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**AN EVALUATION OF THE COGNITIVE OUTCOMES OF  
ELECTROCONVULSIVE THERAPY: A RETROSPECTIVE STUDY**

A thesis presented in partial fulfilment of the requirements for the degree of

Doctorate

in

Clinical Psychology

at Massey University, Wellington

New Zealand.

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2012

# THESIS EMBARGO

## Appendix D

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## ABSTRACT

The aim of the current study detailed in the following pages was to investigate the cognitive functioning from quantitative and qualitative perspectives of a group of 19 people who had received ECT two or more years previously. Reviews of the literature conducted prior to the study suggested the domains most commonly reported affected by ECT were verbal learning and memory, visual learning and memory, global cognitive functioning, subjective complaints, retrograde amnesia/memory, attention, retrieval, autobiographical memory, anterograde amnesia/memory and aspects of executive functioning. The most commonly used objective measures for these domains were the Rey Auditory Verbal Learning Test, the Rey Complex Figure Test, the Mini Mental State Examination and the Autobiographical Memory Inventory. Qualitative assessment most often utilised subjective measures such as the Cognitive Failures Questionnaire or the Squire Subjective Memory Questionnaire. The current study planned to extend qualitative assessment using Interpretative Phenomenological Analysis.

Specific hypothesis were that 1) scores on the RCFT, RAVLT and AMI for patients who received their last ECT two or more years ago would be below the age-matched norms (cut-off ranges in the case of the AMI) for each test, 2) the MoCA would identify more participants with Global Cognitive deficits than the MMSE and 3) participants would *report* a higher degree of difficulty with their memory and cognition than what was identified by the objective assessment measures.

Findings did not confirm hypothesis 1) with the exception of scores on the RCFT. Hypothesis 2) was confirmed, with the MoCA identifying more participants with deficits than the MMSE. Hypothesis 3) was confirmed, with participants reporting subjective complaints that were not identified by the objective measures. The study was limited by small sample size for quantitative analysis and further research utilising a larger sample which assesses at baseline, during and immediately after ECT and the development of a qualitative assessment measure is also recommended.

## ACKNOWLEDGEMENTS

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## CANDIDATES DECLARATION



### Declaration Confirming Content of Digital Version of Thesis

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## CHAPTER 1

### OVERVIEW

Electroconvulsive therapy (ECT) has been used to treat the severely mentally ill since the 1930's having particularly effective results with depression, psychosis, mania, bipolar disorder and suicidal schizophrenic patients (Ottosson & Fink, 2004).

Administered as an electrical current passed through the skull into the brain, ECT induces a grand mal seizure. The exact mechanism of how these seizures can alleviate debilitating psychological symptoms is still unknown, however a number of hypotheses currently exist (Tiller & Lyndon, 2003).

It is generally accepted that this form of treatment relieves many of the symptoms that current medications do not. However, the National Institute for Clinical Excellence (NICE, 2003) guidelines for the use of Electroconvulsive Therapy stipulate that ECT should only be used as a last resort treatment for severe depressive illness, catatonia or a prolonged or severe episode of mania, based on reported benefits and risks to patients.

It has been widely acknowledged that ECT can cause cognitive impairment, and as such, alternative methods of administering ECT continue to be tested. However, debate still exists as to the nature and duration of cognitive problems and how best to assess them (NICE, 2003). Patient subjective reports often contradict results on objective assessment measures, particularly regarding memory loss (NICE, 2003; Tiller & Lyndon, 2003). Accordingly it is suggested that both quantitative and qualitative research is still needed to investigate the cognitive effects of electroconvulsive therapy (NICE, 2003).

The current study was developed as a result of a request from physicians in the Wellington region<sup>1</sup>, who were dissatisfied with current methods used to monitor short and long-term cognitive effects in their patients receiving ECT. After a review of the literature including thorough reading of the NICE Guidelines (2003), the current study was developed - aiming to address some of the issues raised by the

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<sup>1</sup> Physicians within Capital and Coast District Health Board (CCDHB) the governing health board for the Wellington Region

physicians as well as to contribute to the larger body of research regarding longer term outcomes from both quantitative and qualitative perspectives.

Therefore, the present retrospective study aims to consider the effect ECT has on memory and cognition in the longer term, from a qualitative and quantitative perspective and make recommendations on assessment and future research.

As an introduction to the research, the history and background relating to ECT and its side-effects will be presented in Chapter Two. Chapter Three will present in manuscript form a review of the current literature, relating to electroconvulsive therapy, and reported adverse cognitive effects. Chapter Four will present the various measures currently used to assess and monitor aspects of cognitive functioning including those currently used by practitioners in New Zealand, also in manuscript form. Chapter Five will review the variables affecting the outcomes of electroconvulsive therapy. Chapters Seven and Eight will outline the present study and discuss limitations and future research directions both in manuscript form. Finally Chapter Nine will summarise the research findings and present limitations, recommendations for future research, clinical implications and personal reflections.

## CHAPTER 2

### BACKGROUND OF ELECTROCONVULSIVE THERAPY (ECT)

#### *History*

In the 1920s it was observed that people with co-morbid epileptic and mental illness appeared to have improved mental states after a seizure (Freckelton & Wilson, 2001). Based on this idea, the 1930s saw pharmaceutical induced seizures become the first partially effective treatment for schizophrenia and other affective disorders such as mania (Tiller & Lyndon, 2003). This had been pioneered in 1934 by Laszlo Meduna, a Hungarian Neuropsychiatrist, who treated catatonic schizophrenia with pharmaceutical induced seizures (Tiller & Lyndon, 2003; Taylor, 2007). Working first with animals and later with humans by 1936 he published his findings noting that of 43 schizophrenic patients treated with camphor induced seizures, 19 were cured and improvement was seen in another seven (Freckelton & Wilson, 2001). However, the camphor derivatives used often caused toxicity and were eventually replaced by pentylenetetrazol. Although faster acting and more soluble it produced unpleasant sensations in patients who were conscious during the treatment (Tiller & Lyndon, 2003). This led researchers to search for alternative seizure induction methods.

The use of electricity to induce seizures in the mentally ill was instigated and trialled by Ugo Cerletti and Lucio Bini in Rome. Initial animal trials showed some success although the mortality rate of the animals was high. To counteract this, they used a briefer duration of electricity with a higher charge (Freckelton & Wilson, 2001). In 1938 they treated their first human patient, a 39 year old unknown male suffering from delusions and hallucinations, cycling in and out of mutism and neologistic speech (Taylor, 2007). Diagnosed with schizophrenia, he received 11 treatments and recovered completely. This success spurred the growth of ECT as a treatment method (Rudorfer, Henry & Sackeim, 1997; Tiller & Lyndon, 2003).

The following two decades saw continual use and evolvement of ECT as an effective treatment for schizophrenia and severe affective disorders. However it was often abused and overused (as a form of punishment or control of patients) and this is more often what is in the mind of the public today rather than its clinical efficacy

(Rudorfer et al., 1997; Tiller & Lyndon, 2003; Burstow, 2006). Even as early as the 1930's there were concerns about some of the side-effects of ECT, particularly fractures caused by the seizures, and cognitive impairment (Lisanby, 2007). The negative connotations and side-effects associated with ECT coupled with the introduction of psychotropic medications in 1953 led to a reduction in ECT use and an increase in the use of medication (Lisanby, 2007).

Although medication became the predominant treatment for schizophrenia and mania in 1953, in some cases it was found to be less effective than ECT which again slowly found favour as an alternative treatment (Tiller & Lyndon, 2003). During the early 1970s, the antipsychiatry movement targeted ECT as a form of abuse against the vulnerable, resulting in legislation which limited its use. This along with apprehension from patients and some psychiatrists again led to a reduction in its use around 1975 (Rudorfer et al., 1997; Tiller & Lyndon, 2003; Taylor, 2007).

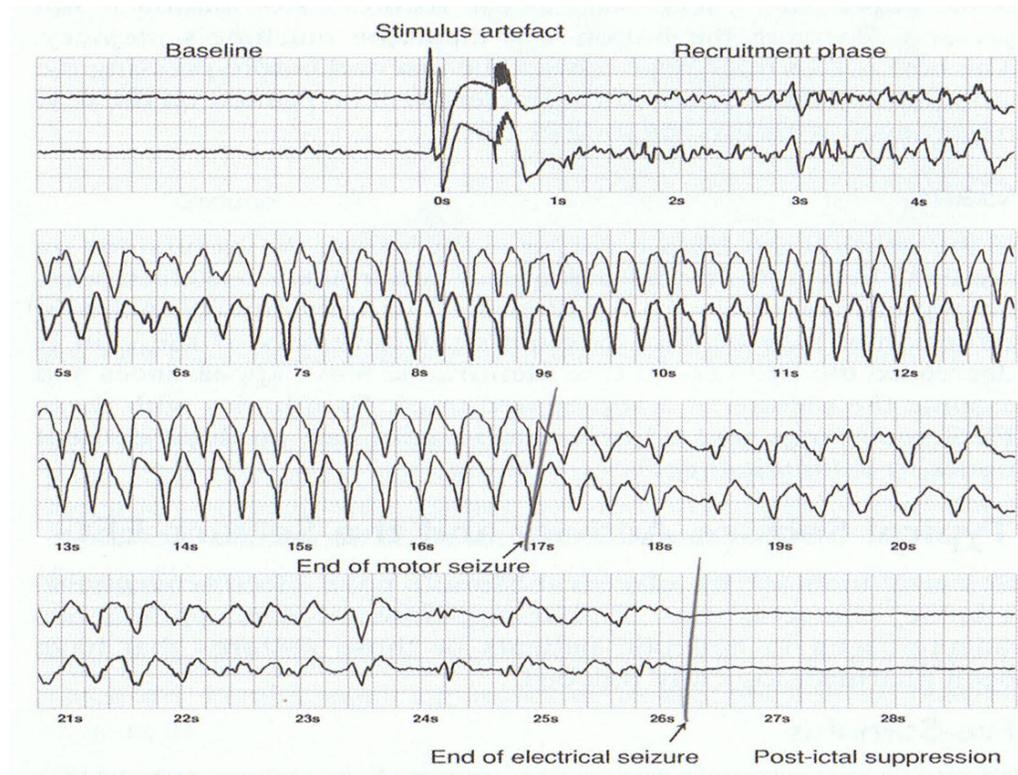
Limitations and toxicities of medications, in depth research into ECT, personal accounts of its benefits from patients, and a more balanced media representation, all led to the re-emergence of ECT as a recognised treatment for mental illness during the 1980's. And this remains the case today (Rudorfer et al. 1997). Used under tight legislation and with strict guidelines, modified ECT (including the use of anaesthetic and muscle relaxants) is especially effective with people who are suicidal, and works faster than medications which may take two or three weeks to have an effect, if they have an effect at all (NICE, 2003).

#### *Present Day ECT Procedure*

ECT uses an electrical current or stimulus to induce a seizure in the patient. The electrical stimulus is passed through the brain via electrodes placed on the scalp and the electricity depolarises neurons which leads to the seizure. The exact mechanism of how this works is still not well understood (Tiller & Lyndon, 2003).

Monitoring by means of electrodes placed in specific areas on the patient's head provides information which is of importance to ECT treatment and effectiveness. It shows whether seizure activity has occurred, shows sub threshold stimulus dose, the presence of seizure activity and its amplitude and symmetry, length of seizure, and

suppression patterns and identifies sub convulsive status (Tiller & Lyndon, 2003). Refer to Figure 1 for a typical EEG pattern.



*Figure 1. EEG Progression of Seizure Induced by ECT*  
With Permission from Dr Lyndon, May 2011.

EEG recording begins prior to the stimulus for baseline readings, however timing begins at the point just after the stimulus has ceased. During the recruitment phase (Figure 1) the EEG initially shows low-amplitude, fast wave activity which then becomes high-amplitude, slow-wave activity (Tiller & Lyndon, 2003). This pattern continues during the seizure, and often for some time after the visible motor seizure has terminated. During post-ictal suppression, the high-amplitude, slow wave activity transitions to low-wave activity of variable amplitude (Tiller & Lyndon, 2003). The duration of the seizure is recorded as the time from the point when the stimulus ends, to the time suppression occurs, and ideally this should be between 15 and 120 seconds. Seizure duration of less than 15 to 20 seconds is considered less effective, while a duration of any greater than 120 seconds should be aborted as it

can cause excessive confusion and disorientation and greater cognitive deficits (Tiller & Lyndon, 2003).

*When should ECT used?*

The NICE guidelines on the use of ECT released in 2003, recommended that ECT be used as a short-term treatment for severe depressive illness, catatonia and prolonged or severe mania, only after all other options have failed; that it not be used as a general treatment for schizophrenia; and that ECT not be used as a maintenance therapy for depression.

In New Zealand a similar set of guidelines were released by the Ministry of Health (MoH) in 2004, recommending that ECT should be considered for depression, mania, schizophrenia and catatonia when there is resistance or intolerance to medication, where therapy is inappropriate, where there is a considerable risk of suicide or neglect, a need for rapid therapeutic action due to suffering, and when ECT has already been used with good outcomes and is required for maintenance (MoH, 2004).

ECT rates of use have been determined largely by the success of clinical trials and the status of alternative methods of treatment such as medication. Though institutionalisation, changes in diagnostic criteria, public attitudes and professional opinion have also influenced the rates of use (Rudorfer et al., 1997). Worldwide, ECT is now used primarily in hospitals and is predominantly used for the treatment of depression when medication is no longer an option (Rudorfer et al., 1997; Ng, Schweitzer, Alexopoulos, Celi, Wong, Tuckwell, et al., 2000; Freckelton & Wilson, 2001; Kho, van Vreeswijk, Simpson & Zwinderman, 2003; Arts, Peters, Ponds, Honig, Menheere & van Os, 2006; Bolwig & Madsen, 2007; Matthews, Blais, Park, Welch, Baity, Murakami et al., 2007). While ECT is used to treat a number of mood disorders, in New Zealand it is used predominantly in the treatment of major depression (MoH, 2004).

For the year beginning 1 July, 2009 until the end of June 2010, a total of 235 patients received ECT in New Zealand (MoH, 2011). Of these patients, 11 were within the Capital and Coast District Health Board (CCDHB, where the study to be described took place) and received on average 30 courses (including ongoing maintenance

ECT) with an average of 3.1 treatments per course (MoH, 2011). Nationwide, patients receiving ECT were predominantly female (168 female versus 62 male and 5 unknown), over the age of 35 and of European decent (MoH, 2011). Approximately 70 – 80% of those receiving ECT had a good clinical response with alleviation of depressive symptomology, and were then able to have a more productive life with symptomology being controlled using medication (MoH, 2006).

#### *Research and Literature on ECT and Cognitive Functioning*

NICE (2003) reported that distress is caused to many ECT patients by memory loss, particularly those who have had bilateral electrode placements. These are generally considered as either medium or long term difficulties, although just what constitutes these two descriptions of time varies (MoH, 2004).

They also make reference to the variability in difficulties between individuals and how this can be a result of the individualised treatment schedules of ECT. Also discussed by NICE (2003) are the difficulties in assessing memory and cognition in Random Controlled Trials (RCT's) with assessment measures not always adequately capturing the problems that are reported qualitatively as prolonged or permanent. Finally, NICE stated that cognitive function should be monitored, and at the least, be assessed at the end of treatment (NICE, 2003).

The MoH (2004) states that assessing the effects that ECT has on memory and cognition is a difficult task as number of other variables such as medications, mood, life experiences and personality can also cause memory difficulties. They also state that memory effects vary between individuals with some actually reporting improvements in their overall memory, and others reporting difficulties. The MoH (2004), also states that after ECT patients usually experience confusion and disorientation which lasts from a few minutes to a number of hours depending greatly on the ECT procedure used.

The most commonly reported memory difficulties are with retrograde (memories prior to ECT) and anterograde (new memories formed after ECT) memories. While these memory difficulties usually resolve within several weeks a number of patients report that the effects have been long term and affect their daily life (Rudorfer et al., 1997; MoH, 2004).

Rudorfer et al. (1997) also reported that memory loss and confusion are common side effects of ECT, and are two of the factors which limit its use. Confusion generally occurs immediately post ECT treatment, while memory deficits such as retrograde and anterograde memory difficulties are commonly reported with retrograde amnesia being more of a problem (Rudorfer et al., 1997).

The exact extent and time frame of the difficulties is variable and depends on the technical aspects of ECT such as placement of electrodes, dose, wave form, and treatment frequency, all of which vary between individuals (Rudorfer et al., 1997).

In a review conducted on the use of ECT in New Zealand for the ECT Review Group, Snelling (2004) compiled information from different sources on the side-effects of ECT given to consumers as part of their informed consent. Table 1 illustrates what each of the sources reviewed states about the side-effects of ECT.

Table 1

*Side-Effects of ECT*

Information Source	Side-Effects
New Zealand, Royal Australian and New Zealand College of Psychiatrists (RANZCP)	<ul style="list-style-type: none"> <li>• Confusion during first few hours after ECT</li> <li>• May have difficulties learning new information during period of ECT treatment, should resolve in days/weeks post ECT treatment</li> <li>• May have a partial loss of memory for events occurring days, weeks and months preceding ECT, most of which return days – months after ECT, however some report longer lasting problems</li> <li>• Some have reported improved memory following ECT due to its ability to lift amnesia associated with severe depression</li> <li>• Memory problems vary based on the type of ECT used are less of a problem with unilateral ECT</li> </ul>
United Kingdom, Royal College of Psychiatrists (RCP)	<ul style="list-style-type: none"> <li>• Some are confused when they wake up after ECT, this usually resolves within an hour or so</li> <li>• Memory for recent events may be affected including dates, names of friends, public events, addresses and telephone numbers, however this should be temporary and resolve itself within days to weeks</li> <li>• Some complain of on-going memory problems for several months</li> <li>• ECT does not appear to have long term effects on memory or intelligence</li> </ul>
Western Australia (Department of Health, Government of Western Australia)	<ul style="list-style-type: none"> <li>• There may be some confusion when waking from ECT this will wear off</li> <li>• Some complain of memory difficulties but this usually does not last</li> </ul>
Scotland (Scottish ECT Audit Network)	<ul style="list-style-type: none"> <li>• Temporary loss of memory is quite common however this can be associated with severe depression</li> <li>• Some studies show the ECT does not increase</li> </ul>

- 
- memory problems caused by severe depression
- 60-70% of patients report short term memory difficulties around the time of ECT and for a few weeks after
  - Memory impairment usually resolves itself gradually over the following 6 months although for some, this can take longer, and some have reported permanent gaps in their memory for past events
- 

*Adapted from "A Review of the literature, the Acts of Parliament and relevant current practices on regulation of the use of ECT in New Zealand and in other like nations" (Snelling, 2004).*

The consensus of the sources reported in Table 1 appears to be that patients undergoing ECT will experience confusion when they wake and memory loss is a common complaint particularly for past personal information and events. There is however no real stated timeframe by which the memory problems should resolve. Most patients recover their memories within approximately six months; however a few report on-going and permanent problems. Differentiating between memory loss due to ECT and memory loss due to severe depression is an on-going problem and something that needs to be considered when assessing memory loss in people who have had ECT.

In summary, while still fairly mixed, there have been significant findings that ECT can cause short and long term cognitive problems. The most adverse effects are thought to be short-term; the most common of which is that of memory dysfunction, with many patients reporting having specific difficulties with new learning after ECT (Tiller & Lyndon, 2003). While there is no specific timeframe in which ECT patients with cognitive problems return to pre ECT cognitive functioning, most Clinicians are in agreement that this happens over varying time. A number of ECT recipients do however report still having problems many years after their treatment has ended, particularly with autobiographical memory.

### **CHAPTER 3**

## **COGNITIVE OUTCOMES OF ELECTROCONVULSIVE THERAPY: A REVIEW**

This chapter is in the form of a manuscript for the purpose of submission to a journal still to be advised. The manuscript that follows is presented in the format required for that submission, with the exception of page numbers and font size, which need to be consistent with the thesis as a whole. Some editing may occur after manuscript submission; however the changes would not affect the overall outcomes of the review. Some repetition of information and references was unavoidable given the structure of this thesis by manuscript.

**Cognitive Outcomes of Electroconvulsive Therapy:  
A Review**

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*Abstract*

Electroconvulsive Therapy (ECT) is a treatment for medication resistant mood disorders and some psychotic illnesses (Royal Australian and New Zealand College of Psychiatrists [RANZCP], 2004). But as with medication, ECT has side-effects. This is particularly seen in cognitive domains which are disrupted during and post ECT treatment. However, variations in research designs and measures have led to contradictions in findings. The current literature review had two main objectives - firstly to review research which investigated the clinical and cognitive outcomes of ECT, with an emphasis on establishing which cognitive domains are commonly assessed and secondly, to establish which domains consistently show dysfunction. Literature searches were conducted using the Search Engines; Web of Science; Google Scholar; Psych INFO; Academic Search Elite; and Medline. Articles from the March 2008 Special Edition on Cognition of The Journal of ECT were also included. Forty-three studies/reviews were included in the current review. Domains were assessed and outcomes of the assessments were used to create a summary table. Of the 43 studies/reviews reviewed, 22 reported improvement in symptomology, four reported mixed results, one case study reported no improvement, and 16 did not report of clinical outcomes. Memory was the most commonly assessed domain and the one most affected by ECT, particularly retrograde memory, subjective complaints, autobiographical memory, retrieval, and anterograde memory. Variability in assessment methods, other variables and cross over between cognitive domains make reviewing cognitive outcomes difficult.

