eta^2=0.1$), immediate and delayed recall ($\eta^2=0.17$)	
15	Vaugh et al, 2005	N=138 Inpatients Schizophrenia Mean age 28.8 Males 64.5%	24 hours over 8 weeks Cogpack Drill & Strategic Learning	<u>Cognitive Assessments:</u> <i>Selective attention</i> – Letter cancellation test <i>Verbal memory</i> – RAVLT <i>Planning abilities</i> - Tower of Hanoi test 3 groups i)(CAST) Computer assisted cognitive strategy training + Vocational rehabilitation (N=47) ii)TSSN – Training of self-management skills for negative symptoms + Vocational rehabilitation (N=45) iii) Vocational rehabilitation alone (N=46)	Effect size Attention (0.46) Verbal learning (0.52) and memory (0.24)	Follow up effect size Verbal memory (0.40)
16	Wolwer, Frommann, Halfmann, Piaszek, Streit	N=77 Schizophrenia	6 week training phase 2 sessions per week (45mins each) Total = 9 hours.	3 groups i)Training of Affect Recognition (TAR) (n=28) ii) Cognitive Remediation	Sig effects delayed recall for CRTvTAU, CRTvTAR	No Follow up

	& Gaebel, 2005	Outpatients	Computer sessions and desk work Cogpack Drill and Strategy Coaching	Therapy (CRT) (n=24) iii) Treatment as usual (TAU) (n=25) <u>Cognitive Assessments:</u> <i>Attention</i> – Concentration Endurance Test d2, TMT-A, AVLT, Digit span <i>Situational understanding</i> – Picture Arrangement <i>Ex Funct</i> – verbal fluency, TMT-B		
17	Fiszdon, Choi, Bryson & Bell, 2006	Outpatients Schizophrenia (106) and Schizoaffective disorder (46)	NET+Work Therapy (WT) 6mths NET – 5 hrs per week NET = CogReHab (Bracy, 1995) Drill & Practice	<u>Cognitive Assessments:</u> Ex Funct- WCST Working Memory – digit span Trails B, Digit symbol, LNS <i>Thought and Language</i> – Logical Memory, Gorham’s Proverb, Hinting task <i>Visual & Verbal Recall</i> - Hopkins Verbal Learning Test, Visual Reproduction (WMS-III)	Sig effects Ex funct and WM within deteriorated group. Persevered grp – sig WM and thought and language.	No Follow up
18	Kurtz 2007	N=42 Schizophrenia and schiozoaffective disorder	100hrs over 12 mths. CogReHab (Bracy, 1995) Drill & Practice	2 groups (randomly assigned) i) Cognitive remediation ii) Computer skills training <u>Cognitive Assessments:</u> <i>Working Memory</i> - Digit span,	CR group sig results on WM, Verbal episodic Memory, Spatial episodic Memory, processing speed	

				<p>arithmetic, LNS (WAIS-III) <i>Verbal Episodic Memory</i>- logical memory, CVLT <i>Speed of information processing</i> – Digit Symbol, Symbol Search, TMT, Grooved pegboard, Letter fluency <i>Visual Episodic Memory</i> – Rey CFT <i>Reasoning and problem solving</i> – Block design, Penn Conditional Exclusion Test, Booklet Category Test.</p>	<p>and reasoning/ex function. Sig result only on working memory for CS group no other sig results.</p>	
19	Greig, Zito, Wexler, Fiszdon & Bell, 2007	N=62 (29 female) Mean age 40 Mean IQ=87 Outpatients Diagnosis of schizophrenia and schioaffective disorder	<p>1 year study of vocational and cognitive rehabilitation</p> <p>Average cognitive rehabilitation time = 125.93 hours.</p> <p>Computer source: Cogrehab (Bracy, 1995) and Sci-Learn (Scientific Learning, 2003)</p> <p>Drill & Coaching Strategy</p>	<p>2 groups i)NET+VOC – 10 hrs per wk for 1 year ii)VOC only</p> <p><u>Cognitive Assessments:</u> <i>Ex Func</i> - WCST <i>Working Memory</i> - Digit Span, LNS from WAIS-III <i>Visual and Verbal Memory</i> - Hopkins Verbal Learning Test Visual Reproduction (WMS-III) <i>Social Cognition</i> - Logical Memory (WMS-III), , Gorham’s Proverb test</p>	<p>MANOVA Ex funct p<0.01</p> <p>Working memory p<0.05</p> <p>No significant effect for verbal or visual memory.</p>	No Follow up

20	Lindenmayer, et al, 2008	<p>N=85</p> <p>Schizophrenia, schizoaffective disorder, bipolar disorder.</p> <p>Mean age 43.5, Males 89%</p>	<p>12 week Randomised Control trial.</p> <p>Baseline and postintervention assessments</p> <p>Cogpack – 24 hours over 12 weeks</p> <p>Drill & Coaching Strategy</p>	<p><u>Measures:</u></p> <p><i>Verbal Working Memory</i>-Digit span</p> <p><i>Psychomotor Speed</i>- TMT-part A</p> <p><i>Information Processing Speed</i>- Digit symbol</p> <p><i>Verbal learning and memory</i>- Rey AVLT</p> <p><i>Executive Functioning</i>- TMT-Part B, WCST</p> <p>2 groups:</p> <p>i)Cognitive remediation group + Work</p> <p>ii)Control – using computer games +Work</p>	<p>Effect size</p> <p>Verbal learning=0.42</p> <p>Attention and psychomotor speed (TMT-Part A) effect size= 0.70</p>	<p>Follow up:</p> <p>CRT group worked significantly more weeks than patients in control group.</p>
----	--------------------------	---	--	--	--	--

Package Contents

64 test and training programs, each with several variants for visomotor, comprehension, reaction, vigilance, memory, language, intellectual and professional skills. Tasks can be edited and expanded.