### *Introduction*

Electroconvulsive Therapy (ECT) is currently used for medication resistant mood disorders and some psychotic illnesses (RANZCP, 2004). As with some medications, ECT is often accompanied by side effects, particularly of a cognitive nature. Current research into the side-effects of ECT however, has not identified precisely the nature of the difficulties experienced by some as a result of ECT. This may be in part due to a lack of standardization between research protocols and other confounding variables which make it difficult to make comparisons between patients such as differences in ECT treatment between patients (MoH, 2004). This review will discuss the use of ECT with depression and other psychiatric disorders and some of the cognitive side-effects that have resulted.

### *ECT and Depression*

Depression is one of the most common psychological disorders (affecting more women than men), with 4% of the adults, surveyed in the Australian Mental Health Survey having had depression of some kind in the month preceding the survey (RANZCP, 2004). Similar patterns are thought to exist in New Zealand (RANZCP, 2004). Depression varies greatly along a continuum from the mildly unwell, to the very disturbed and psychotic who are hospitalised (Rudorfer, Henry & Sackeim, 1997). The severity is defined by the existence of neuro-vegetative and melancholic symptoms, psychosis, and/or suicidal tendencies (Rudorfer et al., 1997; RANZCP, 2004). Those who are more severely ill and not responding to medications are more likely to receive ECT.

Over the last half century three main types of data in favour of ECT have emerged from clinical trials (Rudorfer et al., 1997). Initially the research used case studies, then, during the 1950's and 1960's the focus shifted to controlled studies comparing medication with ECT and finally during the 1970's research shifted to comparison studies of ECT with sham-ECT to control for confounding variables such as the effects of anaesthetic, muscle relaxants and other forms of medication (Rudorfer et al., 1997). In these later studies, ECT was found to be more effective in the treatment of depression compared to sham-ECT, or placebos and medications, with a 75 – 85% response rate overall, and a 32% higher response rate than sham-ECT, 41% higher

response rate than placebo, 20% higher response rate than tricyclic antidepressants and a 45% higher response rate than monoamine oxidase inhibitors (Rudorfer et al., 1997). Further, a German clinical trial found ECT to have a higher response rate than Selective Serotonin Reuptake Inhibitors (71% versus 28%) in a depressed population (Rudorfer et al., 1997). It should be noted that controlled studies comparing ECT with antidepressants are sparse due to difficulties in recruiting participants, and the ethics arising for this type of research where random assignment is necessary (Rudorfer et al., 1997; Tiller & Lyndon, 2003).

A number of studies have also emerged which compare the various technical aspects of ECT with regard to outcomes (Neylan, Canick, Hall, Reus, Sapolsky et al., 2001; Sackeim, Prudic, Nobler, Fitzsimons, Lisanby, et al., 2008). For example, the effectiveness of ECT is influenced by the electrical stimulus, electrode placement, seizure threshold, seizure duration, stimulus waveform and stimulus dose titration along with a number of demographic variables (Tiller & Lyndon, 2003). Research has found that bilateral electrode placement, (where the electrodes are placed on both sides of the head at either the bitemporal position or bifrontal temporal position) gives a better clinical outcome than unilateral however with greater cognitive deficits; that adequate seizure response to the electrical stimulus with the lowest possible charge is necessary for good clinical outcomes hence brief-pulse is preferable to sine wave; that the seizure threshold, or minimum stimulus dose required to produce a quality grand mal seizure is important and that this is predicted by using the age, sex, and electrode placement for each individual; and finally, that the seizure should have a duration not less than 15-20 seconds and no more than 120 seconds (Tiller & Lyndon, 2003).

According to The Electroconvulsive Therapy Annual Statistics for the Period of 1 July, 2003 and 30 June, 2005 released by the Ministry of Health New Zealand (MoH) in 2006, 70% to 80% of ECT patients respond well to the treatment and are then able to move on to using medications to maintain the benefits received from ECT. From the period of 2003/04, 305 individuals were treated with ECT in New Zealand, and 307 were treated in the period 2004/05 (MoH, 2006). Most patients were European (85%), women (69%), and aged between 40-49 years (22%). Many people, who suffer mood disorders such as depression, do not seek help so the

figures presented by the Ministry of Health may be underrepresented. Cultural beliefs may also be responsible for a possible under representation of certain groups in the statistics such as Asian and Maori (MoH, 2006).

#### *Adverse Cognitive Outcomes of ECT*

Like medication, treatment with ECT may come with side-effects. Transient disorientation is almost always present in patients following an ECT seizure. This improves over time, with most returning to normal in a matter of hours (Tiller & Lyndon, 2003). The form of administration of ECT seems to have a large influence on adverse effects. Factors which increase the chances of cognitive problems include bilateral electrode placement, sine-wave ECT, high electrical charge in relation to seizure threshold, treatments spaced close together, and medications such as lithium used post treatment (Tiller & Lyndon, 2003).

In a review of the literature, cognitive domains that are frequently cited as impaired after ECT included autobiographical memory, anterograde and retrograde memory, verbal and visual memory, working memory, attention/concentration and processing speed (McElhiney, Moody, Steif, Prudic, Devanand et al., 1995; Lisanby, Maddox, Prudic, Devanand, & Sackeim, 2000; Weiner, 2000; Tiller & Lyndon, 2003; Fraser, O'Carroll & Ebmeier, 2008). The domain most constantly cited was Autobiographical Memory, also known as personal memory or personal knowledge (Lisanby et al., 2000; Weiner, 2000; Fraser et al., 2008). There is no evidence that creativity, abstract reasoning or semantic memory retention is affected (Tiller & Lyndon, 2003). There is some variability in outcome findings that is partly explained by variability in the objective measures used to assess cognitive functioning.

Recent literature has included more investigation of patient's subjective accounts of cognitive and daily living difficulties. Often these subjective complaints are reported in the absence of impairment on objective measures of cognition (National Institute for Clinical Excellence, 2003; Tiller & Lyndon, 2003; MoH, 2004). This contradiction has become a large focus of the current research and is reflected by the NICE Guidelines (2003) which state that there has been insufficient research into the longer term adverse effects of ECT with both objective *and* subjective assessment, and that more research is required.

The current review aims to provide a current overview of the research and reviews that have been undertaken into the nature and extent of clinical and cognitive outcomes of ECT from both an objective and subjective viewpoint. It is expected, based on current literature, that memory will stand out as the predominant domain of cognitive dysfunction: in particular, autobiographical, retrospective, and anterograde memory.

### *Method*

Literature searches were conducted using the Search Engines; Web of Science; Google Scholar; Psych INFO; Academic Search Elite; and Medline, and the keywords; Electroconvulsive Therapy, ECT, Cognition, Thinking, Memory and Outcomes. The March 2008 Special Edition on Cognition of The Journal of ECT was also searched for articles pertaining to cognitive outcomes of ECT. Articles containing either reviews or studies into the clinical and/or cognitive outcomes of ECT were included in this current review. The review did not aim to differentiate between short term complaints and long term complaints nor did it aim to differentiate between the differing ECT treatment schedules such as unilateral versus bilateral electrode placement. The review aimed to look at the broader state of current trends in clinical and cognitive outcomes of ECT. As each review/study was read, domains of assessment were noted and used to form overall table headings. As each review/study presented the domains of assessment it was noted under the table headings using “Y” for deficits found, “N” for no deficits found, or “M” for mixed findings. Clinical outcomes were also noted using “I” for improvement in mental state, “NI” for no improvement, or “M” for mixed results. These were then tallied to provide information on how many reviews/studies found deficits/no deficits in the domains assessed. The results of the review are shown in Table 1.

**<INSERT TABLE 1 ABOUT HERE>**

## *Results*

From the literature search, 43 studies/reviews were included that assessed the outcomes of ECT on depression and/or cognition between the years 1978 and the end of 2011. Twenty two of these studies showed ECT as improving mental health, four showed mixed results and one, N=1 case study showed no improvement and 16 did not report on the outcomes of mental health (they reported on cognitive outcomes only).

The most commonly assessed cognitive domains included Verbal Learning and Memory (19 studies, 44%), Visual Learning and Memory, Global Cognitive Functioning (14 studies, 33%), Subjective Complaints, Retrograde Amnesia/Memory and Attention (13 studies each, 30%), Retrieval and Autobiographical Memory (12 studies each, 28%), Anterograde Amnesia/Memory (11 studies, 26%), Executive Functioning (10 studies, 23%) and Working Memory (9 studies, 21%).

Less commonly assessed domains were Information Processing Speed (7 studies, 16%), Language and Visuospatial Functioning and Perception (6 studies each, 14%), Encoding/Immediate Memory (4 studies, 9%), Semantic Memory (3 studies, 7%), Cognitive Flexibility and Public Events Memory (2 studies each, 5%) and Everyday Memory, Daily Living/Psychosocial Functioning, Visual Processing Speed, Psychomotor Speed/Functioning and Motor Functioning (1 study each, 2%).

Of the cognitive domains most commonly assessed, the domains most adversely affected by ECT were, Retrograde Amnesia/Memory (92% of studies assessing Retrograde Amnesia/Memory showed a deficit in this domain), Subjective Complaints (86%), Autobiographical Memory and Retrieval (83% each), Anterograde Amnesia/Memory (73%), Global Cognitive Functioning (67%), Verbal Learning and Memory (68%), Visual Learning and Memory (50%), Executive Functioning (50%), Attention (46%), and Working Memory (44%).

Less commonly assessed domains, but adversely affected were Encoding, Public Events Memory, Every Day Memory, Visual Processing Speed and Psychomotor Speed/Functioning (100%), Information Processing Speed (86%), Semantic Memory (67%), Cognitive Flexibility (50%), and Language (33%).

The studies reviewed generally did not study the immediate effects of ECT such as confusion and disorientation. This may be due to the large body of evidence existing which supports these difficulties as being common.

### *Discussion*

The aim of this review was to establish which domains of cognitive functioning are most commonly assessed and which are regularly impaired during and post ECT treatment. The review shows clearly that memory remains the most commonly assessed domain and also the domain most likely to be affected. Retrograde memories appear to be reported as being affected most frequently along with subjective complaints, autobiographical, retrieval, and anterograde memory. Interestingly, there is considerable cross over between these different memory functions and leads to the question, are they all part of the same cognitive process affected by ECT. For example, autobiographical memory can be both retrograde (personal memories formed prior to ECT) and anterograde (personal memories formed after ECT) and retrieval can refer to the recall or recognition of semantic memories or autobiographical memories to name two.

There were a number of limitations with the way this review was conducted. Firstly a number of the studies/reviews included in the current review comprised of a summary of multiple studies, some of which found deficits, and others which did not. Therefore, when some of the reviews were entered into the table they often had an “M” for mixed results. This also meant that some studies may have been included more than once. However given the commonality of domains assessed it is unlikely that this would have made a significant difference to the trends reported. Secondly, there is considerable overlap between the domains. For example, as stated above, autobiographical memory could refer to anterograde or retrograde memory and retrieval could refer to *any* stored memory. Thirdly, when reviewing the domains assessed in each of the studies, the current researcher had to interpret what each of the domains were referring too. For example, what one study interpreted as autobiographical memory may have been interpreted differently in another. The researcher made an educated guess as to whether each study was using the same operational definition when referring to constructs. Accordingly there may have been cross-over between domains, or inaccurate groupings of studies under various

domains. Finally, when reviewing previous studies, it is important to remember that the original studies also have limitations.

Future research and reviews should focus on the crossover between cognitive domains, particularly memory. Clarification is needed as to whether autobiographical memory is a single entity or a construct formed from a number of memory domains. The effect that ECT has on memory functioning still warrants more investigation, using research methods that control for other potential causal factors.

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Table 1

*Clinical and Cognitive Outcomes of Electroconvulsive Therapy (ECT)*

Study	Mood	Type of Study	GS	CF	PM F	MF	IPS	VP S	A	VF & P	SM	ED M	WM	L	E	R	Verbal Learning and Memory	Visual Learning and Memory	RA	AA	AM	PE M	EF	DL	SC
Kellner et al., 2011	NI	Case Study	-	-	-	-	-	-	Y	N	Y	-	-	-	-	Y	Y	Y	-	-	-	-	Y	-	Y
Quante et al., 2011	I	Study	-	-	-	-	-	-	N	-	N	-	N	-	-	Y	Y	-	-	-	-	-	N	-	-
Kayser et al., 2010	M	Study	-	-	-	-	-	-	-	-	-	-	-	N	-	N	N	N	-	-	-	-	N	-	-
Bayless et al., 2010	I	Study	-	N	-	-	-	-	N	N	-	-	N	N	-	N	N	N	-	-	-	-	N	-	-
Semkowska et al., 2010	-	Review	Y	-	-	-	Y	-	N	-	-	-	N	-	-	Y	Y	Y	-	-	-	-	Y	-	-
Sienaert et al., 2010	M	Study	N	-	-	-	-	-	N	-	-	-	N	-	-	-	N	-	-	N	N	-	N	-	N
Sackeim et al., 2009	M	Study	Y	-	-	-	-	-	-	-	-	-	Y	-	-	-	Y	-	Y	Y	Y	-	-	-	-
Fraser et al., 2008	-	Review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	Y
Gardner & O'Connor, 2008	-	Review	M	-	-	-	Y	-	-	-	-	-	N	N	-	-	N	N	Y	-	Y	-	N	-	Y
Ingram et al., 2008	-	Review	-	-	-	-	M	-	M	N	-	-	-	Y	-	-	-	-	Y	Y	-	-	Y	-	-
O'Connor et al., 2008	I	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	N	-	-	-	-	-
Porter et al., 2008	-	Study	N	-	-	-	-	-	Y	-	-	-	Y	-	-	-	Y	-	-	-	Y	-	-	-	-
Sackeim et al., 2008	M	Study	Y	-	-	-	-	-	-	-	-	-	-	Y	-	Y	-	Y	Y	Y	-	-	-	-	-
Vamos, 2008	-	Review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
Fink & Taylor, 2007	I	Review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	Y

Mathew et al., 2007	I	Review	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	-
Sackeim et al., 2007	-	Study	Y	-	Y	-	-	-	Y	-	-	-	-	Y	Y	-	-	-	Y	Y	-	-	-	-
Schat et al., 2007	-	Study	-	-	-	-	-	-	-	Y	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
Tsourtos et al., 2007	I	Study	-	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hihn et al., 2006	-	Study	-	-	-	-	-	-	N	-	-	-	-	-	-	M	M	-	-	-	-	-	-	-
Kho et al., 2006	-	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	Y	-	-	-	Y
MacQueen et al., 2006	-	Study	-	-	-	-	-	-	-	-	-	-	-	Y	Y	Y	N	-	-	-	-	Y	-	Y
Johanson et al., 2005	I	Study	-	Y	-	-	-	-	-	N	-	-	Y	N	-	-	Y	Y	-	-	-	-	-	-
Kellner et al., 2005	I	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
McDiarmid, 2005	-	Personal Journey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
Frasca et al., 2003	-	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	N	-	-	-	-	-	-	-
Kho et al., 2003	I	Meta-analysis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Little et al., 2003	I	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O'Connor et al., 2003	I	Study	-	-	-	-	-	-	-	-	-	Y	-	-	-	Y	-	Y	-	-	-	-	-	-
The UK ECT Review Group, 2003	I	Review	M	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	Y	Y	Y	-	-	-	-
Vothknecht et al., 2003	I	Study	-	-	-	-	N	-	N	-	-	-	-	-	-	N	N	-	-	-	-	-	-	-
Van der Wurff et al., 2003	I	Review	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	Y	-	-	-	-	-
Dannon et al., 2002	I	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brodaty et al., 2001	I	Study	-	-	-	N	-	-	N	-	-	-	-	-	-	N	-	N	N	-	-	-	-	-

Neylan et al., 2001	I	Study	Y	-	-	-	Y	Y	Y	-	-	-	-	-	-	-	Y	N	-	-	-	-	Y	-	-
Swartz et al., 2001	I	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Donahue, 2001	I	Personal Journey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y
Lisanby et al., 2000	-	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	Y	-	-	-
Ng et al., 2000	I	Study	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	-	-	Y	N	-	-	-	N
Sackeim et al., 2000	I	Study	Y	-	-	-	-	-	-	-	-	-	-	Y	Y	Y	Y	Y	Y	Y	-	Y	-	-	N
Peretti et al., 1996	-	Study	N	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	-	-	-	-	-	-	Y
McElhiney et al., 1995	I	Study	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	Y	-	-	-	-
Patterson et al., 1978	-	Study	-	-	-	-	-	-	-	-	-	-	-	-	Y	-	-	-	Y	-	-	-	-	-	-

N: assessed but no difficulties  
 Y: assessed with difficulties found  
 M: mixed results  
 I: improvement  
 -: not assessed/reported  
 NI: No Improvement

IPS: Information Processing Speed  
 A: Attention/Concentration  
 VF & P: Visuospatial Functioning & Perception  
 SM: Semantic Memory  
 EDM: Everyday Memory  
 WM: Working Memory  
 L: Language  
 E: Encoding/Immediate Memory  
 R: Retrieval

PMF: Psychomotor Speed/Functioning  
 RA: Retrograde Memory  
 AA: Anterograde Memory  
 AM: Autobiographical Memory  
 PEM: Public Events Memory  
 EF: Executive Functioning  
 DL: Daily Living/Psychosocial Functioning  
 SC: Subjective Complaints  
 GS: Global Cognitive Status

CF: Cognitive Flexibility  
 MF: Motor Functioning  
 VPS: Visual Processing Speed



MASSEY UNIVERSITY  
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STATEMENT OF CONTRIBUTION  
TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

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**Name of Published Research Output and full reference:**

Cognitive Outcomes of Electroconvulsive Therapy: A Review

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## **CHAPTER 4**

### **OBJECTIVE AND SUBJECTIVE ASSESSMENT OF THE COGNITIVE OUTCOMES OF ELECTROCONVULSIVE THERAPY: A BRIEF REVIEW**

This chapter is in the form of a manuscript for the purpose of submission to a journal still to be advised. The manuscript that follows is presented in the format required for that submission, with the exception of page numbers and font size, which need to be consistent with the thesis as a whole. Some editing may occur after manuscript submission; however the changes would not affect the overall outcomes of the review. Some repetition of information and references was unavoidable given the structure of this thesis by manuscript.

**Objective and Subjective Assessment of the Cognitive Outcomes of  
Electroconvulsive Therapy: A Brief Review**

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*Abstract*

Monitoring cognition plays an important role in the overall process of ECT as it can inform treatment schedules. However, the neuropsychological assessment of cognitive functioning for those receiving electroconvulsive therapy (ECT) is a controversial area of research. This is in part due to discrepancies as to which domains of functioning are affected by ECT, as well as the vast numbers of measures available. The following brief review aimed to establish which measures are currently used for monitoring cognitive function during and after ECT. The review revealed that there is no *Gold Standard* for the assessment of cognitive functioning, however some trends did emerge such as the use of word-lists for verbal learning and memory, the use of complex figures for visual learning and memory, the use of the Autobiographical Memory Inventory for autobiographical memory and retrograde amnesia and the use of the Mini Mental State Examination for global cognitive functioning.

### *Introduction*

Neuropsychological assessment aims to monitor change in cognitive functioning, assist with diagnosis and inform rehabilitation planning (Manning, 2001). An important aspect of both monitoring change and diagnosis is that deficits may be detected early on in their onset allowing for planning to begin at the earliest possible stage (Manning, 2001). One of the difficulties in detecting mild cognitive impairment (MCI) however, is establishing whether the impairment is due to normal ageing, psychological disorders such as depression, (Porter, Heenan & Reeves, 2008; Vamos, 2008; Gangadhar & Thirthalli, 2010) to organic changes or a combination of these factors, which can all impact on the type of treatment/rehabilitation planned (Manning, 2001; Jacova, Kertesz, Blair, Fisk & Feldman, 2007).

Electroconvulsive therapy (ECT) for treatment resistant depression is often associated with cognitive impairment and monitoring of cognitive function for change is important as the outcomes of cognitive assessment during ECT may be used to inform the treatment itself, i.e., if a person is showing signs of cognitive decline, changes to the treatment schedule may be made to minimise these changes (Porter et al., 2008). Despite this, monitoring of cognitive function through formal assessment during and after ECT is inconsistent and the subject generally remains a very controversial area of research (Mangaoang & Lucey, 2007).

This appears to be due a number of factors. Firstly there is debate as to which domains are actually affected by the treatment. For example there is no real evidence to suggest ECT affects the memory for well learned skills or short term recall, resulting in some standard assessment measures such as the Wechsler Memory Scale (WMS) being insensitive to ECT deficits (Robertson & Pryor, 2006). Further, a number of studies indicate that the subjective experience of memory and cognitive deficits may differ from objective findings (Prudic, Peyser & Sackeim, 2000) which has led the National Institute for Clinical Excellence (NICE) (2003) to recommend that research be undertaken using both objective and subjective assessment.

A second factor concerns the measures themselves: the large number currently available for use make it difficult to compare or combine studies; and it is often unclear which tests are both efficient and quick to administer. In discussing the

inconsistency of measures used to assess cognition in those receiving ECT Mangaoang and Lucey (2007) suggest that this may be due to time constraints, lack of access to suitable tests and lack of finances.

It appears that there are very few studies which go so far as to recommend particular measures for the assessment of cognitive deficits of those receiving ECT although Porter, Douglas and Knight (2008) did recommend a battery which aimed to assess memory and cognition in an hour. They suggested using the Modified Mini Mental State Examination (3MSE) or its predecessor the Mini Mental State Examination (MMSE) for global cognitive impairment, the Autobiographical Memory Inventory – Short Form (AMI-SF) for retrograde amnesia, the Rey Auditory Learning Test (RAVLT) for anterograde amnesia, and the Trail Making Test (TMT) for processing speed (Porter et al., 2008).

The following review looks at what measures of clinical outcomes, memory and global cognitive function are commonly used to assess various cognitive deficits in people who have had ECT.

#### *Method*

Literature searches were carried out using the Search Engines; Web of Science; Google Scholar; Psych INFO; Academic Search Elite; and Medline, using the keywords; Electroconvulsive Therapy, ECT, Cognition, Thinking, Memory and Outcomes, and Assessment. The March 2008 Special Edition on Cognition of the Journal of ECT was also searched for articles pertaining to assessment and cognitive outcomes of ECT. Articles containing studies into the cognitive outcomes of ECT were included in this current review. Table headings were based on the most commonly assessed areas of memory plus global cognitive functioning and clinical outcomes.

**<INSERT TABLE 1 ABOUT HERE>**

## *Results*

From the literature search, 28 studies were included that assessed the outcomes of ECT on depression and/or memory and global cognitive functioning between the years 1995 and 2011. There was considerable diversity in the assessment measures used (Refer to Table 1). However some trends emerged.

The Hamilton Depression Rating Scale (HDRS/HRDS [Hamilton, 1960]) was the most commonly utilised assessment for mood (15 studies, 54%), followed by the Beck Depression Inventory (BDI/BDI-II [Beck & Steer, 1987; Beck, Steer & Brown, 1996]) (9 studies, 32%) and the Montgomery Asberg Depression Rating Scale (MADRS [Montgomery & Asberg, 1979]) (6 studies, 21%).

The Mini Mental State Exam (MMSE [Folstein, Folstein & McHugh, 1975]) was most commonly used for Global Cognitive Functioning (9 studies, 32%), followed by its successor the Modified Mini State Exam (3MSE [Teng & Chui, 1987]) (4 studies, 14%). Verbal Learning Lists such as the Rey Auditory Verbal Learning Test (RAVLT [Schmidt, 2004]) and the California Verbal Learning Test (CVLT [Delis, Kramer & Kaplan, 1987; Delis, Kramer, Kaplan & Ober 2000]) were the most common methods used for assessing Verbal Learning and Memory (12 studies, 43%).

Visual Learning and Memory was most commonly assessed, using complex figures such as the Rey Complex Figure Test (RCFT [Meyers & Meyers, 1995]) (3 studies, 11%).

The Autobiographical Memory Inventory (AMI/AMI-SF [Kopelman, Wilson & Baddeley, 1990]) was the most common method of assessing both Autobiographical Memory (10 studies, 36%) and Retrograde Amnesia (5 studies, 18%). And again, Complex Figures such as the RCFT (Meyers & Meyers, 1995) appeared to be the most common methods used for assessing Anterograde Memory (5 studies, 18%). The Wechsler Memory Scales (WMS [Wechsler, 1987]) Digit Span subtest emerged as the most common methods for assessing both Working Memory (3 studies, 11%) and Attention (3 studies, 11%).

A number of different measures emerged for the assessment of Subjective Complaints such as the Cognitive Failures Questionnaire (CFQ [Broadbent, Cooper, FitzGerald & Parkes, 1982]) (4 studies, 14%) and the Squire Subjective Memory Questionnaire (SSMQ [Squire, Wetzel & Slater, 1979]) (2 studies, 7%). No self-reports featured in the studies reviewed.

### *Discussion*

The aim of this review was to determine which measures of cognitive function were commonly used to assess memory and global cognitive deficits in people who have had ECT. It also looked at the measures used for assessing clinical outcomes.

As discussed by Gangadhar and Thirthalli (2010) it is clear that there does not appear to be any *Gold Standard* for assessment. As illustrated by Table 1 and in agreement with Porter et al. (2008) there are a large number of different measures being used in ECT research however some trends emerged from the current review. Firstly, word-lists seemed to be the preferred method for the assessment of verbal learning and memory, and the use of complex figures in the assessment of visual learning and memory. There was also an obvious trend in the use of the Autobiographical Memory Inventory (Kopelman et al., 1990) to assess autobiographical memory and retrograde amnesia. The MMSE (Folstein et al., 1975) emerged as the choice of global cognitive screen, despite being superseded by the Modified Mini Mental State Exam (3MS [Teng & Chui, 1987]). Subjective accounts appeared to be assessed using objective measures and scales such as the Squire Subjective Memory Questionnaire (SSMQ [Squire et al., 1979]) and the Cognitive Failures Questionnaire (CFQ [Broadbent et al., 1982]) rather than patient self-report so therefore may still not necessarily be a true representation of subjective cognitive complaints.

What also emerged is a number of the assessment measures are time consuming to administer, and while thorough, they may not lend themselves to clinicians who are responsible for the monitoring of clinical, memory and cognitive changes in ECT patients. Examples of this include the Hamilton Depression Rating Scale which can take 30 minutes to administer (HDRS/HRDS [Hamilton, 1960]) and the Wechsler Memory Scales (WMS [Wechsler, 1987]).

Therefore many may opt to use brief cognitive screens which might not measure deficits to the same thorough degree as the lengthier, thorough measures.

There were a number of limitations with this review. Firstly only 28 studies were included in the review, which is a small body of research. Secondly, the review did not aim to distinguish between assessment measures used during the ECT period and post ECT, as the review aim was to investigate the overall picture of assessment, although it did appear that the measures used were the same. Thirdly, as the reviewed studies went back as far as 1995 some of the measures reported back then have been superseded by more recent versions (such as the Wechsler Scales) making the older research less valid.

Future research may wish to focus on the battery suggested by Porter et al. (2008) which the current review endorses with the exception of complex figures for visual learning and memory, for which Porter et al. (2008) does not assess. Research should also focus on the creation and validation of a *Gold Standard Battery* as well as an investigation into why subjective cognitive complaints appear to be assessed using objective measures and scales.

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Table 1

*Measures for Assessing Clinical and Cognitive Outcomes of Electroconvulsive Therapy (ECT)*

Authors	Year	Title	Cognitive/Mood Domains Assessed									
			Mood	Global Cognitive Functioning	Verbal Learning & Memory	Visual Learning & Memory	Autobiographical Memory	Retrograde Amnesia	Anterograde Amnesia	Working Memory	Attention	Subjective Complaints
Brakemeier et al.,	2011	Self-evaluation of the cognitive effects of electroconvulsive therapy	HDRS24, CGI, GAS, BDI-II, SADS	MMSE, WAIS-III (Verbal IQ)	Word List	ROCFT		AMI, G-BRMQ				CFQ, SMCQ, GSE-My,
Kellner et al.,	2011	Resolution of the amnesic effects of an extended course of electroconvulsive therapy	GDS	MMSE,	CVLT-II, WMS-III (logical memory I & II & recognition)	RCFT						
Quante et al.,	2011	Effects of 3 different stimulus intensities of ultrabrief stimuli in right unilateral electroconvulsive therapy in major depression: A randomized, double-blind pilot study	HDRS, MADRS, BDI-II, YMRS		VLMT					WMS (digit span)	WMS (digit span), Word Fluency, R-WT	
Bayless et al.,	2010	Pre- and post-electroconvulsive therapy multidomain cognitive assessment in psychotic depression	HAMD2, HAMA, SANS, SAPS	RBANS						WAIS-III (letter-number sequencing)	WAIS-III (letter-number sequencing)	
Kayser et al.,	2010	Antidepressant effects of magnetic seizure therapy and electroconvulsive	HDRS, MADRS, BDI,		Word List, WMS (logical	Shapes, Picture Test	AMI					

Authors	Year	Title	Cognitive/Mood Domains Assessed									
			Mood	Global Cognitive Functioning	Verbal Learning & Memory	Visual Learning & Memory	Autobiographical Memory	Retrograde Amnesia	Anterograde Amnesia	Working Memory	Attention	Subjective Complaints
		therapy in treatment-resistant depression	HAMA, SCL-90		memory I and II)							
Sienaert et al.,	2010	Randomized comparison of ultra-brief bifrontal and unilateral electroconvulsive therapy for major depression: cognitive side-effects	HDRS17	MMSE	RAVLT		AMI			WAIS-III (letter-number sequencing)	CPT, TMT	SSMQ
Sackeim et al.,	2009	Effect of concomitant pharmacotherapy on electroconvulsive therapy outcomes	HRDS, BDI-II, CGI, GAF	MMSE	BSRT		AMI-SF	AMI-SF	BSRT	N-back		
Berman et al.,	2008	Subjective evaluation of the therapeutic and cognitive effects of electroconvulsive therapy	SCID-I/P, HRDS, GSE-Md	MMSE, 3MS	BSRT		AMI-SF	AMI-SF				CFQ, GSE-My
Porter et al.	2008	Early effects of electroconvulsive therapy on cognitive function	MADRS	3MSE	RAVLT		AMI-SF			Digit Span	Digit Span	
Sackeim et al.,	2008	Effects of pulse width and electrode placement on the efficacy and cognitive effects of electroconvulsive therapy	HRSD, BDI-II, CGI, GAS	3MSE				AMI, Goldberg public events, Subjective cognitive evaluation	CFT, BSRT, Randt story recall			GMA
Vamos	2008	The cognitive side effects of modern ECT: Patient experience or objective measurement?										Spontaneous Discussion

Authors	Year	Title	Cognitive/Mood Domains Assessed										
			Mood	Global Cognitive Functioning	Verbal Learning & Memory	Visual Learning & Memory	Autobiographical Memory	Retrograde Amnesia	Anterograde Amnesia	Working Memory	Attention	Subjective Complaints	
Sackeim et al.,	2007	The cognitive effects of electroconvulsive therapy in community settings	SCID-I/P, HRSD	MMSE				AMI-SF		CFT, BSRT		Stroop color-word interference CPT	
Hihn et al.,	2006	Memory performance in severely depressed patients treated by electroconvulsive therapy	HAMD, MADRS		WMS-R (logical memory, verbal paired associated)	WMS-R (figural memory, visual paired associates, visual reproduction)						WMS-R (mental control, digits forwards and backwards, spatial span)	
MacQueen et al.,	2007	The long-term impact of treatment with electroconvulsive therapy on discrete memory systems in patients with bipolar disorder	SCID-IV, HAMD, GAI, YMS			CVLT, Computer Task	CVMT						CFQ
Arts et al.,	2006	S100 and impact of ECT on depression and cognition	HDRS, SCL-90	MMSE		15 Word Learning Task						Stroop Color / Word, MCT	CFQ
Kho et al.,	2006	A retrospective controlled study into memory complaints reported by depressed patients after treatment with electroconvulsive therapy and pharmacotherapy or pharmacotherapy only	BDI, HRSD	MINI				AMI	AMQ				ERAPS, SSMQ

Authors	Year	Title	Cognitive/Mood Domains Assessed										
			Mood	Global Cognitive Functioning	Verbal Learning & Memory	Visual Learning & Memory	Autobiographical Memory	Retrograde Amnesia	Anterograde Amnesia	Working Memory	Attention	Subjective Complaints	
Johanson et al.,	2005	Long-term follow-up in depressed patients treated with electroconvulsive therapy	Unspecified rating scales		Paired Associates	Memory for Objects, Memory for Design, Visual Retention Test						Digit Span	
Frasca et al.,	2003	The relationship between changes in learning and memory after right unilateral electroconvulsive therapy	HRSD		RAVLT								
Vothknecht et al.,	2003	Effects of maintenance electroconvulsive therapy on cognitive functions	HRSD, BDI, GDS, CGI	IQ Test, WMS MQ, GIT-V	WMS (Logic, Association)	BVRT, WMS (Visual production)						WMS (Concentration)	
Brodaty et al.,	2001	'Side effects' of ECT are mainly depressive phenomena and are independent of age	HRSD		WMS (Associate learning)							TMT Part A, SDMT	
Neylan et al.,	2001	Cortisol levels predict cognitive impairment induced by electroconvulsive therapy	HDRS	MDRS	CVLT	WMS (Visual Recall)						TMT	
Lisanby et al.,	2000	The effects of electroconvulsive therapy on memory of autobiographical and public events	SADS, HRSD, BDI				AMI	PIMT					

Authors	Year	Title	Cognitive/Mood Domains Assessed											
			Mood	Global Cognitive Functioning	Verbal Learning & Memory	Visual Learning & Memory	Autobiographical Memory	Retrograde Amnesia	Anterograde Amnesia	Working Memory	Attention	Subjective Complaints		
McCall et al.,	2000	Titrated moderately suprathreshold vs fixed high-dose right unilateral electroconvulsive therapy	HRSD, SCID-R	MMSE	RAVLT	CFT	DPMQ	DPMQ						Subjective Likert Scale
Ng et al.,	2000	Efficacy and cognitive effects of right unilateral electroconvulsive therapy	HDRS17, MADRS, CGI, PGAD	WAIS-R (arithmetic, similarities, picture completion, digit symbol)				The Personal Memory Test			The Randt Memory Test			Self-Rating Scale of Memory Functions
Sackeim et al.,	2000	Electrophysiological correlates of the adverse cognitive effects of electroconvulsive therapy		3MSE				AMI						
Shapira et al.,	2000	Balancing speed of response to ECT in major depression and adverse cognitive side-effects: Role of the treatment schedule	HAMD					PMQ	Word List (recall and recognition), Nonsense shapes recognition, Faces recognition, Word Generation, FEQ, PMQ	Word List (recall and recognition), Nonsense shapes recognition, Faces recognition, Digit span, RCFT, Ritchies Figures, Taylor Figure, Verbal Paired Associates (recall and Recognition), Verbal vs Visual Spatial Recall, Immediate				





MASSEY UNIVERSITY  
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION  
TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Kiri Michelle Luther

Name/Title of Principal Supervisor: Janet Leathem

Name of Published Research Output and full reference:

Objective and Subjective Assessment of the Cognitive Outcomes of Electroconvulsive Therapy: A Brief Review

In which Chapter is the Published Work: Chapter 4

Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:

and / or

- Describe the contribution that the candidate has made to the Published Work:

The candidates contribution to this manuscript is estimated to be 95% including primary responsibility for design, analysis and write up.

\_\_\_\_\_  
Candidate's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Principal Supervisor's signature

\_\_\_\_\_  
Date

## CHAPTER 5

### VARIABLES AFFECTING THE COGNITIVE OUTCOMES OF ELECTROCONVULSIVE THERAPY

Controversy continues as to whether it is electroconvulsive therapy (ECT) that causes cognitive problems or whether other factors may be involved. It is generally accepted that electrode placement, stimulus waveform and intensity, number of treatments and time between treatments and depression can all influence the severity of cognitive problems (Shapira, Tubi & Lerer, 2000; Ingram, Saling & Schweitzer, 2008). Other, less frequently cited factors suggested to have an effect on cognition include anesthetic used, patient age, general intelligence, socioeconomic status, neurological conditions, and medications (Shapira et al., 2000; Neylan, Canick, Hall, Reus, Sapolsky, & Wolkowitz, 2001; Tiller & Lyndon, 2003; Ingram et al., 2008). The multiple potentially confounding variables make studying the effects of ECT on cognition a difficult task.

However as ECT treatment does contribute to cognitive problems there needs to be a balance between maximizing clinical efficacy and minimizing cognitive problems (Loo, Schweitzer & Pratt, 2006; Rasmussen, Varghese, Stevens & Ryan, 2007; Kellner, Tobias & Wiegand, 2010).

The following Chapter reviews the current literature regarding the most important variables to take into account when conducting research into the cognitive outcomes of ECT.

#### *Electrode Placement*

Balancing the effect that ECT has on depressive symptoms and the effect it has on cognition is important when considering the type of electrode placement to be used with a patient (Rudorfer, Henry & Sackeim, 1997). Two main forms of electrode placement are currently used (refer to Figure 1.) and both have advantages and disadvantages. In unilateral ECT the electrodes placed on one side of the head only, usually the non-dominant side (right hemisphere). Right side electrode placement reduces the effects on language and speech dominant in the left hemisphere.

While unilateral placement has been shown to induce less confusion and memory problems it is less effective in relieving clinical symptoms than bilateral ECT (Rudorfer et al., 1997) unless administered in high doses above seizure threshold. Generally speaking, high-dose right side unilateral ECT produces optimum results in terms of treatment response combined with minimal adverse effects at 2.5-6.0 x seizure threshold after stimulus dose titration. Over the period of treatment the stimulus dose increases to counteract the increase in seizure threshold (Tiller & Lyndon, 2003).

In bilateral electrode placement the electrodes are placed on both sides of the head, usually in the bifrontotemporal position. The advantages of this are that the treatment response is faster, and seizure threshold is not as much of a concern (Rudorfer et al., 1997). Although bilateral ECT is considered the most effective in relieving clinical symptoms it has been shown to cause more severe cognitive effects, particularly confusion, disorientation and memory problems. Therefore, it is preferable to use high-dose unilateral ECT initially, and if a patient does not respond after 6 sessions either more high-dose unilateral ECT will be administered or there will be a change to bilateral ECT. Patients with a high seizure threshold may respond better to bilateral ECT as it may be impossible to reach a dose high enough using unilateral (Porter, Douglas & Knight, 2008).

There is a third placement site located in the bifrontal region (refer to Figure 1). Since 2000 there have been a number of studies into the efficacy and cognitive outcomes of the bifrontal electrode placement (Kellner et al., 2010). Initially it was thought that the bifrontal placement would minimise cognitive deficits while maximising clinical efficacy, however this was not found in a recent large scale randomised trial and the bifrontal placement is still being researched (Kellner et al., 2010).

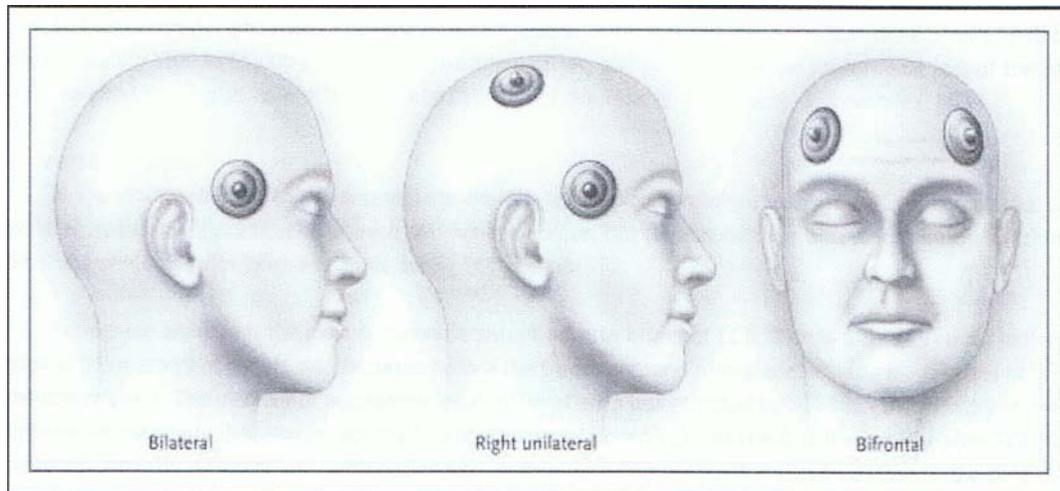


Figure 1. Electrode placements  
Taken from Lisanby (2007).

#### *Waveform and Pulse Width*

Initially ECT used a sine-wave waveform to induce seizures. Sine-waves are a very continuous and intense way of delivering electricity, and as a result patients would often develop serious cognitive deficits after their treatment (Prudic, 2008). As research into the development of ECT progressed, brief-pulse square-wave waveforms came into use. These waves deliver the electricity in pulses usually between 0.5-2.0 milliseconds (ms), allowing for maximum intensity but in short, brief spurts (Sackeim, Prudic, Nobler, Fitzsimons, Lisanby et al. 2008). Research subsequently showed that delivering electricity in this way significantly reduced the cognitive problems that sine-waves caused (Sackeim et al., 2008). Currently practitioners predominately use brief-pulse waveforms and this is the case in New Zealand (MoH, 2005). Recently it has emerged from research that *ultra*-brief pulses (<0.5 ms) may be more efficient causing fewer cognitive deficits than standard brief-pulse (Prudic, 2008; Lisanby, 2007). This is because neuronal depolarization required for the efficacy of ECT occurs between 0.1-0.2 ms suggesting that efficacy may be achieved using even less charge therefore reducing cognitive deficits more so (Prudic, 2008). Sackeim et al., (2008) found a 73% remission rate for patients who were administered ultra-brief pulse unilateral ECT and rated their cognitive deficits as less than those receiving bilateral ultra-brief pulse ECT (35% remission rate),

standard bilateral brief pulse ECT (65% remission rate) and standard unilateral brief pulse ECT (59% remission rate).

#### *Electrical Dosage Relative to Seizure Threshold*

The efficacy of ECT is related to the seizure response to the electrical stimulus. This response must be adequate to have a positive effect on patient symptoms (Tiller & Lyndon, 2003). Electrical stimulus refers to a number of properties associated with electrical charge and energy. Electrical charge refers to the number of electrons during a certain time which are flowing through a conductor and is a *dose* measured in microcoulombs (mC) (Tiller & Lyndon, 2003). Voltage is the force behind the flow of electrons. A greater voltage is required when there is more resistance present. Resistance may come from the skin, the skull and amount of contact between electrodes and the skin of the scalp. Certain characteristics are required to induce a seizure response which is adequate. Firstly, the electrical stimulus needs to be above the seizure threshold for each patient. This is recommended to be between 2.5 and 6.0 times the threshold for unilateral ECT, and 1.5 times the threshold for bilateral ECT (Tiller & Lyndon, 2003). Seizure threshold refers to the minimum dose of ECT required to cause a bilateral grand mal seizure, and is higher for bilateral ECT (100 mC for adults) than for unilateral (75 mC for adults) (Tiller & Lyndon, 2003). Secondly, electrode placement, unilateral or bilateral and the characteristics of the electricity flowing through the electrodes can influence the seizure response (Tiller & Lyndon, 2003; Peterchev, Rosa, Deng, Prudic & Lisanby, 2010). Age and half-age can also be used to ascertain estimates of seizure threshold. Seizure threshold is determined by “stimulus dose titration”.