Applications

CLINICAL: disturbances in performance and motivation, e.g. in the context of functional psychoses and organic brain syndromes.

REHABILITATION: initial orientation and prognosis, initial training, e.g. in occupational therapy.

RESEARCH: e.g. time series in the context of evaluative studies.

EDUCATION: e.g. Special Needs Education.

IN THE HOME: Individual training can be continued with the Home Version.

Training Oriented

The program can be used with add-on learning demonstrations, help with solutions, levels of difficulty, explanation of results, repetition options and adaptive task series, i.e. difficulty of tasks based on previous performance. The sequence of exercises can be made dependent on specific criteria.

Test Oriented

The program can be used with standard settings derived from the normative values provided in some sub-programs.

Motivation

Wide-ranging content and difficulty levels, entertaining initial exercises, help with solutions, learning demos and explanations of results, realistic feedback, accessible comparative scores and user-selected and user-controlled exercises.

Score Reporting

is automatic, differentiated and user-selectable. Overall scores, performance, time and course scores, scores for individual exercises, graphic profiles written to disk, screen or printer. Group statistics are available in the Professional Version.

Comparative Scoring

can be set to update average scores and best scores automatically. The supervisor can decide whether clients see all scores, no scores or only their own score.

Norms

Norms derived from non-patients and various diagnostic groups are available for many exercises and are continuously updated using data from several centers. The Professional Version supports user-defined norms.

Clinically tested

since 1986 in neurological, psychiatric and rehabilitation centers in Austria, Switzerland and Germany. Reports confirm improved skills, high acceptability and the development of realistic self-assessment.

Scientific

data derived from patients with various problems at several centers shows significant and relevant progress in learning and a correlation between test-results and success in the work environment.

Versatile

exercises can be varied by random routines and user-edited exercise material. Instructions, timing, type and scope of exercise series, as well as the exercises themselves can be altered. In the Professional Version user-defined programs and menus can also be linked to COGPACK.

User Friendly

Pull-down Menus. Choice of keyboard or mouse control. On-screen hints and information. Introductory screens before each exercise. Optional trial run. Selected settings are preserved.

Security

is provided by lockable menus, supervisor passwords, elaborate error-routines, optional protection against program interruption.

Documentation

in the manual and on-screen for trainees and supervisors. Editable task files contain formatting information.

Sub-programs

VISOMOTOR SKILLS: Steer, follow or mark a moving figure with the mouse. Divide lines or pies. Reproduce or mirror a drawing. Catch a bouncing ball.

VIGILANCE, COMPREHENSION, REACTION: Scanning, character recognition, catch a falling star. Assembly-line simulation and continuous performance.

LANGUAGE MATERIAL: Use various clues to find words. Questions about text-content. Attribution of quotations to authors or titles to poems. Placing words or syllables in order. Anagrams. Semantic fields. Vocabulary.

MEMORY: remembering series of words, images and labels, patterns, signs, addresses, routes, lively scenes. Various recall and repetition modes.

NUMBERS; LOGIC: problems, geometry, mental arithmetic, quantities, numbers and number words. Connect dots. Simple and deductive comparisons. Complete a block. Continue a series.

KNOWLEDGE, ORIENTATION, EVERYDAY SKILLS: Times, dates, the compass; money, weights and measures, road signs, license plates, abbreviations, keyboard, geography, etc.

SPECIAL ELEMENTS: mazes, color/word interference, tone and pitch, 3-D positioning, assumptions about public opinion.

Hardware Requirements

WINDOWS computer with WINDOWS 95 or higher, color monitor, mouse, sound card, and at least 500 MB free space on the hard disk.

Versions

COGPACK PROFESSIONAL contains the Home Version, supplementary material, more alteration options, tools, personal data management, group statistics, and some source files.

COGPACK HOME for individual training in the home. Substantially less scope in tools, personal data management, manual.

Prices

	€
	net of tax
COGPACK Professional*	450.00
COGPACK Home*	160.00
Language D,E,F,I,N,NL,P, US-English each*	100.00
Additional 1-Station License	150.00
Additional 2-Station License	200.00
Additional 3-Station License	240.00
Additional 4-Station License	270.00
Additional 5-Station License	300.00
Additional 10-Station License which means campus- & LAN-license	400.00
Additional manual English or German	13.70
Upgrade current Professional Version	100.00
Upgrade current Home Version	50.00
2-Year Upgrade Service	300.00

* Prices for the Professional and Home versions include single-station license, one language, one manual, hotline or hotmail advice, delivery to Europe.

19% VAT are added for D and EC if no VAT-ID-No is reported. € 12 shipping fee is added for deliveries to outside Europe. Standard format CD. Some language packages still partly incomplete. The use of additional licencies and of Campus licencies is limited for one place with a named postal adress and require a Professional version. Networking in a LAN with additional 10-station license only. Trade prices on request.

COGPACK®

Program Information
as at January 2009

marker software

Im Steg 9, D-68526 Ladenburg
phone (+49) (0)6203 922256
fax (+49) (0)6203 180304
for further information cf.
www.cogpack.com

email: marker@markersoftware.com

hotline mon-fri 9.00-16.00 CET