#### *Stimulus Dose Titration*

Stimulus dose titration refers to the amount of stimulus required to induce an adequate seizure while minimising potential adverse effects (Tiller & Lyndon, 2003). Advances in the use of ECT have illustrated the importance of stimulus dose titration, particularly with unilateral ECT. The procedure for identifying a patient’s stimulus dose can vary, depending on electrode placement and gender (Tiller & Lyndon, 2003). Unilateral ECT uses a smaller initial stimulus dose than bilateral, such as 25 mC for females and 50 mC for males, while bilateral may use 50 mC for

females and 75 mC for males (Tiller & Lyndon, 2003). These initial doses may not produce a response; at this point the dose will be increased (Lisanby, 2007).

Increasing the dose will continue until a response is initiated, as defined by the presence of a bilateral grand mal seizure, with motor and cardiac responses. This seizure response is known as the threshold stimulus and may be as short as 20 to 30 seconds, however a minimum of 90 to 120 seconds is required before it can be accepted as the stimulus dose for subsequent treatment (Tiller & Lyndon, 2003).

Efficacy and adverse side effects depend on how far above the seizure threshold the treatment dose is given (Prudic, 2008).

#### *Number of Treatments and Frequency*

The number of treatments given and the frequency with which they are given are also related to cognitive deficits, particularly in the short term (during and immediately post treatment) (Prudic, 2008). The more frequent the treatments the faster the treatment response, but the greater the chance of cognitive deficits (Prudic, 2008). Two ECT sessions a week are generally prescribed as this frequency tends to result in fewer cognitive complaints, however on occasion ECT may be given three times a week (Prudic, 2008). However there is evidence that three times a week bilateral ECT is associated with more cognitive complaints than twice a week unilateral ECT due to worse cognitive deficits being associated with bilateral ECT. Accordingly if bilateral ECT is prescribed it may be less detrimental to cognition to prescribe no more than two treatments in a week to balance efficacy with cognitive outcomes (Prudic, 2008).

Gangadhar & Thirthalli (2010) conducted a review into the efficacy of ECT and cognitive deficits associated with the frequency of sessions per week. They found that those receiving ECT three times a week had a greater reduction in depression than those receiving ECT only once a week. They also found evidence to suggest there was no significant difference in efficacy between two and three treatments a week, and that the greater the frequency the greater the cognitive deficits. They concluded that two ECT sessions a week provided the best balance between efficacy and cognitive functioning (Gangadhar & Thirthalli, 2010).

*Depression*

Depression has long been known to exert an influence over cognitive functioning (Porter, Bourke & Gallagher, 2007) and is therefore likely to confound performance during cognitive assessment (Sweet, Newman & Bell, 1992; Kizilbash, Vanderploeg & Curtiss, 2002). Depression has a specific negative effect on executive functioning, attention and concentration, memory and processing speed (McClintock, Husain, Greer & Cullum, 2010) which is not due to psychotropic medication (Porter, Gallagher, Thompson & Young, 2003). The influence of depression makes it particularly difficult to assess the cause of memory and cognition in those receiving ECT, as it is highly likely that ECT has been prescribed for drug-resistant depression.

*Summary*

While there is still much discussion about the extent to which ECT has a negative impact on memory and cognition, it is generally agreed that electrode placements, waveform and pulse width, electrical dosage relative to seizure threshold, and the number and frequency of treatments all influence the extent to which cognitive functioning may be impaired. It is also agreed that depression can influence the extent to which memory and cognition may be impaired. Consideration of these factors is important when conducting research or planning the treatment itself, in order that an accurate a picture of memory and cognition is obtained.

## CHAPTER 6

### CURRENT RESEARCH

The current study grew out of a request from physicians conducting Electroconvulsive Therapy (ECT) in the Wellington region (Capital and Coast District Health Board, CCDHB). They were interested in ensuring that the best measures were used to monitor memory and cognition in their current patient population. They were also interested in the current cognitive functioning of patients seen in the past.

The 2003 guidelines for ECT developed by The National Institute for Clinical Excellence (NICE) were also reviewed when developing the aims of the current research. Amongst a range of issues concerning ECT, they considered a number of studies and patient testimonies which suggested that the objective measures used in Random Controlled Trials (RCT's) were not adequately measuring the nature of the cognitive difficulties associated with ECT. A number of qualitative studies were cited by NICE (2003) suggesting longer term and permanent cognitive difficulties. They therefore suggested that more research was required into the long term cognitive difficulties associated with ECT with an emphasis on both objective and subjective assessment.

It was planned that the current research would not only address the issues raised by CCDHB but contribute to the larger body of research regarding long term outcome after ECT from both quantitative and qualitative perspectives. Given this, and an initial review of relevant background about ECT it was decided to conduct a retrospective investigation into the current cognitive functioning (with an emphasis on memory) of people who had received ECT two or more years previously. This timeframe was chosen due to a general consensus amongst brain injury research that cognitive deficits would reach a plateau of improvement by year two post injury (Lezak, Howieson & Loring, 2004). The study involves both an objective assessment component and a subjective component as suggested by the NICE guidelines, 2003.

### *Assessment of Memory and Global Cognitive Function*

Two reviews were conducted to assist in deciding the domains of memory and cognition to assess. The first review investigated what other research was reporting about the domains affected by ECT, the second investigated what objective and subjective measures were used to assess the domains (refer to Chapters 3 and 4 respectively). Both reviews revealed overlap in both the domains affected and the measures used to assess these domains. For example, autobiographical memory and retrograde amnesia/memory both refer to memory prior to the event at which deficits occurred, in this case ECT, and are both commonly assessed using the Autobiographical Memory Inventory (AMI [Kopelman, Wilson & Baddeley, 1990]).

Based on Chapter 3 and Chapter 4 and other literature it was decided that the domains listed in Table 1 below would be assessed

Table 1

#### *Domains to be Assessed and Measures to be Used*

<b>Domains to be Assessed</b>	<b>Assessment Measures to be Used</b>
Retrograde Amnesia	Autobiographical Memory Inventory (AMI)
Anterograde Amnesia	AMI, Rey Complex Figure Test (RCFT), Rey Auditory Verbal Learning Test (RAVLT)
Autobiographical Memory	AMI
Visual Learning and Memory	RCFT
Verbal Learning and Memory	RAVLT
Attention/Working Memory	Mini Mental State Exam (MMSE), Montreal Cognitive Assessment (MoCA), RAVLT, RCFT
Global Cognitive Status	MMSE, MoCA
Subjective Complaints	Interpretative Phenomenological Analysis (IPA)

#### *Aims and Hypotheses*

The main aims of the current research were as follows;

- 1) To investigate current memory function and global cognitive functioning of patients who received their last ECT two or more years ago. This would be conducted using objective assessment and through subjective accounts.
- 2) To make comparisons between objective assessment outcomes and subjective accounts.
- 3) To make recommendations on future research on assessing and monitoring memory and cognition taking into account time constraints on those who will be assessing patients in the future.

As there has not been previous research utilising this time frame hypotheses were based on the previously mentioned reviews conducted for the purpose of this research, and clinical judgement. Specific hypotheses were;

- 1) Scores on the RCFT, RAVLT and AMI for patients who received their last ECT two or more years ago will be below the age matched norms (cut-off ranges in the case of the AMI) for each test.
- 2) The MoCA will identify more participants with Global Cognitive deficits than the MMSE.
- 3) Participants will subjectively *report* a higher degree of difficulty with their memory and cognition than what was identified by the objective assessment measures.

## **CHAPTER 7**

### **AN EVALUATION OF THE LONG-TERM COGNITIVE OUTCOMES OF ELECTROCONVULSIVE THERAPY (ECT): A RETROSPECTIVE STUDY**

This manuscript will be submitted for consideration for publication in the Journal of ECT in 2012. The manuscript that follows is presented in the format required for that submission, with the exception of page and footnote numbers, referencing style and font size, which need to be consistent with the thesis as a whole. Some repetition of information and references was unavoidable given the structure of this thesis by manuscript.

**An Evaluation of the Long-Term Cognitive Outcomes of Electroconvulsive  
Therapy (ECT): A Retrospective Study**

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*Abstract*

The incongruence between objective and subjective assessment of memory and cognition in an ECT population is still a highly debated area of research. There are a number of proposed reasons for this, however many accept that this is due to the inability of objective measures to adequately identify the types of deficits related to ECT. The current research utilised both quantitative and qualitative methods to investigate the cognitive functioning reported by a group of 19 people who had received ECT two or more years previously. Reviews of the literature conducted as part of the overall study design suggested the domains most commonly affected by ECT were verbal learning and memory, visual learning and memory, global cognitive functioning, subjective complaints, retrograde amnesia/memory, attention, retrieval, autobiographical memory, anterograde amnesia/memory and aspects of executive functioning. The most commonly used objective measures for these domains were found to be the Rey Auditory Verbal Learning Test (RAVLT), the Rey Complex Figure Test (RCFT), the Mini Mental State Exam (MMSE), and the Autobiographical Memory Inventory (AMI). Subjective assessment most often utilised objective measures such as the Cognitive Failures Questionnaire (CFQ) or the Squire Subjective Memory Questionnaire (SSMQ), however for this study a qualitative method - Interpretative Phenomenological Analysis (IPA), was used. A second brief screen, the Montreal Cognitive Assessment (MoCA), was also utilised as a comparison to the MMSE. Using the measures cited above specific hypothesis were that 1) scores on the objective assessment measures would be below age-matched norms (cut-off ranges in the case of the AMI) for each test, 2) the MoCA would identify more participants with global cognitive deficits than the MMSE, and 3) participants would report a higher degree of difficulty with their memory and cognition than was identified by the objective measures. Findings did not confirm hypothesis 1) with the exception of scores on the RCFT. Hypothesis 2) was confirmed, with the MoCA identifying more participants with deficits than the MMSE. Hypothesis 3) was confirmed, with participants reporting subjective complaints that were not identified by the objective measures. Future research should focus on a larger sample size, assessment with a current ECT population, and the development of a qualitative assessment measure.

### *Introduction*

Electroconvulsive Therapy (ECT) has been used as a treatment for the severely mentally ill since the 1930's (Otto & Fink, 2004). While the exact mechanism of how ECT works is still unclear, it is generally accepted that it is the grand mal seizure elicited by the electricity passed through the skull into the brain that alleviates symptoms (Tiller & Lyndon, 2003).

It is now widely accepted that, like many medications, ECT also has its own side-effects in the form of memory and cognitive impairment, although there is still much debate as to the actual nature and duration of these iatrogenic deficits and how best to assess them (National Institute for Clinical Excellence (NICE), 2003).

It is generally accepted that electrode placement, stimulus waveform and intensity, number of treatments and time between treatments and depression can all influence the severity of cognitive problems (Shapira, Tubi & Lerer, 2000; Ingram, Saling & Schweitzer, 2008) other; less frequently cited factors have an effect on cognition. These include anesthetic used, patient age, general intelligence, socioeconomic status, neurological conditions, and medications (Shapira et al., 2000; Neylan, Canick, Hall, Reus, Sapolsky & Wolkowitz, 2001; Tiller & Lyndon, 2003; Ingram et al., 2008). The multiple potentially confounding variables make studying the effects of ECT on cognition a difficult task. It also means that ECT treatment requires finding a balance between maximizing clinical efficacy and minimizing cognitive problems (Loo, Schweitzer & Pratt, 2006; Rasmussen, Varghese, Stevens & Ryan, 2007; Kellner, Tobias & Wiegand, 2010).

The NICE guidelines for ECT (2003) considered a number of studies and patient testimonies which suggested that, although identifying deficits, the objective measures used in Random Controlled Trials (RCT's) were not adequately measuring the nature of the cognitive difficulties associated with ECT. A number of qualitative studies were cited which suggested longer term and permanent cognitive difficulties beyond that identified with objective measures. They therefore suggested that more research was required into the long term cognitive difficulties associated with ECT with an emphasis on both objective and subjective assessment.

Prudic, Peyser and Sackeim (2000) reviewed ECT patient self-assessment of memory and also found an apparent lack of consensus between objective and subjective assessment findings. They also emphasised the positive correlation between subjective accounts as measured by the SSMQ and mood state (Prudic et al., 2000).

Koopowitz, Chur-Hansen, Reid and Blashki (2003), like NICE (2003), stated that very few studies had investigated subjective experience, and the majority of those who had, used predominantly objective research methods and chose quantitative analysis to explore the data even when the potential was available to explore qualitatively. For example, Brakemeier, Berman, Prudic, Zwillenberg and Sackeim (2011) used specific cognitive evaluation tools such as the Squire Memory Complaint Questionnaire (SMCQ), the CFQ and the Global Self-Evaluation of Memory (GSE-My) to assess the self-evaluation of the cognitive effects of ECT. All of these measures would be considered objective in some form as they use pre-determined questions to assess deficits with a focus on quantifying responses rather than allowing for the free-flow of information from participants. While still adding to research into the cognitive outcomes of ECT, studies such as these are not utilising the wealth of information available from the patients themselves when assessing cognitive outcomes.

A review of the literature<sup>2</sup> for the current study suggested that the cognitive domains most commonly affected by ECT are, Retrograde Amnesia/Memory, Subjective Complaints, Autobiographical Memory, Retrieval, Anterograde Amnesia/Memory, Global Cognitive Functioning, Verbal Learning and Memory, Visual Learning and Memory, Executive Functioning, Attention, and Working Memory. Reviews of the literature<sup>3</sup> suggest there is no *Gold Standard* assessment battery for monitoring memory and cognition in an ECT population, however there are some trends. Word lists, complex figures, the Autobiographical memory test (AMI) and the Mini Mental State Examination (MMSE) appear to be used most often in assessment batteries.

NICE (2003) state that cognitive functioning should be regularly monitored in those who have received ECT, and as a minimum, assessed at the end of the treatment.

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<sup>2</sup> Refer to Chapter 3

<sup>3</sup> Refer to Chapter 4

However they do not make recommendations as to what measures should be used. In Wellington, New Zealand<sup>4</sup>, the assessment battery is made up of the MMSE [Folstein, Folstein & McHugh, 1975]), the Modified Mini Mental State Examination (3MS [Teng & Chui, 1987]) the Addenbrooke's Cognitive Exam (ACE-R), The Frontal Assessment Battery (FAB [Dubois, Slachevsky, Litvan & Pillon, 2000]) the AMI [Kopelman, Wilson & Baddeley, 1990]), Montgomery-Asberg Depression Rating Scale (MADRS [Montgomery & Asberg, 1979]), and Mania (Rating Form), and Psychosis (Rating Form) are also assessed<sup>5</sup>. It is recommended that assessment is done at baseline, every two weeks during ECT treatment, and then once a month after treatment for the following 9-12 months. However, this battery does not utilise commonly used assessment measures, is lengthy and in reality is rarely completed in full by the busy treating Psychiatrists or their support staff either at the outset, during or after a treatment is conducted. On occasion the MMSE is used in isolation as it is quick to administer however it has been criticised as it is not covering a broad enough range of cognitive domains, and has a ceiling effect meaning it is not always able to identify mild cognitive impairment (Mamikonyan, Moeberg, Siderowf, Duda, Have, Hurtig, et al., 2009; Nazem, Siderowf, Duda, Have, Colcher, Horn, et al., 2009). The main concern with the battery is that while it is well intentioned it is too long. There are a number of alternatives to this long neuropsychological test. Brief cognitive screens such as the MMSE have been developed to give an overall picture of an individual's cognitive functioning and inform whether further more extensive neuropsychological assessment is required (Jacova, Kertesz, Blair, Fisk & Feldman, 2007).

Cullen, O'Neill, Evans, Coen and Lawlor (2007) state that a good brief cognitive screen should be quick, easy to administer and score, and have good sensitivity and specificity. When problems are detected using a brief screen, referral for full neuropsychological testing can then be made (Cullen et al., 2007; Jacova et al., 2007). There are a number of cognitive screens available for use in consultation, with the most common being the MMSE which was originally developed as a brief screen for an elderly population as it is brief, simple to use and has good validity (McDowell, Kristjansson, Hill, & Herbert, 1997). However, it has some limitations

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<sup>4</sup> Physicians within Capital and Coast District Health Board (CCDHB) the governing health board for the Wellington Region

<sup>5</sup> Refer to Appendix D

in its validity for use with a psychiatric population and those with mild cognitive impairment (MCI) (McDowell et al., 1997).

The MoCA is a relatively new screen designed to detect mild and moderate cognitive impairment (Aggarwal & Kean, 2010). It has high test-retest reliability, good internal consistency and excellent sensitivity which can detect milder forms of cognitive dysfunction which might not be picked up by the MMSE (Gill, Freshman, Blender & Ravina, 2008). It also includes executive functioning tasks, more complex language requirements and visuospatial tasks which the MMSE does not (Nasreddine, Phillips, Bedirian, Charbonneau, Whitehead et al. 2005; Smith, Gildeh & Holmes, 2007).

A number of studies have compared the MMSE with the MoCA, in a number of different populations. Pendlebury, Cuthbertson, Welch, Mehta and Rothwell (2010) reported the MoCA identified more cognitive deficits in patients after a transient ischemic attack and stroke, particularly in executive functioning, attention and delayed recall. And in two separate studies conducted with patients diagnosed with Parkinson's disease, the MoCA successfully identified cognitive deficits, while the MMSE reported over half of the patients to have normal cognition, when they actually had cognitive impairment (Mamikonyan et al., 2009; Nazem et al., 2009). Review of the relevant literature revealed there has been no comparison made between the MMSE and the MoCA used with people who have received ECT.

Accordingly it was planned that the current research would contribute to the larger body of research regarding cognitive outcomes after ECT, in this instance in the medium to long-term. Reviews of the relevant background about ECT, led to a retrospective investigation into the current cognitive functioning (with an emphasis on memory) of people who had received ECT historically. The study involves both an objective assessment component and a subjective component as suggested by the NICE guidelines (2003). Objective measures would include memory tests commonly used for assessing and monitoring deficits during ECT or in the period just post, along with two brief screens of global cognitive functioning (the commonly used MMSE, and the MoCA). Administration of the MMSE as well as the MoCA would add to previous research comparing the measures across different populations. Subjective assessment would utilise interpretative phenomenological analysis, rather

than questionnaires such as the CFQ or the SSMQ which measure subjective experience objectively and therefore may miss important experiences.

It was hypothesised that 1) scores on the objective assessment measures would be below age-matched norms (cut-off ranges in the case of the AMI) for each test, 2) the MoCA would identify more participants with global cognitive deficits than the MMSE, and 3) participants would report a higher degree of difficulty with their memory and cognition than was identified by the objective measures.

### *Participant Recruitment and Demographics*

Ethics approval for this study was given by the Central Health and Disability Ethics Committee in December of 2008<sup>6</sup>.

A list of patients who had received ECT between 1998 and 2008 was then sought from Capital and Coast District Health Board (CCDHB)<sup>7</sup>. This list of 222 patients was reduced due to exclusion criteria including not living in Wellington, over 65 years of age (as within CCDHB people over this age are considered elderly and more prone to cognitive decline due to normal ageing), head injuries or dementia, current admission into a mental health facility, and those with serious intellectual disability. All efforts were made to ensure that invitations to participate were not inadvertently sent to people now deceased.

Invitations included an information sheet, a letter of support from CCDHB, a consent form for assessment and allowing access to files held within CCDHB, and a pre-paid reply envelope<sup>8</sup>. From the 222 patients identified, 118 were identified as fitting the inclusion criteria. Initially invitations were posted to 50 patients who were randomly selected from each of the years between 1998 and 2008. Sending out invitations to a smaller group initially allowed the researcher to get an indication of response numbers (as initial power analyses suggested a minimum of 36 participants would be required for significance on key analyses).

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<sup>6</sup> Refer to Appendix A

<sup>7</sup> Physicians within Capital and Coast District Health Board (CCDHB) the governing health board for the Wellington Region

<sup>8</sup> Refer to Appendix B

From the first 50 invitations 17 consented to participate. Five patients subsequently withdrew due to relapse, or had subsequently moved out of the region, and two were withdrawn by the researcher - one due to the seriousness of their current mental health and lack of ability to complete the assessment and the other due to the pending birth of her baby.

A second posting of 40 invitations to people randomly selected across the years who had not already been invited to participate resulted in a further eight people consenting to participate and 10 invitations were returned due to no longer living at the address. A final 28 invitations (selected in the same manner as above) provided another two consenting participants and six returns due to wrong address. (One of the two consenting participants had never had ECT but wished to discuss her observations of those she had observed after having it – she was excluded from the current study). It was unclear why consent numbers dropped off towards the end of the recruitment phase.

This gave a total of 19 participants, ( $n=14$  female,  $n=5$  male) one of which could only participate in parts of the research – due to becoming distressed during cognitive testing and refusing to continue. This participant gave permission for the completed sections of his assessment to be included in the study (Refer to Table 1 for demographic information).

Table 1

*Participant Demographic Information*

<b><i>N=19 (n=14 female, n=5 male)</i></b>	Mean (Standard Deviation)	Range
Age (years)	46.95 (12.76)	21-64
Education (years) <sup>1</sup>	14.40 (2.99)	10-20
Time Since Last ECT (years)	7.7	2.3-11.8
Number of Treatments per week	1.92 (0.39)	1.25-3.00
Total Dose per person (mC)	5997.00 (10546.57)	325.00-37494.00

Total Number of ECT sessions per person	24.32 (40.43)	3.00-161.00
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<sup>1</sup> It is compulsory for New Zealanders to attend school between the ages of six and sixteen years (10 years formal education), Ministry of Education Website, 2012.

Fifteen of the  $N=19$  participants were currently being treated with psychiatric medications. These were predominately anti-depressants ( $n=9$ ), anti-psychotics ( $n=9$ ), hypnotics ( $n=8$ ), and mood stabilisers ( $n=4$ ).

### *ECT Treatment Demographics*

All participants had received their final ECT treatment more than two years prior to the assessment. Two years was chosen due to literature suggesting that after traumatic brain injury people, return to best functioning by the two year post injury point (Lezak, Howieson & Loring, 2004). It was considered that this would likely apply also to those who had received ECT.

The nature of the ECT that participants received differed over time. Prior to 2003 very little could be gleaned from the records regarding the specifications used for ECT. What is known is that a Thymatron machine administered bilateral ECT at 1.0ms pulse width two to three times a week at 1.5 to 2.0 times seizure threshold. Between 2003 and 2005 the Thymatron was still in use with administration delivered according to the same specifications as prior to 2003, however at a reduced frequency (twice a week).

From 2005 the Mecta, SpECTrum Q5000 machine was used to administer ECT, initially at 1.0ms pulse width, until 2007 when 0.3ms was used unless exceptional circumstances arose such as treatment resistant depression, relapse during or in proximity to the time of ECT or if ECT had been used in the past and the patient had responded to 1.0ms pulse width. In which case 1.0ms pulse width was used. Also from 2005 ECT was administered unilaterally although bilateral ECT was still used for treatment resistant disorders. Dose was administered at six times the seizure threshold for unilateral ECT and 1.5 to 2 times for bilateral ECT. The Mecta SpECTrum Q5000 has the capability of varying pulse width, frequency (Hertz),

duration of stimulus charge and the flow of current (Amps) giving treating psychiatrists more freedom to tailor treatments for individuals. This machine is in current use. It would be expected that those receiving ECT prior to 2007 would experience more cognitive deficits due to the greater pulse width. It had been planned that this, and other variables such as age, years of education, electrode placement, dosage, number of treatments, and frequency of treatments would be controlled for using statistical methods where possible. However due to the small sample size, this was not possible and there was a lack of participants who had received their ECT post 2007 so group comparisons could not be made.

### *Assessment*

Consistent with literature the domains and subsequent measures used are presented in Table 2.

Table 2

#### *Domains to be Assessed and Measures to be Used*

<b>Domains to be Assessed</b>	<b>Assessment Measures to be Used</b>
Retrograde Amnesia	Autobiographical Memory Inventory (AMI)
Anterograde Amnesia	AMI, Rey Complex Figure Test (RCFT), Rey Auditory Verbal Learning Test (RAVLT)
Autobiographical Memory	AMI
Visual Learning and Memory	RCFT
Verbal Learning and Memory	RAVLT
Attention/Working Memory	Mini Mental State Exam (MMSE), Montreal Cognitive Assessment (MoCA), RAVLT, RCFT
Global Cognitive Status	MMSE, MoCA
Subjective Complaints	Interpretative Phenomenological Analysis (IPA)

The AMI is a test of retrograde autobiographical memory for personal events and facts prior to the onset of memory problems (Kopelman et al., 1990). It contains semi structured interviews which collect information on personal semantic

memories, or facts and autobiographical incidents or events both across three time ranges - childhood, early adulthood and recent life (Kopelman et al., 1990). The measure is easy to administer and score, and relatively brief. It has good inter-rater reliability, and discriminates those with difficulties well from healthy controls (Kopelman et al., 1990; Lezak et al., 2004).

The RCFT is used to measure visuospatial construction ability and visual memory (Meyers & Meyers, 1995). The test has normative data for adults between the ages of 18 and 89 years. The test is made up of a copy trial, followed immediately by an immediate recall trial and then a delayed recall trial 30 minutes later. A recognition trial is then given which includes 12 of the 18 units and 12 random units, and is used to assess recognition memory and a participant's ability to retrieve using cues. Altogether the test is able to evaluate a person's ability to encode, store, and retrieve visual information (Meyers & Meyers, 1995). Scoring uses a 36 point method. Eighteen units which make up the figure are assessed with scores between 0 and 2 given for each to obtain a raw score, which is then converted to z or T scores using the correct age normative data and percentile ranges (Meyers & Meyers, 1995). Lezak et al., (2004) state that the RCFT is the most commonly used measure for visual memory and its recall trials are sensitive to a number of different neurological problems.

The RAVLT is a widely used and easily administered measure of verbal learning and memory (Schmidt, 2004). The test consists of a 15 item unrelated-word list which is read to the participant five times with a recall component after each reading. It also contains a recognition aspect, alternate forms and normative data is available for ages 7 through 89 years (Schmidt, 2004). It has high test-retest reliability when retesting is done after a month, excellent face and content validity, and it correlates strongly with other verbal memory tests (Lezak et al., 2004; Schmidt, 2004). It has a number of different normative data including meta-norms.

The MMSE was chosen as it is commonly used in research to assess cognitive functioning in ECT research. It is also the test of Global Cognitive Functioning used currently by the CCDHB when assessing their ECT patients.

The MoCA was chosen as a comparison to the MMSE as Cullen et al., (2007) suggest that more research into other brief screening tools is currently required and because it is more sensitive to milder forms of brain trauma (Smith et al., 2007).

Subjective reports were examined using Interpretative Phenomenological Analysis (IPA) which aims to investigate how a person makes sense of and perceives their world, experience, an account, object or event (Smith, 1996; Brocki & Wearden, 2005; Smith & Osborn, 2008). During this process the researcher also needs to be aware of their own conceptions and ideas about the topic to ensure they are not interpreting what the participant is saying based on their own ideas. Therefore a double-hermeneutic is involved, with the participant trying to make sense of their world and the researcher trying to make sense of the participant making sense (Smith & Osborn, 2008). While there are guidelines as to the process of IPA, it is also accepted that there is no hard and fast way to do IPA (Smith & Osborn, 2008). While many advocate the use of tape-recording the semi-structured interviews (Smith & Osborn, 2008) it was decided that recording the interviews would not be done in the current study (due to complaints during the recruitment phase of the research which centred on privacy), but rather participants would be asked to write down their experiences under two broad headings;

*“Please write in your own words any problems you have experienced from ECT”.*

*“Please write in your own words any benefits you have experienced from ECT”.*

Participants were left alone to write, to ensure that there was no prompting from the researcher. When participants had finished the researcher returned and read through what the participants had written, clarifying each of the points to ensure correct understanding. Following clarification the researcher then used semi-structured questions and prompts to elicit further detail around experiences, such as types of memory problems. Often this brought up new information and information not directly related to ECT. All new information was documented including direct quotes. Each participant’s data was analysed later for emerging themes. Once individual information had been analysed, it was grouped. The themes were structured in layers from overall umbrella themes to the more detailed themes.

Two measures of depression were administered on the day of assessment. This was due to the extent that depression can have on cognitive functioning and the importance of establishing the extent of depressive symptomology experienced by the study population. The MADRS (Montgomery & Asberg, 1979) and the Beck Depression Inventory – Second Edition (BDI-II [Beck, Steer, & Brown, 1996]) were chosen as these are the two measures currently used by CCDHB. Both have the advantage of being briefer than the Hamilton Depression Rating Scale (HDRS/HAM-D) which is often used in ECT research.

The MADRS is a frequently used measure of depression utilising 10 items which are equally weighted for scoring. Some have considered the MADRS to be more sensitive than the HAM-D (Khan, Khan, Shankles & Polissar, 2002). Overall the MADRS is simple to use and score and less experienced researchers can reliably score the test (Khan et al., 2002). A cut-off score of 7 was used as this is the lower boundary for mild depressive symptomology.

The BDI-II is a self-report measure containing 21 items and can be used with a population over the age of 13 years (Beck, Steer & Brown, 1996). The symptoms assessed correspond to the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV). It is one of the most widely used measures for assessing the severity of depressive symptomology in both clinical and normal populations (Beck et al., 1996). The BDI-II has internal consistencies of .92 and .93 for clinical and normal populations respectively and a test re-test correlation of .93 and has good validity (Beck et al., 1996). A cut-off of 14 was used as this is the lower boundary for mild depressive symptomology.

Faking or exaggerating memory problems is always a possibility when conducting research into controversial areas such as ECT (Tiller & Lyndon, 2003). Therefore the Test of Memory Malingering (TOMM) was administered prior to all assessment. The TOMM is a 50-item test of picture recognition which is not sensitive to neurological disorders, is brief and simple to administer (Tombaugh, 1996). Trial One and Two were used as they are generally sufficient enough to assess malingering (Tombaugh, 1996). It was planned that Trial 3 would only be administered if previous scores on Trials One and Two suggested a participant may be malingering.

### *Procedure*

It was planned that patient files would be viewed prior to the assessment. However due to delays in the files being located; in most cases the researcher viewed the files after meeting with participants<sup>9</sup>. Technical ECT information and participant diagnoses were noted from the files<sup>10</sup>. Prior to assessment participant demographic information was collected.

All participants were then assessed for their motivation towards testing using Trials One and Two of TOMM. Participants were then administered the BDI-II and the MADRS followed by Trial Three of the TOMM if required.

Participants were then assessed using the other objective measures followed by the subjective component<sup>11</sup>.

### *Analysis of Data*

Objective data were analysed with SPSS version 19. As there was no baseline data in patient files against which to make current comparisons, objective assessment scores for the RAVLT and the RCFT would be compared to age-matched norms and then converted to z-scores. The AMI only provides for ranges of scores and is not normed based on age as the authors state that age is not a factor in Autobiographical Memory (Kopelman et al., 1990). Therefore participant scores were compared to the cut-off ranges provided and analysed for significance using t-tests. Cut-off scores and t-tests were also used for the MMSE and the MoCA, 23 and 26 respectively (Folstein et al., 1975; Nasreddine et al., 2005).

The MoCA and the MMSE were compared to each other using a correlation. To test the ability of the MoCA to identify deficits, t-tests were then conducted to compare the scores on objective measures for those who were below the MoCA cut-off score ( $n=7$  [Mean MoCA score = 23.00,  $SD = 2.52$ , Mean age = 49.00,  $SD = 13.27$ ; Mean years of education = 14.71,  $SD = 3.65$ , females = 5, males = 2]) and those who

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<sup>9</sup> File viewing times varied depending on how many volumes a file contained. In some cases participant files contained up to 36 volumes, so the process of gathering relevant information was time consuming

<sup>10</sup> Refer to Appendix C

<sup>11</sup> Refer to Appendix C

performed above ( $n=12$  [Mean MoCA score = 28.27,  $SD = 1.19$ , Mean age = 45.75,  $SD = 12.89$ , Mean years of education = 14.21,  $SD = 2.70$ , females = 12, males = 0]).

Personal accounts and discussion outcomes were analysed on an individual basis with the researcher drawing themes and concepts from what each participant had written and any emotions witnessed. Once all interviews had been coded they were able to be looked at as a whole for emerging themes and concepts. Subjective accounts were then compared to objective assessment measures where possible.

### Results

All participants scored at acceptable levels on Trials One and Two of the TOMM indicating that they were motivated to put in their best effort and respond honestly in the assessment process. Trial Three was therefore not administered to any of the participants.

Mean scores on the BDI-II suggested mild depressive symptomology ( $M=18.12$ ,  $SD=18.27$ ), and mean scores on the MADRS also suggested mild depressive symptomology ( $M=13.26$ ,  $SD=12.37$ ). However, standard deviations for both tests' means were variable.

It was observed that attention appeared to be intact during the assessment.

Participants were able to follow instructions, maintain focus on the tasks and did not present as distractible.

Table 3

*Difference between Group Means and Age-Matched Norms (Cut-off Scores for the AMI) for Total Participants and those scoring below and above the Cut-off for the MoCA.*

	Total ( $N=18$ )		$n=7$ below MOCA cut- off		$n=11$ above MOCA cut- off	
RAVLT Total Score <sup>^</sup>	-0.09	$p=.46$	-1.81*	$p=.04$	1.01	$p=.16$
RAVLT Delayed Recall <sup>^</sup>	-0.75	$p=.23$	-1.21	$p=.11$	-0.45	$p=.33$
RAVLT Recognition <sup>^</sup>	1.51	$p=.07$	-0.12	$p=.45$	2.55*	$p=.01$

RCFT Immediate Recall <sup>^</sup>	-6.39*	$p=.00$	-8.37*	$p=.00$	-5.13*	$p=.00$
RCFT Delayed Recall <sup>^</sup>	-7.08*	$p=.00$	-9.68*	$p=.00$	-5.43*	$p=.00$
RCFT Recognition <sup>^</sup>	-2.82*	$p=.00$	-2.08*	$p=.02$	-3.29*	$p=.00$
	Total (N=19) <sup>a</sup>					
AMI Semantic Child	16.87 (3.81) <sup>1</sup>	$p=.33$	17.14 (3.41) <sup>1</sup>	$p=.41$	17.27 (3.85) <sup>1</sup>	$p=.30$
AMI Semantic Early Adult	18.50 (3.75) <sup>1</sup>	$p=.10$	19.43 (1.74) <sup>1</sup>	$p=.01^{**}$	19.05 (2.62) <sup>1</sup>	$p=.03^{**}$
AMI Semantic Recent	18.76 (1.90) <sup>2</sup>	$p=.10$	18.21 (1.10) <sup>2</sup>	$p=.79$	19.41 (1.55) <sup>1</sup>	$p=.40$
AMI Semantic Total	54.03 (6.84) <sup>1</sup>	$p=.99$	54.64 (3.73) <sup>1</sup>	$p=.66$	55.64 (4.92) <sup>1</sup>	$p=.30$
AMI Autobiographical Child	7.74 (2.21) <sup>1</sup>	$p=.00^{**}$	7.71 (2.56) <sup>1</sup>	$p=.13$	8.27 (1.10) <sup>1</sup>	$p=.00^{**}$
AMI Autobiographical Early Adult	7.63 (2.36) <sup>1</sup>	$p=.26$	8.00 (1.41) <sup>1</sup>	$p=.11$	8.09 (1.64) <sup>1</sup>	$p=.05$
AMI Autobiographical Recent	8.00 (1.63) <sup>1</sup>	$p=.02^{**}$	8.00 (1.92) <sup>1</sup>	$p=.22$	8.27 (1.27) <sup>1</sup>	$p=.01^{**}$
AMI Autobiographical Total	23.37 (5.08) <sup>1</sup>	$p=.00^{**}$	23.71 (4.35) <sup>1</sup>	$p=.03^{**}$	24.64 (2.54) <sup>1</sup>	$p=.00^{**}$
MoCA (cut-off 26)	27.83(2.20)	$p=.77$	-		-	
MMSE (cut-off 23)	26.22(3.17)	$p=.00^{**}$	-		-	

<sup>^</sup>Mean z-score (negative z-scores indicate the mean is below the age-matched norm)

\*One tailed significance,  $p=.05$  unless otherwise stated

\*\* Two tailed significance

<sup>a</sup> N=19 was used for the AMI analysis however the extra participant did not complete the MoCA so N=18 was used when comparing the MoCA groups (n=7 and n=11)

<sup>1</sup>Acceptable range (mean & SD)

<sup>2</sup>Borderline Range (mean & SD)

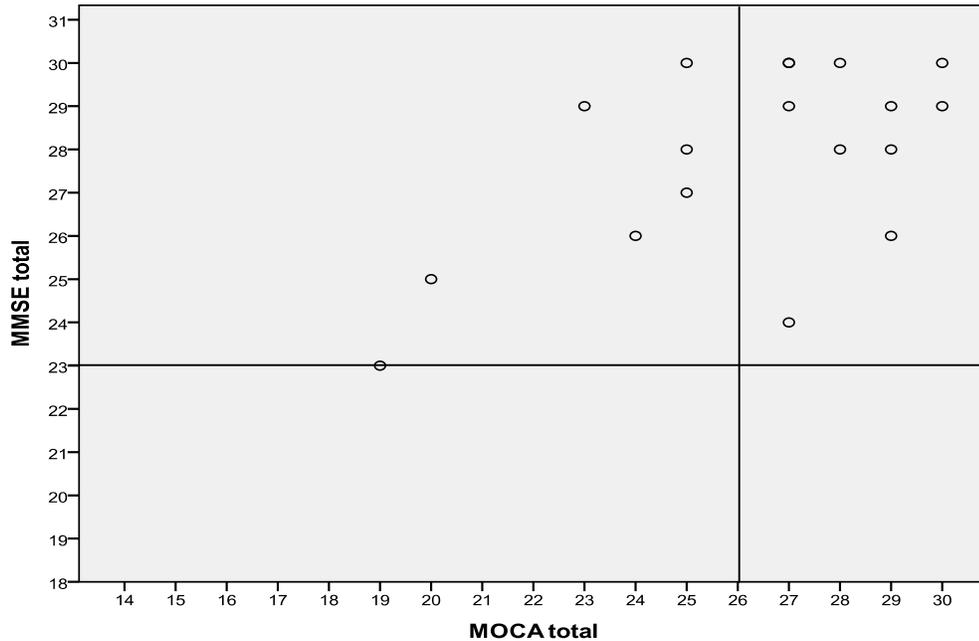
Table 3 shows there were no significant differences between group total means and the age-matched norms for the RAVLT. However none of these findings were statistically significant and therefore may have been due to a chance effect. The RCFT total mean scores were all significantly below the age-matched norms.

Scores of the AMI were within the cut-off of the *acceptable* range with the exception of the Semantic Recent score which was within the *borderline* range.

The AMI total group findings for semantic memory were not statistically significant while the group totals for the autobiographical memory were.

While both the MoCA and the MMSE mean scores were above the cut-off scores, this was significant only for the MMSE.

It was hypothesised that the MoCA would identify more participants with deficits than the MMSE. In order to examine this, the MoCA total scores and MMSE total scores were plotted in a scatter plot along with their standard cut-off scores, 26 for the MoCA and 23 for the MMSE. The scatter plot shows that the MoCA identified seven participants as being cognitively impaired, while the MMSE identified only one (Refer to Figure 1).



*Figure 1 A Comparison of the MoCA Total Score with cut-off (26) and the MMSE Total Score with cut-off (23)*

The Correlation between the MoCA total scores and the MMSE total scores was 0.57 ( $p < .05$ ) suggesting the two measures were only moderately consistent with each other.

Participants performed poorly on the delayed recall trials of both the MoCA and MMSE. Correlations were calculated for the delayed recall sections and total scores of each test to determine the extent to which the delayed recall score was a good indicator of the total score. As shown in Table 4, the correlation for the MoCA was  $r = .75$  ( $p < .05$ ) and for the MMSE was  $r = .76$  ( $p < .05$ ). Converting to a coefficient of determination, the MoCA was  $r^2 = .56$  and therefore accounting for 55.60% of the variability in MoCA scores, and the MMSE was  $r^2 = .58$  and therefore accounting for 58% of the variability in the MMSE scores.

Table 4

*Correlations between the MoCA Total and MMSE Total, MoCA Delayed Recall and MoCA Total, MMSE Recall and MMSE Total*

	MMSE Total (Sig 2-tailed)	MoCA Delayed Recall (Sig 2-tailed)	MMSE Recall (Sig 2-tailed)
MoCA Total	0.57 (0.01)	0.75 (0.00)	0.35 (0.16)
MMSE Total		0.40 (0.10)	0.76 (0.00)
MoCA Delayed Recall			0.50 (0.04)

In order to clarify which of the measures was more accurate, participants were split into two groups according to their MoCA score, i.e., equal or below  $X$  and above  $X$  (where  $X$  was the cut-off score for the MoCA). This resulted in 7 participants in the Low MoCA group and 12 in the High MoCA group. Comparisons between the two groups are shown in Table 3. When the two groups, those who were below the MoCA cut-off ( $n=7$ ) and those who were above the cut-off ( $n=12$ ), were compared

on other objective measures it was found that there were no group differences for mean scores on the AMI. Both groups scored in the *acceptable* range with the exception of the Semantic Recent score – with the  $n=7$  group scoring in the *borderline* range. On the RCFT, both group means were significantly below the norms.

On the RAVLT, the  $n=7$  group scored significantly below the norms for the Total trial only. The  $n=12$  group scored above the norms on the Total trial and Recognition trial, although only the latter was significant (Refer to Table 3).

Table 5

*Three Layers of Themes*

<b>Qualitative Themes</b>		
<i>Layer 1</i>	<i>Layer 2</i>	<i>Layer 3</i>
Retrieval	Personal Memories	Blanks Own Childhood Own Children Growing Up Remembering close friends Couldn't remember how I knew people Couldn't remember things that happened previous week Couldn't remember things that happened previous day Timelines of memories confused Memories around ECT gone Lost memories for about a year after ECT Had memory problems at time of ECT but cannot remember what
	Procedures	How to perform previously learned tasks
	Auditory Information	Peoples Names Object Names Following Conversations Remembering Conversations Learning Lists Can't find Words
	Visual Information	Faces Words aren't connected in sentences
	Day to Day Information	Appointments Dates Repeating oneself Loosing things Forgetting
	New Learning	Reading Studying

		Need to use memory strategies Use images to store new information Need to learn small amounts at a time Need information repeated to learn
	Directions	How to get from A to B Getting Lost
Attention and Concentration	Staying on Task	Jumping from subject to subject Loosing train of thought Being in a daze Confusion
Executive Functioning	Sequencing Multi-Tasking	The order of performing tasks Doing more than one thing Following instructions

Table 5 presents the three layers of themes identified by the qualitative assessment. It was hypothesised that participants would report difficulty with their memory that was not identified by the objective measures. Of the 89.50% who did experience difficulties, 79% reported retrieval deficits, 32% reported deficits with attention and concentration, 21% with executive functioning and, 21% respectively with sequencing, decision making and multi-tasking. Of those reporting retrieval deficits, 84% reported difficulties with personal memories, 16% with procedures, 37% with retrieving auditory/verbal information, 42% with visual information, 32% with day to day memory and forgetting, 26% with new learning and 16% had difficulty retrieving directions.

Table 6

*General Comparison of Objective and Subjective Outcomes*

	<b>Objective</b> % of participants scoring below cut- off	<b>Subjective</b> General Agreement with objective outcomes (Yes/No) <sup>1</sup>
AMI Semantic Child	21.1	No
AMI Semantic Early Adult	10.5	No
AMI Semantic Recent	31.6	No
AMI Semantic Total	21.1	No
AMI Autobiographical Child	10.5	No
AMI Autobiographical Early Adult	10.5	No
AMI Autobiographical Recent	15.8	No
AMI Autobiographical Total	5.3	No

RAVLT Total	33.3	No
RAVLT Delayed	33.3	No
RAVLT Recognition	27.8	No
RCFT Immediate Recall	77.8	No
RCFT Delayed Recall	83.3	No
RCFT Recognition	61.1	No
MMSE	5.6	N/A
MoCA	38.9	N/A

<sup>1</sup> 50% was used to indicate whether there was general agreement. Refer to Appendix E for details

Table 6 presents the overall mean frequencies of participants scoring below the cut-off scores for each of the objective measures and whether this follows trends arising from the subjective assessment.

Closer investigation<sup>12</sup> revealed nine participants (50.00%) scored below cut-off on at least one of the AMI subtests, while 13 (72.22%) subjectively reported deficits with personal memories.

When comparing individual objective and subjective outcomes, six (33.33%) of the participants who scored below cut-off also reported subjective difficulties. All eighteen (100%) scored below cut-off on at least one of the RCFT subtests while four (22.22%) subjectively reported deficits with visual memory. Of the 18 who were below cut-off, four (22.22%) also subjectively reported difficulties. Finally, nine participants (50%) scored below cut-off on at least one of the RAVLT subtests, and six (33.33%) subjectively reported deficits with verbal memory. Of the nine who scored below cut-off, three (16.67%) also subjectively reported difficulties.

There were no subjective reports able to be compared directly with the MoCA or the MMSE. However, a number of deficits were reported subjectively were not assessed objectively, such as executive functioning, memory for procedures, memory for day to day information, memory for directions, a number of the new learning themes, and specific attention and concentration tasks.

<sup>12</sup> Refer to Appendix E for individual objective and subjective participant information

### *Discussion*

A number of domains were assessed during the current research. From the objective assessment measures and observation it can be concluded that in this population overall, retrograde memory (memories formed prior to ECT) was intact, as was autobiographical memory (personal memories for facts and events) and attention and working memory. In regard to anterograde amnesia/memory (memories formed after ECT) it can be concluded that participants' mean scores were generally within or close to the age-matched norms for verbal information but there were deficits with visual learning and memory which followed a retrieval pattern suggesting difficulty with the retrieval of learned information. Overall, and consistent with other objective measures, participants' mean scores were above the cut-off scores on both tests of global cognitive functioning, generally losing marks on the recall questions from the screens. While it was hypothesised that participants would be below age-matched norms on the objective measures, this was not the case for verbal learning and memory. This may be due to the RAVLT not identifying deficits in verbal learning and memory, as deficits were observed in the MoCA and MMSE questions relating to word list recall. It may also be that in this population, there was a deficit in visual learning and memory and not in verbal. While the MoCA and the MMSE are purported to measure the same construct, convergent validity between the two was relatively low ( $r = 0.570$ ). The correlation suggests a problem with at least one of the measures. In this case it may be the MMSE because it was not sufficiently sensitive to identifying six of the seven that scored in the abnormal range on the MoCA (refer to Figure 1). The seven participants who were below the MoCA cut-off score also scored below the norms on the RAVLT (Total Score) and their scores on the RCFT were also below.

Further investigation into the sensitivity of the MoCA was conducted by comparing two groups, those who were below the cut-off on the MoCA ( $n=7$ ) and those who were above ( $n=12$ ). Findings suggest that the MoCA may only be more sensitive than the MMSE in identifying verbal learning/memory deficits. And in general, both screens may only serve as brief screen of verbal learning and memory. However another question arises. Is the MoCA more sensitive to verbal learning and memory deficits than the RAVLT, on which participants showed no significant deficits. It

may be that the extra learning trials of the RAVLT are allowing participants more time and repetition to learn the words.

The primary finding of the comparison between the MoCA and the MMSE is that the MoCA appears to be detecting more participants with cognitive impairment than the MMSE consistent with previous studies. However this may be due to the verbal learning/memory question only, and the small sample size and lack of a *Gold Standard* to compare to makes it difficult to state whether this is the case.

Subjective accounts suggested some deficits that were not confirmed with objective measures, particularly with the recall of personal memories and recall of visual and verbal information. Participants reported difficulties with all of the domains, which were not identified on objective assessment (AMI, RCFT, and RAVLT) and vice versa. In fact very few participants (22.22% which is less than the 50% required for agreement between objective and subjective outcomes) also subjectively reported difficulties with visual learning and memory while 100% of participants scored below the norms on at least one of the RCFT subtests<sup>13</sup>. The findings are consistent with the findings identified by the NICE Guidelines (2003) suggesting incongruence between objective and subjective assessment outcomes. They were also consistent with Prudic et al., (2000) who found incongruence between patient self-report and objective assessment data. This was also illustrated by the other qualitative deficit themes which emerged that were not assessed objectively in this study. Given that objective measures were chosen for this study were based on commonly utilised measures cited in other studies, it may be that they are not adequately measuring the true nature of the cognitive difficulties associated with ECT and again this is consistent with other research findings (Prudic et al., 2000; NICE, 2003).

### *Limitations*

There were a number of limitations to this study. Firstly the small sample size meant that it was not possible to control for a number of variables such as electrode placement, stimulus intensity, number of treatments and time between treatments. These are all important variables as they can all exert an influence on memory and cognition.

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<sup>13</sup> Refer to Appendix E for summary table showing all objective and subjective comparisons

Secondly, as the participants were not currently having ECT pre ECT data was available. Ideally, objective assessment data would have been available to both inform the measures used in this research and to make comparisons. Without this information, even if a deficit was measured by the current objective measures, it cannot be said with any certainty that the deficit has been caused by ECT.

Thirdly, it is also possible that even though participants were achieving within age-matched norms of the assessment measures they could still have been functioning at lower levels than previously. Participants had a mean years of education of  $M=14.44$ ,  $SD=2.99$  suggesting the group at minimum attained the compulsory secondary school education level (10 years). It is possible that a number of participants, prior to ECT would have scored above the age-matched norms and their current scores are less as a result of the ECT.

Also, even though participant's subjective accounts suggested that their short term memory and cognitive deficits were the same as long term deficits, the assessment was only measuring current function. It is unclear whether the results would have been the same earlier in time. Thus these results cannot be extrapolated to recommend the MoCA for the assessment of those *currently* undergoing ECT.

It was also difficult to compare objective and subjective assessment outcomes as they did not *map* perfectly onto each other so summaries were utilised instead. This may have led to some quite specific comparative information being lost.

Finally, while mean scores of depression suggested mild depressive symptomology, however due to the variation as seen in the standard deviations, it cannot be said definitively that depression was not influencing scores. Medications are also known to have an effect on test scores and should not be ruled out as exerting an influence. A control group matched for age, depressive symptomology, medication and treatment schedule (electrode placement, dosage, number of treatments, frequency) may have enabled more definite conclusions to be made.

### *Recommendations*

Future research should concentrate on a larger sample size that would allow statistical control of confounding variables. Assessment of current ECT patients

would enable baseline data to be collected and patients could be monitored throughout their ECT to test whether memory and cognitive changes are occurring.

Further comparisons between the MoCA and the MMSE should be made in a current ECT population to assess the sensitivity of the two measures. While the results of the present study are suggestive a true gold standard of client functioning (clinical interview) should be used so that sensitivity and specificity can be accurately determined. Again, collecting baseline data would greatly assist in this.

Utilising a control group as a means of reducing the influence of variables such as depression and current medication use is also recommended.

Finally, it is recommended that the information collected during the qualitative assessment be viewed with the plan of developing a new assessment measure to be trialled with current ECT patients and assessment measures.

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**STATEMENT OF CONTRIBUTION  
TO DOCTORAL THESIS CONTAINING PUBLICATIONS**

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

**Name of Candidate:** Kiri Michelle Luther

**Name/Title of Principal Supervisor:** Janet Leathem

**Name of Published Research Output and full reference:**

An Evaluation of the Long-Term Cognitive Outcomes of Electroconvulsive Therapy: A Retrospective Study

**In which Chapter is the Published Work:** Chapter 7

Please indicate either:

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- Describe the contribution that the candidate has made to the Published Work:

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\_\_\_\_\_  
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Principal Supervisor's signature

\_\_\_\_\_  
Date

## **CHAPTER 8**

### **QUALITATIVE ASSESSMENT OF THE COGNITIVE OUTCOMES OF ELECTROCONVULSIVE THERAPY**

This chapter is in the form of a manuscript for the purpose of submission to a journal still to be advised. The manuscript that follows is presented in the format required for that submission, with the exception of page numbers and font size, which need to be consistent with the thesis as a whole. Some editing may occur after manuscript submission; however the changes would not affect the overall outcomes of the review. Some repetition of information and references was unavoidable given the structure of this thesis by manuscript.

**Qualitative Assessment of the Cognitive Outcomes of Electroconvulsive  
Therapy**

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*Abstract*

The incongruence between objective and subjective assessment of memory and cognition in an ECT population is still a highly debated area of research. There are a number of proposed reasons for this, however many accept that this is due to the inability of objective measures to adequately identify the types of deficits related to ECT. The current research utilised a qualitative method to investigate the cognitive functioning reported by a group of people who received ECT two or more years previously. Three main themes emerged, retrieval, attention and concentration, and executive functioning. What also emerged was that for those who still experienced deficits, the deficits had not changed since the time of ECT. A number of other themes not directly related to memory and cognition also emerged, such as how ECT benefitted them, the fear experienced in relation to ECT, the embarrassment at needing such a treatment and the kindness of the staff involved with ECT. Future qualitative research should investigate the extent to which executive functioning deficits are due to deficits in attention and concentration.

### *Introduction*

Since the 1930's Electroconvulsive Therapy (ECT) has been used as a treatment for the severely mentally ill (Ottosson & Fink, 2004). While the exact mechanism of how ECT works is still unknown, it is clear that the grand mal seizure elicited by the electricity is what alleviates psychiatric symptoms (Tiller & Lyndon, 2003).

It is now widely accepted that, like other methods of treatment such as medication, ECT also has its own side-effects in the form of memory and cognitive impairment, however there is still much debate as to the actual nature and duration of these deficits and how best to assess them (National Institute for Clinical Excellence (NICE), 2003).

Assessment of the cognitive outcomes of ECT is however a controversial area of research. This is due to the debate as to which cognitive domains are affected by the treatment, and whether the measures used for assessment are adequate (Tiller & Lyndon, 2005). There is also debate as to the extent that the mental illness influences cognition (Vamos, 2008).

Depression has long been known to exert an influence over cognitive functioning (Porter, Bourke & Gallagher, 2007) and is therefore likely to confound performance during cognitive assessment (Sweet, Newman & Bell, 1992; Kizilbash, Vanderploeg & Curtiss, 2002). Depression has a specific negative effect on executive functioning, attention and concentration, memory and processing speed (McClintock, Husain, Greer & Cullum, 2010) which is not due to psychotropic medication (Porter et al., 2003). The influence of depression makes it particularly difficult to assess memory and cognition in those receiving ECT, as it is highly likely that ECT has been prescribed for drug-resistant depression.

The NICE guidelines for ECT (2003) considered a number of studies and patient testimonies which suggested that the objective measures used in Random Controlled Trials (RCT's) were not adequately measuring the nature of the cognitive difficulties associated with ECT. A number of qualitative studies were cited suggesting longer term and permanent cognitive difficulties. They therefore suggested that more research was required into the long term cognitive difficulties associated with ECT with an emphasis on both objective and subjective assessment.

Also controversial is the incongruence which often occurs between objective assessment outcomes and subjective experience (Berman, Prudic, Brakemeier, Olfson & Sackeim, 2008; Vamos, 2008). A number of studies suggest that patients' subjective accounts are related to their mood at the time of the interview (Porter, Douglas & Knight, 2008). However many accept that this is due to the inefficiency of objective measures to adequately identify deficits (NICE, 2003).

Only a few studies into the cognitive outcomes of ECT have attempted to utilise qualitative assessment as a way of investigating subjective experiences and many of these have still utilised objective measures such as the Squire Subjective Memory Questionnaire or the Cognitive Failures Questionnaire (Koopowitz, Chur-Hansen, Reid, & Blashki, 2003; Berman et al., 2008; Brakemeier, Berman, Prudic, Zwillenberg & Sackeim, 2011).

There have however been a few studies utilising qualitative methods. In a study conducted by Vamos (2008), subjective experiences were assessed using patients' written narratives about their experiences. The narratives were then analysed for emerging themes, and the themes presented with examples taken from patient narratives (Vamos, 2008). Four themes arose from the study, the need for clear information in regards to ECT and its potential cognitive side-effects, the importance of validation of experience in relation to cognitive deficits, the impact of cognitive deficits on daily function, and the issue of self-esteem as a result of cognitive difficulties (Vamos, 2008).

Koopowitz, Chur-Hansen, Reid and Blashki (2003) conducted a similar study into the subjective experiences of patients who had received ECT. Eight patients who had received ECT between 1997 and 1999 and were over the age of eighteen were interviewed for 40 to 90 minutes using a semi-structured format. A number of themes emerged from the Koopowitz et al., (2003) study. Fear of ECT was frequently mentioned with most reporting that fear was present at the time but not currently. Memory and cognition was also frequently mentioned with all but one reporting current deficits that they attributed to the ECT such as gaps in their memory and "blanks" (Koopowitz et al., 2003). However despite the memory and cognitive deficits, many reported ECT to be lifesaving.

Rose, Fleischmann and Wykes (2004) also used qualitative research to investigate consumer views of ECT. They accessed already existing data for N=26 patients and looked for emerging themes. Like the Koopowitz et al., (2003) study, memory was frequently discussed with 71% reporting memory loss as a result of ECT and 62% reporting the memory loss to be permanent (Rose et al., 2004). Again, like the Koopowitz study, many reported gaps in their memory such as not being able to remember their child growing up or their own childhood.

The current research utilised a similar type of qualitative analysis. Interpretative Phenomenological Analysis (IPA) assesses individuals' subjective experiences while recognising the influence of the researcher in the process (Brocki & Wearden, 2006). The aim of IPA is for the researcher to 'make sense' of the individual 'making sense' of their experience. For this to occur the researcher needs to be aware of their own conceptions or misconceptions (Smith, 1996). There are no set rules for how IPA is conducted; rather an overall framework is suggested (Smith & Osborn, 2008). While many IPA researchers tape record the discussions, a number also use narratives, and occasionally researchers utilise a semi-structured format which guides the process (Smith & Osborn, 2008).

The overall aim of this research was to allow past ECT patients to openly discuss their experiences of ECT, memory and cognition in both the short term (during and after ECT) and in the long term (currently). By doing so the research would add to the limited qualitative research into subjective outcomes of ECT. As a previous literature review<sup>14</sup> revealed, IPA has not been used to assess subjective experiences in an ECT population, therefore this study would essentially be trialling a new form of assessing subjective complaints. In keeping with the framework of IPA, no predetermined hypotheses are stated (Smith & Osborn, 2008).

#### *Participant Recruitment and Demographics*

Ethics approval for this study was given by the Central Health and Disability Ethics Committee in December of 2008<sup>15</sup>.

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<sup>14</sup> Refer to Chapter 4

<sup>15</sup> Refer to Appendix A

A list of patients who had received ECT between 1998 and 2008 was then sought from Capital and Coast District Health Board (CCDHB)<sup>16</sup>. This list of 222 patients was reduced due to exclusion criteria including not living in Wellington, over 65 years of age (as within CCDHB people over this age are considered elderly and more prone to cognitive decline due to normal ageing), head injuries or dementia, current admission into a mental health facility, and those with serious intellectual disability. All efforts were made to ensure that invitations to participate were not inadvertently sent to people now deceased.

Invitations included an information sheet, a letter of support from CCDHB, a consent form for assessment and allowing access to files held within CCDHB, and a pre-paid reply envelope<sup>17</sup>. From the 222 patients identified, 118 were identified as fitting the inclusion criteria. Initially invitations were posted to 50 patients who were randomly selected from each of the years between 1998 and 2008. Sending out invitations to a smaller group initially allowed the researcher to get an indication of response numbers. From the first 50 invitations 17 consented to participate. Five patients subsequently withdrew due to relapse, or had subsequently moved out of the region, and two were withdrawn by the researcher - one due to the seriousness of their current mental health and lack of ability to complete the assessment and the other due to the pending birth of her baby.

A second posting of 40 invitations to people randomly selected across the years who had not already been invited to participate resulted in a further eight people consenting to participate and 10 invitations were returned due to no longer living at the address. A final 28 invitations (selected in the same manner as above) provided another two consenting participants and six returns due to wrong address. (One of the two consenting participants had never had ECT but wished to discuss her observations of those she had observed after having it). It was unclear why consent numbers dropped off towards the end of the recruitment phase.

This gave a total of 19 participants, (n=14 female, n=5 male) one of which could only participate in parts of the research – due to becoming distressed during

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<sup>16</sup> Physicians within Capital and Coast District Health Board (CCDHB) the governing health board for the Wellington Region

<sup>17</sup> Refer to Appendix B

cognitive testing and refusing to continue. This participant gave permission for the completed sections of the assessment to be included in the study. (Refer to Table 1 for demographic information).

Table 1

*Participant Demographic Information*

<i>N=19 (n=14 female, n=5 male)</i>	<b>Mean (Standard Deviation)</b>	<b>Range</b>
Age (years)	46.95 (12.76)	21-64
Education (years)	14.40 (2.99)	10-20
Time Since Last ECT (years)	7.7	2.3-11.8
Number of Treatments per week	1.92 (0.39)	1.25-3.00
Total Dose per person (mC)	5997.00 (10546.57)	325.00-37494.00
Total Number of ECT sessions per person	24.32 (40.43)	3.00-161.00

Fifteen of the N=19 participants were currently being treated with psychiatric medications. These were predominately anti-depressants (n=9), hypnotics (n=8), mood stabilisers (n=4) and anti-psychotics (n=9).

*ECT Treatment Demographics*

All participants had received their final ECT treatment more than two years prior to the assessment. Two years was chosen due to literature suggesting that after traumatic brain injury people, return to best functioning by the two year post injury point (Lezak, Howieson & Loring, 2004). It was considered that this would likely apply also to those who had received ECT.

The nature of the ECT that participants received differed over time. Prior to 2003 very little could be gleaned from the records regarding the specifications used for ECT. What is known is that a Thymatron machine administered bilateral ECT at

1.0ms pulse width two to three times a week at 1.5 to 2.0 times seizure threshold. Between 2003 and 2005 the Thymatron was still in use with administration delivered according to the same specifications as prior to 2003, however at a reduced frequency (twice a week).

From 2005 the Mecta, SpECTrum Q5000 machine was used to administer ECT, initially at 1.0ms pulse width, until 2007 when 0.3ms was used unless exceptional circumstances arose such as treatment resistant depression, relapse during or in proximity to the time of ECT or if ECT had been used in the past and the patient had responded to 1.0ms pulse width. In which case 1.0ms pulse width was used. Also from 2005 ECT was administered unilaterally although bilateral ECT was still used for treatment resistant disorders. Dose was administered at six times the seizure threshold for unilateral ECT and 1.5 to 2 times for bilateral ECT. The Mecta SpECTrum Q5000 has the capability of varying pulse width, frequency (Hertz), duration of stimulus charge and the flow of current (Amps) giving treating psychiatrists more freedom to tailor treatments for individuals. This machine is in current use.

### *Procedure*

It was planned that patient files would be viewed prior to the assessment. However due to delays in the files being found and ordered in most cases the researcher viewed the files after meeting with participants<sup>18</sup>. Technical ECT information and participant diagnoses were noted from the files. Prior to assessment participant demographic information was collected.

All participants were then assessed for their motivation towards testing using Trials 1 and 2 of the Test of Memory Malingered (TOMM). Participants were then administered two tests of depression, the Beck Depression Inventory Version Two (BDI-II) and the Montgomery Asberg Depression Rating Scale (MADRS) followed by Trial 3 of the TOMM if required.

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<sup>18</sup> File viewing times varied depending on how many volumes a file contained. In some cases participant files contained up to 36 volumes, so the process of gathering relevant information was time consuming

The following was carried out as part of a larger study which also utilised objective cognitive assessment:

Subjective reports were examined using Interpretative Phenomenological Analysis (IPA). During this process the researcher also needs to be aware of their own conceptions and ideas about the topic to ensure they are not interpreting what the participant is saying based on their own ideas. Therefore a double-hermeneutic is involved, with the participant trying to make sense of their world and the researcher trying to make sense of the participant making sense (Smith & Osborn, 2008). While there are guidelines as to the process of IPA, it is also accepted that there is no hard and fast way to do IPA (Smith & Osborn, 2008). While many advocate the use of tape-recording the semi-structured interviews (Smith & Osborn, 2008) it was decided that recording the interviews would not be done in the current study (due to complaints during the recruitment phase of the research which centred on privacy), but rather participants would be asked to write down their experiences under two broad headings:

*“Please write in your own words any problems you have experienced from ECT”.*

*“Please write in your own words any benefits you have experienced from ECT”.*

Participants were left alone to write, to ensure that there was no prompting from the researcher. When participants had finished the researcher returned and read through what the participants had written, clarifying each of the points to ensure correct understanding. Following clarification the researcher then used semi-structured questions and prompts to elicit further detail around experiences, such as types of memory problems. Often this brought up new information and information not directly related to ECT. All new information was documented including direct quotes. Each participant’s data was analysed later for emerging themes. Once individual information had been analysed, it was grouped. The themes were structured in layers from overall umbrella themes to the more detailed themes.

#### *Analysis of Data*

Personal accounts and discussion outcomes were analysed on an individual basis, with each narrative being read and re-read a number of times. The researcher was

constantly drawing themes and concepts from what each participant had written (Smith & Osborn, 2008).

Once all interviews had been coded they were looked at as a group for emerging themes and concepts. An initial grouping of statements formed the first layer of themes, layer 3; common layer 3 themes were then grouped to form layer 2 themes. These were then grouped once again to form layer 1 themes.

### *Results*

All participants scored at acceptable levels on the TOMM indicating that they were motivated to put in their best effort in the assessment process.

Mean scores on the BDI-II ( $M=18.12$ ,  $SD=18.27$ ), and on the MADRS ( $M=13.26$ ,  $SD=12.37$ ) both suggested mild depressive symptomology. However, standard deviations for both tests' means were variable suggesting that while some had mild or no depression some had moderate/severe depression.

Of the  $N=19$  participants,  $n=1$  had never experienced any memory or cognitive deficits,  $n=1$  had experienced memory and cognitive deficits only in the short term (close to the time of ECT), while  $n=17$  stated they still experienced deficits and that these had begun during the ECT treatment and had not changed noticeably over time. It is likely that depressive symptomology may have been having an influence on some participants' subjective complaints. The qualitative themes as listed in Table 2 were derived from the information provided by participants.

Table 2

### *Summary of Qualitative Analysis*

<b>Qualitative Themes</b>		
<i>Layer 1</i>	<i>Layer 2</i>	<i>Layer 3</i>
Retrieval	Personal Memories	Blanks Own Childhood Own Children Growing Up Remembering close friends Couldn't remember how I knew people Couldn't remember things that happened previous week Couldn't remember things that happened previous day

		Timelines of memories confused Memories around ECT gone Lost memories for about a year after ECT Had memory problems at time of ECT but cannot remember what
	Procedures	How to perform previously learned tasks
	Auditory Information	Peoples Names Object Names Following Conversations Remembering Conversations Learning Lists Can't find Words
	Visual Information	Faces Words aren't connected in sentences
	Day to Day Information	Appointments Dates Repeating oneself Loosing things Forgetting
	New Learning	Reading Studying Need to use memory strategies Use images to store new information Need to learn small amounts at a time Need information repeated to learn
	Directions	How to get from A to B Getting Lost
Attention and Concentration	Staying on Task	Jumping from subject to subject Loosing train of thought Being in a daze Confusion
Executive Functioning	Sequencing Multi-Tasking	The order of performing tasks Doing more than one thing Following instructions

Of the N=19 people who participated in the study, n=2 reported no current difficulties with memory or cognition.

### 1) Retrieval

Of the 89.5% who did experience difficulties with memory and/or cognition, 79% reported retrieval deficits. Of these people, 84% also reported difficulties with personal memories, 42% with visual information, 37% with retrieving auditory/verbal information, 32% with day to day memory and forgetting, 26% with new learning and 16% (respectively) had difficulty retrieving directions and

with procedures. The following excerpts illustrate this (participant ID numbers and ages are included in brackets at the end of each quote, also included is whether the statement relates to the now (N), or to the time around the ECT treatment (T), years of education E, average frequency of treatments per week F, total number of treatments NT, total dose received in mC D, time since last treatment in years Y and electrode placement BL or UL):

#### Personal Memories

*“The girls talk about their childhood, went here and there, holidays and that, but I don’t remember mine”* (004, T, N, 61, E=12.5, F=2, NT=6, D=792, Y=3.6, BL)

*“The only reason I know I’ve forgotten is because the girls ask me do you remember when....then I remember”* (004, T, N, 61, E=12.5, F=2, NT=6, D=792, Y=3.6, BL)

*“I can’t remember things that happened last week”* (004, T, N, 61, E=12.5, F=2, NT=6, D=792, Y=3.6, BL)

*“Sometimes I get asked questions like...that was good last week...and I don’t remember. It was the ECT that’s done it”* (004, T, N, 61, E=12.5, F=2, NT=6, D=792, Y=3.6, BL)

*“The saddest of it all is absolutely no memory of my son over that time”* (005, T, 54, E=12, F=1.5, NT=3, D=1475, Y=9.2, BL)

*“I have no memory of the timeline”* (005, T, N, 54, E=12, F=1.5, NT=3, D=1475, Y=9.2, BL)

*“I have about a year I don’t remember. I get told of incidents that I cannot remember doing”* (006, T, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“I am still completely blank even when told by friends it happened...I have found it really disturbing in recent years of hearing about the things I did”* (006, T, N, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“Memory is not getting any better with time”* (006, N, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“I have no recollection of a relationship at the end of 2002 or completing a paper towards my degree”* (008, T, N, 48, E=20, F=2, NT=14, D=4550, Y=7.1, BL)

*“The feeling is similar to an extreme hangover...did I actually do that, read that, see that, or did I dream it”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“I can’t order the timeline I was recently doing my CV and it was like piecing together a difficult puzzle, my husband had to help”* (014, T, N, 50, E=12.5, F=1.4, NT=10, D=1450, Y=9.7, BL)

*“I just go blank”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

*“It’s a bit like being at a drunken party and being drunk. Whole days aren’t erased but details along the way are...this happens every day”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

*“Heaps of details just go missing related to personal events, so I will remember doing something such as going hunting but will forget a lot of the detail relating to the hunting trip”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

*“I remember things that I’m not aware I’ve forgotten, personal things, muddled memories about people”* (016, T, N, 34, E=19, F=1.6, NT=8, D=1150, Y=6.8, BL)

*“I used to pride myself on my memory, who people are, where I met them. Now I can’t remember how I know some acquaintances”* (016, T, N, 34, E=19, F=1.6, NT=8, D=1150, Y=6.8, BL)

*“Years have been erased”* (017, T, N, 64, E=11.5, F=2, NT=5, D=1925, Y=8.9, BL)

*“I don’t remember my daughter growing up at all until she was about 6 years”* (017, T, N, 64, E=11.5, F=2, NT=5, D=1925, Y=8.9, BL)

*“I have muddled memories, the sequence of events is difficult to organise and make sense of...personal memories are staggered and I have no large recollections of one period of time”* (019, T, N, 38, E=16, F=2, NT=18, D=3475, Y=9.9, BL)

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#### Procedures

*“When I returned to work I could not remember important information, details, procedures...that meant I was unsafe in my practice and could not continue”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“I couldn’t remember how to perform dialysis...nearly bled a person’s blood into a bucket...tuned in before it was too late, phew”* (003, T, N, 54, E=16, F=1.8, NT=20, D=4725, Y=8.1, BL)

*“Sometimes I think, is this really happening, you’ve been taught this a thousand times, how to do this, but you’ve gone blank”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

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#### Auditory/Verbal Information

*“It’s hard to participate in conversations that are with more than one person, where the conversation is about facts rather than feeling, and when the conversation moves too quickly...I have to work hard to process what I’m hearing...mostly I will only remember the feeling I had, the ambience, not the content of the conversation...I have a better chance of remembering points of conversation if I’m involved in them, if there is repetition of information, if I’m not hurried and if I can create an image of link to an experience”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“I tend to avoid social situations in case I can’t remember names and get embarrassed”* (003, T, N, 54, E=16, F=1.8, NT=20, D=4725, Y=8.1, BL)

*“I can’t explain things to people...following conversations are hard and if I don’t butt in and say something I forget what it is I want to say, and then what the conversation is about”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

*“I see objects and can’t remember what they are called”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

*“I should know this (finding words)”* (013, T, N, 61, E=13, F=1.7, NT=10, D=2750, Y=10.9, BL)

*“I have difficulty doing crosswords; I go through the words in my mind”* (013, T, N, 61, E=13, F=1.7, NT=10, D=2750, Y=10.9, BL)

*“I forget new names straight away”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

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## Visual Information

*“When trying to read information, books, words are just words and are not connected together”* (003, T, N, 54, E=16, F=1.8, NT=20, D=4725, Y=8.1, BL)

*“I don’t recognise people I went to school with”* (009, T, N, 43, E=11, F=1.7, NT=102, D=33250, Y=8.5, BL)

*“I don’t recognise people when they come and say hi...certainly ECT had a lot to do with it”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

*“I still have problems with faces”* (011, T, N, 53, E=10, F=1.3, NT=161, D=37494, Y=2.9, BL)

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## Day to Day Memory/Forgetting

*“I forget what I have promised to do for children or appointments to keep”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“I can’t remember telling people things; they say yes you already told me that”* (008, T, N, 48, E=20, F=2, NT=14, D=4550, Y=7.1, BL)

*“Before ECT I could remember meetings and places I had to go, after ECT I was pretty lost”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

*“It’s like when you walk into a room and forget what you’re there for. It’s like that but a lot worse and hundreds of times a day”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“It’s like searching in the dark for something you don’t know, and a rising panic, this happens dozens of times a day”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“I forget where I’ve parked the car...I am standing there visually scanning the parks, I’ve gotten upset many times and had to be picked up”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“I use a black book everyday now for writing where the car is parked, lists and thoughts”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“I have trouble remembering what I need to do each day, appointments, errands, tasks, where I parked the car...I have forgotten to pick up the kids many, many times...I now use a note book religiously, a calendar synced to my phone and I have a trusty PA to remind me of appointments”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

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#### New Learning

*“Reading if difficult...I’ll read short articles, even then, will remember only by reviewing again”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“I have lost my ability to learn in any significant way. This ranges for normal day to day learning or more formalised. Makes me sad and frustrated”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“I couldn’t learn anything new, didn’t have space for it in my head, new stuff I learnt just went”* (006, T, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“If I’ve studied it in depth I can remember it”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“I wonder if this is what it’s like to have a learning disability”* (012, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“It seems to take me longer to learn things”* (014, T, N, 50, E=12.5, F=1.4, NT=10, D=1450, Y=9.7, BL)

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#### Directions

*“It’s hard to remember how to get to places when I am driving the car, even on familiar routes”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“In town one day I had no idea how to get home, I had to ask directions, I was completely blank, didn’t know which way to go”* (003, T, 54, E=16, F=1.8, NT=20, D=4725, Y=8.1, BL)

*“I can’t remember how to get from point A to point B even though I’ve done it before”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

*“I doubt myself with directions now”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

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## 2) Attention and Concentration

Of the 89.5% who reported difficulties, 32% reported deficits with attention and concentration. The following excerpts give examples of what some said:

Staying on Task

*“I get confused at times, a continuum of confusion”* (003, T, N, 54, E=16, F=1.8, NT=20, D=4725, Y=8.1, BL)

*“I forget what I’m doing quite a bit”* (006, T, N, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“I jump from one subject to another”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

*“The things I have difficulty remembering are when there is 50 thousand things coming at me during the day”* (012, T, N, 34, E=17.5, F=2, NT=4, D=325, Y=10.5, BL)

*“I get distracted easily and it takes time to get refocused”* (018, T, N, 38, E=12, F=2, NT=7, D=2064, Y=2.3, UL)

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## 3) Executive Functioning

Of the 89.5% who reported difficulties, 21% reported deficits with executive functioning. Specifically, 21% had difficulty with sequencing, 21% had difficulty with decision making and 21% had difficulty multi-tasking. The following excerpts give examples of what some said:

Sequencing

*“I remember sitting in the shower a lot, not knowing what to do with myself, got very confused...the order of which I needed to do things to achieve...something out of whack...it happens even now”* (006, T, N, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“I needed staff to help me dress, shower, cook etc.”* (011, T, 53, E=10, F=1.3, NT=161, D=37494, Y=2.9, BL)

*“It’s like baking a cake, must do things in order to get the right result. Pieces are all there but can’t seem to put in the right order so I’m not getting the right answer or outcome”* (015, T, N, 24, E=13, F=2, NT=4, D=625, Y=7.2, BL)

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#### Multi-Tasking

*“I’m not able to multi-task like I once could”* (002, T, N, 45, E=15, F=2.5, NT=11, D=900, Y=10.7, BL)

*“I could only concentrate on doing one thing for a very long time”* (006, T, 21, E=16.5, F=2, NT=12, D=1600, Y=5.1, BL)

*“I can’t follow instructions, written or visual...and I panic”* (010, T, N, 63, E=12, F=3, NT=9, D=3300, Y=11.8, BL)

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A number of other themes also emerged during the interview which weren’t directly related to memory or cognition. These are presented in table 3.

Table 3

#### *Other Emerging Themes*

<b>Theme</b>	<b>% of Participants Experiencing Theme (N=19)</b>
Benefited Mood	68.4
Embarrassed about needing ECT	26.3
Disbelief at needing ECT	15.8
Frightened of ECT	31.6
Felt Coerced	15.8
Was like Torture	5.3

Became Creative	5.3
Could do Crosswords	5.3
Dizzy after ECT	5.3
Vomiting after ECT	5.3
No Memory Problems at all	10.5
Memory problems were not validated by Mental Health Staff	10.5
Staff were kind	31.6

Despite 89.5% of participant's still experiencing memory or cognitive deficits, 68.4% of them still claimed ECT helped their mental health.

### *Discussion*

This study aimed to investigate memory and cognitive deficits while taking into account current depressive symptomology in a group of people who had received ECT historically using qualitative methods

The results of this study indicated that, overall, most participants had mild depression, and a high number reported that ECT had helped them. Based on this it could be concluded that the deficits people reported were not as a result of current depression however even mild depression can exert influence on memory and cognition and there was variability in depression scores so these results need to be viewed with some caution. A number of participants were also currently using psychiatric medications – it is not clear what influence these might be having on test scores but it is likely that they would have some affect.

Secondly, three overall themes emerged; that participants were having difficulty retrieving information, with attention and concentration, and with some aspects of executive functioning.

Participants reported retrieval deficits in a number of areas, and like the Koopowitz et al., (2003) and Rose et al., (2004) studies, personal memories were frequently mentioned. Retrieval of visual and verbal information such as names and faces was

also reported frequently and many reported difficulties with their day to day memory such as forgetting to do things. A number of participants also reported difficulty with new learning, but stated that if cued or given time they could recall information. The word *blanks* arose frequently in relation to the retrieval of information as it had in the Koopowitz et al., (2003) study. It may be that the phenomenon of *blanks* may have had more to do with information processing speed; however the qualitative material collected could neither confirm nor disconfirm this.

The predominantly reported deficit with attention and concentration was that of staying on task. A number of participants reported having difficulty staying focused on what they are doing particularly if there are a number of stimuli present. This suggests difficulty with sustained, divided and selective attention; however the material collected did not differentiate between these sub groups of attention.

Two areas of executive functioning were frequently mentioned. A number of participants described having difficulty with sequencing and reported knowing the components required to perform a task but being unable to put the components in the correct order to achieve the correct outcome. It is unclear from this study whether the sequencing difficulties are due to attention and concentration, or whether it is a separate phenomenon. A number of participants also reported difficulties with multi-tasking, and again it is unclear whether this is due to attention and concentration, executive function or some combination of both.

While not necessarily related to memory and cognition, a number of other important themes arose during the interviews. Over half of the participants reported that ECT had benefited them, despite having memory and cognitive difficulties currently. This was expected based on a previous review which identified 51% of studies reviewed showing improvement in clinical symptomology<sup>19</sup>. Like the Koopowitz et al., (2003) study, the theme of *fear* was mentioned frequently, as was *embarrassment at needing ECT*. A small percentage reported improvement in functioning such as being able to do crosswords and becoming more creative. And a number of participants commented on the kindness of the staff involved with ECT suggesting that this is an important aspect of the treatment process.

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<sup>19</sup> Refer to Chapter 3 Results

Finally, many who were experiencing memory and cognitive deficits presently had been experiencing the same deficits acutely suggesting that for this group, the types of deficits had not changed with time. This is an important finding as it suggests that those who experience lasting difficulties experienced the same difficulties in the short term and that the deficits do not change over time. It is unclear what influence normal ageing has exerted on participants difficulties. A number of participants were in the *older* age range (over 45 years), however a number of the younger participants', as young as 21 years, were also reporting difficulties. Overall this research has illustrated the way in which qualitative methods such as IPA can be used to elicit meaningful and in-depth subjective experience from an ECT population.

Future qualitative research may wish to investigate the changes in deficits over longer time periods (two plus years) in more detail as it may provide important insights into the assessment and monitoring of memory and cognition both in the short term and the longer term. Research to investigate the themes of attention and concentration, and executive functioning to establish whether they might be part of the same deficits or two standalone deficits would also be worthwhile. An investigation into subjective reports of information processing would also be worthwhile as it may be exerting an influence on the other domains which participants' reported having difficulties with.

Finally, future qualitative research may wish to include depressed groups (with and without medication) who have not had ECT as a way of controlling for any effects of depressive symptomology and medication.

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DRC 16



MASSEY UNIVERSITY  
GRADUATE RESEARCH SCHOOL

**STATEMENT OF CONTRIBUTION  
TO DOCTORAL THESIS CONTAINING PUBLICATIONS**

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

**Name of Candidate:** Kiri Michelle Luther

**Name/Title of Principal Supervisor:** Janet Leathem

**Name of Published Research Output and full reference:**

Qualitative Assessment of the Cognitive Outcomes of Electroconvulsive Therapy

**In which Chapter is the Published Work:** Chapter 8

Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:  
and / or
- Describe the contribution that the candidate has made to the Published Work:

The candidates contribution to this manuscript is estimated to be 95% including primary responsibility for design, analysis and write up.

\_\_\_\_\_  
Candidate's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Principal Supervisor's signature

\_\_\_\_\_  
Date

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## CHAPTER 9

### DISCUSSION

#### *Overview of Findings*

This study aimed to investigate memory and cognitive deficits using both quantitative and qualitative methods while taking into account current depressive symptomology in a group of people who had received ECT historically. Two manuscripts presented the findings. The first manuscript aimed to show both objective and subjective results and compare the two, while the second manuscript was dedicated to the subjective results only. This was due to the lack of purely qualitative research currently published which investigates the long-term cognitive and general experiences of those who have undergone ECT.

The results of this study indicated that, overall, participants were not experiencing moderate to severe depression (two screens were used), and a high number reported that ECT had helped them. However there was a high variability in participant performance on the depression screen, therefore it cannot be concluded that any deficits people were experiencing were not likely to be as a result of current depression.

From the objective assessment measures and observation it was concluded that in this population overall, participants were experiencing difficulties with visual learning and memory functioning. However their mean scores were generally within age-matched norms (cut-offs) on both verbal learning and memory and autobiographical memory. This may suggest difficulty with the retrieval of learned visual information. This would confirm earlier review findings<sup>20</sup> which found 50% of studies reviewed found deficits in visual learning and memory. The deficits found may be due to normal ageing however the norms on the RCFT are normed for age so this is unlikely.

On average participants were above the cut-off scores on both tests of global cognitive functioning, generally losing marks on the recall questions from the screens. However seven participants scored below cut-off of the MoCA and the

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<sup>20</sup> Refer to Chapter 3

MMSE was not sensitive to identifying six of those. Despite scoring low on the verbal recall trials of the MoCA, mean scores on the RAVLT delayed recall trial for those seven participants were not significantly below; their scores on the RCFT were below. Sensitivity of the MoCA was further evaluated by comparing two groups, those who were below the cut-off on the MoCA ( $n=7$ ) and those who were above ( $n=12$ ). Findings suggested that the MoCA may be more sensitive than the MMSE in identifying verbal learning/memory deficits only. In general, both screens may only serve as brief screen of verbal learning and memory. However another question arises. Is the MoCA more sensitive to verbal learning and memory deficits than the RAVLT, on which participants showed no delayed recall deficits. It may be that the extra learning trials of the RAVLT are allowing participants more time and repetition to learn the words. This comparison between the MoCA and the MMSE did not illustrate such strong findings as in the previous studies using different populations conducted by Nazem et al., (2009), Mamikonyan et al., (2009), and Pendlebury et al., (2010).

The primary finding of the comparison between the MoCA and the MMSE was that the MoCA appeared to be detecting more participants with cognitive impairment than the MMSE consistent with previous studies. However this may be due to the verbal learning/memory question only, and the small sample size and lack of a *Gold Standard* to compare to makes it difficult to state whether this is the case.

Subjective accounts suggested deficits that were not as frequently reported on objective measures, particularly with the recall of personal memories and recall of verbal information. Participants reported difficulties with both, while the overall findings of objective assessment suggested otherwise. These findings were consistent with other research and findings identified by the NICE Guidelines (2003). This was also illustrated by the other themes which emerged that were not assessed objectively in this study such as day to day memory, directions and executive functioning. Given that objective measures chosen for this study were based on commonly utilised measures cited in other studies, then they may not be adequately measuring the nature of the cognitive difficulties associated with ECT and again this is consistent with the NICE Guidelines (2003).

Overall, when comparing subjective with objective outcomes, the findings were somewhat incongruent. It appeared there was some inconsistency in what people were reporting as deficits, and what was being measured objectively. Three overall themes emerged from the subjective reports, 1) that participants were having difficulty retrieving information, 2) that they were having difficulty with attention and concentration, and 3) that they were having difficulty with some aspects of executive functioning. Objectively, many participants did perform below norms and cut-offs on a number of assessment *subtests* however when individuals' subjective and objective assessments were compared, there was incongruence.

Finally, many who were experiencing memory and cognitive deficits presently had been experiencing the same deficits acutely suggesting that for this group, the types of deficits had not changed with time. This was an important finding as it suggests that those who experience long term difficulties experienced the same difficulties in the short term and that the deficits do not change over time. It is unclear what influence normal ageing has exerted on participants difficulties. A number of participants were in the *older* age range (over 45 years), however a number of the younger participants', as young as 21 years, were also reporting difficulties. It was also difficult to to ascertain the influence of current depression and medications.

#### *Study Limitations*

There were a number of limitations to this study. Firstly the small sample size meant that it was not possible to control for a number of variables such as electrode placement, stimulus intensity, number of treatments and time between treatments. These are all important variables to be controlled for as they can all exert an influence on memory and cognition.

Secondly, as the participants were not currently having ECT and as there was no assessment data available from the time when they were having ECT, comparisons could not be made. Due to the non-existent baseline and monitoring data, assessment scores were compared to age-matched norms for each test (with the exception of the AMI who provides cut-off ranges only. This meant that even if a deficit was found, without being able to compare to pre-ECT functioning it cannot be said with any certainty that the deficit has been caused by ECT.

Thirdly, even though participants' subjective accounts suggested that their short term memory and cognitive deficits were the same as long term deficits, the objective assessment was only measuring current function. It is unclear whether the results would have been the same earlier in time. Thus these results cannot be extrapolated to recommend for example, the MoCA for the assessment of those *currently* undergoing ECT.

It was also difficult to compare objective and subjective assessment outcomes as they did not *map* perfectly onto each (e.g. the AMI has sub-tests split into different time periods for which the subjective accounts did not illustrate) other so summaries (totals of subtests) were utilised instead. This may have led to some quite specific comparative information being lost.

It is also possible that even though participants were achieving within age-matched norms of the assessment measures they could still have been functioning at lower levels than previously. Participants had a mean years of education of  $M=14.44$ ,  $SD=2.99$  suggesting the group at minimum attained the compulsory secondary school education level (10 years). It is possible that a number of participants, prior to ECT would have scored above the age-matched norms and their current scores are less as a result of the ECT.

Finally, the lack of a control group made it difficult to establish the effect that depression and medication was having on participants' performance.

### *Recommendations*

Future research should concentrate on a larger sample size that would allow statistical control of confounding variables. Investigation of the timeline of cognitive deficits would also be beneficial, but would require a larger sample size. This type of investigation would add greatly to the knowledge on how cognitive deficits may or may not change with time, and therefore how and when to assess and monitor. Assessment of current ECT patients would enable baseline data to be collected and patients could be monitored throughout their ECT to test whether memory and cognitive changes are occurring.

Further comparisons between the MoCA and the MMSE should be made in a current ECT population to assess the sensitivity of the two measures. Again, collecting baseline data would greatly assist in this.

Future qualitative research may wish to investigate the changes in deficits over longer time periods (two plus years) as it may provide important insights into the assessment and monitoring of memory and cognition both in the short term and the longer term. Research to investigate the themes of attention and concentration, and executive functioning to establish whether they might be part of the same deficits or two standalone deficits would also be worthwhile. An investigation into subjective reports of information processing would also be worthwhile as it may be exerting an influence on the other domains which participants' reported having difficulties with.

The use of a control in future research is recommended as a way of minimising the influence that depression and medications may be having on test performance.

Finally it is recommended that the information collected during the qualitative assessment be viewed with the plan of developing a new assessment measure to be trialled with current ECT patients and assessment measures.

### *Clinical Implications*

What became clear during the research is that assessment of memory and cognition in an ECT population is complex and often not thorough due to the time constraints of physicians. It appears that most are attempting to find the quickest most efficient ways to assess deficits. It may however be that no quick way exists – without eventually missing the deficits. This could explain the incongruence often found between objective and subjective assessment. There were also a number of themes which were not of a cognitive/memory nature that arose such as *fear* and *kindness*.

Based on this there may be a role for psychology to play in the assessment and monitoring of ECT, where more time is made available to focus on individuals receiving ECT and follow up. Psychology may also play a role in the ongoing assessment and treatment of those whose ECT experience has been distressing and fearful.

This research goes some way to filling a gap in research identified by the NICE Guidelines (2003). It also illustrates some of the difficulties in ECT research and the potential for qualitative methods in memory and cognitive assessment.

### *Personal Reflections*

This is an additional section in my thesis reflecting on my experience of researching ECT - some of the obstacles and my personal journey. It is hoped that these reflections will assist others wanting to undertake research in this highly controversial area.

I believe that this kind of reflection is an important aspect of the research in itself as one cannot possibly research such an area without being personally touched, affected and influenced.

As a student there is a real naivety about what is learnt in the classroom and what one can only learn by doing. This was certainly the case for me. When designing any research, one is usually very methodical trying to think of all possible outcomes and obstacles. However, in reality this is not always possible and things that one could never imagine happening, can in fact happen.

A student's first obstacle is the Ethics process. It is very easy to get caught up in the procedure of this process and not take into account the humanness of it. We strive to get it right and get the "tick of approval" but what does it all mean? Does it mean we have been given the *right* to conduct research? Now I know that it is not as simple as that. I believe that being given Ethics approval for research means we are being given the permission to proceed with a research area. This does not necessarily mean potential participants will give the same permission, or even see the research in a positive light.

The journey for this research was challenging and rewarding. Early on two complaints received opened my eyes to the complexities of researching such a controversial area as ECT and illustrated my naivety. The complaints were not serious and were resolved by Capital and Coast District Health Board, but to me they were devastating. Here I was, excited and full of passion to do some good and thinking everyone would feel the same way I did. Not so. This was to be my first

glimpse at the controversy surrounding ECT and perhaps the stigma associated with ECT as a treatment.

I am humbled by this research. Many participants wept throughout the assessment, not from distress but more as a release. They said it helped them to talk about their experiences, not just with ECT their illnesses and their lives leading to their illness. I felt humbled that they chose to share their experiences, thoughts and feelings with me and at times it was hard not to feel like weeping myself. One person hugged me at the end of the assessment; I was taken a back at the extent to which people wanted this research. It became more than just gathering data and stories to find results, it became about allowing people a voice, allowing people to speak about their experiences and hopefully it helped them as much as it helped me. The things I learnt about people and mental health were priceless and I will be eternally grateful to those amazing people who have taken the time to be involved and teach me.

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## **APPENDICIES**

**Appendix A:** Ethics Approval HDEC and Massey University

**Appendix B:** Participant Information and Consent Pack

**Appendix C:** Data Collection Forms

**Appendix D:** Current Assessment Forms, CCDHB

**Appendix E:** Individual Participant Information: Objective Compared to Subjective

## APPENDIX A

### Ethics Approval HDEC and Massey University



#### Central Regional Ethics Committee

Ministry of Health  
Level 2, 1-3 The Terrace  
PO Box 5013  
Wellington  
Phone: (04) 496 2405  
Fax: (04) 496 2191  
Email: [central\\_ethicscommittee@moh.govt.nz](mailto:central_ethicscommittee@moh.govt.nz)

17 December 2008

Mr Kiri Luther  
76/3 McAlpine Avenue,  
Mount Cook  
Wellington

Dear Kiri

**An Evaluation of the Cognitive Outcomes of Electroconvulsive Therapy : A Retrospective Study**  
**Mr Kiri Luther**  
**Department of Psychology, Massey University,**  
**CEN/08/11/064**

The above study has been given ethical approval by the **Central Regional Ethics Committee**.

#### Approved Documents

- Outcomes of Electroconvulsive Therapy: Information Sheet. Date 17/10/2008. Version 1.
- Outcomes of Electroconvulsive Therapy: Participant Consent Form. Date 17/10/2008. Version 1.

#### Accreditation

The Committee involved in the approval of this study is accredited by the Health Research Council and is constituted and operates in accordance with the Operational Standard for Ethics Committees, April 2006.

#### Progress Reports

The study is approved until 1 March 2011. The Committee will review the approved application annually and notify the Principal Investigator if it withdraws approval. It is the Principal Investigator's responsibility to forward a progress report covering all sites prior to ethical review of the project in **15 December 2009**. The report form is available on <http://www.ethicscommittees.health.govt.nz>. Please note that failure to provide a progress report may result in the withdrawal of ethical approval. A final report is also required at the conclusion of the study.

#### Amendments

All amendments to the study must be advised to the Committee prior to their implementation, except in the case where immediate implementation is required for reasons of safety. In such cases the Committee must be notified as soon as possible of the change.

#### Please quote the above ethics committee reference number in all correspondence.

The Principal Investigator is responsible for advising any other study sites of approvals and all other correspondence with the Ethics Committee.

**It should be noted that Ethics Committee approval does not imply any resource commitment or administrative facilitation by any healthcare provider within whose facility the research is to be carried out. Where applicable, authority for this must be obtained separately from the appropriate manager within the organisation.**

Yours sincerely

*S. Scott*  
**Sonia Scott**  
**Central Regional Ethics Committee Administrator**

Email: [sonia\\_scott@moh.govt.nz](mailto:sonia_scott@moh.govt.nz)



**Massey University**

OFFICE OF THE ASSISTANT  
TO THE VICE-CHANCELLOR  
(Research Ethics)  
Private Bag 11 222  
Palmerston North 4442  
New Zealand  
T 64 6 350 5573/350 5575  
F 64 6 350 5622  
humanethics@massey.ac.nz  
animalethics@massey.ac.nz  
gtc@massey.ac.nz  
www.massey.ac.nz

9 February 2009

Ms Kiri Luther  
34A Cleveland Street  
Brooklyn  
WELLINGTON

Dear Kiri

**Re: An evaluation of the cognitive outcomes of electroconvulsive therapy: A retrospective study**

Thank you for your HDEC Notification, a copy of which we received on 5 February 2009.

Your project has been recorded on the database for applications referred to HDECs which is reported in the Annual Report of the Massey University Human Ethics Committees.

We also acknowledge receipt of the approval letter from the Central Regional Ethics Committee.

Yours sincerely

A handwritten signature in cursive script that reads "Sylvia Rumball".

Professor Sylvia Rumball, Chair  
**Chair, Human Ethics Chairs' Committee and  
Assistant to the Vice-Chancellor (Research Ethics)**

cc Prof Janet Leatham  
School of Psychology  
WELLINGTON

Dr Mandy Morgan, HoS  
School of Psychology  
PN320

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Massey University Human Ethics Committee  
Accredited by the Health Research Council



## APPENDIX B

### Participant Information and Consent Packs



Private Box 756  
Wellington 6140  
New Zealand  
T 64 4 801 5799  
F 64 4 801 2692  
[www.massey.ac.nz](http://www.massey.ac.nz)

#### Outcomes of Electroconvulsive Therapy

Kiri Luther is a Doctorate of Clinical Psychology student at Massey University. As part of her Doctorate requirements Kiri will be carrying out research into past patients experiences of Electroconvulsive Therapy (ECT) with a particular emphasis on cognition. This will include reviewing patient files, some formal assessment and an opportunity to talk about personal experiences. The information will be used to improve on current methods of monitoring ECT patients during and after their treatment.

If you would like to know more about this research after reading the enclosed information pack, please contact;

Kiri Luther, BA (Hons) Psychology  
C/O Massey University Psychology Clinic  
Massey University  
PO Box 756  
Wellington  
Free phone (04) 801-4988

This information pack contains

- Introduction to Information Pack for participants
- Letter of support from Dr Rosie Edwards (CCDHB)
- Information Sheet
- Consent Form
- An addressed prepaid reply envelope





Dear Participant

I would like to invite you to participate in a research project that is being undertaken by Kiri Luther, a Doctorate student from Massey University.

As part of her Doctorate in Clinical Psychology, Kiri Luther is investigating the outcomes of electroconvulsive therapy on cognitive functions such as memory.

This research is being carried out so that we may be able to improve on current methods of monitoring cognition, and provide the best ongoing care and support to all of past, present and future patients.

Also with this letter is pack containing information for you to read to aid you in your decision. We support this research and have agreed to assist the researcher how we can.

If you are interested, please **reply to the researcher** using the volunteer reply form - you do not need to let the hospital staff know whether you have agreed to take part. You are under no obligation at all to agree to take part and the study and **we will not be told whether or not you volunteer.**

As you will see from the information pack the research will take place at the Wellington Massey University Campus, however, in some circumstances the researcher may be able to come to you in your home. Any files containing information about you that the researcher looks at will not be removed from our premises. Your contribution would be greatly appreciated for both the Doctorate student and for the knowledge generated from the project.

For more information please contact the researcher directly, contact details are contained in the information pack.

Yours sincerely

A handwritten signature in blue ink, appearing to read "Rosie Edwards".

Dr. Rosie Edwards, FRANZCP  
Consultant Psychiatrist  
Clinical Leader  
General Adult Mental Health Services



Private Box 756  
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## ***Outcomes of Electroconvulsive Therapy***

### **INFORMATION SHEET**

#### **Introduction**

Kiri Luther, a fulltime Doctorate of Clinical Psychology student at Massey University, will be conducting research into the effects that Electroconvulsive Therapy has on thinking. The findings of this research will then be used to develop effective ways of monitoring and assessing the effects that Electroconvulsive Therapy is having on people while they are having treatment and when they have finished.

#### **Participant Recruitment**

Your historical files are kept within CCDHB however we need your permission to be able to view them and gather information from them. You do not have to give us permission to view your files, nor do you have to consent to meeting with us for a discussion and assessment. By filling in the consent form and sending it back to us you will be giving us permission to view your files and meet with us. We will then be in touch to discuss a time for meeting with us so that we may hear your personal views and do some assessment. This research is being conducted under the supervision of Professor Janet Leatham and Dr Steve Humphries, both of Massey University.

#### **Project Procedures**

The individual data collected will be added with all the data collected and analysed. Therefore your individual data will not be reported. Your name or identifying information will not be reported. Data and analysis will be included in a journal publication, conference presentation and a Doctorate Thesis. No one will be allowed to see the raw data except for Kiri Luther, Professor Janet Leatham and Dr Steve Humphries. Data collected electronically will be stored on computer under password protection. Any paper data collected will be locked in a secure cabinet which is situated in a locked room at the Massey University Campus. Massey University has a 10 year policy for storage and disposal of data. After 10 years all the raw data will be destroyed.

You may request a summary of the research findings by indicating so on the consent form. The summary will be posted to you at the conclusion of the project.

#### **What will you have to do?**

If you agree to participate you will need to read all the information in this information pack. Then you need to sign the consent form and post it back to us in the stamped addressed envelope included in this information pack. If you have questions you would like to discuss you may contact the researcher on the contact details provided on page two of this information sheet.

Once we have viewed your files we will contact you to set up an assessment time. The assessment should take no longer than two hours, however extra time may be required at your discretion. There will be some formal assessment measures given to you during this appointment which will take approximately one hour. We would also like to hear about your personal experiences with ECT. All this information will be kept confidential and no one outside the three people named above will view information collected.

**You are under no obligation to accept this invitation. If you decide to participate, you have the right to:**

- *decline to answer any particular question;*
- *withdraw from the study at any time;*
- *ask any questions about the study at any time during participation;*
- *provide information on the understanding that your name will not be used unless you give permission to the researcher;*
- *be given access to a summary of the project findings when it is concluded*

During the research if any difficulties in cognitive functioning become evident, the researcher, with permission from you, will contact your GP and pass on the information so that a follow up may be arranged.

Parking on the campus will be free of charge, and we are happy to discuss reimbursement of travel costs with you. In some cases we may be able to come to you for the assessment.

If you have any questions regarding this research please feel free to contact the principal investigator:

**Principal Investigator**

Kiri Luther, DClinPsych student  
C/O Psychology Clinic  
Massey University  
PO Box 756  
Wellington  
Phone (04) 801-4988

---

This study has received ethical approval from the Central Ethics Committee.

**Please feel free to contact the researcher if you have any questions about this study.**



Private Box 756  
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T 64 4 801 5799  
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## Outcomes of Electroconvulsive Therapy

### PARTICIPANT CONSENT FORM

This consent form will be held for a period of ten (10) years

I have read the Information Sheet and have had the details of the study explained to me. I have had time to consider my participation and my questions have been answered to my satisfaction. I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet and I understand that I can withdraw myself and my data from the study at any time.

I am happy for my GP or Care Manager to be contacted if there are any concerns which arise during the research.

Yes No

GP's/Care Manager's Name

Address

Phone Number

I wish to receive a summary of the research when it is completed Yes No

Postal Address for Summary:

.....  
.....

Contact Phone Number:.....

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Full Name - printed \_\_\_\_\_



**APPENDIX C**

**Data Collection Forms**

ECT Technical Data

ID

Treatment Schedule #

From:

To:

Total Number of Treatments:

Average Frequency

Electrode Placement

Dosage (mC)

Anaesthetic

Relaxant

Duration Range (EEG)

Seizure Quality Range

Other

Demographic Information

Participant ID#.....Address.....

Date of Birth..... Phone Number.....

Education

Current Medication

Head Injury	Yes	No
-------------	-----	----

Dementia	Yes	No
----------	-----	----

Last ECT.....

Other Medical Conditions

Psychological

Assessed previously?

Yes

No

Ethnicity

Follow up



Qualitative Forms

Participant ID #.....

Please write in your own words any benefits you have experienced from ECT

Participant ID #.....

Please write in your own words any problems you have experienced from ECT

Participant ID #.....

IPA Discussion Notes

**APPENDIX D**

**Current Assessment Forms, CCDHB**

ECT TREATMENT RESPONSE EVALUATION							
Suggested as baseline and then weekly through index course of ECT							
RATING SCALES		base	date	date	date	date	date
	CGII *						
	CGIC **						
	MADRS						
TARGET SYMPTOMS (DSM IV)							
+++ severe ++ moderate +mild							
D E P R E S S I O N	Depressed mood						
	Diminished interest						
	Appetite disturbance – weight loss						
	Sleep disturbance						
	Psychomotor agitation						
	Psychomotor retardation						
	Fatigue – loss of energy						
	Feelings of worthlessness, hopelessness, etc						
	Reduced ability to think, concentrate, etc						
	Recurrent thoughts of death, suicide						
	Mood congruent delusions:						
M A N I A	Inflated self-esteem, grandiosity						
	Decreased need for sleep						
	Flight of ideas						
	Distractibility						
	Increase in activity						
P S Y C H O S I S	Excessive involvement in pleasurable, risk taking, etc activities:						
	Delusions						
	Hallucinations						
	Grossly disorganised speech/ thinking						
	Grossly disorganised or catatonic behaviour						
M E M O R Y & C O G	Other:						
	Folstein's MMSE	/30	/30	/30	/30	/30	/30
	Modified Mental State Examination (3MS)	/100	/100	/100	/100	/100	/100
	Addenbrooke's Cognitive Exam (ACE)	/100	/100	/100	/100	/100	/100
	Frontal Assessment battery (FAB) ( Score less than 13 means impairment)						
Autobiographical Memory (AM)							

Patient Label (STICK HERE)

Date of ECT Treatment:

**ECT TREATMENT RESPONSE EVALUATION** Date:

RATING SCALES		Scores
CGII *		
CGIC **		
MADRS		
<b>TARGET SYMPTOMS (DSM IV)</b>		<b>Enter +</b>
+++ severe ++ moderate + mild		
D E P R E S S I O N	Depressed mood	
	Diminished interest	
	Appetite disturbance – weight loss	
	Sleep disturbance	
	Psychomotor agitation	
	Psychomotor retardation	
	Fatigue – loss of energy	
	Feelings of worthlessness, hopelessness, etc	
	Reduced ability to think, concentrate, etc	
	Recurrent thoughts of death, suicide	
M A N I A	Mood congruent delusions:	
	Inflated self-esteem, grandiosity	
	Decreased need for sleep	
	Flight of ideas	
	Distractibility	
P S Y C H O S I S	Increase in activity	
	Excessive involvement in pleasurable, risk taking, etc activities:	
	Delusions	
	Hallucinations	
M E M O R Y & C O G	Grossly disorganised speech/ thinking	
	Grossly disorganised or catatonic behaviour	
	Other:	
		<b>Scores</b>
Extended Mental State Examination (EMS):		
Folstein's MMSE		/30
Modified Mini Mental State Examination (3MS)		/100
Addenbrooke's Cognitive Exam (ACE)		/100
Frontal Assessment battery (FAB)		>13 - <13 -
Autobiographical Memory (AM)		

**\* Diagnosis CG11 clinical global impression of illness**

1. Normal – not ill
2. Borderline illness
3. Mildly ill
4. Moderately ill
5. Marked ill
6. Severely ill
7. Among the most extremely ill

**\*\* CGIC clinical global impression of change from onset**

1. Very much improved
2. Much improved
3. Minimally improved
4. No change
5. Minimally worse
6. Much worse
7. Very much worse

**\*\*\*Memory and Cognition**

- One baseline
- then once every two weeks during ECT course
- then once a month post ECT course for next 9 – 12 months.

*o EMS after every 2nd ECT*

The EMS tests memory and cognition in greater depth and is more reliable than doing only Folstein's MMSE. This test **has to be completed** after every second ECT before prescribing further ECTs.

**APPENDIX E****Individual Participant Information: Objective Compared to Subjective***Participants reporting deficits (both objective and subjective)*

ID	Scores below cut-off on any AMI subtest	Subjective reports of deficits in personal memory	Scores below cut-off on any RCFT subtest	Subjective reports of deficits in visual memory	Scores below cut-off on any RAVLT subtest	Subjective reports of deficits in verbal memory
001	Y		Y		Y	
002	Y	Y	Y	Y	Y	Y
003	Y	Y	Y	Y	Y	Y
004	Y	Y	Y			
005			Y			
006		Y	Y			
007			Y			
008			Y			
009		Y	Y		Y	
010	Y	Y	Y	Y		Y
011 <sup>1</sup>	Y		Y			
012		Y	Y		Y	
013		Y	Y			Y
014	Y	Y	Y			Y
015	Y	Y	Y		Y	
016		Y	Y			
017		Y	Y	Y	Y	Y
018	Y		Y		Y	
019	Y	Y	Y		Y	

<sup>1</sup> Participant was excluded from this summary as did not complete all of the objective assessment.